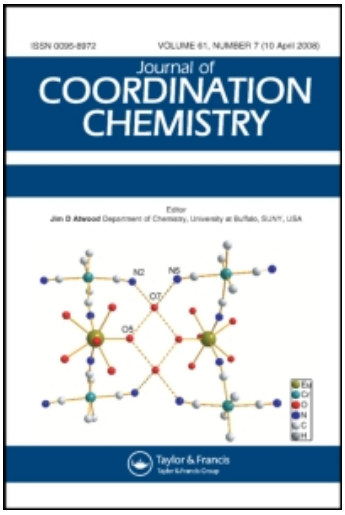

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COPPER(II) COORDINATION COMPOUNDS: CLASSIFICATION AND ANALYSIS OF CRYSTALLOGRAPHIC AND STRUCTURAL DATA III. DIMERIC COMPOUNDS

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Review

COPPER(II) COORDINATION COMPOUNDS: CLASSIFICATION AND ANALYSIS OF CRYSTALLOGRAPHIC AND STRUCTURAL DATA III. DIMERIC COMPOUNDS*

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This review summarizes the data for over nine hundred dimeric Cu(II) coordination compounds. There are several types of the bridges, from which doubly bridges by far prevail. The most common ligands are O- and N- donors. From the stereochemical point of view, a square-pyramidal arrangement with different degrees of distortion about Cu(II), is the most common. Several relationships were found between the Cu–Cu distances and the Cu–L–Cu bridge angle and the type of bridging, between the intra-ligand L–Cu–L ring angles and coordination numbers.

Keywords: Review; Cu(II); crystallography; structures; dimers

CONTENTS

* Part II. *J. Coord. Chem.*, **45**, 31 (1998).
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0. ABBREVIATIONS

aamt	4-amino-3,5-bis(aminomethyl)-1,2,4-triazole
aanp	ligand involving two deprotonated amide, two izomethine nitrogen and two phenoxide donors
aapen	tetraanionic ligand derived from the condensation of 1,2-diaminoethane with o-acetoacetylphenol
ac	acetate
acacha	acetylacetone-mono-(o-hydroxyanile)
acachfacac	acetylacetonate hexafluoro acetylacetonate
acacP(O)	o-(diphenylphosphino)benzoyl)pinacolone
acgly	N-acetylglycinate
acm	5-acetamido-1,3,4-thiadiazole-2-sulfonamide
acr	acridine
ad	adenine
ae	7-amino-4-methyl-5-aza-3-heptene-2-one
aett	3,4-bis(2-aminoethylthio)toluene
ahm	N,N′-bis(5-amino-3-hydroxypentyl)malonamide
β-ala	β-alanine

amazph	2,6-bis(5′-amino-1′-methyl-2′-azapent-1′-enyl)-4methylphenolate
ambt	α-aminoisobutyrate
2-amepy	2-aminomethylpyridine
ammph	ammonoimethyl(methyl)phosphine
amoc	8-amino-5-aza-4-methyl-3-octene-2-onate
amp	2-aminopyrimidine
5′-amp	5′-monophosphate of adenosine
6-ampur	6-aminopurine
2-ampy	2-aminopyridine
3-ampy	3-aminopyridine
3-ampyH	3-aminopyridinium
4-ampyH	4-aminopyridinium
amsbph	2,6-bis(4-amino-2-thiabutyl)-4-methylphenolate
amzh	7-amino-4-methyl-5-azahept-3-en-2-onate
[12]-aneS_2	5,8-dithiadodecane
[20]-aneN_4	20-membered N_4 binucleating macrocycles ligand
[24]-aneN_2O_6	polyaza-polyoxamacrocyclic ligand
[24]-aneN_2S_4	1,3-diaza-4,10,16,22-tetrathiacyclotetracosane
[24]-aneN_6	1,5,9,13,17,21-hexaazacyclotetradecane
[24]-aneN_6O_2	cryptate macrocyclic ligand
[30]-aneN_{10}	1,4,7,10,13,16,19,22,25,28-decaazacyclotriacontane
apcs	Shiff base ligand derived from the condensation of 3-aminopropanol with 5-chlorosalicylaldehyde
apha	6-amino-1-(2′-hydroxyphenyl)-3-methyl-4-azahept-2-en-1-one
aples	Schiff base ligand derived from the condensation of 3-aminopropanol with 5,6-benzosalicylaldehyde
apns	Schiff base ligand derived from the condensation of 3-aminopropanol with 3-nitrosalicylaldehyde
arg	L-arginine
asp	aspirinate
2-ath	2-aminothiazole
athal	N-(2-aminoethyl)thiophen-2-aldimine
baa	1-phenyl-1,3,5-hexanetrione
baaep	Schiff base derived from 2,3-butanedione-2-oxime and 2-(2-aminoethyl)pyridine
2-bae	2-dibutylaminoethanolate
bba	N-n-butyl(5-chloro-α-phenyl-2-hydroxybenzylidene)aminate

2-bbenz	2-benzoylbenzoate
bbi	5-tert-butyl-m-xylene bis(acetylacetone imine)(3,3′-[5-(1,1-dimethylethyl)-1,3-phenylene bis(methylene)]) bis (4-amino-3-penten-2-one)
bbo	3,3′-(trimethylenedinitrilo)bis(butan-2-one-oximate)
bdd	2,3-butanedione dioximate
bdhe	bis(2-(diethylamino)ethyl)-2-hydroxyethylamine
bdo	N,N di (n-butyl)diaminoalcohole
bddo	1,8-bis-(3,5-dimethyl-1-pyrazolyl)-3,6-dithiaoctane
bdta	1,4-butanediaminetetraacetate
bedao	N,N′-bis(6-ethyl-3,6-diazaoctyl)oxamidate
bi-dptmd	4,16,20,32-tetraethyl-5,15,21,31-tetramethyl-8,12,24,28,33,34,35,36-octaazapentacyclo [28.2.1.1^{3,6}]^{14,17}]^{19,22}]hexatriconta-1,3,5,7,12,14(35),15,17,19,21,23,28,30(33),31-tetradecane
bilm	2,2′biimidazolate
bim	benzimidazole
bimp	2,6-bis[(bis((1-ethylimidazol-2-yl)methyl)amino)methyl]-4-methylphenol
bimpr	1,3-bis(benzimidazol-2-yl)propane
bistren	7,19,30-trioxa-1,4,10,13,16,22,27,33-octaazabicyclo-[11.11.11]pentriacontane
biu	biuretate
bmmp	2,6-bis{bis[2-(methylthio)ethyl]aminomethyl}-4-methylphenole
bmpc	2,6-bis((N-methylpiperazino)methyl-4-chlorophenol
bmpi	1,3-bis(2-(4-methylpyridyl)imino)isoindoline
boaep	Schiff base derived from 2,3-butanedione-2-oxime and 2-(2-aminoethyl)pyridine
botb	1,4-bis[(1-oxa-4,10 dithia-7-azacyclododecane-7-yl)-methyl]-benzene
bpap	1,4-bis[(2-pyridyl)amino]phthalazine
bpca	bis(2-pyridylcarbonyl)amide
bpden	N,N′-bis(3′-pyridazinecarboxamido)-1,2-ethane
bpep	2,5-bis[N,N-bis(2′-pyridylethyl)aminomethyl]pyrazine
bpim	4,5-bis[(2-(2-pyridyl)ethylaminomethyl]imidazolate
bpip	2,2′bipiperidine
bpm	2,2′-bipyrimidine
bpmab	1,3-bis[bis(2-pyridylmethyl)amino]benzene
bpmb	1-[bis-(2-pyridylmethyl)amino]-3-[(2-pyridylmethyl)amino]benzene

bpmp	2,6-bis[bis(2-pyridylmethyl)-aminomethyl]-4-methylphenolate
bpmpp	2,5-bis[N,N-bis(2′-pyridylmethyl)aminomethyl]pyrazine
bpsp	[(R)-1,1-bis(2-butoxy-5-tert-butylphenyl)-3-phenyl-2-salicylideneamino-1-propanolate
bpy	2,2′-bipyridine
bpyH	4,4′-bipyridilium
bpyo	2,2′-bipyridine-N,N′-dioxide
bpt	3,5-bis(pyridin-2-yl)-1,2,4-triazolate N',N^1,N^2,N''
bptp	3,6-bis(2-pyridylthio)pyridazine
Br_3ac	tribromoacetate
2-Brbz	2-bromobenzoate
3-Brbz	3-bromobenzoate
4-Br-3-CO_2mepz	4-bromo-3-carboxylatomethylpyrazole
4-Brdmpz	4-bromodimethylpyrazole
bsda	N,N′-bissalicylidene-1,5-diimino-3-azapentane
btim	1,2,4,5-tetrakis(4,5-dihydroimidazol-2-yl).benzene
Bu-nso	2-[2-(di n-butylamino)ethylthio]ethanol
bu^{t}py	4-tert-butylpyridine
bz	benzoate
bzacac	benzoylacetonate
bz-α-ala	N-benzoyl-α-alaninate
bzcarb	N-benzimidazolyl-2-carbamin acid
bz-15-crown-5	benzo-15-crown-5
bzd	benzidine(4,4′-diaminobiphenyl)
bzmh	benzoyltrimethylhydrazine
4-bzpipH	4-benzylpiperidinium
2-bzpy	2-benzoylpyridine
bzsmph	2,6-bis[4-(2-benzimidazolyl)-2-thiabutyl]-4-methylphenole
bztz	benzotriazolate
c	cubic
ca	dianion of chloranile acid
caf	caffeine (3,7-dihydro-1,3,7-trimethyl-1H-purine-2,6-dione)
cha	cyclohexylamine
car	β-alanyl-L-histidine (carnosine)
CH_2Cl_2	monomethylenedichloride
C_6H_6	benzene
$C_7H_7N_4S$	2-pyridinecarbaldehyde-thiosemicarbazone

$C_7H_{18}N_2$	N′-isopropyl-2-methyl-1,2-propanediamine
$C_8H_{13}NOCO_2$	2,2,5,5-tetramethylpyrrolin-1-oxyl-3-carboxylate
$C_8H_{16}N_3O$	2-(N,N-dimethyl-2-aminoethyl)imino-3-butanone oximate
$C_8H_{16}N_3O_2$	2-(N-(2-hydroxyethyl)-2-aminoethyl)imino-3-butanone oximate
C_5H_4NO	α-pyridone(2-hydroxypyridine)
$C_7H_5N_2$	7-azaindolate
$C_{11}H_{13}NO_2$	2-hydroxy-N-3-hydroxypropyl-α-methylbenzylideneaminate
$C_{12}H_{10}NO$	N-methyl-2-hydroxy-1-naphthaldiminate
$C_{12}H_{14}NO_2$	(4S)-4,5-dihydro-4-isopropyl-2-(2′-oxidophenyl)oxazole
$C_{12}H_{14}N_2O_4$	N,N′-bis(1-methyl-3-oxo-2-butenyl)oxamidate
$C_{12}H_{15}N_2O$	condensation product of 1,4-diazacycloheptane and salicylaldehyde
$C_{12}H_{21}N_4O_2$	2-oximino-11-oximinato-3,10-dimethyl-4,9-diazadodeca-3,9-diene
$C_{13}H_9F_3NCO_2$	N-3-trifluoromethylphenylanthranilate
$C_{13}H_{32}N_4S_4$	ligand prepared from 5,5-bis(4-amino-2-thiabutyl)-3,7-dithianonane-1,9-diamine and lithium dithionate
$C_{14}H_{33}N_3$	N,N-bis(diethylaminoethyl)-ethylamine
$C_{14}H_{26}N_6$	5,12-dimethyl-3,7,10,14,15,16-tetraazapentacyclo-[7.5.$1^{2,8}$,$1^{5,16}$,$1^{12,15}$] octadecane
$C_{14}H_{29}N_4O_2$	4,4,9,9-tetramethyl-5,8-diazadodecane-2,11-dione dioxime
$C_{15}H_{10}N_2O_4$	2-hydroxy-N-3-hydroxypropyl-5-nitrobenzylideneaminate
$C_{15}H_{20}N_3O_2$	bis(1-N′-(N-2-aminoethylmorpholine)-1-phenylpropane-2-oxime
$C_{17}H_{20}F_{12}N_2O_2$	Schiff base prepared by condensation of 5,5,5-trifluoro-4-hydroxy-4-(trifluoromethyl)-2-pentanone with diamine
$C_{17}H_{22}N_4O$	2,6-bis(N,N′-dimethylethylenamineformimidoyl)-4-methylphenolate
$C_{17}H_{27}N_4O$	2,6-bis(N,N′-dimethylethyleneamine formimidoyl)-4-methylphenolate
$C_{17}H_{30}N_6$	3,5-bis[(2-diethylamino)ethylaminomethyl]pyrazole
$C_{19}H_{23}N_3O_2$	Schiff base derived from 1,1′-(2,6-pyridyl)-bis-1,3-butane-dione and 3-amino-1-propanole
$C_{22}H_{21}N_4O_2$	2,6-bis[N-2-(2′-pyridylethyl)formimidoyl]-4-hydroxy-1-phenolate

$C_{24}H_{28}N_4O_4$	ligand derived by template condensation of 2,6-diformyl-4-R-phenol with 1,3-diamino-2-hydroxypropane
$C_{24}H_{36}N_4O_2$	ligand derived by template condensation of 4-methyl-2,6-diformylphenol with 1,3-diaminopropane
$C_{24}H_{48}N_4O_2S_4$	1,7,13,19-tetraza-4,16-dioxa-10,22,32,-tetrathiatricyclo [17.5.5.$5^{7,13}$] tetratriacontane
$C_{32}H_{46}N_8$	7,7′-ethylene bis[2,12-dimethyl-3,7,11,17-tetraazabicyclo[11.3.1]-heptadeca-1(17),2,11,13,15-pentaene
$C_{34}H_{34}N_4O_2$	N,N′-bis(2-((o-hydroxybenzhydrylidene)-amino)ethyl)piperazine
$C_{36}H_{40}N_6$	ligand synthesized by the reaction of bis(20(-pyridyl)-ethyl)amine with α,α'-dibromo-p-xylene
$C_{37}H_{36}N_2O_3$	2-hydroxypropane-1,3-diylbis(3′-t-butyl-5′-methyl-salicylideneiminate
$C_{74}H_{88}N_8$	porphyrine
Clac	chloroacetate
Cl_3ac	trichloroacetate
2-Clbz	2-chlorobenzoate
$ClC_6H_4CH_2OCO_2$	2-chlorophenoxyethanolate
2-Cl-5-NO_2py	2-chloro-5-nitropyridine
2,4-Cl_2pac	2,4-dichlorophenoxyacetate
2,4,5-Cl_3pac	2,4,5-trichlorophenoxyacetate
2,4,6-Cl_3ph	2,4,6-trichlorophenolate
2-Clpr	2-chloropropanoate
3-Clpr	3-chloropropanoate
4-Clpt	p-chlorophenylthio
2-Clpy	2-chloropyridine
3-Clpy	3-chloropyridine
2,5-Cl_2py	2,5-dichloropyridine
3,5-Cl_2py	3,5-dichloropyridine
4,7-Cl_2qu	4,7-dichloroquinoline
cmp	cytidine-5′-phosphate
3-CNbz	3-cyanobenzoate
3-CNpy	3-cyanopyridine
4-CNpy	4-cyanopyridine
C_4O_4	squaric acid
cpca	3-chlorophenylcyanamide
15-crown-5	macrocyclic polyethers
crot	crotonate
C_2S_4	tetrathiooxalate

csmp	2-(2-chlorophenylthio)-2-methylpropanoate
cychol	trans-1,2-cycloheptanediol
cycol	1,2-cyclohexanediol
dabco	1,4-diazabicyclo[2.2.2]octane
dacado	diacetylazine dioxime
dacpd	20 membered Schiff base derived from 2,6-diacetylpyridine and 1,3-diamino-2-hydroxyallane
daea	di-(2-aminoethyl)amine
dalthc	dialyldithiocarbamate
damet	2-diethylaminoethanolate
damol	diaminoalcohole
damp	N(2-dimethylaminoethyl) 3-aminopropanolate
dana	1,5-bis(p-methoxyphenyl)-1,3,5-pentanetrionate
dapsc	2,6-diacetylpyridine disemicarbazone
dapo	1-(N,N-dimethyl-2-aminoethyl)-1-phenyl-2-oximopropane
dapp	α-dithionaphthothionate hydroxyalkane
dbta	2,3-dioxybutan-1,4-diamin-N,N,N′,N′-tetraacetate
dbz-18-crown-6	dibenzo-18-crown-6
dbztsf	dibenzotetrathiafulvalene
dbztsfH	dibenzotetrathiafulvalenium
dcp	3,5-dicarboxypyrazolate
dcpmta	(2,4-dichloro-5-methylphenylthio)acetate
dd	5,5-bis(3,7-diazanonane-1,9-diamine
ddd	5,5′-bis(3,7-dehydro-3,7-diazanonane-4,6-dione-1,9-diamine)
deamp	2,6-bis[N-(2-diethylaminoethyl)-N-ethyl-aminomethyl]-4-methylphenol
deapo	3-diethylaminopropan-1-olate
deha	disubstituted aminoalcohole
dempz	3,5-diethyl-4-methylpyrazole
den	di-(2-aminoethyl)amine
denc	N,N-diethylnicotinamide
desc	diethyldithiocarbamate
dfpp	ligand derived from 2,6-diformyl-4-chlorophenol and polyamine
dhnq	dianion of 5,8-dihydroxy-1,4-naphthoquinone
dhph	1,4-dihydrazinophthalazine
dien	diethylenetriamine
[14]-4,11-dieneN$_4$	5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclotetradeca-4,11-diene

dio	1,4-dioxane
diimH	Schiff base formed by the condensation of 2-aminoethanol with 2,4-pentanedione
dma	dimethylamine
dmaeoxd	N,N′-bis[2-(dimethylamino)ethyl]oxamide
dmaep	2-(2-dimethylaminoethyl)pyridine
dmapr	1,3-bis(dimethylamino)-2-propanol
dmb	2,6-dimethoxybenzoate
dmda	N,N-dimethyldiaminoalcohole
dmdc	3,4-dimethoxy-α-β-dihydrocinnamate
dmf	dimethylformamide
dmg	dimethylglyoxime
dmpa	ligand prepared by the condensation of 1,3-diaminopropan-2-ol with methyl acetoacetate
dmtp	5,7-dimethyl[1,2,4]triazolo[1,5-a]pyrimidine
2,4-dnph	2,4-dinitrophenolate
2,6-dnph	2,6-dinitrophenolate
dp-7	hexyldiporphyrin-7
dpa	2,2′-dipyridylamine
dpae	2-dipropylaminoethanolate
dpba	ligand prepared by the condensation of 1,3-diamino-propane-2-ol with benzoylacetone
dpce	dipyridine crown ether
dpepd	ligand prepared by the condensation of 1,3-diamino-propan-2-ol with 3-ethoxymethylenepentane-2,4-dione
dpma	ligand prepared by the condensation of 1,3-diaminopropan-2-ol with methyl acetoacetate
dpp	3,6-di(2-pyridyl)pyridazine-N,N′,N″,N‴
dppn	N,N′-dipicolinoyl-1,3-propanediamine
dpr	di(3-aminopropyl)amine
1,3-dpt	1,3-diphenyltriazene
dptd	2,5-di-(2′-methylpyridylthio)thiadiazole
dpy	di-2-pyridylmethane
dpyam	2,2′-N,N′-bispyridylamine
dpye	1,1-di-2-pyridylethanol
dtbsq	3,5-di-tert-butyl-o-semiquinate
dtic	5-(3,3-dimethyl-1-triazenyl)-imidazole-4-carboxamide
dtma	4-diethylenetriamineacetic acid
dt(metome)$_2$	N,N′-(1,2-dithioxoethane-1,2-diyl)bis(methyl methionate)
dzcyc	1,4-diazacycloheptane
eaep	2-(2-ethylaminoethyl)pyridine

eap	N,N′-ethylene bis(2-hydroxyacetophenimine)
ebdta	ethylene bis(oxyethylene)diamine-N,N,N′,N′-tetraacetate
ebs	N,N′-ethylene bis(salicylideneiminate)
edta	ethylenediaminetetraacetate
egta	octadentate ligand
ehmpr	2-ethyl-2-hydroxymethyl-1,3-propanediol
enaoH	2,2′-(1,2-diaminoethane)bis(2-methyl-3-butanone)oximate
enbpa	N,N′-ethylene bis(pyrrol-2-ylmethyleneaminate)
epma	N,N′-ethanediylidene bis(1-isopropyl-2-methyl-propylamine)
epthscarb	ethyl pyruvate thiosemicarbazone
etap	N-(2-ethylthioethyl)-3-aminopropanol
etapds	3-diethylamino-5-phenyl-1,2,4-dithiazolium
Etbitp	3,6-bis(N-ethyl-2-benzimidazolylthio)pyridazine
Etbzi	N-ethyl-2-hydroxybenzideniminate
Et_5dien	N,N,N′,N″,N″-pentaethyldiethylenetriamine
Et_2NCO_2	N,N-diethylcarbamate
Et_2NH	diethylimine
ete	2-(ethylthio)ethanol
Et_3en	N,N,N′-triethylenediamine
Et_4en	N,N,N′,N′-tetraethylenediamine
Et-nso	2-[2-(diethylamino)ethylthio]ethanol
EtO	ethoxy
EtOH	ethanol
2-Etpy	2-ethylpyridine
Fac	fluoroacetate
F_3ac	trifluoroacetate
F_3acac	1,1,1-trifluoro-2,4-pentanedionate
F_3acpt	2,5-bis(trifluoroacetyl)cyclopentanone
F_5bz	pentafluorobenzoate
2-Fbzth	2-fluorobenzothiazole
fbb	difluoro{3,3′-(trimethylenedinitrilo)bis(butan-2-one oximate)
fbo	perfluoro-tert-butoxy
F_6clobzim	1,1,1,5,5,5-hexafluoro-2,4-pentanedionato(N-ethyl-5-chloro-2-hydroxybenzylideneiminate
fdmen	ligand derived from the condensation of 2,6-diformyl-4-methylphenol with 1,1-dimethylene diamine
fluf	flufenamate
fm	formiate

fmclaph	Schiff base derived from the condensation of 2,6-diformyl-4-chlorophenol and (+)1-aminoethanephosphonic acid
F_6mobzim	1,1,1,5,5,5-hexafluoro-2,4-pentanedionato-(N-(2-methylethyl)-2-hydroxybenzylideneiminate
fmp	ligand formed by template condensation of 2,6-diformyl-4-methylphenol with 3,6-bis((aminoethyl)thio)pyridazine
4-Fpac	4-fluorophenoxyacetate
fpb	2,6-diformyl-4-tert-butyl-phenyl di(benzoylhydrazone)
F_6pd	1,1,1,5,5,5-hexafluoropentane-2,4-dionate
F_6pdhb	1,1,1,5,5,5-hexafluoro-2,4-pentanedionate-(N-(2,2-dimethylethyl)-2-hydroxybenzylideneiminate
F_5pho	(pentafluorophenyl)oxy
F_6phobzim	1,1,1,5,5,5-hexafluoro-2,4-pentanedionato(N-phenyl-2-hydroxybenzylidene)iminate
fpts	deprotonated 2-formylpyridine thiosemicarbazone
fsaen	3,3′-[1,2-ethanediyl-bis(nitrilomethylidyne)-bis(2-hydroxybenzoate)
F_3sbmobzim	4,4,4-trifluoro-1-(2-thienyl)-1,3-butanedionate-(N-(2-methylethyl)-2-hydroxybenzylideneiminate
fum	fumarate
gggly	glycylglycylglycine
3′-gmp	guanosine monophosphate
glth	glutathione
glu	glutarate
glygly	glycylglycinate
glyhgly	glycyl-L-histidylglycine
guan	guanine
hadt	1,4,7,13,16,19-hexaaza-10,22-dioxacyclotetracosane
(H)-apenol	2-((2-((o-hydroxy-α-methylbenzylidene)amino)ethyl) amino)amino)ethanole
H_2atp	nucleoside polyphosphate
$HB(3,5\text{-i-}Pr_2pz)_3$	hydrotris(3,5-isopropyl-1-pyrazolyl)borate
$HB(pz)_3$	hydrotris-(pyrazol-1-yl)borate
$H_2B(pz)_2$	dihydrobis(1-pyrazolyl)borate
Hbz	benzoic acid
hbzoct	3′-hydroxybenzo[1′,2′-b]-1,4-diazabicyclo[2.2.2] octane
hdN_6O	heptadentate macrocyclic ligand N_6O

hebd	N,N′-bis(2-hydroxy-3-carboxybenzilidene)-1,2-diaminoethane
heiob	2-(2-hydroxyethyl)imino-3-oximobutanate
hem	chemically modified hemocyanin derivatives
hemnim	1-(2-hydroxyethyl)-2-methyl-5-nitroimidazole
hepk	N-(2-hydroxyethyl)-2-pyridinecarboxaldimine
hepra	di-(2-hydroxyethyl) n-propylamine
hesc	N,N-bis(2-hydroxyethyl)dithiocarbamate
hfc	9-hydroxy-9H-fluorene-9-carboxylate
Hfpts	2-formylpyridine thiosemicarbazone
him	hexaimidazole ligand
hip	hippurate
hmit	1,3-bis(hydroxymethyl)-2-imidazolidinethione
hmtam	hexamethylenetetramine
hnimet	2-[[(2-hydroxy-1-naphtyl)methyl]imino]-ethanolate
hphen	2-(2-hydroxyphenyl)-1,10-phenanthroline
htr	heptanetrionate
hx	hexagonal
hxa	dihydroxamic acid
ia	iodanilate
ibpd	3,3′-imino bis(propanamidoxime)
idaH	iminodiacetate
im	imidazole
imiph	2,6-bis[((4-imidazolylethyl)imino)methyl]-4-methylphenolate
5′-imp	inosine 5′monophosphate
impyae	1-(imidazol-4-yl)-2-[(2-pyridylmethylene)amino]ethane
ipr_3ph	triisopropylphosphite
ips	(N-isopropyl-2-hydroxybenzylidene)aminate
Kbz-15-crown-5	benzo-15-crown-5 complexed potassium
L-Et	N,N,N′,N′-tetrakis(2-(1-ethylbenzimidazolyl))-2-hydroxy-1,3-diaminopropane
LS	2,6-bis(4′-cyclohexyl-4′-hydroxy-2′,3′-diazabuta-1′,3′-dien-1′-yl)-4-methylthiophenolate
L2py	2-[2-(α-pyridyl)ethyl]imino-3-butanone oxime
maepy	2-(2-methylaminoethyl)pyridine
mal	malonate
maldpr	ligand prepared by condensation of 2-hydroxy-5-methylisophthaldehyde with 1-amino-3-N,N–dimethylaminopropane

mapycarb	bis(2-N,N–dimethylaminoethyl)pyridine-2,6-dicarboxamide 1-oxide
mapyNO	2-methylaminopyridine 1-oxide
mbrsalpr	N-methyl-N′-(5-bromosalicylidene)-1,3-propanediamine
mdd	5,7,7-trimethyl-4,8-diazaundec-4-ene-1,11-diolate
mddc	2,9-bis(methoxymethyl)-2,9-dimethyl-4,7-dioxadecanedionate
mdmsp	N-methyl-N′-(4,6-dimethoxysalicylidene)-1,3-propanediamine
Me_3ac	trimethylacetate
Me_3(9-aneN_3)	trimethyl 1,4,7-triazacyclononane
Me_6-22-aneN_4	22 membered homoleque of curtis type
Me_2bcen	N,N′-bis(β-carbamoylethyl)-N,N′-dimethylethylenediamine
2-Mebz	2-methylbenzoate
Me_2CO	acetone
Me_5dien	1,1,4,7,7-pentamethyldiethylenetriamine
Meen	N-methylenediamine
Me_2en	N,N-dimethyleethylenediamine
Me_4en	N,N,N′,N′-tetramethylethylenediamine
megtb	1,8-bis[bis(1′-methylbenzimidazol-2′-ylmethylamino]-3,6-dioxaoctane
Me_4hd	2,2,6,6-tetramethylheptane-3,5-dionate
1-Me-im	N-methylimidazole
2-Me-im	2-methylimidazole
5-Me-imH	5-methylimidazole
Menic	methyl nicotinate
Me-nso	2-[2-(dimethylamino)-ethylthio]ethanol
MeO	methoxo
MeOH	methanol
4-MeOpyNO	4-methoxypyridine-1-oxide
4-Meox	4-methyloxazole
mep	mepirizole (4-methoxy-2-(5-methoxy-3-methyl-pyrazol-l-yl)-6-methylpyrimidine
mepH	2-amino-2-methyl-1-propanol
3-Mephpz	3-methyl-5-phenylpyrazole
3,4-Me_2phpz	3,4-dimethyl-5-phenylpyrazole
4,5-Me_2phpz	4,5-dimethyl-3-phenylpyrazole
Me_4pip	(1-oxy-2,2,6,6-tetramethylpiperidin-4-yl)-pivaloylacetate
Me_4pn	N,N,N′,N′-tetramethyl-1,3-propanediamine

2,2-Me_2pr	2,2-dimethylpropanoate
2-Mepy	2-methylpyridine
3-Mepy	3-methylpyridine
4-Mepy	4-methylpyridine
2,3-Me_2py	2,3-dimethylpyridine
2,5-Me_2py	2,5-dimethylpyridine
3,4-Me_2py	3,4-dimethylpyridine
3,5-Me_2py	3,5-dimethylpyridine
1-MepyH	1-methylpyridinium
1,2-Me_2pyH	1,2-dimethylpyridinium
4-MepyNO	4-methylpyridine 1-oxide
2,2,5,5-Me_4pyNO	2,2,5,5-tetramethylpyridine N-oxide
5-Mepz	5-methylpyrazole
3,5-Me_2pz	3,5-dimethylpyrazole
3,4,5-Me_3pz	3,4,5-trimethylpyrazole
4-Mequ	4-methylquinoline
7-Mequ	7-methylquinoline
mesalpr	N-methyl-N′-(5-methoxysalicylidene)-1,3-propanediamine
MeSbpy	2-(3,3-dimethyl-2-thiabutyl)pyridine
Me_2SO	dimethylsulphoxide
Mesprp	N-methyl-N-salicylidene-1,3-propanediaminate
4-Meth	4-methylthiazole
mhbi	N-methyl-2-hydroxybenzylideneiminate
mhsalim	N-(1,1-dimethyl-2-hydroxyethyl)salicylaldimine
mip	1,4-bis(1-methyl-2-imidazolyl)phthalazine
mmfp	4-methyl-2,6-bis[N-(2-methylthioethyl)-formimidoyl]phenolate
[30]-mN_6O_4	30-membered 'N_6O_4' macrocyclic Schiff base ligand
[20]-mN_6	20-membered macrocycle tetraimine ligand
mnsalpr	N-methyl-N′-(5-nitrosalicylidene)-1,3-propanediamine
[28]-mN_8	28-membered 'N_8' macrocyclic Schiff base ligand
mnthc	12-methyl-12-nitro-1,4,7,10-tetra-azacyclotridecane
mor	morpholine
mpp	2-methyl-1,3-di-2-pyridyl-2-propanole
mprph	2,6-bis[3-(dimethylamino)propyliminomethyl]-4-methylphenolate
4-mpt	p-methylphenylthio
mpzdad	1,1′-(4-methylpyrazole-3,5-diyl)diacetaldehyde dioxime

msimp	N-trimethylsilyl-iminotriphenylphosphoran
mtbne	2-[7-(methoxymethyl)-1,3,5,7-tetraazabicyclo[3.3.1]-nonan-3-yl]ethanolate
naa	nicotinic acid amide
α-nac	α-naphthylacetate
napr	naproxen (6-methoxy-α-methyl-2-naphthaleneacetic acid
nba	bis(β-diketone) ligand based on the larger 2,7-naphthalenediyl bis(methylene) bridge
N_3bz	benzotriazole
N-chsalim	N-cyclohexylsalicylideneaminate
N-Etsala	N-ethylsalicylaldimine
nmedtb	N,N,N′,N′-tetrakis[(1-methyl-2-benzimidazolyl)methyl]-1,2-ethanediamine
N-Mesala	N-methylsalicylaldimine
2-NH_2pm	2-aminopyrimidine
nic	nicotinamide
nipr	3-[1-(4-nitroimidazoyl)]propionate
NMe_4	tetramethylammonium
[24]-N_6O_2	1,13-dioxa-4,7,10,16,19,22-hexaazacyclotetracosane
2-NO_2bz,	2-nitrobenzoate
4-NO_2bz	4-nitrobenzoate
npsalim	N-n-nitrophenylsalicylaldiminate
NPr_4	tetrapropylammonium
nthy	1,8-naphthyridine
Obim	deprotonated form of 2-α-hydroxybenzylbenzimidazole
2-Obza	o-hydroxybenzylamine
2-O-6-Clpy	6-chloro-2-hydroxypyridine
ocoxb	cyclo-octahydrooxooctacosa-oxooctadecaborate
oct	octanoate
N-oed	1-(2-hydroxyethyl)-3,5-dimethylpyrazole
odt	2-oxo-1,3-dithiole-4,5-dithiolate
OHbim	2-α-hydroxybenzylbenzimidazole
3-OHbz	3-hydroxobenzoic acid
6-OHpur	6-hydroxypurinate
8-OHqu	8-hydroxyquinolinate
ophsalim	N-(2-hydroxy-2-phenylethyl)salicylideneiminate
2-Opy	2-pyridonate
2-O-3-Etpy	3-ethyl-2-pyridonate
or	orthorhombic
ox	oxalate

oxd	oxamidate
oxpn	N,N′-bis(3-aminopropyl)oxamide
oxtbz	2-oxyethylimino-2-oxy-1-benzaldehydate
pa	tetradentate phthalazine
paaan	2,2-dimethyl-7-(phenylimino)-3,5,7-octanetrionate
paaet	2,2-dimethyl-7-(ethylimino)-3,5-octanedionate
paapnan	2,2-dimethyl-7-(4-nitrophenyl(imino))-3,5,7-octanetrionate
paapr	2,2-dimethyl-7-(n-propylimino)-3,5-octanedionate
pamph	2,6-bis(bis(2′-pyridylethyl)aminomethyl)phenol
pan	1-(2-pyridylazo)-2-naphtholate
pap	1,4-di(2′-pyridyl)aminophthalazine
papfs	1,4-di-(4′,6-dimethylpyridin-2′-ylamino)-phthalazine
paphy	pyridine-2-carbaldehyde 2′-pyridylhydrazone
pap4me	1,4-bis(2-pyridylamino)phthalazine
pap6me	1,4-bis((6-methylpyrid-2-yl)amino)phthalazine
pap46Me	1,4-bis(4,6-dimethyl-2-pyridylamino)phthalazne
pbsalim	Schiff base prepared from salicylaldehyde and m-phenylenediamine
pca	phenylcyanamide
pcdp	Schiff base derived from pyrrole-2-carboxaldehyde and 3-aminopropanole
pcib	p-chlorophenoxyisobutyrate
pdcno	2,6-dicarboxylate-N-oxide
pdnm	phenyldinitromethanate
pdta	m-phenylenediamine-N,N,N′,N′-tetra-acetic acid
pdtb	N,N,N′,N′-tetrakis(benzimidazol-2-ylmethyl)-1,3-propane-diamine
pea	bis(2-(2-pyridyl)ethyl)amine
penas	D-penicillamine disulfide
pfpac	(pentafluorophenoxy)acetate
Ph	phenyl
phac	phenylacetate
phba	N-phenyl(2-hydroxybenzylidene)aminate
phbi	N-n-propyl-2-hydroxybenzylideneiminate
PhCN	benzonitrile
phed	diphenylethanedione dioxime
phen	1,10-phenanthroline
Ph_4mdP	tetraphenylmethylenediphosphine
Ph_3mgly	N-triphenylmethylglycine
PhOH	phenol
Ph_2P	diphenylphosphine

Ph_3P	triphenylphosphine
Ph_3PO	triphenylphosphine oxide
4-phpyNO	4-phenylpyridine-1-oxide
pht	phthalate
$phtN_6$	1,4-dihydrazinophthalazine-bis(2-pyridine)acetaldimine
pia	$N(CH_2)_3OH$
p-Ian	p-iodoaniline
piapr	N-(picolinoyl)-3-amino-1-propoxide
pib	phenoxyisobutyrate
piol	2,3-dimethyl-2,3-butanediol (pinacol)
pipcl	ligand derived from 2,6-dipiperazine and p-chlorophenol
pipH	piperidinium
pkph	di-2-pyridylketone[phenyl(semicarbazono)acetyl]hydrazone
plamph	N-pyridoxylideneaminomethyl-phosphonic acid
pmaH	analogue of bleomycin
pmp	2,6-bis(N-(2-pyridylmethyl)formidoyl)-4-methylphenol
pmk	*trans-trans* bis(2-pyridylmethyl)ketazine
1,3-pn	1,3-diaminopropane
pN_6O	phenoxo bridged binucleating ligand
pnthpy	2,7-bis(2-pyridyl)-1,8-naphthyridine
poapH	4-(phosphonomethyl)-2-hydroxy-2-oxo-1,4,2-oxazaphosphorinane
poh	5-phosphopyridoxylidenehistaminate
por	disubstituted porphyrine
ppd	3,6-bis(1-pyrazolyl)pyridazine
ppdn	N,N′-dipicolinoyl-1,3-propane)-bis(sulphate)
ppdme	3,6-bis(3,5-dimethyl-1-pyrazolyl)pyridazine
pprz	2,5-bis(2′-pyridyl)pyrazine
pr	propionate
prahmft	tetra Schiff base macrocycle formed by condensation of propane-1,3-diamine with 2-hydroxy-5-methylisophthalaldehyde
pramcres	2,6-bis[(bis[2-(1-pyrazolyl)ethyl]amino]methyl-p-cresolate
prl	pyrrolidone
Pr-nso	2-[2-(di n-propylamino)ethylthio]ethanol
2-PrOH	2-propanol
proxyl	2,2,5,5-tetramethylpyrrolinyl-1-oxy
$(prp)_2en$	N,N′-ethylene bis(2-hydroxypropiophenoneiminate)
ptp	o-phospho-DL-thereonine-pyridoxal Schiff base
py	pyridine
pyaa	N-(2-pyridinyl)-acetoacetamide

pyames	2-[(2-pyridylmethyl)amino]ethylsulphinate
3-pycac	3-pyridylcarbinol
pycaro	N,N′-bis(2′-pyridinecarboxamide 1′-oxide)-1,2-ethane
pydca	pyridine-2,6-dicarboxylate
pydiox	2,2-bis(2-pyridyl)-1,3-dioxolane
pyeth	2-[2-(2-pyridyl)ethylthio]ethanol
pyimcres	2,6-bis[(2-pyridyl)methyliminomethyl]-p-cresolate
pyNO	pyridine 1-oxide
pypep	ligand related to bleomycin
pyqux	2-(2′-pyridyl)quinoxaline
pyra	pyrazine
4-pyx	4-pyridoxic acid
pz	pyrazole
pzc	pyrazine-2-carboxylate
pzdad	pyridazine-3,6-dicarbaldehyde dioximate
qu	quinoline
qpy	quinquepyridine
rib	riboflavin
sal	salicylate
sal-β-ala	N-salicylidene-β-alaninate
salal	salicylaldehydate
salapr	3-(salicylideneamino)-1-propanolate
$(salim)_2pr$	N,N′-propylene bis(salicylideneiminate)
salpa	N-(2-hydroxypropyl)salicylaldimine
salphala	N-salicylidene-L-phenylalaninate
salqu	8-(salicylideneamino)quinoline
sata	1,2,3,4-tetrakis(salicylideneamino)-2,3-dimethylbutane
sb	Schiff base ligand derived from 1,3-diaminopropane-2-ol and acetylacetone
sbm	dinucleating Schiff base macrocycle
sbN_6O	ligand was prepared by a template rection from 2,6-diacetylpyridine and 1,3-diamino-2-hydroxypropane
sbzph	Schiff-base ligand involving sulphides and benzimidazoles in addition to phenoxide
scsal	semicarbazone of salicylaldehyde
sd	ligand formed by the condensation of salicylaldehyde with 1,3-diamino-2-propanol
sdap	1,3-bis(salicylideneamino)propan-2-ol
sdb	Schiff base formed from the condensation of salicylaldehyde and 1,4-diamino butane-2-ol

sdp_3	ligand formed by the condensation of salicylaldehyde with 1,5-diamino-3-pentanol
shbr	N-salicylidene-2-hydroxy-5-bromobenzylamine
smtp	6-thio-9-methylpurine
spca	N^3-salicyloylpyridine-2-carboxamidrazone
S_4tpp	2,5,9,12-tetrathia[13](2,5)thiophenophane
S_5tpp	pentathia-thiophenophane
suc	succinate
suqn	5-sulphonic-8-quinolinate
tabm	5,5-bis(4′-amino-2-azabutyl)-1,9-diamino-3,7-diazanonane
tacac	1,4,7-triazacyclononane-1-acetic acid
tach	1,5,9,13-tetra-azacyclohexadecane
taec	N,N′,N″,N‴-tetrakis(2-aminoethyl)-1,4,8,11-tetra-azacyclotetradecane
taet	N,N′,N″,N‴-tetra(2-aminoethyl)-1,1,2,2-ethanetetraamide
taep	1,4,8,12-tetra-azacyclopentadecane
tart	dl-tartrate
tba	thiobenzamide
tbi	thiobenzimide
tbne	2-(1,3,5,7-tetraazabicyclo[3.3.1]nonan-3-yl)ethanolate
tbnp	3-(1,3,5,7-tetraazabicyclo[3.3.1]nona-3-yl)propanolate
tcb	tetracarboxylatobenzene
tcc	tetrachloro-o-catecholate
tcnq	7,7,8,8-tetracyanoquinodimethane
tcoa	1,5,8,12,15,22,26-octaazatricyclo[17.9.2.$2^{5,15}$]dotriaconta
tempo	2,2,6,6-tetramethylpiperidinyl-1-oxy
terpy	2,2′:6′,2″-terpyridine
tetac	1,4,7-trimethyl-1,4,7-triazacyclononane
tetb	(μ)-5,5,7,12,14-hexamethyl-1,4,8,11-tetraazacyclotetradecane
tfmd	8,8,8-trifluoro-7-(trifluoromethyl)-5-methyl-4-azaoct-4-ene-1,7-diolate
tfmd′	9,9,9-trifluoro-8-(trifluoromethyl)-6-methyl-5-azanon-5-ene-1,8-diolate
tgly	N-tosylglycinate
thf	tetrahydrofuran
thp	2(1H)-tetrahydropyrimidinone
tlma	di-p-tolylmethylamide
tmsfs	tetra(methylthio)tetrathiafulvalene
tmso	tetramethylene sulfoxide
tmp	2,4-diamino-5-(3′,4′,5′-trimethoxybenzyl)pyrimidine (trimethoprim)

tmtacd	2,4,4,9-tetramethyl-1,5,9-triazacyclododec-1-ene
tol	toluene
tolm	tolmetin (1-methyl-5-(p-toluoyl)-1H-pyrrole-2-acetic acid)
topcb	ligand derived from 1,4,7,10-tetraoxa-13-azacyclopentadecane with 5′-chlorocarbonyl-2,2′-bipyridine
tos	1,3-propanediyl ditosylate
tp	binucleating ligand containing μ-alkoxo backbones amidopyridyl "end" groups
tpe	1,1,2,2,-tetrakis(2-pyridyl)ethylene
tped	N,N,N′,N′-tetrakis[2-(3,5-dimethyl-1-pyrazolyl)ethyl]-1,2-ethylenediamine
tpma	tris[(2-pyridyl)methyl]amine
tpmc	N,N′,N″,N‴-tetrakis(2-pyridylmethyl)-1,4,8,11-tetrakis (2-pyridylmethyl)-1,4,8,11-tetraazacyclotetradecane
tpmta	1,4,8,11-tetrakis(2-pyridylmethyl)-1,4,8,11-azacyclotetradecane
tpt	teraphthalate
tpydax	N,N,N,N′-tetrakis[2-(-pyridyl)ethyl]-α,α′-diamino-m-xylene
tr	triclinic
tren	2,2′,2″-triaminoethylamine
trienMe6	N,N-bis(dimethylaminoethyl-N,N′-diethyl)-1,2-diaminoethane
trg	trigonal
tris	tris(hydroxymethyl)methylamine
tsval	N-tosylvalinate
ttc	cystamine-N,N,N′,N′-tetraacetate
ttc6	tropocoronand ligand
ttha	triethylenetetra-aminehexa-acetate
5′-ump	uridine-5′-monophosphate
upm	macrocyclic ligand derived by condensation of 4-methyl-2,6-diformylphenol with 1,3-diaminopropane
vlp	valproate (2-propyl-ethanoic acid)
xba	3,3′-[1,3-phenylene bis(methylene)] bis(2,4-pentanedione)

1. INTRODUCTION

Copper is a tough, soft and ductile reddish metal. The dipositive state is the most important one for copper. Most Cu(I) compounds are fairly readily

oxidized to Cu(II) compounds, but further oxidation to Cu(III) is more difficult. The d^9 configuration makes Cu(II) subject to Jahn-Teller distortion if placed in an environment of cubic symmetry, and this has a profound effect on all its stereochemistry.[1,2] The chemistry of copper compounds has been extensively investigated, and the relationship between structure and reactivity, ranging from industrial catalysis to biochemical activity, is of major importance.

Dimeric Cu(II) compounds, especially Cu(II) acetate type compounds constitute a class of compounds with long history. The earliest quotation to copper acetate is from the year 1594.[3]

In spite of this fact, attempts to specify the magnetic interaction in detail of Cu(II) acetate have been plagued by controversy and there are still differences of opinion.[3–8] In a recent, extensive review article only some ten Cu(II) acetate type dimers were mentioned.[9,10]

Many structural studies of copper compounds have been carried out, and have been sporadically summarized in annual reports.[11,12] There are complete reviews of the crystallographic and structural data of mixed-valence, Cu(I)–Cu(II),[13] and Cu(I) compounds.[14] To our knowledge, no complete review of the crystallographic and structural data of Cu(II) compounds exists. A comprehensive overview of mononuclear Cu(II) structural chemistry has also been reviewed recently by us.[15,16] Complete review of the crystallographic and structural data of dimeric Cu(II) compounds has not yet appeared. This review includes nine hundred published dimeric Cu(II) structures which have been analyzed and classified in order to assist in understanding the stereochemical interactions in the coordination sphere of the Cu(II) species.

The structures have been classified according to the type of bridge between two Cu(II) atoms. The referencing is in the order of increasing copper–copper separation. Under varying conditions Cu(II) has been isolated with coordination number from four to six, with five being by far the most common.

2. DIMERIC Cu(II) COMPOUNDS

2.1 Cu(II) Acetate Type

Crystallographic and structural data for two hundred Cu(II) acetate type dimers are gathered in Table I. A survey of green (blue-green) Cu(II) acetate type dimeric complex units containing either a CuO_5 (Table IA), CuO_4N (Table IB), CuO_4P (Table IC), CuO_4N, CuN_4Cl, CuO_3N_2, CuN_4, or

TABLE I Crystallographic and structural data for copper(II)acetate type dimers[a]

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
A: CuO_5										
$[Cu(pr)_2 \cdot 0.5dio]_2$	m	9.009(2)		CuO_5	O_{eq}[b]	1.953(2, 5)	2.5634(4)	O,O[b]	not given	17
(blue green)	$P2_1/c$	8.137(2)	109.92(5)		$dioO_{ap}$	2.227(2)	not given			
	4	15.121(4)								
$[Cu(but)_2]_2$[c]	tr	9.004(5)	94.7(5)	CuO_5	O_{eq}	1.982(–, 82)	2.565	O,O	not given	18
(bright green)	P-1	11.736(5)	71.3(5)		O_{ap}	2.245	not given			
	2	5.162(5)	95.2(5)							
$[Cu(bz)_2 \cdot 0.5dio]dio$	tg	14.6786(15)		CuO_5	O_{eq}	1.964(8, 8)	2.569(3)	O,O	not given	19
(blue green)	P_4/ncc				$dioO_{ap}$	2.179(8, 11)	not given			
	8	19.3689(28)								
$[Cu(pr)_2H_2O]_2$	m	15.102(7)		CuO_5	O_{eq}	1.95(1, 4)	2.575(4)	O,O	92.5(6, 6.3)	20
(blue green)	$P2_1/c$	17.186(5)	94.24(3)		H_2O_{ap}	2.11(1)	0.185		169.0(6, 4)	
	4	15.190(4)								
				CuO_5	O_{eq}	1.95(1, 6)	2.589(5)	O,O	92.0(6, 3.6)	
					H_2O_{ap}	2.07(1)	0.188(4)		168.8(6, 4)	
$[Cu(tgly)_2]$[c]	m	24.655(3)		CuO_5	O_{eq}	1.956(7, 5)	2.577(3)	O_{eq},O_{eq}	89.6(3, 2.8)	21
(green)	$P2_1/n$	7.697(2)	87.34(8)		O_{ap}	2.168(7)	0.171		169.8(4, 2)	
	4	12.378(3)						O_{eq},O_{ap}	95.0(4, 3.4)	
$[Cu(Me_2PhSiCO_2)_2H_2O]_2$	tr	14.067(6)	90.33(4)	CuO_5	O_{eq}	1.976(7, 144)	2.578(1)	O_{eq},O_{eq}	89.6(2, 11.2)	22
(blue green)	P-1	11.952(3)	130.80(4)		H_2O_{ap}	2.191(6, 111)	0.13		169.8(2, 3.6)	
	2	14.147(9)	68.91(2)					O_{eq},O_{ap}	94.8(2, 6.8)	
$[Cu(pr)_2]_2$[c]	tr	5.19(2)	87.5(3)	CuO_5	O_{eq}	1.94(1, 8)	2.578(4)	O,O	83.2(4, 7)	23
(green)	P-1	8.58(5)	90.0(3)		O_{ap}	2.28(1)	0.22			
	2	9.69(5)	75.5(3)							
$[Cu(fm)_2 \cdot 0.5dio]_2$[d]	tr	6.62(1)	112.5	CuO_5	O_{eq}	1.94(2, 3)	2.58(1)		not given	24
(not given)	P-1	9.05(2)	98.5		$dioO_{ap}$	2.19(2)	0.17			
	4	13.31(2)	112.5							
				CuO_5	O_{eq}	1.97(2, 6)	2.58(1)		not given	
					$dioO_{ap}$	2.33(2)	0.20			

$[Cu(piv)_2]_2$	tr	10.078(5)	70.87(2)	CuO_5	O_{eq}	1.95(2, 7)	2.580(2)	O_{eq},O_{eq}	89.5(8, 1.4)	25
(green)	P-1	11.516(2)	89.49(3)		O_{ap}	2.34(2, 2)	not given		169.4(8, 2.7)	
	2	11.895(2)	75.64(3)					O_{eq},O_{ap}	95.2(8, 15.6)	
$[Cu(ac)_2acH]_2$	m	15.153(2)		CuO_5	O_{eq}	1.967(2, 31)	2.581(1)	O_{eq},O_{eq}	89.5(1, 4)	26
(blue green)	$P2_1/n$	7.772(1)	103.08(1)		$HacO_{ap}$	2.197(2)	0.18	O_{eq},O_{ap}	95.2(1, 6.0)	
	2	8.229(1)								
$[Cu(but^i)_2]_2$[c]	tr	5.178(1)	88.25(2)	CuO_5	O_{eq}	1.95(2, 5)	2.582(5)	O_{eq},O_{eq}	89.4(9, 1.7)	25
(green)	P-1	8.497(2)	85.95(2)		O_{ap}	2.26(2)	not given		168.4(9, 7)	
	1	14.415(5)	75.58(2)					O_{eq},O_{ap}	95.6(9, 15.4)	
$[Cu(val)_2]_2$[c]	tr	5.176(1)	74.18(5)	CuO_5	O_{eq}	1.964(3, 44)	2.5822(6)	O_{eq},O_{eq}	89.5(1, 1.1)	25
(green)	P-1	9.356(8)	89.69(3)		O_{ap}	2.216(2)	not given		169.6(1, 0)	
	1	11.183(7)	89.69(4)					O_{eq},O_{ap}	95.2(1, 15.6)	
$[Cu(2\text{-}ClC_6H_4CH_2OCO_2]_2$[c]	m	11.587(3)		CuO_5	O_{eq}	1.965(5, 59)	2.583(2)	O,O	92.2(2, 16.5)	27
(not given)	$P2_1/c$	5.084(2)	103.76(2)		O_{ap}	2.169(5)	not given		169.7(2, 2)	
	2	29.600(6)								
$[Cu(but)_2]_2$[c]	tr	9.035(2)	85.88(2)	CuO_5	O_{eq}	1.964(2, 46)	2.584(1)	O,O	92.4(1, 18.8)	28
(not given)	P-1	5.192(2)	95.04(2)		O_{ap}	2.223(2)	not given		167.0(1, 4.8)	
	1	11.695(3)	109.32(2)							
$[Cu(but^i)_2]_2$[c]	tr	5.179(2)	101.64(1)	CuO_5	O_{eq}	1.94(1, 6)	2.584(5)	O_{eq},O_{eq}	89.4(2, 4)	29
(green)	P-1	10.548(1)	97.76(2)		O_{ap}	2.24(1)	not given		168.3(2, 2)	
	1	12.355(2)	96.71(2)					O_{eq},O_{ap}	95.7(2, 15.7)	
$[Cu(Me_2acr)_2(EtOH)]_2$[d]	tr	10.484(2)	65.97(1)	CuO_5	O_{eq}	1.962(3, 15)	2.586(1)	O_{eq},O_{eq}	89.5(1, 1.0)	30
(not given)	P-1	12.296(2)	71.69(1)		$EtHO_{ap}$	2.154(4)	0.185		169.4(1, 1)	
	2	14.303(3)	68.93(1)					O_{eq},O_{ap}	95.3(1, 8)	
				CuO_5	O_{eq}	1.965(3, 22)	2.601(2)	O_{eq},O_{eq}	89.5(1, 7)	
					$EtHO_{ap}$	2.156(4)	0.185		169.0(2, 0)	
								O_{eq},O_{ap}	95.5(1, 2.1)	
$[Cu(mptp)_2]_2$[c]	m	39.71(2)		CuO_5	O_{eq}	1.975(9, 38)	2.586(3)	O_{eq},O_{eq}	89.5(5, 8)	31
(dark green)	C2/c	5.268(2)	114.66(2)		O_{ap}	2.280(9)	not given		168.6(5, 2)	
	4	21.68(1)						O_{eq},O_{ap}	95.6(5, 16.9)	
$[Cu(ac)_2(iph)]_2$	tr	13.616(4)	87.54(3)	CuO_5	O_{eq}	1.963(2, 27)	2.587(1)	O_{eq},O_{eq}	89.5(1, 1.2)	32
(brown)	P-1	8.193(3)	97.32(3)		$ihpO_{ap}$	2.175(2)	0.183		169.3(1, 1)	
	1	8.140(3)	96.17(3)					O_{eq},O_{ap}	95.4(1, 2.5)	
$[Cu(i\text{-}val)_2]_2$[c]	tr	5.191(1)	83.12(1)	CuO_5	O_{ap}	1.959(5, 51)	2.588(2)	O,O	88.7(2, 9.5)	33
(blue)	P-1	10.840(2)	86.92(2)		O_{ap}	2.227(4)	not given		169.6(2, 4)	
	1	11.063(2)	85.60(2)							

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(ac)_2MeOH]_2$	m	8.129(2)		CuO_5	O_{eq}	1.967(2, 13)	2.596(1)	O_{eq},O_{eq}	89.5(1, 4)	26
(blue green)	$P2_1/n$	7.447(1)	92.21(1)		$MeHO_{ap}$	2.160(3)	0.18	O_{eq},O_{ap}	95.3(1, 1.5)	
	2	13.332(1)								
$[Cu(ptiba)_2(EtOH)]_2$[d]	tr	13.313(4)	116.64(2)	CuO_5	O_{eq}	1.952(5, 12)	2.596(1)	O_{eq},O_{eq}	89.5(2, 1.6)	31
(dark green)	P-1	14.281(4)	99.63(2)		$EtHO_{ap}$	2.222(3)	not given		169.5(2, 2)	
	2	15.446(4)	101.16(2)					O_{eq},O_{ap}	95.2(2, 2.3)	
				CuO_5	O_{eq}	1.968(4, 11)	2.616(1)	O_{eq},O_{eq}	89.4(2, 1.8)	
					$EtHO_{ap}$	2.177(4)	not given		168.5(2, 1)	
								O_{eq},O_{ap}	95.7(2, 2.9)	
$[Cu(piv)_2(pivH)]_2$	m	19.352(5)		CuO_5	O_{eq}	1.96(1, 3)	2.596(2)	O_{eq},O_{eq}	89.5(5, 1.2)	29
(green)	I2/c	11.704(2)	116.02(2)		$HpivO_{ap}$	2.206(7)	not given		168.7(4, 3)	
	4	19.521(2)						O_{eq},O_{ap}	95.5(3, 6.8)	
$[Cu(dmb)(ac)(H_2O)]_2$	m	7.898(2)		CuO_5	O_{eq}	1.961(2, 26)	2.597(1)	O_{eq},O_{eq}	89.51(9, 86)	34
(blue)	$P2_1/a$	20.334(6)	101.31(3)		H_2O_{ap}	2.202(3)	~0.0		169.33(9, 24)	
	2	8.148						O_{eq},O_{ap}	95.3(1, 2.0)	
$[Cu(dmpa)_2dmf)]_2$	tr	12.747(1)	80.05(2)	CuO_5	O_{eq}	1.948(4, 10)	2.598(1)	O_{eq},O_{eq}	89.5(2, 8)	35
(red)	P-1	14.596(8)	87.39(2)		$dmfO_{ap}$	2.124(5)	0.19		168.9(2, 1)	
	1	8.6135(4)	74.55(1)					O_{eq},O_{ap}	95.6(2, 6.4)	
$[Cu(2\text{-}Clbz)_2(H_2O)]_2$	m	7.214(2)		CuO_5	O_{eq}	1.967(2, 23)	2.599(1)	O_{eq},O_{eq}	89.4(1, 2.5)	36
(green)	$P2_1/n$	19.554(4)	103.82		H_2O_{ap}	2.138(2)	not given		168.6(1, 0)	
	2	10.877(4)						O_{eq},O_{ap}	95.6(1, 1.2)	
$[Cu(dmfa)_2(dmf)]_2$	m	10.710(1)		CuO_5	O_{eq}	1.96(1, 2)	2.601(3)	O_{eq},O_{eq}	89.5(4, 2.4)	37
(olive green)	$P2_1/c$	10.4430(5)	98.08(1)		$dmfO_{ap}$	2.16(1)	0.18		169.1(4, 1)	
	2	29.222(3)						O_{eq},O_{ap}	95.4(4, 2.9)	
$[Cu(2\text{-}phbz)_2(2\text{-}phbzH)]_2$	m	12.333(2)		CuO_5	O_{eq}	1.960(3, 27)	2.602(1)	O_{eq},O_{eq}	85.9(1, 1.2)	38
(dark green)	$P2_1/c$	15.392(2)	98.55(1)		$HphbzO_{ap}$	2.182(3)			169.2(1, 2)	
	2	17.327(2)						O_{eq},O_{ap}	95.4(1, 6.3)	
$[Cu(C_3H_5COO)_2(C_3H_5COOH)]_2$	m	9.015(2)		CuO_5	O_{eq}	1.977(4, 29)	2.602(2)	O_{eq},O_{eq}	89.5(2, 8)	39
(brown)	$P2_1/c$	19.704(4)	116.96		O_{ap}	2.207(3)	not given		169.0(2, 1)	
	2	9.034(2)						O_{eq},O_{ap}	95.5(1, 4.7)	

$[Cu(bz)_2MeOH]_2 \cdot 2MeOH$	tg	25.967(5)		CuO_5	O_{eq}	1.95(2, 2)	2.606(3)	O,O	not given	40
(not given)	R3				$MeHO_{ap}$	2.24(1)	not given			
	18	13.628(8)								
$[Cu(but)_2H_2O]_2$	m	26.924(8)		CuO_5	O_{eq}	1.939(5)	2.608(3)	O,O	not given	20
(blue green)	C2/c	14.615(5)	110.22(5)		H_2O_{ap}	2.16(1)	not given			
	8	25.15(18)								
$[Cu(ac)_2(cpl)]_2 \cdot C_6H_{12}$	tr	11.103(4)	94.85(4)	CuO_5	O_{eq}	1.958(6, 6)	2.609(2)	O_{eq},O_{eq}	89.5(3, 1.0)	41
(dark green)	P-1	11.865(6)	115.20(2)		$cplO_{ap}$	2.138(5)	0.207		168.6(2, 2)	
	1	9.912(3)	103.25(4)					O_{eq},O_{ap}	95.7(2, 3.5)	
$[Cu(ac)_2(EtOH)]_2 \cdot$	tr	11.470(3)	104.33	CuO_5	O_{eq}	1.963(8, 23)	2.609(1)	O_{eq},O_{eq}	89.5(3, 1.8)	42
$[Cu(ac)(mdmsp)]_2$	P-1	11.202(3)	106.32(2)		$EtHO_{ap}$	2.198(9)	not given		168.9(4, 7)	
(blue green)	2	10.771(3)	85.38(2)					O_{eq},O_{ap}	95.5(4, 3.9)	
				CuO_3N_2	O	1.910(8)	3.475(1)		not given	
					N	1.990(9, 65)				
					O_{br}	1.980(7)				
					O_{br}	2.570(7)				
$[Cu(pr)_2H_2O]_2$	m	15.314(7)		CuO_5	O_{eq}	1.92–2.01	2.61		not given	43
(not given)	$P2_1/b$	15.109(7)			H_2O_{ap}	2.11–2.18	not given			
	8	17.443(8)	94.36(1)							
$[Cu(suc)_2H_2O]_2 \cdot 2H_2O$	tr	6.437(11)	103.54(8)	CuO_5	O_{eq}	1.975(7, 15)	2.610(1)	O_{eq},O_{ap}	90.0(3, 5)	44
(not given)	P-1	7.623(4)	73.30(21)		H_2O_{ap}	2.102(9)	0.197		168.5(3, 1)	
	2	8.081(5)	98.37(13)					O_{eq},O_{ap}	92.5(3, 2.1)	
$[Cu(bz)_2(Hbz)]_2$	m	15.283(2)		CuO_5	O_{eq}	1.965(4, 37)	2.610(1)	O_{eq},O_{eq}	89.5(1, 6)	45
(blue green)	$P2_1/n$	11.716(2)	91.37(1)		$HbzO_{ap}$	2.197(2)	0.188(2)		169.0(1, 1)	
	2	10.783(1)						O_{eq},O_{ap}	95.4(1, 5.4)	
$[Cu(dmdc)_2MeOH]_2$	tr	15.084(2)	71.50(1)	CuO_5	O_{eq}	1.963(2, 8)	2.612(5)	O_{eq},O_{eq}	89.48(9, 84)	46
(green)	P-1	11.820(1)	77.61(1)		$MeHO_{ap}$	2.206(2)	0.1883		168.95(8, 4)	
	1	7.5253(7)	68.68(1)					O_{eq},O_{ap}	95.52(8, 3.73)	
$[Cu(ac\text{-}\beta\text{-}ala)_2(H_2O)]_2 \cdot 2H_2O$	m	9.120(1)		CuO_5	O_{eq}	1.968(4, 11)	2.613(1)	O_{eq},O_{eq}	89.5(2, 1.0)	47
(green)	$P2_1/c$	18.527(3)	98.61(1)		H_2O_{ap}	2.156(4)	not given		168.6(2, 1)	
	2	8.978(3)						O_{eq},O_{ap}	95.7(1, 5.5)	
$[Cu(2,3\text{-}C_{14}H_{14}NCO_2)_2dmf]_2$	m	8.940(2)		CuO_5	O_{eq}	1.97(1, 1)	2.613(2)	O_{eq},O_{eq}	89.4(3, 6)	48
(dark green)	$P2_1/c$	14.870(2)	103.30(2)				not given		168.5(3, 1)	
	2	23.394(3)			$(dmf)O_{ap}$	2.16(1)		O_{eq},O_{ap}	97.3(2, 12.7)	

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(ac)_2dmf]_2$	tr	8.002(1)	105.85(2)	CuO_5	O_{eq}	1.964(3, 7)	2.614(1)	O_{eq},O_{eq}	89.4(1, 1.1)	26
(blue green)	P-1	8.140(1)	92.31(2)		$dmfO_{ap}$	2.163(3)	0.20	O_{eq},O_{ap}	95.8(1, 3.2)	
	1	9.394(2)	113.84(1)							
$[Cu(dmpa)_2(dmf)]_2$	m	22.549(2)		CuO_5	O_{eq}	1.961(2, 7)	2.614(1)	O_{eq},O_{eq}	89.4(1, 7)	35
(green)	$P2_1/n$	16.598(1)	95.865(8)		$dmfO_{ap}$	2.151(2)	0.20		168.5(1, 3)	
	2	8.4222(2)						O_{eq},O_{ap}	95.6(1, 9.4)	
$[Cu(ac)_2H_2O]_2$	m	13.167(4)		CuO_5	O_{eq}	1.969(2, 22)	2.6143	O_{eq},O_{eq}	88.7(1, 2.3)	49
(green)	C2/c	8.563(2)	117.019(2)		H_2O_{ap}	2.1613(17)	not given		168.70(7)	
	4	13.862(7)						O_{eq},O_{ap}	94.5(1, 3.6)	
$[Cu(4\text{-}NO_2bz)_2H_2O]_2{\cdot}4H_2O$	tr	6.716(3)	99.44(4)	CuO_5	O_{eq}	1.979(–, 8)	2.615	O,O	not given	50
(green)	P1	11.797(4)	103.71		H_2O_{ap}	2.122	not given			
	2	12.479(2)	96.32(3)							
$[Cu(ac)_2H_2O]_2(acH)_2$	tr	7.530(1)	94.29(4)	CuO_5	O_{eq}	1.974(2, 25)	2.616(1)	O,O	not given	51
(green)	P-1	8.118(2)	94.34(7)		H_2O_{ap}	2.127(3)	not given			
	2	8.657(2)	105.59(4)							
$[Cu(F_5bz)_2(dio)_{0.5}]_2{\cdot}2dio$	tr	8.926(1)	96.49(1)	CuO_5	O_{eq}	1.958(7, 10)	2.616(1)	O,O	not given	52
(not given)	P1	12.175(2)	100.51(1)		$(dio)O_{ap}$	2.138(6)	0.192			
	1	11.636(2)	111.22(1)							
$[Cu(ac)_2(H_2O)]_2$	m	13.168(2)		CuO_5	O_{eq}	1.969(3, 25)	2.616(1)	O_{eq},O_{eq}	89.5(2, 1.6)	53
(dark green)	C2/c	8.564(2)	117.02(1)		H_2O_{ap}	2.156(4)	not given		168.8(2, 2)	
	4	13.858(2)						$O_{eq}O_{ap}$	95.6(2, 2.8)	
$[Cu(asp)_2]_2$[c]	m	8.208(3)		CuO_5	O_{eq}	1.963(8, 10)	2.617(3)	O_{eq},O_{eq}	89.5(4, 1.6)	54
(blue)	$P2_1/c$	10.39(2)	104.74(5)		O_{ap}	2.241(8)	not given	O_{eq},O_{ap}	95.5(3, 1.7)	
	4	21.56(1)								
$[Cu(2,4\text{-}Cl_2pac)_2dio]_2{\cdot}3dio$	tr	12.557(1)	112.56(3)	CuO_5	O_{eq}	1.97(–, 1)	2.620	O_{eq},O_{eq}	89.5(–, 1.1)	55
(not given)	P1	14.391(2)	99.62(3)		$dioO_{ap}$	2.19	not given			
	2	9.537(11)	92.77(3)							
$[Cu(dmb)_2(H_2O)]_2$	or	27.890(7)		CuO_5	O_{eq}	1.969(3, 12)	2.620(1)	O_{eq},O_{eq}	89.981,1.9)	34
(green)	Cmca	7.098(3)			H_2O_{ap}	2.131(4)	0.37		168.5(1)	
	4	19.691(5)						$O_{eq}.O_{ap}$	95.8(1, 6)	

$[Cu(phac)_2urea]_2$[d]	tr	11.854(5)	106.82(2)	CuO_5	O_{eq}	1.964(4, 22)	2.623(1)	O,O	not given	56
(green)	P-1	15.524(4)	87.64(3)		$ureaO_{ap}$	2.148(5)	0.202			
	4	19.794(6)	81.32(3)							
				CuO_5	O_{eq}	1.964(5, 14)	2.630(1)	O,O	not given	
					$ureaO_{ap}$	2.155(5)	0.196			
$[Cu(\alpha\text{-nac})_2(dmf)]_2\cdot(dmf)_2\cdot H_2O$	tr	11.912(4)	95.03(2)	CuO_5	O_{eq}	1.969(8, 28)	2.623(1)	O_{eq},O_{eq}	89.4(5, 2.5)	57
(green)	P-1	13.626(2)	114.8(3)		$dmfO_{ap}$	2.147(7, 16)	0.20		168.0(4, 2.3)	
	1	10.040(3)	73.58(3)					O_{eq},O_{ap}	94.3(4, 7.8)	
$[Cu(C_{13}H_9F_3NCO_2)_2dmf]_2$	m	26.955(4)		CuO_5	O_{eq}	1.97(2, 1)	2.623(3)	O_{eq},O_{eq}	89.5(6, 1.7)	48
(dark green)	$P2_1/a$	12.736(2)			$dmfO_{ap}$	2.15(2)	not given		169.0(7, 4)	
	2	9.252(2)	102.82(2)					$O_{eq}O_{ap}$	95.5(6, 4.3)	
$[Cu(ac)_2urea]_2 2H_2O$	m	8.758(1)		CuO_5	$urcaO_{eq}$	1.970(2, 14)	2.624(1)	O,O	89.4(1, 1.3)	58
(dark green)	$P2_1/c$	14.152(2)	109.01(1)		O_{ap}	2.135(1)	0.200		168.0(1, 0)	
	2	8.502						O,O_{ap}	96.0(1, 1.3)	
$[Cu(csmp)_2(H_2O)]_2$	tr	7.340	104.33(2)	CuO_5	O_{eq}	1.971(7, 16)	2.624(2)	O_{eq},O_{eq}	89.5(2, 3.2)	59
(green)	P-1	14.863(5)	98.18(2)		H_2O_{aq}	2.169(7, 14)	not given		167.8(3, 1.4)	
	2	22.963(8)	102.18(2)					O_{eq},O_{ap}	96.0(3, 5.1)	
$[Cu(2\text{-}Brbz)2(H_2O)]_2$	m	7.384(6)		CuO_5	O_{eq}	1.99(2, 3)	2.624(7)	O_{eq},O_{eq}	90(1, 2)	60
(green)	$P2_1/n$	20.02(2)	105.4(1)		H_2O_{aq}	2.17(2)	0.20		168.5(1.0,5)	
	2	11.04(1)						O_{eq},O_{ap}	96(1, 1)	
$[Cu(mddc)H_2O]_2$	tr	11.506(4)	101.01(1)	CuO_5	O_{eq}	1.953(4, 16)	2.626(2)	O_{eq},O_{eq}	89.5(2, 1.0)	61
(green)	P-1	7.149(2)	114.06(2)		H_2O_{ap}	2.144(3)	not given	O_{eq},O_{eq}	95.7(2, 2.6)	
	1	13.085(3)	90.85(2)							
$[Cu(bz)_2Me_2SO]_2$	m	19.030(8)		CuO_5	O_{eq}	1.96(1, 4)	2.627(2)	O_{eq},O_{eq}	89.4(4, 2.8)	62
(dark green)	C2/c	15.494(9)	103.73(4)		Me_2SO_{ap}	2.17(1, 1)	0.202		168.2(4, 2.8)	
	4	23.828(11)						O_{eq},O_{ap}	95.9(4, 5.9)	
$[Cu(napr)_2(Me_2SO)]_2$	m	17.166(2)		CuO_5	O_{eq}	1.966(4, 29)	2.629(1)	O_{eq},O_{eq}	89.4(2, 1.7)	63
(green)	$P2_1$	10.518(2)	118.69(1)		Me_2SO_{ap}	2.139(5, 11)	0.203		168.1(2, 3.2)	
	2	18.184(3)						O_{eq},O_{ap}	95.2(2, 3.6)	
$[Cu(\beta\text{-ala})_2H_2O]_2(NO_3)_4\cdot 4H_2O$	tr	12.499(1)	77.74(2)	CuO_5	O_{eq}	1.975(4, 14)	2.639(1)	O_{eq},O_{eq}	89.5(2, 1.1)	64
(green)	P-1	8.717(1)	82.44(1)		H_2O_{ap}	2.124(3)	not given		168.6(1, 1)	
	1	8.070(1)	71.48(1)					O_{eq},O_{ap}	95.7(2, 1.2)	

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(p\text{-}OHC_6H_4CO_2)_2$ $Me_2SO]_2 \cdot 4Me_2SO$ (not given)	or Pbca 8	18.623(4) 18.867(4) 15.019(3)		CuO_5	O_{eq} Me_2SO_{ap}	1.96(1, 2) 2.12(1)	2.639(3) not given		not given	40
$[Cu(2,4\text{-}Cl_2pac)_2H_2O]_2 \cdot 2H_2O$ (turquoise)	m C2/c 4	36.98(3) 7.582(2) 14.972	105.52(6)	CuO_5	O_{eq} H_2O_{ap}	1.971(10, 16) 2.120(10)	2.639(5) 0.24	O_{eq},O_{eq} $O_{eq}O_{ap}$	89.4(5, 2.0) 168.8(5, 5) 102.8(5, 19.3)	65
$[Cu(dcmpta)_2H_2O]_2 \cdot 2Me_2CO$ (not given)	tr P-1 1	8.140(3) 9.501(5) 18.58(1)	90.73(5) 99.56(5) 108.72(4)	CuO_5	O_{eq} H_2O_{ap}	1.99(2, 2) 2.13(2)	2.639(5) not given	O_{eq},O_{eq} O_{eq},O_{ap}	89.4(7, 1.7) 168.2(7, 6) 95.9(7, 6.3)	66
$[Cu(ac)_2H_2O]_2$ (dark green)	m C2/c 4	13.15 8.52 13.90	117.0	CuO_5	O_{eq} H_2O_{ap}	1.97(–, 2) 2.20	2.64 not given	O,O	not given	67
$[Cu(sal)_2H_2O]_2H_2O \cdot dio$ (pale green)	m $P2_1/c$ 2	11.65 6.90 22.36	104.42	CuO_5	O_{eq} H_2O_{ap}	1.98–2.03 2.15(–6)	2.64 0.206	O,O	not given	68
$[Cu(2\text{-}bbenz)_2H_2O]_2$ (green)	m $P2_1$ 2	11.02(1) 17.86(2) 13.06(2)	105.69(3)	CuO_5	O_{eq} H_2O_{ap}	1.97(2, 4) 2.22(2, 3)	2.64(1) 0.22(–, 5)	O_{eq},O_{eq} O_{eq},O_{ap}	89.3(8, 1.8) 167.3(7, 3.9) 96.4(7, 9.0)	69
$[Cu(C_8H_{15}NOCO_2)_2(EtOH)]_2$ H_2O (not given)	tr P-1 1	12.924(41) 13.441(11) 8.033(9)	82.82(8) 90.51(9) 115.01(6)	CuO_5	O_{eq} $EtHO_{ap}$	1.983(–, 20) 2.17	2.644 not given	O_{eq},O_{eq} O_{eq},O_{ap}	88(–, 2) 93(–, 1)	70
$[Cu(pfpac)_2H_2O]_2$ (not given)	m $P2_1/c$ 4	7.635(5) 12.958(4) 37.45(3)	94.45(4)	CuO_5	O_{eq} H_2O_{ap}	1.96(1, 3) 2.15(1, 2)	2.644(4) not given	O_{eq},O_{eq} O_{eq},O_{eq}	89.4(5, 2.9) 167.9(5, 5) 96.0(5, 2.4)	71
$[Cu(2,4\text{-}dcpmta)_2(Me_2CO)]_2$ (light green)	tr P-1 1	8.357(1) 12.502(2) 13.721(2)	107.20(1) 96.09(1) 104.94(1)	CuO_5	O_{eq} Me_2CO_{ap}	1.961(4, 3) 2.206(3)	2.646(1) not given	O_{eq},O_{eq} O_{eq},O_{ap}	89.4(2, 2.4) 167.9(1, 1) 94.9(1, 1.6)	72
$[Cu(nipr)_2H_2O]_2 \cdot 2H_2O$ (green)	or Pbca 4	13.450(2) 14.403(3) 19.619(3)		CuO_5	O_{eq} H_2O_{ap}	1.965(3, 5) 2.118(3)	2.647(1) not given	O_{eq},O_{eq} O_{eq},O_{ap}	89.4(1, 1.7) 167.8(1, 1) 96.1(1, 5.4)	73

$[Cu(3\text{-}Clpr)_2(Ph_3PO)]_2$	tr	8.603(6)	76.94(3)	CuO_5	O_{eq}	1.969(2, 7)	2.649(1)	O,O	not given	74
(green)	P-1	12.605(4)	71.74(4)		Ph_3PO_{ap}	2.097(2)	0.2063(4)			
	1	12.624(5)	74.42(4)							
$[Cu(Clac)_2urea]_2$	m	7.816(2)		CuO_5	O_{eq}	1.97(−, 1)	2.651	O,O	not given	75
(green)	not given	7.677(3)			$ureaO_{ap}$	2.08	0.21			
	2	18.425(7)	107.91(3)							
$[Cu(Me_3NCH_2CO_2)_2(ClO_4)_2]_2$	m	12.186		CuO_5	O_{eq}	1.96(2)	2.652(7)	O,O	not given	76
(not given)	C2	12.652	100.00		O_3ClO_{ap}	2.29(3)	not given			
	4	12.857								
$[Cu(fm)_2urea]_2$	tr	6.797(2)	116.46(1)	CuO_5	O_{eq}	1.977(2, 12)	2.655(1)	O,O	89.3(1, 8)	58
(green)	P-1	6.687(1)	76.64(2)		$ureaO_{ap}$	2.120(1)	0.213		167.9(1, 1)	
	1	9.088(1)	113.01(1)					O,O_{ap}	96.2(1, 2.6)	
$[Cu(bz)(Ph_3PO)]_2$	m	24.337(3)		CuO_5	O_{eq}	1.968(2, 9)	2.657(1)	O_{eq},O_{eq}	89.3(1, 1.8)	77
(blue)	A2/a	10.566(1)	93.18(1)		Ph_3PO_{ap}	2.143(2)	0.210		167.7(1, 0)	
	4	21.579						O_{eq},O_{ap}	96.1(1, 9)	
$[Cu(Fac)_2urea]_2$	tr	8.156(3)	81.42(6)	CuO_5	O_{eq}	1.971(7, 15)	2.657(3)	O,O	not given	79
(green)	P-1	8.735(5)	90.12(5)		$ureaO_{ap}$	2.099(7)	0.209			
	2	13.61	92.25(4)							
				CuO_5	O_{eq}	1.975(7, 13)	2.674(3)	O,O	not given	
					$ureaO_{ap}$	2.105(7)	0.215			
$[Cu(fm)_2(urea)]_2$	tr	6.677(13)	78.44(10)	CuO_5	O_{eq}	1.952(16, 13)	2.657(7)	O_{eq},O_{eq}	89.3(6, 1.0)	78
(green)	P-1	6.822(14)	116.20(10)		$ureaO_{ap}$	2.114(13)	0.22		167.3(6, 2)	
	2	9.093(18)	113.0(1)					O_{eq},O_{ap}	96.4(6, 3.4)	
$[Cu(tolm)_2(Me_2SO)]_2$	tr	9.008(2)	97.98(2)	CuO_5	O_{eq}	1.962(2, 11)	2.6621	O_{eq},O_{eq}	89.3(1, 4)	63
(green)	P-1	12.902(4)	81.52(2)		Me_2SO_{ap}	2.131(1)	0.219		167.2(2, 0)	
	1	14.446(4)	108.94(2)					O_{eq},O_{ap}	96.4(1, 1.6)	
$[Cu(bz\text{-}\alpha\text{-}ala)_2(H_2O)]_2$	tr	9.421(2)	74.31(2)	CuO_5	O_{eq}	1.968(3, 10)	2.664(1)	O_{eq},O_{eq}	89.3(1, 1.5)	80
(blue green)	P-1	9.549(2)	79.21(2)		H_2O_{ap}	2.138(4)	0.21		167.2(2, 2)	
	1	12.618(3)	88.69(2)					O_{eq},O_{ap}	96.4(1, 5.6)	
$[Cu(acgly)_2H_2O]_2$	m	7.288(2)		CuO_5	O_{eq}	1.971(3, 17)	2.666(1)	O_{eq},O_{eq}	89.3(1, 1.7)	81
(not given)	$P2_1/c$	8.892(2)	103.04(3)		H_2O_{ap}	2.108(3)	not given		167.5(1, 2)	
	4	19.473						O_{eq},O_{ap}	96.3(1, 4.7)	

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(Fac)_2H_2O]_2$	m	12.736(4)		CuO_5	O_{eq}	1.969(2, 17)	2.674(1)	O_{eq},O_{eq}	89.3(1, 1.7)	82
(light green)	C2/c	9.537(3)	118.09(2)		H_2O_{ap}	2.131(4)	0.314		167.5(1, 1)	
	4	13.683(4)						O_{eq},O_{ap}	96.2(1, 6.2)	
$[Cu(Fac)_3]_2(deha)_2$	tr	7.825	74.28(5)	CuO_5	O_{eq}	1.976(2, 6)	2.685(0)	O_{eq},O_{eq}	89.3(1, 7)	82
(not given)	P-1	8.816(7)	86.57(4)		O_{ap}	2.135(1)	0.219		167.3(1, 1)	
	1	12.986(6)	85.18(6)					O_{eq},O_{ap}	96.4(1, 3.9)	
$[Cu(\beta\text{-ala})_2(Ph_2P)]_2(Ph_2P)_2\cdot H_2O$	tr	9.781(3)	94.59(5)	CuO_5	O_{eq}	1.979(4, 16)	2.688(1)	O_{eq},O_{eq}	89.2(2, 2.9)	83
(dark green)	P-1	14.247(4)	94.73(5)		Ph_3PO_{ap}	2.091(4)	0.229		166.7(2, 3)	
	1	13.809(4)	114.67(5)					O_{eq},O_{ap}	96.5(2, 3.6)	
$[Cu(2\text{-}Clpr)_2(Ph_3PO)]_2$	m	11.191(8)		CuO_5	O_{eq}	1.974(6, 23)	2.696(2)	O_{eq},O_{eq}	89.5(2)	84
(dark green)	$P2_1/n$	17.161(8)	91.69(3)		Ph_3PO_{ap}	2.095(5)	0.230	O_{eq},O_{ap}	95.5(2, 2.1)	
	2	13.102(4)								
$[Cu(2\text{-}NO_2bz)_2(Me_2SO)]_2$	m	10.621(4)		CuO_5	O_{eq}	1.984(3, 18)	2.702(1)	O_{eq},O_{eq}	167.0(1, 1)	85
(green)	$P2_1/n$	10.480(3)	96.15(8)		Me_2SO_{ap}	2.167(3)	0.225	O_{eq},O_{ap}	96.5(1, 4.1)	
	2	17.567(10)								
$Cu(H_2O)_4[Cu_2(pib)_5]_2$	tr	14.32(1)	99.17(4)	CuO_5	O	1.97(4, 11)	2.85(1)	O,O	90(1, 6)	86
(dark green)	P-1	10.950(8)	90.32(4)				not given			
	1	19.67(1)	117.22(4)	CuO_4 (monomer)	H_2O	1.92(4, 0)		O,O	89(2)	
$Cu(H_2O)_4[Cu_2(pib)_5]\cdot 4H_2O$	m	41.90(1)		CuO_5	O	1.962(9, 63)	2.929(1)	O,O	90.8(4, 4.9)	86
(dark green)	C2/c	12.135(4)	91.13(2)			2.211(9, 10)	not given		164.2(4, 17.6)	
	4	21.501(3)							94.3(4, 26.5)	
				CuO_4 (monomer)	H_2O	1.952(4, 0)		O,O	74.1(3)	
						2.46(1)			89.2(3)	
$[Cu(Cl_3ac)_2(proxyl)]_2$	tr	9.826(3)	94.02(2)	CuO_5	O_{eq}	1.919(4, 9)	3.197(2)	O_{eq},O_{eq}	90.9(2, 11.2)	87
(dark green)	P-1	13.216(4)	114.99(2)		O_{eq}	2.165(4, 127)			130.3(2, 1)	
	2	18.022(2)	100.45(2)		proxylO_{ap}	1.965(4, 5)			177.0(2, 1)	
								O_{eq},O_{ap}	93.5(2, 8.6)	
									119.2(8.4)	

$[Cu(Cl_3ac)_2(tempo)]_2$	m	12.134(3)		CuO_5	O_{eq}	1.910(9, 14)	3.256(2)	O_{eq},O_{eq}	89.7(4, 3.8)	87
(deep green)	$P2_1/n$	22.465(5)	100.43(2)		O_{eq}	2.1946(8, 4)			125.7(4, 9)	
	4	16.693(3)			tempoO_{ap}	1.946(8, 4)			175.3(4, 2.4)	
								O_{eq},O_{ap}	93.4(4, 7.5)	
									120.8(4, 8.3)	
$[Cu(2,4\text{-dcpmta})_2(Me_2CO)$	tr	8.140(3)	90.78(5)	CuO_5		not given				72
$H_2O]_2$	P-1	9.501(5)	99.56(5)							
(green)	1	18.58(1)	108.72(4)							
B: CuO_4N										
$[Cu(ac)_2pyra]_2$	m	7.9156(9)		CuO_4N	O_{eq}	1.965(4, 2)	2.576(1)	O,O	89.3(1, 1.2)	89
(at 100 K)	C2/m	14.024(3)	100.99(2)		N_{ap}	2.167(5)	0.26	O,N	95.1(1, 1.4)	
	not given	7.3022(9)								
$[Cu(ac)_2pyra]_2$	m	7.967(9)		CuO_4N	O_{eq}	1.964(5, 4)	2.583(1)	O,O	89.6(2, 1.0)	89
(at 300 K)	C2/m	14.211(1)	101.23(2)		N_{ap}	2.171(6)	0.28	O,N	95.4(2, 1.5)	
	not given	7.3210(8)								
$[Cu(ac)_2(Menic)]_2$	m	8.710(2)		CuO_4N	O_{eq}	1.974(3, 10)	2.607(1)	O,O	not given	90
(not given)	$P2_1/c$	18.823(5)	92.56(2)		N_{ap}	2.173(3)	0.179(1)	O,N	95.7(1, 1.2)	
	2	8.059(2)								
$[Cu(pr)_2py]_2$[d]	tr	16.204(9)	103.9(1)	CuO_4N	O_{eq}	1.97(1, 2)	2.619(2)		not given	91
(green)	P-1	8.442(5)	121.0(1)		N_{ap}	2.13(1)	not given			
	4	11.618(7)	90.4(1)							
				CuO_4N	O_{eq}	1.96(1, 0)	2.642(2)		not given	
					N_{ap}	2.17(1)	not given			
$[Cu(ac)_2(hmtam)]_2$	or	15.616(4)		CuO_4N	O_{eq}	1.975(2, 6)	2.624(1)	O,O	90.0(1, 2.3)	92
(green)	Cmma	15.459(5)			N_{ap}	2.212(2)	not given		145.1	
	4	8.066(5)						O,N	98.9(1)	
$[Cu(ac)_2py]_2$	m	12.520(2)		CuO_4N	O_{eq}	1.974(5, 9)	2.628(1)	O,O	89.4(3, 7)	58
(green)	A2/a	17.310(4)	96.73(2)		N_{ap}	2.163(4, 7)	0.207	O,N	96.0(2, 9)	
	4	9.930(2)								
$[Cu(2\text{-bbenz})_2(p\text{-Ian})]_2$	tr	13.429(3)	103.85(2)	CuO_4N	O_{eq}	1.954(1, 26)	2.630(1)	O,O	89.4(1, 1.9)	93
(green)	P-1	12.999(5)	107.95(2)		N_{ap}	2.221(1)	0.20		168.1(1, 3)	
	1	10.192(2)	106.51(2)					O,N	95.9(1, 2.2)	

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]	*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]	*Ref.*
$[Cu(vlp)_2py]_2$ (green blue)	tr P-1 1	10.5074(4) 11.5436(6) 10.4440(7)	95.126 103.373(5) 74.771(4)	CuO_4N	O_{eq} 1.963 N_{ap} 2.165(9)	2.630(2) 0.205	not given	94
$[Cu(pr)_2(3\text{-Mepy})]_2$ (not given)	m C2/c 8	20.702(4) 7.306(2) 18.957	107.78	CuO_4N	O_{eq} 1.971(2, 10) N_{ap} 2.167(2)	2.6312(4) not given	not given	95
$[Cu(ac)_2dabco]_2$ (blue green)	m A2/m 2	7.709(7) 15.490(8) 8.172(3)	105.51(5)	CuO_4N	O_{eq} 1.975(6, 3) N_{ap} 2.193(8)	2.632(2) 0.21	O,O 89.8(2, 1.4) O,N 96.1(2, 3)	26
$[Cu(ac)_2(2\text{-ampy})]_2$ (green)	m C2/c 4	15.126(3) 13.709(1) 8.659(2)	93.79(1)	CuO_4N	O_{eq} 1.967(5, 17) N_{ap} 2.218(5)	0.633(2) not given	O,O 89.4(3, 3) 167.8(2, 2) O,N 96.1(2, 2.8)	96
$[Cu(ac)_2(3\text{-pycar})]_2 \cdot CH_2Cl_2$[d] (green)	m $P2_1/c$ 4	16.778(13) 19.853(14) 8.384(4)	97.38(5)	CuO_4N	O_{eq} 1.970(4, 10) N_{ap} 2.152(5)	2.634(1) 0.205	O,O 89.4(2, 1.3) 168.1(2, 1) O,N 96.0(2, 1.6)	97
				CuO_4N	O_{eq} 1.964(4, 15) N_{ap} 2.197(5)	2.654(1) 0.217	O,O 89.3(2, 9) 167.3(2, 1) O,N 96.4(2, 3.2)	
$[Cu(pr)_2(nic)]_2$ (light green)	tr P-1 2	9.895(7) 11.204(7) 13.509(7)	87.36(5) 89.17(5) 74.25(5)	CuO_4N	O_{eq} 1.978(6, 27) N_{ap} 2.181(8, 5)	2.635(2) 0.20	O,O 90.5(3, 3.5) 168.2(3, 3) O,N 95.9(3, 2.2)	98
$Cu_2(pr)_4(pycac)_2$ (green)	or Pbca 4	19.350(4) 15.390(3) 10.725(2)		CuO_4N	O_{eq} 1.972(2, 21) N_{ap} 2.167(2)	2.6396(8) 0.211(1)	O,O 89.1(1, 5) O,N 96.1(1, 6)	100
$[Cu(ac)_2py]_2$ (green)	or Pbca 4	13.079(21) 8.594(1) 19.572(5)		CuO_4N	O_{eq} 1.972(3, 12) N_{ap} 2.191(2)	2.641(1) 0.208	O,O 89.4(1, 9) 167.9(1, 1) O,N 96.1(1, 8)	58
$[Cu(ac)_2(NCS)]_2(Me_4N)_2$ (green)	tg I4/mmm 2	8.873 – 18.087		CuO_4N	O_{eq} 2.03(1) N_{ap} 2.08(2)	2.643(3) not given	not given	99

$[Cu(ac)_2(naa)]_2 \cdot 2H_2O$	tr	10.974(4)	96.55(4)	CuO_4N	O_{eq}	1.980(4, 29)	2.644(2)	O,O	89.4(2, 1.2)	101
(dark green)	P-1	8.132(3)	110.75(3)		N_{ap}	2.168(4)	0.209		167.9(2, 2)	
	2	7.899(4)	89.12(9)					O,N	96.1(2, 1.3)	
$[Cu(pr)_2(3,5\text{-}Me_2py)]_2$	tr	8.6652(14)	77.31(8)	CuO_4N	O_{eq}	1.975(2, 4)	2.6447(6)	O,O	89.3(1, 7)	102
(green)	P-1	8.7357(6)	67.67(13)		N_{ap}	2.168(2)	not given		167.9(1, 1)	
	1	10.8223(14)	85.69					O,N	96.1(1, 1.2)	
$[Cu(bz)_2(caf)]_2$	m	12.922(2)		CuO_4N	O_{eq}	1.967(2, 11)	2.647	O,O	89.4(1, 7)	45
(green)	$P2_1/n$	22.122(2)	99.42(1)		N_{ap}	2.222(3)	0.204(2)		168.1(1, 1)	
	2	10.898(1)						O,N	95.9(1, 7.2)	
$[Cu(pr)_2(2\text{-}Mepy)]_2$	tr	8.080(7)	111.9(1)	CuO_4N	O_{eq}	1.97(1, 1)	2.647(4)		not given	103
(not given)	P-1	8.290(7)	75.7(1)		N_{ap}	2.21(2)	not given			
	2	12.444(10)	119.4(1)							
$[Cu(2,2\text{-}Me_2pr)_2(4\text{-}Mepy)]_2$	rh	31.902(4)		CuO_4N	O_{eq}	1.971(8, 2)	2.648(5)	O,O	89.4(3, 3.1)	104
C_6H_6	R-3m				N_{ap}	2.125(13)	not given		168.4(4, 1)	
(green)	9	11.111(2)						O,N	95.9(4, 1)	
$[Cu(oct)_2(py)]_2$	tr	8.379(3)	108.42(4)	CuO_4N	O_{eq}	2.007(3, 31)	2.651(1)	O,O	89.4(2, 1.1)	105
(dark green)	P-1	10.921(6)	96.21(4)		N_{ap}	2.194(4)	0.209(3)		168.1(1, 2)	
	1	13.286(6)	92.06(4)					O,N	96.0(2, 1.4)	
$[Cu(ac)_2 2\text{-}ampy)]_2 \cdot dio$	tr	7.356(2)	74.26(2)	CuO_4N	O_{eq}	1.970(9.14)	2.651(2)	O,O	89.3(4, 8)	106
(green)	P-1	8.122(2)	82.31(2)		N_{ap}	2.185(11)	0.22		167.3(4,3)	
	1	12.293(2)	82.88(2)					O,N	96.4(4, 2.3)	
$[Cu(ac)_2qu]_2$	or	21.17(1)		CuO_4N	O_{eq}	1.977(6, 20)	2.652(2)		not given	107
(not given)	Pbca	14.319(6)			N_{ap}	2.224(6)	0.227			
	4	8.852(5)								
$[Cu(mddc)_2py]_2$	tr	11.230(4)	112.16(3)	CuO_4N	O_{eq}	1.969(5, 7)	2.655(1)	O,O	89.3(2, 5)	61
(green)	P-1	9.940(4)	107.26(3)		N_{ap}	2.179(6)	not given	O,N	96.2(2, 1.4)	
	1	10.954(4)	81.22(3)							
$[Cu(pr)_2(4\text{-}Mepy)]_2$	or	20.300(3)		CuO_4N	O_{eq}	1.970(9, 3)	2.655(3)		not given	108
(green)	Cccm	14.244(3)			N_{ap}	2.143(9)	not given			
	8	20.479(6)								
				CuO_4N	O_{eq}	1.972(9, 22)	2.659(3)		not given	
					N_{ap}	2.148(9)	not given			

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(2,2\text{-}Me_2pr)_2(3\text{-}Mepy)]_2$	trg	18.246(2)		CuO_4N	O_{eq}	1.972(11, 52)	2.657(3)	O,O	89.5(4, 1.2)	104
C_6H_6	$P3_121$	–			N_{ap}	2.176(20)	not given		168(5, 5.0)	
(green)	3	11.303						O,N	96.0(6, 4.6)	
$[Cu(bz)_2(py)]_2$	m	10.036		CuO_4N	O_{eq}	1.972(2, 12)	2.658(1)	O,O	89.3(1, 1.2)	109
(blue)	$P2_1/n$	10.467(1)	98.66(1)		N_{ap}	2.170(3)	0.217(1)		167.4(1, 2)	
	2	17.344(2)						O,N	96.3(2, 2.8)	
$[Cu(Et_2NCO_2)_2(Et_2NH)]_2$	tr	11.182(3)	81.36(4)	CuO_4N	O_{eq}	1.961(6, 15)	2.658(2)	O,O	89.3(2, 2.3)	110
(turquoise)	P-1	11.004(4)	99.02(2)		N_{ap}	2.23(2)	0.22		167.2(3, 1)	
	1	8.872(3)	70.08(3)					O,N	96.4(4, 1.6)	
$[Cu(ac)_2(2\text{-}ath)]_2$	m	9.144(2)		CuO_4N	O_{eq}	1.975(3, 7)	2.658(1)	O,O	89.3(1, 1.6)	111
(green)	$P2_1/n$	8.467(2)	106.91(2)		N_{ap}	2.156(3)	0.22		167.1(1, 1)	
	2	14.546(2)						O,N	96.4(1, 2.7)	
$[Cu(crot)_2qu]_2$	m	14.594(1)		CuO_4N	O_{eq}	1.970(7, 6)	2.660(3)	O,O	89.3(2, 1.5)	112
(not given)	$P2_1/n$	10.863(1)	99.52		N_{ap}	2.219(6)	0.216(5)	O,N	96.3(2, 5.1)	
	2	10.581(1)								
$[Cu(ac)_2(bim)]_2$	*or*	21.63(5)		CuO_4N	O_{eq}	1.979(5, 8)	2.663(1)	O,O	89.3(2, 1.7)	113
(green)	Pbca	14.411(4)			N_{ap}	2.145(5)	0.215(5)	O,N	not given	
	2	8.037(2)								
$[Cu(ac)_2(denc)]_2$	*or*	8.731(3)		CuO_4N	O_{eq}	1.973(6, 15)	2.663(3)	O,O	89.5(3, 6)	114
(not given)	Pcab	12.685(4)			N_{ap}	2.175(6)	0.184		169.3(3, 2)	
	4	30.83(1)						O,N	95.4(2, 2.9)	
$[Cu(bz)_2(3\text{-}Mepy)]_2$	m	17.326(2)		CuO_4N	O_{eq}	1.973(4, 8)	2.664(1)	O,O	89.3(1, 2)	45
(green)	$P2_1/n$	10.554(1)	95.56(1)		N_{ap}	2.151(4)	0.217		167.4(1, 2)	
	2	10.655(2)						O,N	96.3	
$[Cu(3\text{-}CNbz)_2]_2$[c]	tr	6.545(4)	74.40(3)	CuO_4N	O_{eq}	1.965(3, 10)	2.664(2)	O,O	89.3(1, 1.9)	115
(green blue)	P-1	10.235(5)	85.02(4)		N_{ap}	2.191(4)	not given	O,N	not given	
	2	12.174(6)	78.64(3)							

$[Cu(bz)_2(4,7\text{-}Cl_2qu)]_2$	tr	10.657(2)	97.79(1)	CuO_4N	O_{eq}	1.972(2, 12)	2.665(1)	O,O	89.3(1, 4)	45
(green)	P1	11.047(2)	115.08(1)		N_{ap}	2.235(2)	0.215(1)		167.5(1, 1)	
	1	10.640(2)	69.13					O,N	96.3(1, 5.8)	
$[Cu(ac)_2(2\text{-}ampy)]_2$	m	7.433(3)		CuO_4N	O_{eq}	1.974(3, 8)	2.669(1)	O,O	89.3(1, 3)	106
(green)	$P2_1/c$	19.563(4)	114.28(3)		N_{ap}	2.218(3)	0.22		167.0(1, 1)	
	2	8.101(3)						O,N	96.5(1, 1.5)	
$[Cu(bz)_2qu]_2$	or	16.940(5)		CuO_4N	O_{eq}	1.969(6, 12)	2.671(2)	O,O	89.4(3, 3.2)	116
(not given)	Pcab	19.684(7)			N_{ap}	2.186(8)	not given	O,N	95.9(3, 4.9)	
	4	11.482(5)								
$[Cu(ac)_2(2\text{-}Mepy)]_2$	m	7.675(4)		CuO_4N	O_{eq}	1.976(10, 27)	2.671(4)	O,O	89.3(4, 7)	117
(green)	$P2_1/c$	20.008(6)	115.99(3)		N_{ap}	2.240(12)	0.23		166.8(4, 3)	
	4	8.207(4)						O,N	96.6(5, 3.5)	
$[Cu(3\text{-}Clpr)_2(4\text{-}Mepy)]_2$	tr	8.475(3)	97.27(3)	CuO_4N	O_{eq}	1.972(2, 10)	2.675(1)	O,O	89.3(1, 1.7)	118
(light green)	P-I	8.903(3)	92.45(4)		N_{ap}	2.170(2)	0.221		167.1(1, 0)	
	1	10.204(5)	93.721(3)					O,N	96.5(1, 2.2)	
$[Cu(2\text{-}Clbz)]_2$	m	23.365(3)		CuO_4N	O_{eq}	1.974(5, 17)	2.679(1)	O,O	89.3(2, 7)	36
(green)	$P2_1/a$	10.688(1)	100.03(1)		N_{ap}	2.149(6, 3)	not given		167.2(2, 2.0)	
	4	20.542(2)						O,N	96.4(2, 3.2)	
$[Cu(ac)_2(tmp)]_2 \cdot (C_6H_6)_2 \cdot$	m	24.109(5)		CuO_4N	O_{eq}	1.972(6, 22)	2.679(1)	O,O	89.3(2, 5)	119
MeOH	C2/c	15.256(3)	116.89(2)		N_{ap}	2.170(5)	0.23		166.6(2, 2)	
(green)	4	16.532(3)						O,N	not given	
$[Cu(bz)_2py]_2 \cdot 2H_2O$	m	10.134(10)		CuO_4N	O_{eq}	1.978(5, 6)	2.681(1)	O,O	89.2(2, 6)	120
(green)	$P2_1/n$	10.530(5)	98.45(8)		N_{ap}	2.184(7)	not given		167.7(2, 0)	
	2	17.460(16)						O,N	96.1(2, 3.0)	
$Cu_2(ac)_4(bddo)$	tr	8.501(1)	84.54(2)	CuO_4N	O_{eq}	1.973(4, 5)	2.682(2)	O,O	89.3(2, 1.0)	121
(green)	P-1	8.590(1)	82.10(2)		N_{ap}	2.230(5)	not given		166.8(2, 2)	
	2	10.854(2)	84.73(2)					O,N	96.7(2, 4)	
$[Cu(Clac)_2(3\text{-}Mepy)]_2$	m	8.282(3)		CuO_4N	O_{eq}	1.973(−, 7)	2.685(2)		not given	122
(dark green)	$P2_1/b$	8.308(4)	114.61(3)		pyN_{ap}	2.269(4)	0.228			
	2	21.057(6)								
$[Cu(bz)_2(7\text{-}Mequ)]_2$	m	18.029(3)		CuO_4N	O_{eq}	1.973(5, 35)	2.688(1)	O,O	89.3(2, 1.4)	45
(green)	$P2_1/n$	20.427(2)	97.76(2)		quN_{ap}	2.231(5, 6)	0.189(3)		166.5(2, 4.0)	
	4	11.673(3)						O,N	96.7(2, 8.5)	

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(bz)_2(4\text{-Mequ})]_2$	tr	10.684(3)	92.55(2)	CuO_4N	O_{eq}	1.968(2, 8)	2.688(1)	O,O	89.2(1, 7)	45
(not given)										
	P-1	10.780(2)	109.78(3)		quN_{ap}	2.207(2)	0.230(1)		166.6(1, 1)	
	1	10.207(2)	68.44(2)					O,N	96.7(1, 5.0)	
$[Cu(pcib)_2(4\text{-apm})]_2$	tr	8.848(1)	102.66(2)	CuO_4N	$apmO_{eq}$	1.969(7, 10)	2.689(2)	O,O	89.3(3, 1.9)	86
(dark green)	P-1	12.358(4)	123.58(4)		N_{ap}	2.198(7)	not given		166.5(3, 3)	
	1	12.844(3)	96.10(2)					O,N	96.7(3, 4.8)	
$[Cu(2\text{-}ClC_6H_4CH_2OCO_2)_2 \cdot$	tr	17.543(5)	77.89(3)	CuO_4N	O_{eq}	1.970(9, 5)	2.700(3)	O,O	89.2(5, 2.2)	27
$(2\text{-ampy})]_2$[d]	P-1	13.344(5)	81.43(3)		$ampyN_{ap}$	2.248(10)	not given		166.5(5, 1)	
(not given)	2	8.459(3)	87.61(3)					O,N	96.7(5, 3.8)	
				CuO_4N	O_{eq}	1.975(9, 11)	2.730(3)	O,O	89.1(5, 5)	
					$ampyN_{ap}$	2.243(9)	not given		165.3(5, 4)	
								O,N	97.4(5, 4.2)	
$[Cu(Me_3ac)_2(acr)]_2$	tr	9.448(4)	105.61(3)	CuO_4N	O_{eq}	1.968(1, 5)	2.702(1)		not given	123
(green)	P-1	11.463(5)	103.40(3)		$acrN_{ap}$	2.371(5)	0.24			
	1	11.963(4)	105.92(3)							
$[Cu(4\text{-}Fpac)_2(2\text{-}NH_2pm)]_2$	tr	12.688(2)	78.74(1)	CuO_4N	O_{eq}	1.977(3, 10)	2.710(1)	O,O	89.1(1, 3.1)	124
(dark green)	P1	11.422(2)	107.51(1)		pmN_{ap}	2.176(3)	not given		166.0(2, 1)	
	1	7.951(1)	75.78(1)					O,N	96.4(1, 3.3)	
$[Cu(Clac)_2caf]_2$	tr	7.932(2)	93.19(6)	CuO_4N	O_{eq}	1.97(4, 2)	2.711(3)	O,O	89.2(4, 9)	125
(green)	P-1	12.798(2)	109.95(3)		$cafN_{ap}$	2.23(4)	0.236		166.2(4, 1)	
	1	9.078(5)	96.92(6)					O,N	96.9(4, 8.3)	
$[Cu(2,4,5\text{-}Cl_3pac)_2py]_2$	tr	12.184(8)	99.69(5)	CuO_4N	O_{eq}	1.973(12, 11)	2.716(7)	O,O	89.2(10, 2.1)	65
(green)	P-1	13.719(7)	99.15(5)		pyN_{ap}	2.142(12)	0.23		166.2(10, 1)	
	1	8.687(6)	114.01(4)					O,N	96.8(11, 1.1)	
$[Cu(fm)_2(NCS)_2]_2 \cdot (NMe_4)_2$	tg	8.917		CuO_4N	O_{eq}	1.983(4)	2.716(2)		not given	99
(green)	I4/mmm	–			SCN_{ap}	2.093(9)	not given			
	2	15.800								
$[Cu(Clac)_2qu]_2$	tr	7.622(1)	73.30(1)	CuO_4N	O_{eq}	1.974(6, 13)	2.724(2)		not given	107
(not given)	P-1	9.145(2)	96.61(1)		quN_{ap}	2.211(7)	0.248			
	1	11.297(2)	92.78(1)							

$[Cu(Fac)_2qu]_2$	m	8.284(9)		CuO_4N	O_{eq}	1.977(2, 10)	2.725(1)		not given	126
(not given)	$P2_1/b$	20.218(14)			quN_{ap}	2.210(3)	0.239			
	2	8.188(13)	79.37(5)							
$[Cu(Cl_3ac)_2(PhCN)]_2$[d]	tr	12.780(1)	108.39(1)	CuO_4N	O_{eq}	1.964(6, 9)	2.731(1)	O,O	89.1(3, 1.1)	127
(green)	P-1	16.064(1)	113.34(1)		$PhCN_{ap}$	2.141(9)	0.251		165.3(3, 3)	
	2	10.130(1)	81.07(1)					O,N	97.4(3, 3.2)	
				CuO_4N	O_{eq}	1.966(7, 7)	2.732(1)	O,O	89.1(3, 1.4)	
					$PhCN_{ap}$	2.138(6)	0.247		165.6(2, 1)	
								O,N	97.2(3, 3.2)	
$[Cu(Cl_3ac)_2caf]_2 \cdot 2tol$	tg	15.731(2)		CuO_4N	O_{eq}	1.957(7, 12)	2.736(1)	O,O	89.8(5, 3.1)	128
(pale green)	$P4_2/ncm$					2.11(1)	not given		163.5(5, 2.3)	
	4	19.115(3)			$cafN_{ap}$	2.116(4)		O,N	97.1(4, 7.1)	
$[Cu(Clac)_2(2\text{-}Mepy)]_2$	tr	7.881(15)	115.53(5)	CuO_4N	O_{eq}	1.975(9, 23)	2.747(3)		not given	129
(green)	P-1	8.913(9)	87.7(5)		pyN_{ap}	2.1611(10)	0.26			
	1	10.995(19)	87.42(6)							
$[Cu(Cl_3ac)_2(2\text{-}Fbzth)]_2$	tr	10.336(2)	107.30(1)	CuO_4N	O_{eq}	1.970(4, 9)	2.761(1)	O,O	89.0(2, 8)	128
(green)	P-1	11.381(3)	94.63(2)		thN_{ap}	2.153(5)	not given		164.7(2, 2)	
	1	9.272(2)	66.53(2)					O,N	97.7(2, 3.3)	
$[Cu(Cl_3ac)_2(2\text{-}Clpy)]_2$	tr	9.316(9)	57.22(2)	CuO_4N	O_{eq}	1.957(5, 16)	2.766(3)	O,O	88.85(21, 2.6	130
(light green)	P-1	10.707(10)	107.02(3)		pyN_{ap}	2.145(5)	0.28		163.66(19, 34)	
	1	10.493(11)	100.01(3)					O,N	98.06(19, 7.2)	
$[Cu(Br_3ac)_2(2\text{-}Clpy)]_2$	tr	10.452(4)	69.87(2)	CuO_4N	O_{eq}	not given	2.766(3)		not given	131
(not given)	P-1	9.767(4)	116.44(3)		pyN_{ap}	not given	not given			
	1	10.697(4)	98.57(3)							
$[Cu(Cl_3ac)_2(4\text{-}CNpy)]_2$	m	20.788(5)		CuO_4N	O_{eq}	1.977(6)	2.769(1)	O,O	89.0(2, 6)	128
(pale green)	$P2_1/a$	17.951(4)	99.45(2)		pyN_{ap}	2.134(6, 8)	not given		164.7(2, 2.5)	
	4	9.693(2)						O,N	97.3(2, 5.4)	
$[Cu(Cl_3ac)_2(3\text{-}Clpy)]_2$	tr	10.246(1)	103.27(1)	CuO_4N	O_{eq}	1.976(3, 5)	2.774(1)	O,O	89.0(1, 1.1)	128
(pale green)	P-1	10.739(1)	111.23(1)		pyN_{ap}	2.120(4)	not given		164.4(1, 1)	
	1	9.598(1)	62.36(1)					O,N	97.9(1, 3.4)	
$[Cu(Cl_3ac)_2(4, 7\text{-}Cl_2qu)]_2$	tr	10.201(1)	107.37(1)	CuO_4N	O_{eq}	1.971(3, 10)	2.785(1)	O,O	88.9(1, 1.1)	128
(green)	P-1	11.688(2)	100.45(1)		quN_{ap}	2.161(4)	not given		163.9(1, 1)	
	1	9.301(1)	73.99(1)					O,N	98.0(1, 5.)	

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(F_3ac)_2qu]_2 \cdot 2H_2O$ (light green)	m C2/c 4	14.886(24) 16.707(29) 13.694(23)	111.26(5)	CuO_4N	O_{eq} quN_{ap}	1.972(6, 19) 2.109(6)	2.886(4) 0.32	O,O O,N	88.5(3, 1.7) 161.2(3, 2) 99.4(3, 2.4)	132
$[Cu(Cl_3ac)_2(2,5\text{-}Cl_2py)]_2$ (pale green)	tr P-1 2	11.359(1) 17.928(2) 9.324(1)	97.35(1) 103.04(1) 92.66(1)	CuO_4N	O_{eq} pyN_{ap}	1.952(4, 30) 2.118(5, 3)	2.951(1) not given	O,O O,N	89.1(2, 1.6) 145.5(2, 1) 174.0(2, 5) 92.5(2, 2.4) 122.4(2, 2.0)	128
$[Cu(Cl_3ac)_2(3,5\text{-}Me_2py)]_2 \cdot 2C_6H_6$ (pale green)	m C2/c 4	19.547(3) 14.990(1) 17.181(3)	106.93(3)	CuO_4N	O_{eq} pyN_{ap}	1.920(5, 11) 2.071(5, 24) 2.071(4)	3.031(1) not given	O,O O,N	88.8(2, 2.3) 141.5(1) 172.6(2) 95.7(2, 4.0) 118.8(2)	128
$[Cu(Cl_3ac)_2(2\text{-}Cl\text{-}5\text{-}NO_2py)]_2$ (pale green)	tr P-1 2	13.683(2) 14.122(2) 9.796(2)	98.269(1) 93.762(1) 80.286(1)	CuO_4N	O_{eq} pyN_{ap}	1.94(1, 6) 2.17(1, 4) 2.12(1, 1)	3.054(3) not given	O,O O,N	89.4(5, 2.5) 136.9(5, 3) 175.1(5, 6) 91.3(5, 2.5) 131.0(5, 6)	128
$[Cu(Cl_3ac)_2caf]_2$ (pale green)	m C2/c 4	20.048(2) 17.575(2) 12.350(7)	106.01(2)	CuO_4N	O_{eq} $cafN_{ap}$	1.959(2, 27) 2.167(2) 2.045(3)	3.062(1) not given	O,O O,N	89.0(1, 3.3) 138.2(1) 174.5(1) 91.9(1, 2.0) 131.4(1)	128
$[Cu(Cl_3ac)_2(3\text{-}CNpy)]_2$ (pale green)	tr P-1 2	10.952(1) 16.338(2) 10.833(1)	106.80(1) 97.02(1) 71.90(1)	CuO_4N	O_{eq} pyN_{ap}	1.953(6, 131) 2.219(5, 45) 2.065(7, 8) 127.0(2, 104)	3.066(1) not given	O,O O,N	89.5(2, 2.2) 137.4(2, 1) 177.3(2, 1) 92.7(2, 13.3)	128
$[Cu(Cl_3ac)_2(2,5\text{-}Cl_2py)]_2 \cdot C_6H_6$ (pale green)	m $P2_1/a$ 4	20.370(2) 18.296(3) 11.585(2)	100.35(1)	CuO_4N	O_{eq} pyN_{ap}	1.95(1, 6) 2.07(1)	3.113(3) not given	O,O	89.2(4, 2.8) 134.7(4, 7) 175.3(4, 7)	128

								O,N	91.0(4, 2.1) 133.9(4, 1)	
$[Cu(Cl_3ac)_2(3,5\text{-}Cl_2py]_2\cdot tol$ (green)	tr P-1 2	10.859(2) 19.225(2) 10.692(2)	91.01(1) 97.89(2) 81.11(1)	CuO_4N	O_{eq} pyN_{ap}	1.941(6, 43) 2.026(5, 7)	3.177(1) not given	O,O O,N	89.6(2, 3.4) 131.0(2, 1) 176.99(2, 5) 89.0(2, 3.6) 143.0(2, 8)	128
$[Cu(Cl_3ac)_2(3,4\text{-}Me_2py)]_2$ (pale green)	m $P2_1/c$ 4	20.567(2) 10.414(2) 18.231(2)	 106.13(1) 	CuO_4N	O_{eq} pyN_{ap}	1.979(6, 100) 2.014(7, 7)	3.186(2) not given	O,O O,N	89.0(2, 2.0) 132.3(2, 4) 174.7(2, 1) 94.9(2, 6.9) 128.3(2, 2.0)	128
$[Cu(Cl_3ac)_2(2,3\text{-}Me_2py)]_2\cdot tol$ (pale green)	m $P2_1/n$ 4	21.544(4) 18.099(4) 11.423(2)	 99.49(2) 	CuO_4N	O_{eq} pyN_{ap}	1.966(9, 66) 2.212(9, 14) 2.019(8)	3.206(2) not given	O,O O,N	88.8(4, 2.6) 131.8(4, 1) 173.9(3, 1) 94.2(4, 3.6) 131.2(4, 7)	128
$[Cu(Cl_3ac)_2(2,5\text{-}Me_2py)]_2\cdot tol$ (pale blue)	m $P2_1/a$ 4	21.010(1) 18.725(2) 11.574(1)	 104.90(1) 	CuO_4N	O_{eq} pyN_{ap}	1.951(6, 69) 2.233(6, 16) 2.012(6, 5)	3.226(1) not given	O,O O,N	89.0(2, 2.2) 131.0(2, 1) 174.4(2, 3) 93.7(2, 6.0) 132.1(2, 2.8)	128
$[Cu(Cl_3ac)_2(2\text{-}Etpy)]_2$ (pale green)	tr P-1 2	11.144(1) 18.291(2) 9.206(1)	97.56(1) 100.53(1) 84.05(1)	CuO_4N	O_{eq} pyN_{ap}	1.958(4, 54) 2.306(4, 22) 2.032(4, 1)	3.261(1) not given	O,O O,N	88.8(2, 2.2) 129.6(2, 2) 173.8(2, 4) 92.2(2, 3.7) 137.9(2, 1.1)	128
***C*: CuO_4P**										
$[Cu(mddc)_2Ph_3P]_2$ (dull green)	tr P-1 1	14.593(1) 10.747(1) 11.894(2)	75.025(6) 115.011(6) 99.567(6)	CuO_4P	O_{eq} Ph_3P_{ap}	1.967(3, 12) 2.570(2)	2.676(1) not given	O,O O,P	89.3(2, 1.9) 96.6(2, 9.1)	61
$[Cu(ac)_2(Ph_3P)]_2$ (green)	tr P-1 1	9.149(7) 9.559(3) 14.709(3)	61.00(2) 72.67(5) 90.34(5)	CuO_4P	O_{eq} Ph_3P	1.956(6, 22) 2.570(2)	2.709(1) 0.245	O,O O,P	89.1(2, 2.0) 165.6(2, 1) 97.1(2, 7.1)	133

TABLE I (*Continued*)

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu – out of the plane* [Å]	*L–Cu–L* [°]		*Ref.*
D:										
$[Cu(1,3\text{-dpt})_2]_2$	tr	10.373(3)	99.51(2)	CuN_4	N	2.020(6,47)	2.441(2)	N,N	89.8(3,2.8)	134
(olive green)	P-1	15.916(5)	94.85(3)				0.2			
	2	13.612(3)	102.33(2)							
$[Cu(2\text{-O-}6\text{-Clpy})_2]_2$	or	15.394(2)		CuO_2N_2	O	1.928(–,4)	2.499(1)	O,O	90.0(2,1.8)	135
(deep red)	$P2_12_12_1$	15.892(2)			N	2.014(–,14)			178.3(9)	
(at 150 K)	8	18.497(2)						N,N	90.0(2,1.8)	
									167.3(2)	
$[Cu(2\text{-O-}3\text{-Etpy})_2(dmf)]_2$	m	9.906(1)		CuO_3N_2	O_{eq}	1.959(6,3)	2.550(1)	O_{eq},O_{eq}	88.3(3)	136
(dark)	$P2_1/n$	13.494(3)	103.8(1)		N_{eq}	2.000(6,3)	not given	O_{eq},N_{eq}	90.5(2,1.0)	
	4	14.029(2)			$dmfO_{ap}$	2.283(6)			172.1(2,3)	
								O_{eq},O_{ap}	89.8(2)	
$[Cu(C_5H_4NO)_2(Me_2SO)]_2$	m	9.452(2)		CuO_3N_2	O_{eq}	1.95(1,0)	2.587(4)	O_{eq},O_{eq}	89.8(5)	137
(black green)	$P2_1/n$	9.183(1)	101.34(2)		N_{eq}	2.01(1,0)	0.152(8)	N,N	88.5(6)	
	2	15.849(3)			$dmsO_{ap}$	2.26(1)		O_{eq},N	90.2(5,4)	
									171.2(5,4)	
$[Cu(C_7H_5N_2)_2dmf]_2$	m	9.377(6)		CuN_4O	N_{eq}	2.003(4,19)	2.782(1)	N,N	89.4(1,1.4)	138
(not given)	$P2_1/n$	13.854(3)	94.10(4)		$dmfO_{ap}$	2.325(3)	not given		167.7(1,1)	
	2	12.928(4)						N,O	96.1(1,4.1)	
$[Cu(6\text{-ampur})_2(H_2O)]_2$	tr	9.458(2)	102.98(2)	CuN_4O	N_{eq}	2.03(–,1)	2.947(2)	N,N	88.0(–,1.1)	139
(blue violet)	P-1	10.452(2)	116.58(2)		H_2O_{ap}	2.20	0.27	N,O	not given	
	2	9.410(3)	79.81(2)							
$[Cu(ad)_2H_2O]_2(ClO_4)_4\cdot 2H_2O$	m	12.212(6)		CuN_4O	N_{eq}	2.020(8,18)	2.951(4)	N,N	82.4(1,5.2)	140
(purple)	$P2_1/c$	12.240(6)	130.27(3)		H_2O_{ap}	2.166	0.269(2)	N,O	97.7(2,4.1)	
	4	17.635(9)								
$[Cu(MeO)(C_7H_5N_2)(dmf)_{0.5}]_4$	tr	9.189(3)	88.09(2)	CuO_2N_2	N	1.966(2,1)	–	O,O	75.88(9)	138
(not given)	P-1	9.511(2)	83.26(3)		MeO	1.921(2,6)	–	N,N	93.6(1)	
	1	12.704(2)	66.75(3)					O,N	94.5(1,9)	
				CuO_3N_2	N	1.985(2,9)	3.007(1,8)	O,O	97.2(1,4)	

					dmfO	2.422(3)	103.0(1, 5)	N,N	92.4(1)	
$[Cu(6\text{-}OHpur)_2Cl]_2 \cdot 3H_2O$	tr	9.858(2)	102.53(3)	CuN_4Cl	N_{eq}	1.998(−, 90)	3.024	N,N	88.8(−, 1.2)	141
(turquoise)	P-1	10.259(4)	89.36(2)		Cl_{ap}	2.431	0.29	N,Cl	98.2(−, 1.0)	
	2	9.717(3)	102.21(3)							
$[Cu(ad)_2Cl]_2 \cdot Cl_2 \cdot 6H_2O$	or	23.92		CuN_4Cl	N_{eq}	2.025(11, 17)	3.066(4)	N,N	88.4(4, 1.6)	142
(blue green)	Cmca	13.44			Cl_{ap}	2.429(6)	0.33	N,Cl	99.4(4, 9)	
	4	11.262								
E:										
$Cu_2(fluf)_4(cof)(H_2O)$	m	4.772(2)		CuO_5	O_{eq}	1.956(3, 1)	2.633(1)	O_{eq},O_{eq}	89.5(2, 2.0)	143
(blue)	$P2_1/n$	23.156(5)	95.67(3)		H_2O_a	2.141(5)	O,0.189		168.9(1)	
	4	12.502(3)						O_{eq},O_{ap}	95.6(2, 2.5)	
				CuO_4N	O_{eq}	1.960(3, 4)		O_{eq},O_{eq}	89.3(2, 1.5)	
					$cafN_{ap}$	2.239(5)	N,0.223		166.9(1)	
								O_{eq},N_{ap}	96.5(2, 6.4)	

[a] Where more than one chemically equivalent distance or angle is present the mean value is tabulated. The first number in parenthesis is l.s.d., the second is a maximum deviation from the mean value. [b] The chemical identity of coordinated atom. [c] Dimers in polymeric chain. [d] There are two crystallographically independent molecules.

CuO_2N_2 (Table ID) chromophores. In the complexes (Table IA–C) two Cu(II) atoms are bridged by four carboxylate groups in a syn–syn arrangement (Figure 1). The apical position are occupied usually either by oxygen, nitrogen or phosphorus containing ligands. Except,[91] where the coordination polyhedron can be described as trigonal bipyramidal, all other (Table IA–C) about each Cu(II) displays a distorted square pyramidal geometry. There is usually a center of symmetry within a dimeric unit. However, there are twelve complex units, where there is only C_i symmetry element involved. Selected bond distances and angles for CuO_5 and CuO_4N chromophores are summarized in Table IF.

While the Cu–O(basal) bond distances were in the range of 1.943–1.987 Å (average 1.965 Å) and 1.955–1.985Å (average 1.97 Å) for the CuO_5 and CuO_4N chromophores, respectively, the remaining three distances, Cu–L(apical), Cu–Cu and out of O4 plane, show wide ranges. There are strong correlations between the Cu–Cu distance and out of plane deviation, the Cu(II) atoms to be pushed out from the basal O4 plane upon elongation of the Cu–Cu distance. The correlations are 0.887 and 0.977 for the CuO_5 and CuO_4N types, respectively.[6,8]

There is also strong correlation of −0.929 between the average angle Cu–O–C and O–C–O for the CuO_5 type dimers. When the former opens the

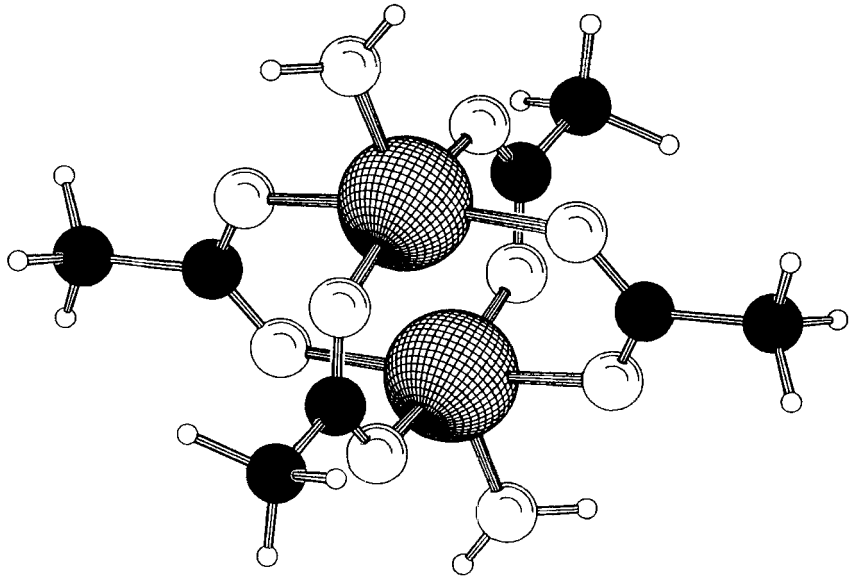


FIGURE 1 A schematic structure of Cu(II) acetate type dimer.

TABLE IF Summary of selected bond distances and angles for CuO_4O and CuO_4N chromophores type[a]

	CuO_4O	CuO_4N
Distances [Å]		
Cu–O (basal)	1.943–1.987(1.965)	1.955–1.985(1.97)
Cu–L (apical)	2.074–2.238(2.15)	2.11–2.269(2.18)
Cu–Cu	2.563–3.256	2.576–3.261
Cu – out of O_4 plane	0.13–0.24	0.184–0.322
Angles [°]		
Cu–O–C	119.8–130.2(123.2)	121.5–125.0(123.5)
O–C–O	111.6–132.0(125.0)	122.4–129.3(125.8)
[b]	0.719–15.852	0–12.733

[a] The mean values are given in parenthesis. [b] Values for the apical deviation angle between Cu–L (apical) line and the perpendicular to the basal O_4 plane.

latter closes. Surprisingly, the correlation is not so good for the CuO_4N type dimers. The structural parameter showing the greatest coefficient of variation is the apical deviation angle for both type of chromophores (Table IF). This indicates that the data depart significantly from a normal distribution. Because the range values are wide, this may indicate a weakness in the chemical bonding in the apical direction.

There are also some structures where the equatorial ligand is the same whereas the apical ligand is changed. The apical ligand influence on the Cu–O(basal) distances range is wider for the CuO_5 structure type. The sum for the bond lengths in a coordination polyhedron is almost constant for each chromophore type, 10.01 Å for CuO_5 and 10.06 Å for CuO_4N. This illustrates nicely the plasticity effect in Cu(II) compounds.[144]

There are two green examples[61,133] (Table IC) in which apical positions are occupied by PPh_3 molecules. The mean Cu–P bond distance of 2.570(2) Å is longer than those of Cu–N (apical) and Cu–O (apical) with the values of 2.18 and 2.15 Å, respectively, as expected.

In Table ID are examples, in which two Cu(II) atoms are bridged by four bidentate N-donor; ligands in a syn–syn configuration. In olive green $Cu_2(dpt)_4$[134] pairs of very closely separated metal atoms (2.441(2) Å) are bridged by four dpt groups in a syn–syn arrangement such that the environment of each Cu(II) atom is almost square-planar with the mean Cu–N bond distance of 2.020(6) Å. The Cu–Cu distance of 2.441(2) Å is the shortest found in the series of Cu(II) acetate type structure.

In deep red $Cu_2(2\text{-O-}6\text{-Clpy})_4$[135] and dark $Cu_2(2\text{-O-}3\text{-Etpy})_4(dmf)_2$[136] two Cu(II) atoms are held together by four bidentate -O,N-donor; anions in a syn–syn arrangements. Each Cu(II) atom in the former is square-planar with the mean Cu–O of 1.928 Å and Cu–N of 2.014 Å. The Cu–Cu

TABLE II Crystallographic and structural data for doubly bridged copper(II) dimers[a]

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
A:Cu(μ-F)$_2$Cu										
[Cu(μ-F)(3, 5-Me$_2$pz)$_3$]$_2$(BF$_4$)$_2$	trg	28.649(7)		CuN_3F_2	N[b]	1.96(1, 4)	2.893(4)	F,N[b]	87.9(4, 27)	145
(blue)	R-3	–			μF	1.876(6)	91.1		103.9(3, 4)	
	12	17.133(4)				2.166(6)	88.9(3)	N,N	179.1(4)	
									93.6(5, 9)	
									151.2(4)	
[Cu(μ-F)(3-Mephpz)$_2$]$_2$(BF$_4$)$_2$	m	9.912(2)		CuF_2N_2	N	1.939(5, 13)	2.922(2)	N,N	102.0(2)	146
(blue)	P2$_1$/c	9.993(2)	92.69(2)		μF	1.923(3, 5)	98.9(8)			
	2	21.330(6)					81.1(1)			
[Cu(μ-F)(5-Mepz)(3, 5Me$_2$pz)$_2$]$_2$·	m	9.954(1)		CuN_3F_2	MepzN	1.997(3)	2.9962(9)	N,F	87.8(1, 1.4)	147
(BF$_4$)$_2$	P2$_1$/c	11.862(2)	99.45(1)		Me$_2$pzN	1.974(4, 10)	93.73(8)		103.5(1, 2.4)	
(blue)	2	17.679(4)			μF	1.901(2)	86.27(8)		175.3(1)	
						2.195(2)		N,N	94.1(1, 9)	
									152.0(2)	
[Cu(μ-F)(3, 4,5-Me$_3$pz)$_3$]$_2$(BF$_4$)$_2$	m	11.514(4)		CuN_3F_2	N	1.196(3, 31)	3.0141(8)	N,F	87.0(1, 1.9)	147
(light blue)	P2$_1$/n	16.439(3)	101.82(2)		μF	1.911(2)	94.59(7)		103.1(1, 2.5)	
	2	13.159(3)				2.183(2)	85.41(7)		174.3(1)	
								N,N	95.4(1, 6)	
									151.6(1)	
[Cu(μ-F)(3, 5Me$_2$pz)(5-Mepz)$_2$]$_2$·	trg	9.578(2)	104.27(1)	CuN_3F_2	Me$_2$pzN	1.977(2, 0)	3.131(1)	F,N	93.8(1, 8.7)	148
(BF$_4$)$_2$	P-1	9.893(1)	109.04(2)		MepzN	1.976(4, 3)	97.19(8)		172.6(1)	
(blue)	1	10.994(2)	99.12(1)		μF	1.904(2, 0)	82.81(8)	N,N	91.9(1, 13)	
						2.258(2, 0)			159.9(1)	
[Cu(μ-F)(tpma)]$_2$(PF$_6$)$_2$	m	11.649(4)		CuN_4F_2	N	2.002(5, 38)	3.444(1)	F,N	85.3(2, 3.5)	149
(not given)	P2$_1$/n	12.942(4)	110.67(2)			2.329(5)	88.0(2)		100.2(2, 7.4)	
	4	14.654(4)			μF	1.862(4)	92.0(2)		159.9(2)	
						2.960(5)			171.8(2)	
								N,N	82.8(2, 22)[c]	
									100.0(2)	
									167.1(2)	

B:Cu(μ-OL)$_2$Cu

[Cu(μ-dpye)I]$_2$	or	14.113(2)		CuO_2N_2I	N	2.051(4, 69)	2.830(2)[d]	O,N	121.40[c]	150
(not given)	Pbcn	10.113(2)			I	2.759(2)	91.77		161.63	
	4	17.900(3)			μO	1.972(3, 33)	82.02	I,O	98.84(−, 1.36)	
									137.08	
								I,N	100.95	
[Cu(μ-dmapr)Cl$_2$]$_2$	m	18.619(3)		CuO_2Cl_2N	N	2.041(4)	2.847(1)	Cl,Cl	104.76(5)	151
(green)	C2/c	12.129(2)	106.69(1)		Cl	2.288(1)	92.6(1)	Cl,O	97.87(9, 7.72)	
	4	13.822(2)				2.530(1)	75.8(1)		149.4(1)	
					μO	1.970(3, 11)		Cl,N	97.3(1, 12)	
								O,N	83.8(1)[c]	
									157.3(1)	
[Cu(μ-OH)(bpm)(H_2O)$_2$]$_2$	tr	7.021(1)	100.83(1)	CuO_4N_2	bmpN	2.021(3, 1)	2.870(1)	O,N	96.7(1, 1.1)	152
$(ClO_4)_2 \cdot H_2O$	P-1	10.004(1)	95.8(1)		H_2O	2.496(3, 115)	95.0(1)		88.3(1, 2.4)	
(dark blue)	1	10.721(1)	99.05(1)		μHO	1.950(2)	85.0(1)		175.2(1, 18)	
								O,O	90.4(1, 2.0)	
								N,N	80.3(1)	
[Cu(μ-OH)(bpy)(ClO_4)]$_2$	m	13.614(3)		CuO_4N_2	bpyN	1.990(3, 0)	2.871(1)	O,O	85.86(12)	153
(dark blue)	C2/m	15.244(3)	113.64(4)		O_3ClO	2.797(4, 0)	96.94(15)		169.59(10)	
	2	6.279(1)			μHO	1.918(2, 0)	83.06(14)	N,O	94.28(13, 3.48)	
									176.98(3)	
								N,N	81.58(11)[c]	
[Cu(pipcl)(OH)(H_2O)$_2$](ClO$_4$)$_2$	or	12.309(6)		CuO_3N_2	H_2O	2.323(8)	2.872(2)		not given	154
H_2O[e]	Pmc2$_1$	15.848(9)			N	2.007(9, 27)	94.1(4, 2.4)			
(blue green)	4	14.959(8)			μHO	1.963(7, 39)	not given			
				CuO_3N_2	H_2O	2.268(8)	2.857(3)			
					N	2.016(10, 24)	93.9(2, 2.5)			
					μHO	1.956(7, 40)	not given			
[Cu(μ-tbne)(Me_2SO)]$_2$(ClO_4)$_2$	m	9.175(2)		CuO_3N_2	Me_2SO	2.254(4)	2.8865(15)	N,N	86.6(2)	155
(blue)	P2$_1$/c	13.511(3)	99.86(1)		N	2.004(5, 14)	96.09(17)	N,O	89.60(19.3.43)	
	4	12.934(2)			μO	1.941(4, 14)	83.46(14)		86.17(18)	
									103.82(18, 10.80)	
									161.60(19, 8.30)	
								O,O	92.48(17, 8.57)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(\mu\text{-}OH)(bpy)(CF_3SO_3)]_2$[e]	tr	8.165(2)	93.10(1)	CuO_3N_2	N	2.000(4, 4)	2.8917(1)	O,O	96.5(1, 1.1)	156
(blue)	P-1	14.265(2)	100.58(2)		O	2.436(4, 18)	97.3(1, 4)	O,N	97.5(1, 1.1)	
	3	18.748(5)	99.17(1)		μHO	1.926(3, 9)	82.7(1, 1)		171.6(2, 2.7)	
								N,N	81.1(2, 2)[c]	
				CuO_3N_2	N	1.996(4, 10)	2.920(1)	O,O	96.8(1, 7)	
					O	2.438(3, 0)	98.5(1)	O,N	95.2(2, 5.2)	
					μHO	1.927(3, 5)	81.5(1)		170.8(1, 1.9)	
								N,N	81.5(2, 0)[c]	
$[Cu_2(\mu\text{-}OH)_2(bpy)_2(H_2O)(SO_4)]\cdot 4H_2O$	m	9.683(10)		CuO_3N_2	N	2.001(6, 20)	2.893	N,N	80.5(3, 6)[c]	157
	$P2_1/c$	34.52(3)	103.50(5)		H_2O	2.247(5)	96.5(2, 6)	O,N	96.8(2, 37)	
(blue)	4	7.882(10)			O_3SO	2.207(5)	83.3(2, 4)		166.5(2, 30)	
					μHO	1.939(5, 22)		O,O	95.5(2, 4.2)	
$[Cu_2(\mu\text{-}OH)_2(bpy)_2(H_2O)(SO_4)]\cdot 4H_2O$	m	9.658(12)		CuO_3N_2	N	2.01(1, 3)	2.896(7)	N,N	80.1(3, 8)[c]	158
	$P2_1/c$	34.29(3)	103.3(1)		H_2O	2.23(1)	94.1(5, 2)	O,N	96.7(5, 5.3)	
(at 4.2K)	4	7.626(10)			O_3SO	2.207(5)	85.7(4, 3)		168.2(6, 2.4)	
(blue)					μOH	1.98(1, 2)		O,O	94.1(5, 3.6)	
$[Cu_2(aanp)]\cdot H_2O$	m	16.4854(9)		CuO_2N_2	N	1.875(10, 18)	2.898(2)	O,N	94.4(4, 3)	159
(brown)	$P2_1/n$	7.6005(13)	104.090(5)		μO	1.895(8, 23)	99.8(4, 8)		172.4(5, 27)	
	4	21.162(11)					80.1(3, 3)	N,N	90.5(5, 3)	
$[Cu_2(deamp)Cl]_2$	or	14.138(4)		CuO_2NCl	N	2.046(11, 3)	2.903(3)	Cl,N	99.3(3, 12)	160
(blue)	Pbca	19.705(5)			Cl	2.207(5, 1)	97.9(4, 1)	Cl,O	99.6(3, 3)	
	8	14.729(4)			μO	1.924(10, 16)	76.8(4, 3)	O,N	84.1(4, 13)[c]	
$[Cu(\mu\text{-tbne})(ClO_4)]_2MeOH$	tr	8.970(4)	101.09(3)	CuO_3N_2	O_3ClO	2.441(5)	2.9114(20)	N,N	87.14(16)	155
(purple)	P-1	9.974(2)	128.57(3)		N	1.996(4, 0)	96.54(14)	N,O	95.59(20, 9.42)	
	2	10.123(5)	93.93(3)		μHO	1.951(3, 1)	83.46(14)		164.76(15, 6.20)	
									86.17(14)[c]	
								O,O	95.35(19, 4.04)	
$[Cu(\mu\text{-}OH)(eaep)(ClO_4)]_2$	m	9.195(19)		CuO_3N_2	N	2.008(10, 45)	2.917(5)	N,N	94.7(5, 1.7)[g]	161
(violet)	$P2_1$	19.290(44)	77.00(7)		O_3SO	2.590(9, 28)	99.2(2, 4)	N,O	93.0(5, 6.8)	
	2	7.679(16)			μHO	1.916(8, 21)	80.9(2, 7)		170.2(4, 4.6)	
								O,O	92.7(3, 2.0)	

$[Cu(\mu\text{-OH})(dpyam)]_2(BF_4)_2$	tr	9.686(2)	69.90(1)	CuO_2N_2	N	1.977(3, 0)	2.917(1)	N,O	95.5(1)	162
(steel blue)	P-1	9.429(3)	97.53(2)		μHO	1.914(2, 8)	99.3(2)		161.4(1)	
	1	7.414(3)	106.97(3)				80.7(2)	N,N	92.7(1)	
$[Cu_2(\mu\text{-fpb})(\mu\text{-EtO})(MeOH)]$	tr	10.552(1)	72.53(1)	CuO_3N	O	1.961(6)	2.924(2)	O,μO	81.0(3)	163
$(ClO_4)_2$	P-1	13.271(2)	78.46(2)		N	1.923(7)	98.5(3, 2.3)		107.1(3)	
(green)	2	14.418(4)	72.83(1)		μO	1.958(6)	80.6(3, 4)		171.8(3)	
					μEtO	1.886(6)		O,N	86.0(3, 2.3)[c]	
									168.4(3)	
				CuO_4N	MeHO	2.296(8)		O,O	99.4(3, 7.1)	
					O	1.964(8)			167.6(4)	
					N	1.962(8)		O,N	88.5(3)[g]	
					μO	1.970(6)			164.3(3)	
					μEtO	1.908(6)				
$[Cu_2(\mu\text{-hepra})Cl]_2$[g]	m	19.459(5)		CuO_3NCl	O	2.28(1)	2.926(3)	O,O	96.9(4, 3.9)	164
(not given)	P2/a	18.202(5)			N	2.05(1)	95.8(5)	O,N	83.5(5, 1.5)[c]	
	16	13.251(6)	67.21(2)		μO	1.97(2, 0)	80.5(6)	O,Cl	97.5(3, 1.5)	
					Cl	2.236(6)		N,Cl	97.8(4)	
				CuO_3NCl	O	2.30(1)	2.954(4)	O,O	98.2(4, 4.3)	
					N	2.07(1)	97.0(4)	O,N	84.1(5, 1.7)[c]	
					μO	1.97(1, 2)	79.6(3)	O,Cl	97.3(3, 8)	
					Cl	2.232(4)		N,Cl	97.0(3)	
				CuO_3NCl	O	2.30(1)	2.956(4)	O,O	98.6(4, 5.6)	
					N	2.07(1)	97.0(4)	O,N	82.9(4, 2.0)[c]	
					μO	1.97(1, 2)	79.7(3)	O,Cl	97.4(3, 7)	
					Cl	2.236(6)		N,Cl	97.5(4)	
				CuO_3NCl	O	2.28(1)	2.973(3)	O,O	99.3(4, 3.6)	
					N	2.05(1)	97.5(7)	O,N	83.4(4, 1.3)[c]	
					μO	1.98(1, 0)	79.7(5)	O,Cl	96.5(3, 1)	
					Cl	2.250(4)		N,Cl	98.0(3)	
$[Cu(\mu\text{-mdd})]_2(ClO_4)_2$	or	19.704(9)		CuO_3N_2		*not given*	2.929(1)		*not given*	165
(dark green)	Pbca	12.735(3)					not given			
	8	13.508(4)								
$[Cu(\mu\text{-mdd})]_2(ClO_4)_2$	m	8.4495(6)		CuO_3N_2	O	2.292(6)	2.929	O,O	99.2(5)	166
(dark green)	$P2_1/c$	23.612(5)	115.43(1)		N	1.977(8, 11)	98.2(6)	O,N	78.9(5)[c]	
	2	8.3041(8)			μO	1.958(6)	81.8(5)		85.0(5)[f]	
						2.292(6)			103.4(5, 36)	
									164.8(6, 12.8)	
								N,N	94.3(6)[f]	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(\mu\text{-OH})(cha)_2]_2(ClO_4)_2$	m	27.77(1)		CuO_2N_2	N	2.008(7, 6)	2.934(8)	N,N	96.1(2, 4.5)	167
(blue)	*C*2/*c*	14.45(1)	91.7(1)		μHO	1.941(6, 27)	98.2(2, 16)	O,N	94.1(3, 2.5)	
	8	17.68(1)					76.1(2, 0)			
$[Cu(\mu\text{-OH})(dmaep)(ClO_4)]_2$	m	7.266(3)		CuO_3N_2	N	2.005(3, 1)	2.935(1)	O,N	93.1(1, 7.9)	168
(dark blue)	$P2_1/c$	16.500(9)	82.43(3)		O_3ClO	2.721(4)	not given		171.0(2, 3)	
	2	10.851(9)			μHO	1.910(3, 10)	79.6(1)	O,O	86.9(1, 3.3)	
								N,N	95.2(1)	
$\{Cu\{HB(3, 5\text{-i-}Pr_2pz)_3\}(OH)\}_2 \cdot$	tr	16.466(4)	112.92(2)	CuO_3N_2	N	2.000(8, 16)	2.937(2)	N,O	92.7(3, 11.8)	169
$1.5CH_2Cl_2$	P-1	16.904(5)	99.21(2)			2.371(6)	not given		118.5(2, 1.2)	
(not given)	2	14.077(3)	90.76(2)			2.640(7)	79.4(2, 2)		157.7(3, 2.5)	
					μHO	1.944(6, 10)			172.8(3, 1)	
								N,N	88.2(3, 7.8)[f]	
$(pipH)_2[Cu(\mu\text{-MeOH}) \cdot$	or	13.935(3)		CuO_6	O	1.948(4, 12)	2.939(1)	O,O	76.7(2, 1.2)	170
$(2, 4\text{-dnph})_2]_2$	Pcab	14.725(3)				2.421(4, 3.1)	98.3(1)		94.2(2, 9.8)	
(olive green)	4	21.730(5)			μMeO	1.939(4, 10)	81.8(2)		174.4(2, 2.0)	
									156.8(2)	
$[Cu(\mu\text{-dmda})(ClO_4)]_2$	m	16.435(4)		CuO_3N_2	N	2.032	2.939		not given	171
(not given)	$P2_1/a$	14.522(3)	109.98(2)		μO	1.941	98.4			
	4	11.678(2)			O_3ClO	2.590(6, 51)				
$Cu_2(\mu\text{-hebd})(MeOH)$	m	11.456(5)		CuO_4	O	1.879(3, 6)	2.942	O,O	93.5(2, 2.0)[f]	172
(blue black)	$P2_1/n$	11.425(3)	104.15(3)		μ-O	1.924(3, 5)	100.1(1, 2)		171.4(1, 3)	
	4	14.357(4)					79.8(1, 3)			
				CuO_3N_2	MeO	2.266(4)		O,O	94.2(2, 8)[f]	
					N	1.901(4, 6)		O,N	96.5(2, 4.1)	
					μO	1.913(3, 11)			167.2(2, 3.3)	
								N,N	87.5(2)[e]	
$[Cu(2\text{-Brbz})(damet)]_2$	m	12.228(9)		CuO_4N	O	1.921(7)	2.946(2)	O,N	91.2(7, 5.7)	173
(not given)	$P2_1/c$	8.633(5)	97.63(6)			2.897(8)	101.5(4)		155.9(4)	
	2	14.297(8)			N	2.017(9)	78.5(4)	O,O	100.6(3)	
					μO	1.902(8, 11)			174.7(7)	

$[Cu(etap)Cl(H_2O)]_2$	tr	8.133(1)	94.50(1)	CuO_3NSCl	Cl	2.7792(8)	2.9461(5)	Cl,S	97.44(2)	174
(dark green)	P-1	10.459(1)	97.86(1)		S	2.4101(6)	99.11(6)	S,O	74.04(4)	
	1	6.689(1)	81.63(1)		H_2O	2.792(2)	80.89(6)		97.89(4)	
					N	1.991(2)		S,N	87.61(5)[c]	
					μO	1.936(1, 17)		Cl,O	96.46(5, 2.2)	
									170.88(4)	
								O,O	90.2(7, 1)	
								Cl,N	90.27(6)	
								O,N	89.3(7, 3.1)[f]	
$(pipH)_2[Cu(2,4\text{-dnph})_2(MeO)]_2$·	or	13.552(3)		CuO_6	phO	1.971(5, 32)	2.947(2)	O,O	77.8(2, 0)[c]	175
2MeOH	Pbca	13.874(3)				2.354(6, 17)	99.0(2)		94.0(2, 4.7)[f]	
(green)	8	26.170(5)			μMeO	1.937(5, 9)	80.9(2)		168.7(2, 5.8)	
$[Cu_2(dmf)(MeO)]$·fpb	tr	12.035(2)	101.03(1)	CuO_3N	O	1.906(5, 1)	2.947(1)	O,N	87.4(2, 4.2)[c]	176
(dark green)	P-1	15.461(3)	101.06(1)		N	1.902(6, 0)	99.3(2)	O,O	105.9(2, 3)	
	2	7.614(1)	99.55(1)		μO	1.934(5, 4)	79.4(2, 0)			
					μHO	1.898(5, 7)				
$[Cu(piapr)(H_2O)]_2$·$2H_2O$	m	20.328(7)		CuO_3N_2	H_2O	2.394(6)	2.948(2)	N,N	82.1(2)[c]	177
(dark green)	C2/c	7.317(3)	119.58(2)		N	1.965(5, 46)	98.3(2)	N,O	95.8(2, 5.9)[f]	
	4	16.862(3)			μO	1.949(4, 3)	80.4(2)		176.3(2)	
								O,O	100.3(2, 8.9)	
$Cu_2(fsaen)(H_2O)$	m	13.961(5)		CuO_4	O	1.877(5, 6)	2.949(1)		not given	178
(deep purple)	$P2_1/n$	11.787(3)	113.09(2)		μO	1.912(5, 3)	not given			
	4	11.622(3)								
				CuO_3N_2	H_2O	2.557(5)				
					N	1.880(6, 1)				
					μO	1.899(5, 1)				
$[Cu(2,4\text{-dnph})(py)(MeO)]_2$	m	9.652(1)		CuO_4N	pyN	2.007(4)	2.953(1)	O,O	80.2(2)[f]	179
(not given)	$P2_1/b$	15.159(2)			O	1.921(4)	99.9(2)		89.8(2, 9.6)	
	2	9.327(1)	92.21(1)			2.351(4)	80.1(2)		173.9(2)	
					μMeO	1.929(4, 15)		O,N	93.0(2, 2.2)	
									109.6(2)	
									162.2(2)	
$[Cu_2(damp)_2(H_2O)(ClO_4)](ClO_4)$	m	15.04(1)		CuO_3N_2	H_2O	2.62(1)	2.953(3)	N,N	86.2(3, 7)	180
not given)	$P2_1/c$	12.85(1)	100.1(1)		O_3ClO	2.52(1)	99.4(2, 1)	N,O	91.1(2, 4)	
	4	16.24(1)			N	2.027(8, 55)	79.4(2, 5)		100.9(3, 5)	
					μO	1.935(6, 20)				

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(damet)(3\text{-}OHbz)]_2$	m	8.733(5)		CuO_3N	bzO	1.918(6, 1)	2.958(2)	O,N	84.7(3, 1.6)	181
(dark blue)	$P2_1/n$	21.670(19)	96.14(5)		aeN	2.004(8, 20)	101.7(3, 1.2)		101.7(3, 6.4)	
	4	15.270(10)			μO	1.907(7, 28)	77.7(3, 4)		159.1(3, 4)	
								O,O	84.1(2, 4.9)[c]	
									103.0(2)	
									93.2(3, 1.7)	
									173.2(3, 1.1)	
$Cu_2(aapen)(H_2O)$	m	12.991(5)		CuO_2N_2	N	1.893(14, 11)	2.96	N,N	89.5(5)[c]	182
(green)	$P2_1/c$	8.530(4)	104.10(4)		μO	1.921(11, 3)	99.9(4, 3)	O,N	94.8(5, 1)[f]	
	4	18.546(6)					80.1(4, 8)		174.9(5, 6)	
				CuO_5	H_2O	2.284(11)				
					O	1.875(11, 0)		O,O	90.6(4, 5)[f]	
					μO	1.953(10, 4)			96.1(4, 5.4)	
									164.7(4, 1)	
$Na_2[Cu_2(fmclaph)(OH)(H_2O)_2]\cdot 11H_2O$	tr	17.129(5)	95.95(3)	CuO_4N	N	1.968(5, 8)	2.964(1)	O,O	89.(2, 8.7)	183
	P-1	11.558(5)	104.72(3)		O	1.950(4, 0)	99.1(2, 1.6)	O,N	89.9(2)[c]	
(deep green)	2	8.372(5)	76.21(3)		H_2O	2.278(4)	80.7(1, 0)		91.2(2)[f]	
						2.509(5)				
					μO	1.971(4, 6)				
					μHO	1.927(4, 7)				
$[Cu(Me_4en)(OH)]_2(ClO_4)_2$	m	7.707(1)		CuO_2N_2	N	2.014(–, 19)	2.966(3)	O,N	96.3	184
(burgundy)	$P2_1/c$	14.996(2)	109.13(1)		μHO	1.914(–, 17)	101.6(4)	N,N	87.8[c]	
	2	11.627(2)					78.4(4)			
$[Cu(\mu\text{-mtbne})(Me_2SO)]_2(ClO_4)_2$	m	12.431(2)		CuO_3N_2	O	2.204(2)	2.9662(10)	N,N	85.98(11)[f]	155
(blue green)	$P2_1/n$	14.251(3)	108.01(2)		N	2.039(3, 24)	98.31(10)	N,O	88.99(10, 2.94)	
	4	11.132(2)			μMe_2SOO	1.961(2, 4)	81.69(10)		102.74(10, 23)	
									162.26(19, 6.65)	
									86.05(10)[c]	
								O,O	98.82(10, 77)	
$[Cu(bz)(Me_4hd)]_2$	tr	13.462(5)	82.13(4)	CuO_4	O	1.887(5, 4)	2.970(2)	O,O	94.3(7, 2)	185
(purple)	P-1	6.064(2)	115.61(2)		μbzO	1.909(5, 1)	102.1(2)		94.1(7)[f]	
	1	12.756(6)	90.56(3)				77.9(2)			

$[Cu_2([20]\text{-}aneN_4)(MeO)_2 \cdot (MeCN)_2](BPh_4)_2$ (bright green)	m $P2_1/n$ 2	17.697(12) 14.830(13) 12.237(9)	 105.0(1) 	CuN_3O_2	N MeCN μMeO	2.056(24) 2.232(31) 1.787(42) 1.764(25) 2.070(25)	2.970(7) 101.3 78.7(11)	N,N	94.0(1, 6.5) 92.7(1, 3.2) 134.6(1, 6.7) 173.5(15)	186
$Cu_2([20]\text{-}aneN_4)(EtO)_2(NCS)_2$ (green)	m I2/c 4	15.356(10) 10.239(9) 18.662(16)	 102.5(1) 	CuN_3O_2	N SCN μEtO	2.192(19, 92) 1.947(17) 1.932(13, 29)	3.003(3) 102.73 78.0(5)	N,N O,N	92.6(7, 4.1)[f] 93.9(6, 1.8) 121.5(6) 140.9(6) 173.7(7)	186 187
$[Cu(Me_3([9]\text{-}aneN_3)(OH)]_2(ClO_4)_2$ (blue)	not given			CuN_3O_2	N μHO	2.072(5, 12) 2.238(4) 1.938(4, 1)	2.971(1) 100.1(2) 79.9(2)	N,O N,N	98.7(2, 3.9) 84.7(2, 1.1)[c]	188
$[Cu(Me_4pip)(EtO)]_2$ (purple)	m $P2_1/n$ 2	12.073(2) 11.510(2) 14.78(2)	 101.47(2) 	CuO_4	O μEtO	1.920(3, 23) 1.901(3, 2)	2.974(2) 103.0(2) 77.0(2)	O,O	92.8(1)[f] 93.2(1, 12.5)	189
$[Cu(Me_4en)(OH)]_2(ClO_4)_2$ (violet)	m $P2_1/c$ 2	7.557(5) 16.025(17) 14.014(9)	 103.56(3) 	CuO_2N_2	N μHO	2.064(5, 40) 1.903(4, 4)	2.978(2) 103.0(2) 77.0(2)	O,N N,N	98.2(2, 1) 87.8(2)[c]	190
$[Cu(bimpr)(EtO)]_2(ClO_4)_2 \cdot EtOH$ (violet)	m $P2_1/n$ 4	9.848(2) 13.000(2) 18.750(3)	 96.46(1) 	CuO_2N_2	N μEtO	1.972(9, 2) 1.910(6, 2)	2.979(2)[d] 102.46(29) 77.54(27)	N,O N,N	96.8(3, 3) 173.1(3, 2) 88.5(3)[c]	191
$[Cu_2(C_{17}H_{27}N_4O)(OH)(MeCN)]_2[Cu_6I_{10}]$ (not given)	tr P-1 2	10.476(3) 11.846(6) 13.558(7)	97.77(4) 99.62(3) 96.33(3)	CuO_2N_2	N μO μHO	1.976(7, 63) 1.954(6) 1.915(7)	2.980(2)[d] 98.49 102.95 78.8(−, 3)	N,N O,N	84.9(3)[c] 96.6(3, 4.8) 166.1(3, 1.2)	192
				CuN_3O_2	N μO μHO	1.952(8, 40) 2.490(9) 1.988(6) 1.896(7)		N,N O,N	86.0(3)[c] 95.7(3, 1.4)[f] 94.2(3, 9.5) 170.2(3, 4.8)	
$Cu_2\{acacP(O)\}(MeO)(MeOH)$ (blue)	m $P2_1/n$ 2	9.750(2) 16.399(2) 16.698(4)	 97.25(2) 	CuO_5	O MeHO μMeO	1.938(9, 2) 2.418(10) 1.923(9, 1)	2.982(3) 101.6(4) 78.4(4)	O,O	93.5(4, 7.9) 94.2(3)[f] 161.2(4)	193

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(2\text{-bae})Br]_2$	or	21.16(2)		CuO_2NBr	N	2.071	2.984(124)[d]	O,N	88.4(3.0,6.29)[f]	194
(olive green)	$P2_12_12_1$	15.15(2)			Br	2.369	105.2(3.3,7.0)		157.4(3.79,1.6)	
	4	8.40(1)			μO	1.885	74.7(2.9,5)	Br,N	94.1(2.49,67)	
								Br,O	97.8(2.4,3.3)	
									163.5(2.4,10.7)	
$[Cu(pyeth)(NO_3)]_2[Cu(pyeth)$-	tr	11.234(2)	95.13(2)	CuO_3NS	O_2NO	2.255(6)	2.986(1)	O,S	85.5(1)[e]	195
$(H_2O)]_2(NO_3)_2$[c]	P-1	15.605(2)	121.74(1)		N	1.964(5)	100.6(2)		110.1(1)	
(dark green)	2	8.535(2)	72.90(1)		S	2.335(2)	79.4(2)		153.4(2)	
					μO	1.941(1, 23)		O,N	96.6(2, 1.3)	
									169.6(2)	
								S,N	93.2(2)[f]	
								O,O	93.9(2, 1.0)	
				CuO_3NS	H_2O	2.193(5)	3.004(1)	O,S	85.6(2)	
					N	1.985(4)	101.9(2)		101.0(2)	
					S	2.348(2)	78.1(2)		155.8(1)	
					μO	1.935(6, 4)		O,N	96.8(2, 1.6)	
									164.6(2)	
								S,N	92.5(2)[f]	
								O,O	99.8(2, 4)	
$[Cu(mpp)]_2[Cu(mpp)(H_2O)]_2$·	tr	11.277(3)	89.93(2)	CuO_2N_2	N	1.991(3, 3)	2.986(1)	O,N	92.2(1, 4)[f]	196
$[CuCl_4]_2$[c]	P-1	11.554(3)	86.09(2)		μO	1.904(3, 4)	—		167.6(1, 1.7)	
(green)	1	12.275(3)	81.51(2)				76.7(1)	N,N	99.0(1)	
				CuO_3N_2	H_2O	2.681(4)	3.005(1)	O,O	89.2(1, 5.8)	
					N	1.982(3, 3)	—	O,N	92.0(1, 10.3)[f]	
					μO	1.917(2, 3)	76.7(1)		168.9(1, 4)	
									101.1(1)	
								N,N	98.4(1)	
				$CuCl_4$	Cl	2.250(1, 22)		Cl,Cl	109.5(1, 24.9)	

$[Cu(acacha)]_2$	tr	8.914(10)	101.6(3)	CuO_3N	N	1.988(11, 14)	2.989(3)	O,O	99.8(5, 8)	197
(green)	P-1	10.485(10)	110.6(3)		O	1.890(12, 10)	98.9(4, 18)	O,N	84.3(5, 3)[c]	
	2	11.733(10)	92.5(3)		μO	1.967(9, 65)	78.3(4)		98.0(5, 5)[f]	
$[Cu_2(pamph)(OMe)](ClO_4)_2 \cdot$	tr	13.571(4)	91.43(2)	CuO_3N_2	N	2.050(9, 38)	2.989(3)	O,N	106.9(3, 4)	198
0.5MeOH	P-1	12.316(3)	103.59(2)		μO	2.069(7, 1)	98.2(3, 5.7)		126.9(3, 1)	
(not given)	2	14.072(3)	122.80(2)		μMeO	1.899(7, 3)	not given		171.7(3, 1)	
								N,N	124.6(4, 2)	
$[Tl_4Cu[Cu(ocoxb)]_2 \cdot 10H_2O$	or	12.836(8)		CuO_4	O	1.942(12, 30)	2.990(6)	O,O	93.9(8, 1)[f]	199
(blue)	Amm2	24.933(9)					98.7(9)			
	2	7.482(3)					81.3(9)			
$[Cu(C_{22}H_{21}N_4O_2)(OH)(ClO_4)_2]$	tr	9.399(2)	102.72(2)	CuO_3N_2	O_3ClO	2.481(9)	2.991(2)	O,O	88.7(3, 5.0)	200
(dark green)	P-1	10.469(1)	100.71(2)		N	1.967(10, 47)	100.6(3, 1.4)	O,N	92.4(4, 5.6)[f]	
	2	14.612(4)	104.60(2)		μO	1.971(6)	78.7(3, 1)		168.9(3, 4.7)	
					μHO	1.991(2)		N,N	96.1(4, 2)[f]	
$[Cu(C_{22}H_{21}N_4O)(OH)]_2(BF_4)_2$	tr	9.323(4)	102.30(4)	CuO_2N_2	N	1.965(5, 32)	2.990(2)	N,N	96.5(2, 1)	201
(dark green)	P-1	10.449(2)	102.43(2)		μO	1.968(4, 1)	not given	N,O	92.9(2, 2.4)	
	2	14.179(4)	101.84(2)		μHO	1.910(4, 1)	not given		169.3(2, 3.2)	
								O,O	78.3(2, 0)	
$[Cu(tmp)(MeO)Cl]_2$	m	12.09(2)		CuO_2NCl	N	1.964(4)	2.992(1)	Cl,N	94.2(1)	202
(violet)	$P2_1/n$	7.647(3)	96.63(2)		Cl	2.257(4)	102.6(2)	Cl,O	95.9(1)	
	2	19.815(5)			μMeO	1.917(4, 17)	77.4(2)		169.8(1)	
								N,O	93.2(2)	
									168.7(2)	
$[Cu_2(pmp)(OH)(NO_3)$	m	7.438(2)		CuO_3N_2	H_2O	2.213(4)	2.992(1)	O,O	90.9(1, 2.7)	203
$(H_2O)]NO_3$	Pn	14.823(2)	90.23(2)		N	1.970(6, 37)	101.1(2, 1.2)	N,N	83.6(2)[e]	
(blue green)	2	10.399(4)			μO	1.981(3)	78.5(1, 9)	O,N	91.0(2)[f]	
					μHO	1.930(3)			102.2(2, 6.3)	
									165.3(2, 4)	
				CuO_4N_2	O_2NO	2.808(4, 96)		O,O	94.0(1, 8.9)	
					N	1.950(4, 25)			165.1(2)	
					μO	1.927(3)		N,N	84.6(2)[e]	
					μHO	1.913(3)		O,N	92.5(2)[f]	
									89.4(2, 14.5)	
									172.2(2, 1.1)	
$[Cu(Pr\text{-}nso)Br]_2$	m	17.765(2)	102.71(1)	CuO_2NSBr	Br	2.381(1)	2.992(1)	O,S	84.9(2)[e]	204
(not given)	$P2_1/a$	10.363(1)			N	2.443(5)	101.3(3)	S,Br	94.14(6)	
	2	7.831(1)			S	2.315(2)	78.7(2)	O,Br	100.5(1)	
					μO	1.935(5, 5)		O,N	99.1(2, 4)	
								S,N	84.6(2)[e]	
								Br,N	104.7(1)	

TABLE II *(Continued)*

Compound (color)	*Cryst. cl. space G. Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(2\text{-Me-im})_2(OH)]_2(ClO_4)_2 \cdot 2H_2O$	m	14.920(6)	103.2(3)	CuO_2N_2	N	1.980(3)	2.993(1)	O,N	93.6(1)	205
	C2/a	13.768(7)			μHO	1.963(2)	99.3(2)		168.2(1)	
(not given)	2	7.482(4)					80.7(1)	N,N	93.9(1)	
$[Cu_2(bzsmph)(OH)(ClO_4)_2]$	or	26.30(1)		CuO_3NS	O_3ClO	2.596(10)	2.994(1)	S,O	90.0(2)[f]	206
(not given)	Fdd2	18.801(8)			S	2.335(3)	101.7(5, 4.8)		164.0(2)	
	8	14.831(9)			N	1.911(8)	78.3(3)	S,N	91.9(2)[f]	
					μO	2.001(6)		O,N	99.1(3)	
					μHO	1.868(6)			175.8(3)	
$[Cu(\mu\text{-tbnp})(ClO_4)]_2$	tr	9.074(1)	82.39(1)	CuO_3N_2	O_3ClO	2.540(2)	2.9949(6)	N,N	86.22(7)[f]	155
(deep blue)	P-1	9.971(1)	104.77(1)		N	2.012(2, 13)	102.41(6)	N,O	96.03(7, 3.61)	
	2	7.708(1)	107.02(1)		μO	1.921(1, 8)	77.59(6)		169.41(7, 2.36)	
									97.35(6)[f]	
								O,O	94.87(6, 4.59)	
$[Cu(tfmd)]_2$	m	9.144(2)		CuO_3N	N	1.973(2)	2.995(2)	O,O	94.33(8)[f]	207
(not given)	$P2_1/c$	11.364(3)	97.05(1)		O	1.876(2)	not given		169.33(7)	
	4	12.008(2)			μO	1.911(2, 15)	76.80(8)	N,O	94.59(8, 4)[h]	
									170.74(8)	
$[Cu(2, 6\text{-dnph})(py)(MeO)_2]_2$	m	15.503(2)		CuO_4N	pyN	1.986(4)	2.996(1)	O,O	78.2(1)[f]	179
(not given)	A2/a	15.350(2)			O	1.927(4)	102.7(1)		93.2(1, 9.1)	
	4	12.609(1)	109.20(2)			2.383(4)	77.3(1)		173.3(1)	
					μMeO	1.918(4, 1)		O,N	93.8(1, 3.7)	
									168.2(1)	
$[Cu(Me\text{-nso})Cl]_2$	tr	7.677(1)	99.68(1)	CuO_2NSCl	Cl	2.233(1)	2.9955(6)	O,S	84.72(8)[e]	204
(not given)	P-1	9.131(1)	69.87(1)		N	2.356(3)	101.6(1)	S,Cl	96.62(3)	
	1	7.564(1)	71.79(1)		S	2.341(1)	78.4(1)	O,Cl	98.00(8)	
					μO	1.933(2, 6)		O,N	98.8(1, 1.9)	
								S,N	84.94(8)[e]	
								Cl,N	102.87(7)	
$[Cu(Bu\text{-nso})Br]_2$	m	10.284(1)	96.76(1)	CuO_2NSBr	Br	2.391(1)	2.998(1)	O,S	84.6(1)[e]	204
(not given)	$P2_1/a$	19.806(3)			N	2.428(5)	100.9(2)	S,Br	94.63(5)	
	2	7.955(1)			S	2.314(2)	79.1(2)	O,Cl	100.0(1)	
					μO	1.945(4, 12)		O,N	98.02(2, 5)	

								S,N	85.0(1)[c]	
								Br,N	106.6(1)	
[Cu(Pr-nso)Cl]$_2$	m	17.829(3)	102.73(1)	CuO_2NSCl	Cl	2.236(2)	2.999(1)	O,S	84.6(1)[c]	204
(not given)	$P2_1/a$	10.322(2)			N	2.468(3)	101.6(2)	S,Cl	94.78(6)	
	2	7.639(1)			S	2.330(2)	78.4(2)	O,Cl	100.6(1)	
					μO	1.935(4, 10)		O,N	99.2(1, 1)	
								S,N	83.9(1)[c]	
								Cl,N	103.3(1)	
[Cu(Me$_4$en)(OH)]$_2$Br$_2$	or	17.072(5)		CuO_2N_2	N	2.030(10, 0)	3.000(4)	O,N	98.8(27)	208
(burgundy)	Fddd	18.482(5)			μHO	1.902(3, 0)	104.08(17)	N,N	86.7(80)[c]	
	8	12.825(5)					75.92(17)			
[Cu(pcdp)]$_2$	m	25.61(2)		CuO_2N_2	N	1.947(13, 5)	3.001(4)	O,N	95.2(4)[f]	209
(red)	C2/c	5.46(1)	136.33(10)		μO	1.906(11, 15)	103.9(4)		100.6(4, 5.4)	
	4	16.90(2)					76.1(4)	N,N	83.2(5)[c]	
Cu(ambt)	m	16.661(6)		CuO_2N_2	N	1.952(3, 47)	3.002(1)	O,N	99.7(1, 2.6)	210
(red purple)	$P2_1/n$	10.256(4)	98.69(2)		μO	1.912(3, 12)	103.5(1)		97.1(1)[f]	
	2	5.333(1)					76.5(1)		174.4(1, 1.0)	
								N,N	84.2(1)[c]	
[Cu(2, 4,6-Cl$_3$ph)(qu)(ac)]$_2$	m	9.494(3)		CuO_3NCl	quN	2.001(14)	3.004(1)	N,O	95.0(9, 2.9)	211
(black green)	$P2_1/b$	11.397(4)	94.44(7)		Cl$_3$phO	1.911(11)	102.9(5)	Cl,O	72.1(5)[c]	
	4	14.705(4)			μCl	2.983(6)	77.1(7)		96.2(6, 2.5)	
					μacO	1.921(11, 4)		Cl,N	102.9(6)	
[Cu(3-Brbz)(damet)]$_2$	tr	8.263(5)	87.54(4)	CuO_4N	O	1.895(6)	3.005(2)	O,N	91.9(3, 6.9)	173
(not given)	P-1	8.759(5)	80.74(5)			2.895(7)	104.0(3)		159.6(3)	
	1	10.552(6)	87.47(5)		N	1.029(9)	76.0(3)	O,O	100.1(3)	
					μO	1.907(6, 18)			175.9(3)	
Cu_2(eap)Cl$_2$	m	7.639(2)		CuO_2N_2	N	1.919(8, 9)	3.006	N,N	89.8(3)[c]	212
(not given)	$P2_1/c$	18.527(3)	116.93(1)		μO	1.884(6, 13)	100.6(3, 3.1)	O,N	94.2(3, 1.0)[f]	
	4	14.633(3)					78.5(3, 3.5)		175.7(3, 8)	
				CuO_2Cl_2	Cl	2.181(3, 1)		Cl,Cl	105.8(1)	
					μO	1.952(7)		O,Cl	103.6(2, 3.5)	
						2.097(6)			136.1(2, 3.9)	
[Cu(damet)I]$_2$	tr	6.297(3)	73.33(3)	CuO_2NI	I	2.554(1)	3.007(1)	N,O	84.5(1)[c]	213
(dark violet)	P-I	8.059(2)	76.84(3)		N	2.045(3)	103.6(1)		155.9(1)	
	2	10.464(4)	71.57(3)		μO	1.913(3, 6)	76.4(1)	N,I	101.4(1)	
								I,O	100.3(1)	
									167.8(1)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(Etbzi)(NO_3)]_2$	m	9.678(6)		CuO_4N	O_2NO	1.985(3)	3.008(1)	O,O	103.3(1, 5.6)	214
(black)	$P2_1/c$	9.82(1)	134.69(4)			2.448(3)	101.1(1)		160.8(1)	
	2	16.267(7)			N	1.930(3)	78.9(1)	O,N	95.5(1, 17)[f]	
					μO	1.947(3, 21)			158.1(1)	
$[Cu(apns)]_2$	m	4.597(1)		CuO_3N	O	1.892(1)	3.009(1)[d]	O,N	95.6(1, 1.1)[f]	215
(not given)	$P2_1/c$	15.515(5)	113.28(2)		N	1.939(1)	103.4(2)		170.8(2)	
	2	16.345(4)			μO	1.918(1, 9)	76.6(1)	O,O	92.9(1)[f]	
									167.7(1)	
$[Cu(OHbim)(Obim)]_2(ClO_4)_2 \cdot$	tr	19.380(4)	102.52(2)	CuO_3N_2	O	2.452(8, 1)	3.008(4)	N,O	78.4(3, 4.2)[c]	216
5EtOH	P-1	21.345(6)	103.93(2)		N	1.965(8, 7)	102.6(3, 1)		95.2(3, 1.4)	
(blue)	2	9.484(3)	105.76(2)		μO	1.927(7, 3)	76.7(3, 1)		157.1(3, 1)	
									170.8(3, 5)	
								O,O	76.6(3)	
									99.4(3, 1.6)	
								N,N	105.3(3, 2)	
$[Cu(Me\text{-}nso)(NCS)]_2$	m	10.025(3)	110.49(2)	CuO_2N_2S	SCN	1.940(9)	3.009(2)	S,O	84.1(2)[c]	217
(dark green)	$P2_1/a$	14.421(3)			S	2.361(3)	103.0(2)		160.8(2)	
	2	8.595(2)			N	2.296(7)	77.0(2)	S,N	92.0(2, 7.6)[f]	
					μO	1.922(7, 20)		O,N	100.6(3, 3.5)	
									159.0(3)	
								N,N	98.7(3)	
$[Cu(dpae)(OCN)]_2$	m	10.469(7)		CuO_2N_2	OCN	1.890(3)	3.010(1)	O,N	83.8(1)[c]	218
(dark green)	$P2_1/n$	12.742(8)	95.92(1)		N	2.047(2)	104.2(1)		100.5(1, 1.5)	
	2	8.695(6)			μO	1.908(2, 17)	75.8(1)		165.3(1, 6.9)	
								N,N	102.0(1)	
$[Cu(Pr\text{-}nso)Cl]_2$	m	17.647(3)	102.98(1)	CuO_2NSCl	Cl	2.244(1)	3.010(1)	S,O	85.0(1)[c]	219
(at 120 K)	$P2_1/a$	10.246(1)			N	2.431(2)	101.6(1)		163.4(1)	
(dark green)	2	7.636(1)			S	2.335(1)	78.4(1)	S,Cl	95.1(1)	
					μO	1.943(2, 1)		S,N	84.4(1)[c]	
								O,N	98.4(1, 7)	
								O,Cl	100.2(1)	
									156.5(1)	
								N,Cl	104.3(1)	

$[Cu_2(imiph)(OH)(H_2O)(ClO_4)]\cdot ClO_4$ (green blue)	m $P2_1/c$ 4	7.354(4) 21.781(19) 16.175(8)	90.70(4)	CuO_3N_2	H_2O O_3ClO N μO μHO	2.185(18) 2.990(14) 1.943(14, 18) 1.938(13, 5) 1.925(15, 28)	3.011(4) 102.04 77.96	N,N N,O O,O	94.81(59, 29)[f] 94.45(62, 2.48)[f] 90.82(63, 7.98)	220
$[Cu(mapyNO)Cl_2]_2$ (amber)	tr P-1 1	11.0483(11) 9.2975(9) 9.4998(9)	124.61(1) 92.85(1) 99.26(1)	CuO_3Cl_2	Cl O μO	2.231 2.515 1.928 1.958(–, 30)	3.011(1) 112.4(3) 71.1(1)	O,O Cl,O Cl,Cl	88.3(1) 159.3(1) 146.4(1) 95.7(1, 4.4) 114.9(1)	221
$Cu_2(salen)(F_3acac)_2$[e] (dark)	tr P-1 4	17.03(4) 19.11(4) 9.89(2)	96.58(11) 100.10 107.70(13)	CuO_2N_2	N μO	1.960(17, 37) 1.934(13, 1) 1.959(13, 36)	3.011(3) 91.1(6, 8.7) 81.4(6, 9.0)	N,N O,N	83.6(8)[c] 92.9(7, 2.5)[f] 174.6(7, 9)	222
				CuO_6	O μO	2.305(11) 2.007(13) 2.576(12)		O,O	88.8(5, 1.6)[f] 92.0(6, 13.3) 172.3(6, 5.6)	
				CuO_2N_2	N μO	1.917(18, 18) 1.900(14, 24)	3.124(4) 100.0(6, 4.7) 79.5(5, 6.2)	N,N O,N	84.0(8)[c] 94.9(7, 1.0)[f] 177.1(7, 8)	
				CuO_6	O μO	1.980(14, 48) 2.260(15) 2.024(11) 2.335(12)		O,O	87.3(5, 3.4)[f] 92.5(6, 10.7) 175.5(6, 2.5)	
$[Cu(scsal)]_2NO_3\cdot H_2O$ (not given)	m $P2_1/n$ 4	18.817(7) 8.689(4) 7.289(5)	104.916(3)	CuO_3N	N O μO	1.939(4) 1.993(4) 1.963(3, 1)	3.012(2) 100.2(2) 79.7(1)	O,O O,N	105.5(2) 80.9(2)[c] 91.9(2)[f]	223
$[Cu(\mu\text{-bdo})]_2ClO_4$ (not given)	tr P-1 1	9.829(3) 12.431(3) 8.741(3)	104.15(2) 115.77(2) 69.53(2)	CuO_2N_2	N μO	2.008 1.934	3.013 102.4		not given	171
$[Cu(tfmd')]_2$ (not given)	or Pbca 4	12.486(3) 19.387(4) 10.754(2)		CuO_3N	O N μO	1.892(2) 1.998(2) 1.911(2, 13)	3.014(2) not given 75.94(9)	O,O O,N	93.59(8)[f] 169.50(8) 95.2(9, 3.4)[h] 174.55(9)	207
$[Cu(hbzoct)(NO_3)_2]_2$ (green)	tr P-1 2	8.830(4) 9.224(4) 9.230(3)	87.76(3) 113.74(3) 107.41(3)	CuO_4N	O_2NO N μO	1.940(5) 2.383(7) 2.035(6) 1.945(5, 3)	3.016 not given 78.3(2)	O,N O,O	91.7(2, 5.8)[f] 93.8(2, 10.9)	224

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(hfc)(phen)]_2$	m	9.101(2)		CuO_3N_2	phenN	1.993(3)	3.016	O,O	83.3(1)[c]	225
(dark blue)	$P2_1/n$	20.681(3)	93.55(2)			2.305(3)	*102.4(1)*		*151.9(1)*	
	2	11.101(1)			O	1.962(3)	77.6(1)	O,N	95.9(1, 3.6)	
					μO	1.935(2, 27)			113.5(1, 6)	
									169.5(1)	
								N,N	77.5(1)[c]	
$[Cu(OHbim)(Obim)(NO_3)]_2 \cdot 4Me_2SO$	m	15.932(8)		CuO_3N_2	O_2NO	2.447(8)	3.017(5)	N,O	74.1(3)[c]	226
	$P2_1/n$	9.227(1)	98.51(3)		OHbimN	1.955(7)	102.3(4)		95.9(3)	
(blue)	2	21.180(2)			ObimN	1.967(7)	77.3(3)		170.2(2)	
					μO	1.938(6, 1)		O,O	99.5(3)	
								N,N	82.6(3)	
									105.3(3)	
$[Cu(fmp)](BF_4)_2 \cdot H_2O$	m	38.80(2)		CuN_3O_2	N	1.98(2, 4)	3.017(5)	O,N	90.6(7, 7)[f]	227
(green)	C2/c	12.618(6)	112.42(4)			2.64(2, 5)	101.18(6, 1.3)		154.7(7, 5.0)	
	4	18.366(8)			μO	1.94(1, 4)	78.3(6, 6)	N,N	106.5(8, 1.4)	
$[Cu_2(maldpr)(OH)](ClO_4)_2$	m	7.807(1)		CuO_2N_2	N	1.961(4, 53)	3.018(1)	O,N	98.2(2, 7.1)[f]	228
(violet)	$P2_1/c$	23.232(3)	103.845(4)		μO	1.962(3, 4)	103.5(2, 2.9)		172.6(2, 5.2)	
	4	16.215(2)			μHO	1.887(4, 14)	76.8(1, 0)	N,N	87.0(2, 1)[c]	
$[Cu(Et\text{-}nso)Cl]_2$	tr	8.694(2)	94.03(2)	CuO_2NSCl	Cl	2.229(2)	3.018(9)	O,S	85.00(9)[c]	204
(not given)	P-1	9.879(2)	114.59(2)		N	2.421(4)	102.6(1)	S,Cl	95.90(6)	
	1	7.591(2)	83.61(2)		S	2.334(1)	77.4(1)	O,Cl	99.2(1)	
					μO	1.934(3, 3)		O,N	99.7(1, 1)	
								S,N	84.66(9)[c]	
								Cl,N	105.8(1)	
$[Cu(bba)Br]_2$	m	10.895(7)		CuO_2NBr	Br	2.304(6)	3.019(7)	O,N	89.8(8)[f]	229
(black)	$P2_1/c$	8.978(5)	113.46(7)		N	2.01(2)	101.2(9)		152.1(8)	
	2	19.90(2)			μO	1.96(2, 1)	78.8(8)	O,Br	100.7(6)	
									152.5(6)	
								N,Br	101.0(6)	

α-[Cu(2-bae)Br]$_2$	or	21.235(13)		CuO_2NBr	Br	2.333(4)	3.019(4)	O,Br	99.0(5, 2)	230
(not given)	$P2_1P2_1P2_1$	15.220(8)			N	2.06(2, 1)	103.8(7, 5)		171.7(7, 1.6)	
	4	8.390(5)			μO	1.92(2, 1)	76.2(7, 5)	O,N	82.5(7, 7)[c]	
									158.5(7, 1)	
								Br,N	102.5(6, 2)	
$K_2[Cu(biu)(OH)]_2 \cdot 4H_2O$	m	3.784(1)		CuO_2N_2	N	1.912(5, 1)	3.020(1)	O,N	94.2(2, 5)	231
(not given)	$P2_1/c$	14.505(2)	101.80(1)		μHO	1.955(4, 6)	101.1(2)	N,N	92.7(2)[f]	
	2	15.035(2)					not given			
$[Cu_2(bmmp)(OH)](CLO_4)_2$	m	21.531(6)	90.47(2)	CuO_2S_2N	N	2.005(8, 1)	3.020(2)	O,S	97.0(2, 3.1)[f]	232
(not given)	$P2_1/a$	18.479(2)			S	2.393(3, 35)	102.0(3, 2.9)		110.4(2, 2.2)	
	4	8.177(1)			μO	1.984(7, 10)	78.1(3, 5)		132.1(2, 3.9)	
					μHO	1.906(8, 0)		O,N	92.1(3, 7)[f]	
									169.6(3, 5)	
								N,S	88.2(2, 1.4)[c]	
								S,S	117.4(1, 1.7)	
$[Cu(salapr)]_2$	m	9.018(5)		CuO_3N	O	1.896(14)	3.021(4)		not given	233
(violet)	$P2_1/c$	10.810(4)	106.62(9)		N	1.896(18)	103.5(4)			
	2	10.233(5)			μO	1.924(16, 7)				
$Cu_2(F_6pd)(ebs)$[e]	tr	21.374(6)	79.8(1)	CuO_2N_2	N	1.927(8, 11)	3.021(3)	N,N	84.6(4)[c]	234
(not given)	P-1	17.065(5)	104.21(1)		μO	1.916(8, 16)	not given	O,N	94.3(3, 6)[f]	
	4	9.938(4)	121.5(1)				78.8(3, 7.9)		177.2(3, 5)	
				CuO_6	O	1.959(6, 29)		O,O	87.0(3, 3)[f]	
						2.269(9)			93.5(3, 13.0)	
					μO	1.995(4)			172.4(3, 5.9)	
						2.492(9)				
				CuO_2N_2	N	1.933(8, 7)	3.137(2)	N,N	85.5(4)[c]	
					μO	1.916(6, 20)	not given	O,N	93.6(3, 4)[f]	
							80.3(3, 7.0)		177.7(4, 1.0)	
				CuO_6	O	1.938(7, 46)		O,O	85.9(3, 2.8)[f]	
						2.289(8)			93.6(3, 9.5)	
					μO	2.031(5)			175.6(3, 2.4)	
						2.376(7)				
$Cu_2(mprph)(OH)(H_2O)(ClO_4)$	m	29.924(2)		CuO_3N_2	H_2O	2.346(4)	3.021(1)	O,O	93.9(1, 3.1)	235
(blue)	C2/c	12.289(1)	91.84(1)		O_3ClO	2.544(3)	101.7(1, 3.0)		111.8(1)	
	8	15.168(1)			N	2.000(3, 71)	78.2(1, 5)	O,N	92.2(1, 5.7)[f]	
					μO	1.991(2, 11)			164.1(1, 7.2)	
					μHO	1.907(3, 9)		N,N	97.3(1, 1.4)[f]	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
Cu_2(bpsp)	m	17.657(1)		CuO_3N	N	1.921(5, 1)	3.023(1)	O,O	102.5(2, 3)	236
(dark green)	$P2_1$	25.573(2)	91.58(1)		O	1.862(4, 1)	101.2(2, 8)		173.0(2, 1.9)	
	2	9.165(1)			μO	1.956(4, 40)	78.5(1, 4)	O,N	86.1(2, 1)[c]	
									92.8(2, 4)[f]	
									169.7(2, 1.2)	
[Cu(apcs)]$_2$	m	9.475(1)		CuO_3N	O	1.886(1)	3.026(1)[d]	O,N	96.(1, 8)[f]	215
(brown)	$P2_1/c$	11.251(3)	102.84(2)		N	1.943(2)	103.6(1)		169.1(1)	
	2	9.875(2)			μO	1.925(1, 8)	76.4(1)	O,O	93.1(1)[f]	
									164.4(1)	
[Cu(pia)]$_2$	m	5.98(1)		CuO_3N	N	1.83(1)	3.026(6)	O,N	97.3(7, 2.3)	237
(brown)	$P2_1/c$	10.97(2)	106.75(10)		O	1.96(2)	106.4(6)		173.1(6)	
	4	14.42(2)			μO	1.89(1, 3)	73.6(6)	O,O	91.8(6)	
[Cu(damet)Br]$_2$	m	8.579(2)		CuO_2NBr	Br	2.239(2)	3.026(2)	N,O	83.8(3)[c]	238
(green)	$P2_1/n$	12.062(3)	102.72(2)		N	2.036(8)	104.5(4)	Br,N	100.9(2)	
	4	8.919(1)			μO	1.914(8, 10)	not given	Br,O	172.4(3)	
[Cu_2(bimp)(MeO)](ClO$_4$)$_2$·	m	23.221(3)		CuN_3O_2	N	2.027(4, 23)	3.026(1)	N,O	99.9(2, 7.7)[f]	239
2MeOH	C2/c	12.903(2)	125.34			2.128(4)	102.1(1, 3.4)		114.7(1)	
(green)	4	17.681(3)			μO	1.994(2)	77.9(1)		130.4(1)	
					μMeO	1.901(2)			169.9(1)	
								N,N	82.0(1, 1.6)[c]	
									113.1(1)	
[Cu(phbi)(NO$_3$)]$_2$	tr	10.420(3)	107.38(6)	CuO_4N	O_2NO	1.958(1)	3.027(1)	O,O	56.67(6)[i]	240
(not given)	P-1	8.489(8)	90.96(2)			2.457(1)	100.05(6)		87.97(6)	
	1	11.687(2)	131.19(8)		N	1.924(1)	79.95(6)		105.1(6, 4.8)	
					μO	1.974(1, 66)			161.4(7)	
								O,N	94.70(6, 76)[f]	
									124.68(7)	
									147.08(6)	
[Cu(ete)Br]$_2$	tr	7.320(3)	103.88(2)	CuO_2SBr	Br	2.381(2)	3.028(2)	O,S	85.4(3)[c]	241
(not given)	P-1	8.544(3)	99.61(3)		S	2.303(3)	102.9(4)		161.7(3)	
	1	6.181(2)	88.15(3)		μO	1.937(10, 2)	77.1(4)	O,Br	99.9(3)	
									167.7(2)	
								S,Br	95.9(1)	

$[Cu_2(ahm)]\cdot 3H_2O$	m	22.613(21)		CuO_2N_2	N	1.960(8, 30)	3.029(3)	O,N	95.1(3, 8)[f]	242
(not given)	$P2_1/n$	8.890(7)	93.00(8)		μO	1.925(6, 15)	103.8(3, 5)	N,N	93.6(3, 2.0)[f]	
	4	9.496(5)					76.3(2, 5)			
$[Cu(paaan)]_2\cdot C_6H_6$	m	19.001(9)		CuO_3N	N	1.924(4)	3.030(1)	O,O	93.4(1)[f].	243
(not given)	C2/c	6.516(3)	113.36(3)		O	1.928(3)	103.7(1)	O,N	95.2(2, 1.0)[f]	
	2	15.802(6)			μO	1.908(3, 38)	76.3(1)			
$[Cu(aples)]_2$	m	10.982(8)		CuO_3N	O	1.887(3)	3.030(2)[d]	O,N	95.(1, 1.9)[f]	215
(not given)	$P2_1/c$	8.799(2)	90.68(3)		N	1.935(4)	104.0(1)		170.9(1)	
	2	12.322(2)			μO	1.923(3, 6)	76.0(1)	O,O	92.8(1)[f]	
									168.4(1)	
$[Cu_2(Me_3([9]\text{-aneN}_3)(H_2O)]\cdot(ClO_4)_2$	not given	not given	not given	CuN_3O_2	N	2.069(7, 5)	3.032(1)	N,O	91.0(2, 2)	188
(green)						2.221(7)	88.6(2)		107.8(2)	
					μO	2.199(5)	91.4(2)	N,N	85.2(3, 1.2)[c]	
					μH_2O	2.220(5)				
$Cu_2\{Fe_6pd)_2\{(prp)_2en\}$	m	13.702(3)		CuO_2N_2	N	2.092	3.032		not given	244
(not given)	$P2_1/c$	20.010(8)	96.81(1)		μO	1.981	95.6(–, 6.2)			
	4	12.579(3)				2.305				
				CuO_6	O	1.985				
					μO	2.210				
						2.400				
$[Cu(damet)Br]_2$	m	8.946(9)		CuO_2NBr	Br	2.356(3)	3.033(5)	Br,O	100.7(4)	245
(not given)	$P2_1/n$	12.188(12)	102.45(18)		N	2.021(11)	105.0(6)		171.3(4)	
	2	8.576(9)			μO	1.911(13, 38)	75.0(6)	Br,N	101.7(3)	
								O,N	83.1(5)[c]	
									157.4(5)	
$[Cu_2(Me_2\text{-}[22]\text{-aneN}_4)(MeO)_2]\cdot(CLO_4)_2$	m	16.734(3)		CuO_2N_2	N	2.013(3, 6)	3.034(1)		not given	246
	$P2_1/a$	8.549(1)	111.05(1)		μMeO	1.945(2, 7)	102.50(8)			
(blue green)	2	13.103(2)					77.50(8)			
$[Cu\{Me_2N(CH_2)_3NH(CH_2)_2O\}\text{-}(MeOH)]_2(CLO_4)_2$	or	14.760(5)		CuO_3N_2	MeHO	2.348(10)	3.034(2)	O,N	94.5(4, 10.7)	247
	Pbca	16.441(5)			N	2.031(10, 21)	103.6(2)		83.8(3)[c]	
(deep green)	8	11.911(4)			μO	1.930(7, 4)	76.3(3)	N,N	94.7(3)[f]	
								O,O	96.8(4, 3.5)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(ete)Cl]_2$	tr	7.243(3)	102.68(3)	CuO_2SCl	Cl	2.230(2)	3.034(1)	O,S	85.8(1)[c]	241
(not given)	P-1	8.459(3)	99.11(3)		S	2.319(2)	103.9(2)		161.6(1)	
	1	6.068(2)	88.59(4)		μO	1.925(4, 2)	76.1(2)	O,Cl	100.3(1)	
									168.3(1)	
								S,Cl	96.91(6)	
$[Cu(dana)(py)]_2$	m	8.413(2)		CuO_4N	pyN	2.298(3)	3.0351(9)	N,O	93.9(9, 2.0)	248
(blue)	$P2_1/c$	22.791(5)	91.60(2)		O	1.899(2, 9)	102.44(9)		105.76(9)	
	2	11.109(2)			μO	1.947(2, 16)	77.56(9)	O,O	92.4(8, 7)[f]	
									93.1(9, 1.4)	
									163.1(11, 3.7)	
$[Cu_2(C_{34}H_{40}N_6O)(OH)](PF_6)_2$	or	11.205(2)		CuN_3O_2	N	2.028(31, 34)	3.037(5)	O,N	90.4(10, 7.7)[f]	249
(not given)	$P2_1P2_1P2_1$	23.261(5)				2.209(19, 11)	100.8(9, 3.0)		101.8(8, 3.8)	
	4	16.333(4)			μO	2.015(21, 0)	77.6(8, 1)		157.6(10, 6.5)	
					μHO	1.1932(18, 3)		N,N	97.2(11, 5.8)[f]	
$[Cu(H_2O)_2(4\text{-}NO_2bz)(py)]_2$	tr	6.943(4)	122.29(5)	CuO_5N	bzO	1.91(1, 1)	3.04	O,O	89.4(1, 7.0)	250
(blue)	P-1	13.942(8)	97.78(6)		H_2O	2.44(1)	100.4(1)		174.9(1, 1.9)	
	1	12.979(9)	78.44(5)		μH_2O	79.1(1)	79.1(1)	O,N	92.5(1, 6.7)	
									173.3(1)	
$[Cu(N\text{-}Mesala)Cl]_2$	tr	6.998(2)	90.32(1)	CuO_2NCl	Cl	2.202(4)	3.041(1)	O,N	94.5(4)[f]	212
(not given)	P-1	10.165(2)	105.77(1)		N	1.94(1)	102.2(2)	N,Cl	97.5(3)	
	1	7.189(1)	115.51(1)		μO	1.954(7, 39)	77.8(2)	O,Cl	149.1(1)	
$[Cu(N\text{-}oed)Br]_2$	tr	4.5213(6)	81.5(3)	CuO_2NBr	Br	2.348(4)	3.042(4)	Br,N	99.3(6)	251
(dark green)	P-1	8.484(1)	85.79(4)		O	1.94(2)	not given	Br,O	159.3(5)	
	1	13.052(7)	77.79(2)		μO	1.92(2, 0)	74.1(7)	N,O	92.1(7)[f]	
$[Cu(bdhe)]_2(ClO_4)_2$	m	9.349(2)		CuN_3O_2	N	2.050(6, 57)	3.044(2)	O,N	84.0(3)[c]	252
(deep green)	$P2_1/n$	17.676(4)	93.02(2)			2.504(7)	103.1(3)		107.4(3, 2.6)	
	2	11.720(3)			μO	1.944(6, 30)	76.9(2)		118.5(3)	
								N,N	84.3(3, 3.4)[c]	
									109.1(3)	

$[Cu(deapo)(NCO)]_2$	m	7.363(3)		CuO_2N_2	OCN	1.913(2)	3.044(1)	O,N	168.0(1, 6)	253
(blue green)	$P2_1/c$	12.422(5)	96.37(2)		N	2.058(2)	104.7(1)		95.8(2)[f]	
	4	11.117(5)			μO	1.922(2, 22)	not given	N,N	92.6(1)	
$[Cu(damol)(EtOH)]_2BF_4$	m	16.004(2)		CuO_3N_2	N	2.008	3.045		not given	171
(not given)	$P2_1/a$	9.579(2)	103.16(1)		μO	1.922	104.8			
	2	9.410(1)			EtHO	2.448				
$[Cu(phba)Cl]_2$	tr	12.236(3)	114.39(2)	CuO_2NCl	Cl	2.192(2)	3.045(1)[d]	Cl,O	101.7(1)	254
(dark brown)	P-1	7.658(3)	77.04(2)		N	1.949(2)	103.3(1)		151.6(1)	
	1	7.312(3)	105.56(2)		μO	1.943(3, 19)	76.7(1)	Cl,N	100.5(1)	
								O,N	92.2(1)[f]	
									151.0(1)	
$[Cu(paapnan)]_2.2C_6H_6$	m	15.312(3)		CuO_3N	N	1.926(3)	3.046(1)	O,O	93.7(1)[f]	243
(not given)	C2/c	10.399(2)	91.82(1)		O	1.918(2)	103.9(1)	O,N	95.1(1, 8)[f]	
	4	23.743(4)			μO	1.903(2, 29)	76.1(1)			
$[Cu(Bu\text{-}nso)Cl]_2$	m	15.109(2)	109.70(1)	CuO_2NSCl	Cl	2.229(1)	3.0463(5)	O,S	84.95(6)[c]	204
(not given)	$P2_1/a$	9.915(1)			N	2.448(3)	104.22(9)	S,Cl	96.82(3)	
	2	11.529(1)			S	2.3446(8)	75.78(8)	O,Cl	98.38(7)	
					μO	1.930(2, 3)		O,N	104.1(1, 2)	
								S,N	84.32(6)[c]	
								Cl,N	97.40(7)	
$[Cu(C_{12}H_{15}N_2O)(ac)(EtOH)]_2$	m	20.867(3)	94.12(2)	CuO_4N	acO	1.936(3)	3.050(1)	O,O	95.1(2, 3.6)	255
(dark green)	$P2_1/a$	10.168(3)			EtO	2.267(4)	101.6(1)		173.5(1)	
	2	7.960(1)			N	2.023(4)	78.4(1)	O,N	94.9(1, 6.8)[f]	
					μO	1.968(3, 19)			157.7(1)	
$[Cu(N\text{-}Etsala)Cl]_2$	tr	9.989(1)	122.56(1)	CuO_2NCl	N	1.950(4)	3.051(1)	O,N	92.1(2)[f]	212
(not given)	P-1	7.441(1)	98.74(1)		Cl	2.202(1)	103.3(2)	N,Cl	99.2(1)	
	1	8.396(1)	104.28(1)		μO	1.945(3, 22)	76.7(2)	O,Cl	154.0(1)	
$[Cu(htr)(py)]_2$	tr	9.60(3)	123.7(3)	CuO_4N	pyN	1.91(2, 3)	3.051(3)	O,O	96(1, 8)[f]	256
(black)	P-1	9.94(3)	91.6(3)		O	2.32(2)	103(1)	N,O	95(1, 4)	
	1	8.61(3)	108.2(3)		μO	1.95(2, 3)	77(1)			
$[Cu(N\text{-}Etsala)Br]_2$	tr	10.169	121.40	CuO_2NBr	N	1.95(2)	3.05(1)	O,N	92.6(5)[f]	212
(not given)	P-1	7.674	97.92		Br	2.34(3)	104.6(2)	N,Br	99.8(4)	
	1	8.380	106.43		μO	1.93(1, 4)	75.4(2)	O,Br	150.7(4)	
$[Cu_2(pramcres)(OH)](BF_4)_2$	m	22.32(1)		CuN_3O_2	N	2.007(11, 48)	3.053(4)	N,O	92.2(4, 11.2)[f]	257
(brown black)	$P2_1/c$	9.551(5)	95.76(3)			2.075(10, 26)	102.8(4, 9)		139.6(4)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]	*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]	*Ref.*
	4	16.715(8)			μO 1.965(8, 38) μHO 1.941(6, 1)	77.1(3, 9)	164.2(4, 9.3) N,N 95.6(5, 2)[f] 102.4(5, 11.3)	
$[Cu_2(C_{29}H_{37}N_{10}O)](BF_4)_2$ (not given)	m $P2_1/c$ 4	22.329(1) 9.552(1) 16.715(1)	95.70(2)	CuN_3O_2	N 2.065(15, 89) μO 1.967(11, 41) μHO 1.961(8, 3)	3.054(4) 102.1(5, 3) 77.8(4, 1.1)	N,N 100.2(6, 13.4) N,O 93.7(6, 9.3) 147.1(6, 6.7) 169.5(5, 1.0)	258
$[Cu(baa)(py)]_2 \cdot 2py$ (reddish brown)	or Pbca 4	8.473(3) 25.377(15) 19.000(10)		CuO_4N	pyN 2.274(10) O 1.908(11, 7) μO 1.945(11, 3)	3.055(3) 103.5(3) 76.5(3)	O,O 93.4(6, 9)[f] N,O 96.9(5, 5.0)	259
$[Cu_2(paaet)_2] \cdot 0.5\ C_6H_6$ (black)	tr P-1 2	9.438(4) 13.323(2) 11.384(1)	75.68(1) 89.68(2) 82.34(2)	CuO_3N	N 1.938(3, 4) O 1.881(3, 3) μO 1.938(3, 15)	3.060(1) 104.3(1, 2) 75.7(1, 1)	N,O 95.8(1, 1.5) 170.1(1, 5) O,O 92.7(1, 1)[f]	260
$[Cu(C_{12}H_{15}N_2O)(ac)(MeOH)]_2$ (dark green)	m $P2_1/a$ 2	20.627(3) 9.987(3) 7.839(3)	92.41(2)	CuO_4N	acO 1.936(3) MeOH 2.370(4) N 2.017(4) μO 1.964(3, 22)	3.061(1) 102.4(1) 77.6(1)	O,O 95.0(2, 3.7) 173.5(1) O,N 95.1(1, 6.1)[f] 157.9(1)	255
$[Cu(F_3acpt)(H_2O)]_2 \cdot H_2O$ (not given)	or Pbca 4	10.721(10) 24.634(10) 17.739(16)		CuO_5	H_2O 2.314(8, 7) O 1.906(7, 11) μO 1.944(6, 21)	3.064(8) 103.8 85.8	O,O 94.6(3, 4.4)[f]	259
$[Cu_2(fmp)](BF_4)_2 \cdot MeOH$ (green)	tr P-1 2	14.194(3) 15.887(3) 12.240(3)	107.54(2) 113.22(2) 82.44(2)	CuN_3O_2	N 1.963(8, 11) 2.281(9) μO 1.955(7, 15)	3.066(2) 102.8(3, 2.6) 77.2(3, 5)	O,N 88.3(3, 6.6)[f] 138.5(3, 6.0) 166.9(3, 1.2) N,N 91.0(4, 1.6) 107.1(3) 104.7(4, 3) 134.2(3)	227
$[Cu(dapp)(ac)]_2$ (dark green)	m $P2_1/c$ 2	12.585(11) 8.421(8) 18.175(16)	121.30(7)	CuO_4N	acO 1.938(2) 2.491(3) N 2.028(3) μO 1.949(2, 23)	3.067(1) 103.84(16) 76.16(4)	O,O 58.26(6)[e] 95.49(8) 169.8(8) O,N 94.7(1)[d] 92.7 159.2	261

$[Cu(dapp)(ac)(MeOH)]_2$	or	7.423(7)		CuO_4N	acO	1.932(5)	3.067(2)	O,O	95.4(1, 4.1)	261
(dark green)	Pbna	24.444(28)				2.421(6)	101.1(3)		163.65(12)	
	4	19.142(7)			N	2.044(6)	78.89(10)	O,N	92.4(1, 1.5)	
					μO	1.986(5, 1)			172.54(11)	
$[Cu(ips)Cl]_2$	tr	7.432(4)	81.87(5)	CuO_2NCl	Cl	2.209(1)	3.067(1)	Cl,O	99.32(3)	262
(dark black)	P-1	7.867(9)	84.52(4)		N	1.965(1)	103.56(4)		148.16(4)	
	2	10.740(4)	63.41(6)		μO	1.952(1, 24)	76.44(4)	Cl,N	104.31(4)	
								O,N	92.97(5)[f]	
$[Cu(2\text{-}Mebz)(hmit)]_2$	m	12.48(2)		CuO_3S	bzO	1.908(5)	3.069(3)	O,S	94.2(2, 1.3)[f]	263
(dark green)	$P2_1/c$	9.228(8)	115.07(5)		S	2.308(3)	105.5(2)		169.9(2)	
	2	14.44(1)			μO	1.928(5, 10)	74.5(2)	O,O	97.0(2)	
									170.1(2)	
$[Cu(F_3acac)(\mu\text{-}F_5pho)]_2$	tr	9.670(2)	107.09(2)	CuO_5	O	1.905(4, 3)	3.070(2)	O,O	94.8(2, 3.5)	264a
(moss green)	P-1	10.054(2)	92.15(2)			2.279(5)	103.4(1)		166.3(2, 5)	
	2	10.776(3)	112.07(2)		μO	1.928(4, 26)	76.6(1)		94.4(2)[f]	
$[Cu_2(\mu\text{-}ac)_2(pea)](ClO_4)_2$	m	8.182(4)		CuN_3O_2	N	1.998(14, 6)	3.070(2)	O,N	95.5(5, 1.4)	264b
(green)	$P2_1/m$	13.912(7)	93.20(4)			2.363(13)	105.07(2, 1)		108.5(6, 6.8)	
	2	17.245(6)			μacO	1.934(9, 0)	77.8(5)		160.3(6, 8.1)	
								N,N	90.2(6, 1.5)	
$Cu_2\{(salim)_2pr\}Cl_2$	m	11.15(2)		CuO_2N_2	N	1.955(10, 5)	3.07(1)[d]	N,N	100.3(5)[f]	265
(not given)	$P2_1/c$	8.438(8)	97.63(6)		μO	1.95(1, 1)	102.2(5, 8)	O,N	91.1(5, 1.7)[f]	
	4	18.17(2)					76.9(5, 8)		168.2(5, 1.5)	
				CuO_2Cl_2	Cl	2.178(5, 2)		Cl,Cl	106.3(2)	
					μO	1.985(0, 25)		O,Cl	107.9(4, 5.4)	
									129.4(4, 4.1)	
$[Cu(bpy)(dbcat)]_2$	or	15.731(4)		CuO_3N_2	bpyN	2.007(3, 11)	3.0742(8)	O,O	95.9(1, 8.6)	266
(purple)	Pbca	14.204(3)			O	1.909(2)		N,N	79.8(1)	
	8	19.449(3)			μO	1.908(2)	87.5(1)	O,N	96.2(1, 1)	
						2.330(2)			166.0(1, 6.8)	
$[Cu(shbr)(Me_2SO)]_2(Me_2SO)_2$	m	17.095(12)		CuO_4N	Me_2SO	2.480(11)	3.077(2)		not given	267a
(dark green)	$P2_1/n$	8.547(1)	111.72(2)		N	1.912(11)	101.6(4)			
	2	16.074(8)			shbrN	1.911(9)				
					μO	1.986(9, 16)				
$[Cu_2(C_{36}H_{39}N_6O)(OH)](PF_6)_2$	m	18.221(3)		CuN_3O_2	N	2.024(14, 18)	3.081[d]	N,N	97.0(6, 5.4)	267b
(green)	$P2_1/c$	13.323(3)	102.39(2)			2.204(15, 55)	103.5(5, 1.0)	N,O	95.2(6, 6.4)	
	4	18.643(4)			μO	1.976(11, 4)	76.5(4, 2)		160.9(5, 3.8)	
					μHO	1.950(10, 12)				

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(C_{36}H_{39}N_6O)(OH)](PF_6)_2$	m	18.221(3)		CuN_3O_2	N	2.024(16, 52)	3.082(1)	O,N	95.2(6, 6.4)[f]	268
(green)	$P2_1/c$	13.323(3)	102.39(2)			2.204(15, 55)	103.5(5, 1.0)		160.9(5, 3.8)	
	4	18.643(4)			μO	1.976(11, 4)	76.5(4, 2)	N,N	97.1(6, 5.3)[f]	
					μHO	1.950(10, 12)				
$[Cu(paapr)]_2$	m	11.274(6)		CuO_3N	N	1.930(3)	3.083(1)	O,O	93.4(1)[f]	260
(deep green)	$P2_1/c$	6.249(1)	94.47(3)		O	1.877(2)	105.2(1)		167.6(1)	
	2	19.237(3)			μO	1.941(2)	74.83(9)	O,N	96.0(1, 6)	
									170.0(1)	
$[Cu_2(ump)(MeOH)_2]\cdot$	m	8.6516(7)		CuO_3N_2	MeOH	2.413(4)	3.088(1)	O,N	91.47(17, 5.7)[f]	269
$(ClO_4)_2$	$P2_1/n$	11.6832(9)	92.596(5)		N	1.990(4, 1)	103.88(12)		166.79(15, 1.0)	
(brown)	2	16.7205(6)			μO	1.961(3, 2)	76.12(10)	N,N	99.58(16)[f]	
								O,O	95.8(13, 3.3)	
$[Cu_2(C_{24}H_{28}N_4O_4)(MeOH)$-	m	12.139(6)		CuO_3N_2	O_3ClO	2.440(9)	3.089(2)	N,N	98.3(4)[f]	270
$(CLO_4)](ClO_4)$	$P2_1/c$	17.051(4)	93.51(2)		N	1.950(9, 1)	103.8(1)	O,N	93.0(3, 1)[f]	
(green)	4	14.457(3)			μO	1.958(7, 12)	75.8(3, 0)		168.3(4, 4)	
				CuO_3N_2	MeHO	2.311(9)		N,N	95.5(4)[f]	
					N	1.938(9, 9)		O,N	94.8(4, 6)[f]	
					μO	1.958(7, 2)			165.9(4, 3.8)	
$[Cu(F_6pdhb)]_2$	m	8.918(3)		CuO_4N	N	2.011(3)	3.089(1)	O,O	89.4(1, 7.8)[f]	240
(not given)	$P2_1/c$	12.776(3)	103.57(2)		O	2.037(4, 99)	101.3(1)		171.8(1)	
	2	16.674(4)			μO	1.904(3)	78.7(1)	O,N	94.0(1, 3.5)[f]	
						2.098(3)			135.4(2, 7)	
$[Cu_2(upm)(H_2O)_2(ClO_4)_2]\cdot$	m	14.7242(5)	105.681(3)	CuO_3N_2	H_2O	2.451(6)	3.096(3)	O,N	94.1(3, 3.7)[f]	271
$[Cu_2(upm)(H_2O)_2](ClO_4)_2$	$P2_1/a$	12.3816(3)			N	1.965(9, 22)	103.6(3)		168.7(3, 6)	
(green)	4	16.5571(6)			μO	1.970(6, 0)	76.4(3)	O,O	89.2(24, 2.86)	
								N,N	96.8(4)[f]	
				CuO_4N_2	H_2O	2.451(9)	3.091(3)	O,N	92.2(4, 3.6)[f]	
					O_3ClO	2.589(10)	102.3(3)		170.1(3, 2)	
					N	1.957(8, 1)	77.7(3)	O,O	88.2(4, 7.0)	
					μO	1.985(6, 4)			168.9(4)	
								N,N	97.2(4)[f]	

$Cu_2(C_{15}H_{10}N_2O_4)_2$	m	10.988(5)		CuO_3N	N	2.04(2)	3.1	O,O	95.4(9)	272
(not given)	$P2_1/c$	5.444(5)	96.49(5)		O	1.93(2)	106.1(10)		168.8(8)	
	2	17.455(7)			μO	1.90(2, 2)	73.9(10)			
$[Cu_2(upm)I_2]\cdot H_2O$	m	8.2826(8)	99.107(14)	CuO_2N_2I	I	3.0264(15)	3.104(2)	I,O	93.83(19, 1.56)	273
(brown)	$P2_1/a$	16.7383(8)			N	1.962(8, 6)	not given	I,N	96.28(24, 14)	
	4	9.6470(12)			μO	1.975(6, 1)	76.34(24)	O,N	92.6(3, 1)[f]	
									165.4(3, 2.1)	
								N,N	96.8(3)[f]	
$[Cu_2(Qpy2)(OH)](BPh_4)_2\cdot$	tr	13.089(4)	101.13(2)	CuN_3O_2	N	2.026(9, 39)	3.108	N,N	96.4(4, 3.1)[f]	274
Me_2CO	P-1	15.146(3)	96.46(2)		N	2.222(9, 3)	104.7(3, 4)	N,O	95.9(3, 6.1)[f]	
(not given)	2	21.971(5)	103.35(2)		μO	1.969(7, 16)	75.4(3, 4)		160.9(3, 1.6)	
					μHO	1.959(7, 1)				
$[Cu_2(ump)](tcnq)$	tr	11.592(2)	90.45(3)	CuO_2N_2	N	1.957(4, 11)	3.110(2)	O,N	94.1(2, 3.0)[f]	275
(violet black)	P-1	14.232(3)	98.52(1)			2.378(5)	104.2(2)		166.2(2, 4)	
	1	6.971(3)	112.84(2)		μO	1.971(3, 6)	75.8(2)	N,N	94.9(2, 2.7)[f]	
$Cu_2(ebs)Cl_2$	m	9.791(6)		CuO_2N_2	N	1.91(1, 1)	3.11(1)[d]	N,N	85.8(5)[c]	265
(not given)	$P2_1/n$	16.781(6)	100.80(1)		μO	1.905(10, 15)	100.5(5, 5.2)	O,N	94.8(5, 9)[f]	
	4	10.536(5)					79.0(5, 6.8)		175.0(5, 6)	
				CuO_2Cl_2	Cl	2.264(5, 24)		Cl,Cl	93.0(2)	
					μO	1.98(1)		O,Cl	102.5(3, 9.5)	
						2.30(1)			174.3(3)	
$[Cu(F_6mobzim)]_2$	m	12.142(3)		CuO_4N	N	1.963(1)	3.119(1)	O,O	91.8(6, 7.2)[f]	240
(not given)	$P2_1/c$	16.104(6)	94.88(1)		O	1.983(1, 25)	95.43(5)		174.14(5)	
	2	8.835(1)			μO	1.908(1)	84.57(5)	O,N	94.4(6, 4.9)[f]	
						2.298(1)			167.42(6)	
$[Cu_2(tpydax)(MeO)](PF_6)_2$	m	13.481(2)		CuN_3O_2	N	2.050(8, 45)	3.121(3)	N,N	93.2(3, 1.7)[f]	276
(not given)	$C2/c$	14.530(2)	99.81(1)			2.218(8)	not given	N,O	98.2(3, 5.1)[f]	
	4	22.393(3)			μO	1.964(5)	74.1(3)		162.9(3, 5.9)	
					μMeO	1.946(5)				
$[Cu_2(H\text{-}apenol)(apenol)]ClO_4$	m	16.126(3)		CuO_3N_2	N	1.951(3, 36)	3.121(9)	O,O	91.7(1, 4.7)	277
(blue green)	$P2_1/c$	13.403(3)	115.69(3)		O	1.878(2)	107.2(1)	O,N	88.7(1, 8.0)	
	4	14.004(3)				2.383(3)	88.9(1)		111.0(1, 5.4)	
					μO	1.921(3, 40)	80.6(1, 78)		166.0(1, 9.0)	
						2.524(3)			81.9(1, 1.2)[c]	
									92.9(1)[f]	
								N,N	87.5(1, 6)[c]	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(ump)Br_2]\cdot 4H_2O$	m	7.9196(13)		CuO_2N_2Br	Br	2.7365(20)	3.124(2)	Br,O	98.15(5, 0)	273
(green)	C2/m	17.1380(4)	92.111(13)		N	1.972(6, 0)	103.6(3)	Br,N	94.11(20, 0)	
	2	11.2232(14)			μO	1.989(4, 0)	76.43(20)	O,N	92.04(22, 0)[f]	
									164.21(21)	
								N,N	97.0(3)[f]	
$[Cu_2(hem)(MeO)](BPh_4)_2$	tr	10.843(2)	90.14(2)	CuN_3O_2	N	2.031(26, 37)	3.128(10)	O,N	95.2(9, 5.1)[f]	278
(green)	P-1	15.045(3)	100.29(2)			2.231(29, 20)	105.6(9, 1.7)		104.9(10)	
	2	23.170(4)	96.27(2)		μO	1.986(19, 34)	74.4(8, 5)		162.0(10, 7.5)	
					μMeO	1.943(21, 10)		N,N	96.2(11, 3.0)[f]	
$[Cu_2(prahmft)Cl_2]\cdot 6H_2O$	m	7.720(1)		CuO_2N_2Cl	Cl	2.582(2)	3.133(1)	N,N	96.3(2)[f]	279
(green)	C2/m	17.079(1)	91.50(1)		N	1.978(3)	104.5(1)	N,O	92.8(1)[f]	
	2	11.171(1)			μO	1.981(2)	75.5(1)	Cl,N	93.7(1)	
								Cl,O	99.1(1)	
$[Cu(F_6phobzim)]_2$	tr	9.066(1)	99.64(3)	CuO_4N	N	1.968(1)	3.147(1)	O,O	91.2(1, 5.7)[f]	240
(not given)	P-1	10.583(3)	114.33(3)		O	1.968(1, 23)	93.74(5)		174.70(5)	
	1	10.710(6)	94.58(2)		μO	1.896(1)	86.26(5)	O,N	94.17(6, 4.4)[f]	
						2.391(1)			169.16(6)	
$[Cu(F_6clobzim)]_2$	tr	9.044(3)	95.46(2)	CuO_4N	N	1.986(1)	3.143(1)	O,O	89.1(3, 3.9)[f]	240
(not given)	P-1	9.300(3)	117.51(2)		O	1.977(1, 24)	94.14(3)		174.70(3)	
	1	13.432(4)	108.14(2)		μO	1.901(1)	85.86(3)	O,N	92.6(4, 6)[f]	
						2.368(1)			106.03(4)	
									165.06(4)	
$[Cu(N\text{-}mhbi)(F_6pdhb)]_2$	m	23.414(2)		CuO_4N	O	1.969(4, 113)	3.181	O,O	89.6(1)[f]	280
(green)	C2/c	7.727(1)	91.33(1)			2.450(4)	93.2(1)		89.4(1, 3.5)	
	4	16.430(1)			N	1.959(4)	86.8(1)		175.2(1)	
					μO	1.895(3)		O,N	94.0(2)[f]	
									96.1(2, 5.4)	
									168.1(2)	
$[Cu_2(C_{36}H_{36}N_5O)$	m	23.149(6)		CuN_3O_2	N	2.004(11, 65)	3.197	O,N	94.9(4, 5.0)	281
$(Cl\text{-}C_6H_4CO_3)](ClO_4)_2\cdot MeCN$	C2/c	13.327(3)	97.78(2)			2.162(9, 4)	109.1(4, 8)		108.0(4, 1.5)	
(not given)	8	32.935(5)			μO	1.954(8, 6)	71.0(3, 2)		156.9(4, 6.6)	
					μO	1.972(9, 1)		N,N	96.5(4, 3.6)[f]	

$[Cu(oxtbz)(3\text{-}Mepy)(NO_3)]_2$	tr	10.651(3)	114.23(3)	CuO_4N_2	N	1.958(3, 36)	3.208	O,O	174.2(1)	282
(green)	P-1	9.853(3)	87.36(3)		O_2NO	2.636(3)	not given	N,O	90.0(1, 7.2)	
	2	8.658(4)	80.30(3)		O	2.059(3)			82.8(1)[c]	
					μO	1.919(3)			91.7(1)[f]	
						2.476(3)		N,N	172.4(2)	
$[Cu(PhO)_2(en)]_2{\cdot}2PhOH$	m	19.000(13)		CuO_3N_2	enN	2.029(5, 4)	3.215(3)	O,O	100.1(3, 1.3)	283
(deep green)	$P2_1/n$	10.930(9)	89.20(2)		O	1.947(4)	99.9(2)	O,N	94.2(3, 6.9)	
	4	8.968(5)			μPhO	1.926(3)	80.1(3)		157.2(4)	
						2.265(4)			171.6(4)	
								N,N	83.5(3)[c]	
$[Cu(pyNO)Cl_2]_2$	m	5.844(5)		CuO_2Cl_2	Cl	2.22(–, 2)	3.23		not given	284
(green)	$P2_1/b$	10.049(5)			μO	2.05(3, 6)	104			
	4	13.643(5)	104.52(10)				76			
$[Cu(4\text{-}phpyNO)Cl_2]_2{\cdot}$	tr	10.069(8)	106.16(5)	CuO_3Cl_2	Cl	2.217(2, 28)	3.285(1)	Cl,Cl	99.3(1)	285
$[Cu(4\text{-}pyNO)(H_2O)Cl_2]_2$	P-1	12.857(5)	99.75(5)		H_2O	2.356(7)	109.6(2)	Cl,O	95.9(2, 3.0)	
(green)	2	10.143(5)	97.3(5)		μ-O	2.010(6, 30)	70.4(2)		162.8(7, 3)	
								O,O	91.0(3, 1)	
				CuO_2Cl_2	Cl	2.198(2, 14)	3.236(1)	Cl,Cl	101.9(1, 4.5)	
					μO	1.982(2, 4)	109.6(2)	Cl,O	79.2(2, 2.8)	
							70.4(2)		95.6(2, 4)	
									164.1(6, 2.4)	
$[Cu(pyNO)Br_2]_2$	m	10.977(5)		CuO_2Br_2	Br	2.333(2, 1)	3.244(2)	Br,Br	99.2(1, 1.4)	286
(dark brown)	$P2_1/c$	10.007(5)	110.30(10)		μO	1.980(9, 15)	110.1(4)	O,Br	89.4(3, 7.1)	
	2	7.88(1)					69.9(3)			
$[Cu(pyNO)Cl_2]_2$	m	5.844(5)		CuO_2Cl_2	Cl	2.212(5, 6)	3.245(4)	Cl,Cl	99.4(3)	287
(green)	$P2_1/b$	10.049(5)			μO	2.008(11, 29)	107.8(6)	Cl,O	96.0(6, 1.6)	
	4	13.643(5)	104.52(10)				72.2(10)			
$[Cu(F_3sbmobzim)]_2$	tr	7.978(2)	117.89(2)	CuO_4N	N	1.990(1)	3.248(1)	O,O	90.2(4, 5.59)[f]	240
(not given)	P-1	10.031(1)	100.46(2)			1.958(1, 13)	96.14(4)		171.28(4)	
	1	12.399(3)	92.65(2)		μO	1.902(1)	83.86(4)	O,N	93.2(1, 1)[f]	
						2.437(1)			109.21(4)	
									154.98(4)	
$[Cu(4\text{-}MepyNO)Br_2]_2$	m	6.086(1)		CuO_2Br_2	Br	2.342(1, 5)	3.252(1)	Br,Br	98.4(1, 11.7)	288
(dark brown)	$P2_1/c$	15.064(3)	106.14(1)		μO	1.995(3, 12)	109.2(2)	O,Br	89.5(1, 5.0)	
	4	10.469(2)	70.8(2)				70.8(2)		165.4(1)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(C_{21}H_{23}N_3)(OH)]_2(PF_6)_2 \cdot 2H_2O$	tr	9.426(4)	74.78(2)	CuN_3O_2	N	2.028(7, 35)	3.271	N,N	91.0(2, 1.4)[f]	289
	P-1	11.415(2)	88.72(2)		μHO	1.931(3)	101.0(2)		168.0(2)	
(blue)	1	11.586(3)	74.14(2)			2.298(4)	79.0(2)	O,N	89.0(2, 9)	
									103.7(2, 2.8)	
									174.4(2)	
$[Cu(pyNO)(H_2O)Cl_2]_2$	tr	7.976(2)	81.02(2)	CuO_3Cl_2	Cl	2.218(1, 3)	3.272(1)	O,Cl	96.4(1, 3.1)	290
(green)	P-1	9.469(3)	96.38(2)		H_2O	2.336(3)	109.4(1)	Cl,Cl	97.33(3)	
	1	5.906(1)	98.77(3)		μO	2.005(2, 10)	70.6(1)	O,O	93.8(1, 6)	
$[Cu(pyNO)(H_2O)Cl_2]_2$	tr	5.912(2)	81.25(3)	CuO_3Cl_2	Cl	2.217(1, 4)	3.272(1)	Cl,O	96.7(1, 2.8)	291
(dopped with Mn(II))	P-1	7.973(3)	81.06(3)		H_2O	2.342(4)	110.3(2)		161.2(1, 1)	
(not given)	1	9.462(3)	83.66(2)		μO	1.993(4, 14)	69.7(2)	Cl,Cl	97.44(5)	
								O,O	93.6(2, 4)	
$[Cu(pyNO)(H_2O)Cl_2]_2$	m	9.899(2)		CuO_3Cl_2	Cl	2.221(14, 2)	3.288(15)	O,O	92.9(14, 48)	292
(green)	$P2_1/c$	10.028(1)	117.20(1)		H_2O	2.267(8)	109.6(1.5)	Cl,O	95.1(20, 19)	
	2	10.006(2)			μO	2.012(33, 2)	70.4(1.2,)		101.7(14)	
									160.1(19, 5.4)	
$[Cu(salpa)Cl]_2$	m	8.56(1)		CuO_3NCl	Cl	2.115(6)	3.294(7)	Cl,O	104.4(4, 5.8)	293a
(brown)	$P2_1/c$	12.35(2)	18.43(3)		N	2.18(2)	110.3(6)		126.2(5)	
	2	10.31(2)			O	2.24(2)	69.7(6)	Cl,N	92.5(5)	
					μO	1.78(1)		O,O	76.0(6)	
						2.22(1)			99.6(6)[f]	
									123.4(7)	
								O,N	104.0(6)	
									168.9(6)	
$[Cu(salphala)Cl]_2$	m	22.053(6)		CuO_4N	O	1.96(2, 3)	3.30(1)	O,N	84.9(9)[e]	293b
(brown)	C2	12.715(3)	89.98(2)		N	1.91(2, 0)	not given		94.4(9)	
	12	16.476(3)			μH_2O	1.97(2, 1)	not given		107.8(8)	
									158.2(8)	
								O,O	89.1(8, 4.1)	
									177.3(9, 9)	

$[Cu(ae)(ac)]_2$	tr	8.1362(8)	92.42(1)	CuO_3N_2	aeN	1.975(2, 37)	3.305	O,N	93.53(6, 10.12)	294
(blue)	P-1	9.9886(8)	96.48(1)		aeO	1.925(1)	95.34(5)		172.70(5, 1.62)	
	1	7.345(11)	69.76(1)		μacO	1.955(1)	84.66(5)		94.58(6)[f]	
						2.490(1)		O,O	87.59(6, 2.93)	
								N,N	85.67(6)[c]	
$[Cu(pyNO)_2Cl_2]_2$	m	6.900(4)		CuO_3Cl_2	Cl	2.187(1)	3.306(1)	O,Cl	94.1(1, 1)	295
(yellow)	$P2_1/c$	15.065(7)	97.00(4)		H_2O	2.225(1, 1)	110.0(1)	Cl,Cl	97.0(1)	
	4	12.065(5)			μO	2.018(1, 21)	70.0(1)	O,O	87.3(1)	
$[Cu(Hfpts)(\mu\text{-}OSO_3)]_2$	m	14.75(3)		CuO_2N_2S	N	1.989(2, 36)	3.310(1)[d]	N,N	80.24(8)[c]	296
(blue green)	C2/c	9.138(2)	104.9(2)		S	2.279(1)	102.70(7)	S,N	85.09(6)[c]	
	4	17.468(4)			μO	1.923(2)	77.30(8)		160.07(7)	
						2.305(2)		O,N	93.73(11, 1.54)	
									101.43(8)	
									175.31(11)	
								O,S	101.77(10, 2.18)	
$[Cu(tgly)_2(bpy)]_2 \cdot 2H_2O$	tr	15.799(2)	87.88(1)	CuO_3N_2	N	1.997(3, 5)	3.317(1)	N,N	80.9(1)c	297
(blue)	P-1	10.337(2)	102.01(1)		O	1.933(2)	100.0(1)	N,O	96.7(1, 3.5)	
	1	9.574(2)	80.41(1)		μO	1.968(2)	80.0(1)		172.7(1, 2.0)	
						2.350(3)		O,O	87.1(1, 7.1)	
$[Cu(hip)_2(H_2O)_2]_2$	m	7.253(1)		CuO_5	H_2O	2.00(1, 0)	3.33(1)	O,O	92.7(5, 2.3)	298
(blue green)	$P2_1/c$	40.169(3)	102.81(1)		O	1.91(1)	101.0(5)		176.4(5)	
	4	7.466(1)			μO	1.93(1)	79.0(5)			
						2.37(1)				
γ-$[Cu(N\text{-}Mesala)_2]_2$	or	18.86(2)		CuO_3N_2	O	1.89(−, 1)	3.33	N,O	90.0(−, 3.2)[f]	299
(brown)	$P2_1P2_1P2_1$	10.25(2)			N	1.96(−, 4)	100.4(−, 6)			
	8	14.64(2)			μO	1.90(−, 1)	79.6(−, 5)			
						2.45(−, 1)				
$[Cu(bpyo)_2Cl_2]_2$	m	7.912(2)		CuO_3Cl_2	Cl	2.220(1, 1)	3.333(1)	Cl,Cl	102.2(1)	300
(yellow orange)	$P2_1/c$	9.878(2)	99.86(2)		O	2.173(4)	109.2(1)	Cl,O	97.3(1, 5.2)	
	2	15.086(3)			μO	2.045(3, 17)	70.8(1)		158.6(1, 3.9)	
								O,O	90.9(1, 18)[h]	
$[Cu(pyNO)_2Br_2]_2$[e]	tr	10.510(2)	78.57(3)	CuO_3Br_2	O	1.944(4)	3.336(1)	Br,Br	118.60(4)	301
(not given)	P-1	10.883(1)	89.88(3)		Br	2.454(1, 53)	107.4	Br,O	96.01(14, 1.42)	
	2	11.818(5)	81.17(1)		μO	1.975(4)	72.60(16)		106.03(11)	
						2.162(4)			134.61(11)	
								O,O	84.34(18)	
									156.33(19)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
				CuO_3Br_2	O	1.949(4)	3.415(1)	Br,Br	134.65(4)	
					Br	2.427(1, 27)	108	Br,O	93.19(15, 4.40)	
					μO	1.976(4)	71.99(15)		112.30(12, 5.72)	
						2.240(4)		O,O	90.93(17)	
									162.48(17)	
$[Cu(pyNO)(Me_2SO)Cl_2]_2$	m	7.17(1)		CuO_3Cl_2	Me_2SO	2.279(6)	3.342(3)	O,O	91.0(3, 1.3)	302
(light green)	$P2_1/c$	15.444(7)	104.8(1)		Cl	2.252(4, 9)	109.2(3)	O,Cl	94.3(2, 4)	
	4	11.183(4)			μO	2.050(7)	70.8(2		101.9(2, 5)	
									160.6(2, 1.0)	
								Cl,Cl	97.1(1)	
$[Cu(dpyam)(salal)(ClO_4)]_2$	tr	9.363(2)	75.39(2)	CuO_4N_2	N	2.006(3, 1)	3.343(1)[d]	O,O	87.97(8)[f]	303
(dark green)	P-1	9.964(3)	73.49(4)		O_3ClO	2.642(3)	99.2(1)	O,N	90.64(9, 1)	
	2	10.093(2)	83.34(3)		O	1.974(2)	80.78(9)		171.55(9, 1.31)	
					μO	1.932(2)		N,N	91.9(1)[f]	
						2.436(2)				
$[Cu(4\text{-}MepyNO)_2Cl_2]_2$	m	7.368(10)		CuO_2Cl_2	O	1.925(5)	3.348(2)	Cl,Cl	119.8(1)	304
(yellow)	$P2_1/n$	19.857(5)	111.25(10)		Cl	2.306(3, 48)	109.0(2)	Cl,O	96.4(2, 1.3)	
	2	10.773(5)			μO	1.925(5)	71.0(2)		103.0(2)	
						2.153(6)			136.3(3)	
								O,O	85.0(2)	
									109.0(2)	
									154.1(5)	
$[Cu(dtbsq)_2]_2$	tr	10.262(3)	101.09(2)	CuO_5	O	1.938(4, 20)	3.360(2)[d]	O,O	91.4(2, 7.5)	305
(dark green)	P-1	14.554(4)	92.31(2)		μO	1.944(4)	100.3(2)		84.6(2, 3)[e]	
	2	9.418(2)	108.87(2)			2.416(4)	79.7(2)		119.7(2)	
									151.8(2)	
									177.1(2)	
$[Cu(salal)(phen)(ClO_4)]_2$	tr	9.139(4)	96.27(2)	CuO_4N_2	O_3ClO	2.496(3)	3.369(1)	O,O	89.7(9, 8.2)	306a
(green)	P-1	9.290(3)	111.07(2)		N	1.994(3, 1)	95.00(8)		175.06(8)	
	2	11.679(5)	97.00(2)		μO	1.921(2, 21)	93.5(1)	O,N	91.0(9, 4.1)	
									173.5(1, 4)	
								N,N	82.3(1)[e]	

$[Cu(Mesprp)(ac)]_2$	tr	8.247(3)	108.88(2)	CuO_3N_2	N	2.005(4, 40)	3.379(2)	N,N	94.2(2)[c]	306b
(not given)	P-1	9.173(2)	111.20(3)		O	1.918(3)	not given	O,N	88.0(2, 5.5)	
	1	10.239(3)	76.49(3)		acO	2.828(6)	not given		103.5(2)	
					μacO	1.978(3)			171.1(2, 2.4)	
						2.512(5)		O,O	51.1(2)[i]	
									86.5(2, 1)	
$[Cu(N\text{-}chsalim)_2]_2$	m	23.134(6)		CuO_3N_2	O	1.90(1, 1)	3.383(3)	O,N	91.5(6, 2.2)[f]	307
(green)	$P2_1/n$	9.525(3)	99.42(1)		N	2.03(1, 1)	95.4(5, 9)		114.1(5, 3.5)	
	8	21.472(8)			μO	1.91(1, 1)	80.1(4, 4)	O,O	85.7(8, 1.2)	
									164.9(5, 1.7)	
								N,N	154.8(6, 2.7)	
$[Cu(mesalpr)(\mu\text{-}ac)]_2 \cdot 2H_2O$	m	17.755(3)		CuO_3N_2	O	1.895(8)	3.384(3)	O,N	84.(3, 1.8)[f]	308
(green)	C2/c	9.208(3)	105.26(2)		N	1.993(10, 30)	98.1(3)		100.0(3, 6.7)	
	4	20.393(3)			μacO	1.960(8)	81.9(3)	O,O	88.1(3, 6)	
						2.498(8)		N,N	93.6(3)[f]	
$[Cu(C_{12}H_{10}NO)_2]_2 \cdot 2H_2O$	m	10.5250(6)		CuO_2N_2	N	1.971(5)	3.388(1)[d]	O,N	92.9(2, 3.2)[f]	309
(brown)	$P2_1/c$	14.740(11)	104.80(2)		μO	1.917(4)	96.01(17)	O,O	97.2(2)	
	4	12.605(19)				2.600(4)	84.0(2)		178.1(2)	
								N,N	171.2(2)	
$[Cu(C_{12}H_{10}NO)_2]_2$	m	10.5250(6)		CuO_3N	O	1.917(4)	3.3878(9)	O,N	91.5(2, 4.7)[f]	310
(brown)	$P2_1/c$	14.740(11)	104.80(2)		N	1.971(4)	96.0(2)	O,O	97.2(2)	
	4	12.605(19)			μO	2.600(4)	84.0(1)		178.1(2)	
								N,N	171.2(2)	
$[Cu(F_6pd)(bzacac)]_2$	m	12.289		CuO_5	F_6acacO	1.948(3, 3)	3.39	O,O	92.5(1, 1.5)[f]	310
(green)	$P2_1/c$	8.571	108.21		bzacacO	1.887(3)	not given			
	4	16.645			μbzaacaO	1.903(3)	93.9(1)			
						2.56				
$[Cu(mnsalpr)(ac)]_2$	tr	9.305(3)	94.94(2)	CuO_4N_2	prO	1.933(2)	3.409(1)	O,O	54.9(1)[i]	311
(green)	P-1	9.209(3)	94.92(2)		N	1.988(3, 41)	96.1		90.0(1, 2.0)	
	1	8.993(3)	92.78(2)		acO	2.630(3)	83.9(1)		138.8(1)	
					μacO	1.976(2)		O,N	85.1(1, 4.3)	
						2.577(2)			96.0(1, 2.9)	
									92.9(2)[f]	
									110.6(1, 1.9)	
									165.9(1, 1.4)	
								N,N	98.3(2,)[f]	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(npsalim)]_2 \cdot 2dio$	tr	12.402(3)	101.10(1)	CuO_3N_2	O	1.881	3.41	O,N	92.5(2, 6.3)[f]	312
(not given)	P-1	10.187(2)	87.76(2)		N	2.049(7, 2)	97.7	N,N	166.0(3)	
	2	11.617(2)	106.97(1)		μO	1.910(7)	82.3(2)	O,O	94.1(2)	
						2.58			176.4(3)	
$[Cu(thp)_5]_2 \cdot (ClO_4)_2$	tr	11.709(8)	62.98(7)	CuO_6	O	1.947(9, 13)	3.417(3)	O,O	91.1(3, 5.5)	313
(not given)	P-1	12.750(12)	67.90(6)			2.372(6)	100.9(3)		175.3(3, 1.3)	
	2	12.891(11)	71.75(7)		μO	1.971(9)	79.1(3)			
						2.436(6)				
$[Cu(salphala)(H_2O)]_2$	trg	12.724(3)		CuO_4N	H_2O	1.939(16, 29)	3.422(3)	O,N	88.9(6, 6.0)	314
(not given)	$P3_12_1$				N	1.949(13)	98.0(6)		156.6(6)	
	3	16.476(3)			μO	1.966(16)	not given	O,O	90.7(6, 4.7)	
						2.541(15)			176.7(5)	
$[Cu(pyames)(H_2O)]_2Cl_2$	tr	7.139(1)	107.07(3)	CuO_3N_2	H_2O	1.974(6)	3.426(2)	N,N	83.3(3)[e]	315a
(green)	P-1	8.586(2)	90.14(3)		N	1.980(7, 20)	not given	N,O	98.4(2, 8.9)	
	1	10.072(2)	102.94(3)		μO	1.967(5)	75.4(2)		165.6(3, 6.6)	
						2.353(5)		O,O	92.3(2, 1.5)	
$[Cu(acachfacac)]_2$	tr	6.6958(2)	89.35(4)	CuO_5	O	1.921(6, 19)	3.43	O,O	92.7(2, 1.9)	315b
(green)	P-1	12.061(8)	114.07(2)		μO	1.896(6)	not given			
	2	8.776(2)	80.01(4)			2.704	not given			
$[Cu_2(dien)_2(OH)(ClO_4)_3]$	m	11.896(7)		CuO_3N_3	O_3ClO	2.57(1, 7)	3.435(1)	N,O	91.1(6, 6)	316
(blue violet)	$P2_1$	9.424(3)	117.97(4)		N	2.02(1, 5)	128.1(4)		101.6(6, 5)	
	2	11.468(7)			μO	1.910(7, 7)	not given	N,N	84.6(7, 2.9)[e]	
					μO_3ClO	2.62(2, 10)				
β-$[Cu(8\text{-}OHqu)_2]$	m	10.644(4)		CuO_3N_2	N	1.973(9, 1)	3.441	O,N	90.0(6, 5.8)	317
(brown)	$P2_1/c$	8.593(3)	102.18		O	1.925(9)	not given		84.5(6)[e]	
	4	15.239(4)			μO	1.935(9)	not given	O,O	179.3(6)	
						2.830(9)		N,N	173.3(6)	
$[Cu(pht)(bpy)]_2 \cdot 4H_2O$	m	15.685(11)		CuO_3N_2	bpyN	1.995(4, 9)	3.442(2)	N,N	81.3(2)[e]	318
(dark blue)	$P2_1/n$	12.900(9)	100.45(3)		O	1.898(4)	not given	O,O	94.8(1)	
	4	8.825(3)			μO	1.948(3)	76.4(1)	O,N	89.7(1)	
						2.416(3)			105.0(1)	

$[Cu(C_7H_7N_4S)(\mu\text{-ac})]_2$	tr	8.834(1)	117.48(1)	CuO_2N_2S	N	2.011(2, 65)	3.442(3)	O,S	99.2(1, 3)	319
(black)	P-1	8.989(1)	91.77(1)		S	2.268(1)	not given	N,S	83.2(1)[c]	
	1	8.801(1)	110.94(1)		μacO	1.946(2)	76.5(1)		162.5(1)	
						2.422(2)		N,O	94.3(1, 2.5)	
									174.5(1)	
								N,N	80.5(1)[c]	
$[Cu(mhsalim)(\mu\text{-ac})]_2 \cdot H_2O \cdot$	m	10.587(3)		CuO_4N	N	1.937(2, 0)	3.445(1)	O,O	90.2(1, 2.8)	320
EtOH	$P2_1/n$	16.972(8)	97.37(2)		O	2.002(1, 4)	99.2(1, 3.5)		175.2(2, 1.7)	
(green)	4	18.432(6)				2.615(2, 169)	81.8(1)	O,N	94.9(1, 4)[f]	
					μacO	1.929(1, 41)			83.1(1, 2)[c]	
									107.3(1)	
									169.6(1)	
$[Cu(2\text{-bae})Br]_2$	or	21.16(2)		CuO_2NBr	Br	2.38	3.450(2)	Br,O	98	321
(olive green)	$P2_1P2_1P2_1$	15.15(2)			N	2.06	105	N,O	86[c]	
	4	8.40(1)			μO	1.89(−, 8)	75			
$[Cu(fpts)(\mu\text{-ac})]_2$	tr	8.827(3)	117.49(2)	CuO_2N_2S	N	2.015(2, 45)	3.450(1)[d]	N,N	80.60(8)[c]	296
(dark green)	P-1	8.813(3)	110.96(3)		S	2.274(1)	103.5	S,N	83.20(7)[c]	
	1	8.997(3)	91.65(3)		μO	1.951(2)	76.53(8)		162.60(7)	
						2.427(2)		O,N	91.61(7)	
									174.50(9)	
								O,S	99.2(6, 3)	
$[Cu(bpy)(salal)(ClO_4)]_2$	tr	8.513(5)	77.93(5)	CuO_4N_2	bpyN	1.982(3, 1)	3.454(2)[d]	O,O	88.1(6, 6.5)[f]	322
(green)	P-1	9.453(8)	69.71(6)		O_3ClO	2.555(4)	96.08(1)	O,N	94.1(1, 2.9)	
	2	11.826(6)	83.10(4)		O	1.948(3)	83.92(1)		173.4(1, 7)	
					μO	1.897(2)		N,N	81.8(1)[c]	
$[Cu(pyNO)_2(NO_3)_2]_2$	m	11.820(5)		CuO_5	O_2NO	1.967(5, 1)	3.458(5)	O,O	91.3(−, 6.1)	323a
(green)	$P2_1/n$	14.862(1)	95.50(2)		pyNO	1.951(5)	102.9			
	4	8.005(5)			μO	1.968(5)	77.1			
						2.439(6)				
$[Cu(mal)(Meen)(H_2O)]_2$	tr	9.607(8)	102.86(6)	CuO_3N_2	enN	2.019(7, 7)	3.4647(7, 7)	N,N	85.2(3)[c]	323b
(not given)	P-1	9.016(6)	79.09(7)		H_2O	2.513(7)	not given	O,O	95.4(2, 4.6)	
	2	5.785(5)	79.46(7)		μmalO	1.940(6)	not given	N,O	89.6(6, 4.1)	
						2.681(6)				
$[Cu(bpy)(Ph_3mgly)_2]_2$	tr	10.098(1)	93.11(3)	CuO_3N_2	bpyN	2.031(4, 0)	3.470(1)	N,N	79.9(2)[c]	324
(blue)	P-1	12.573(11)	102.70(1)		O	1.922(3)	103.7(1)	N,O	98.7(2, 10.7)	
	1	16.979(3)	99.99(2)		μO	1.975(3)	76.3(1)		172.2(2, 6)	
						2.423(3)		O,O	90.3(2, 17)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(plamph)]_2 \cdot H_2O$	m	16.75(1)		CuO_4N	N	1.962(2)	3.488(2)	N,O	90.1(2, 2.7)[c]	325
(not given)	C2/c	9.46(1)	92.0(1)		O	1.936(3, 8)	not given	O,O	91.8(2, 4.7)	
	8	15.03(1)			*μ*O	1.894(3)	81.0(2)		106.7(2)	
						2.663(3)				
$[Cu(glyhgly)]_2 \cdot 12H_2O$	tg	14.41(1)		CuN_3O_2	N	2.01(−, 4)	3.50		not given	326
(blue violet)	$P4_12_12$				*μ*O	2.27(−, 27)	not given			
	8	26.50(3)					not given			
$[Cu(tsval)_2(bpy)]_2$[e]	tr	16.864(4)	75.6(1)	CuO_3N_2	bpyN	2.006(9, 39)	3.501	N,N	81.4(5)[c]	327
(deep blue)	P-1	16.075(4)	73.4(1)		O	1.899(7)	103.7	N,O	92.1(5, 8)	
	2	13.783(3)	85.5(1)		*μ*O	1.983(6)	76.3		106.3(4)	
						2.452(8)			173.3(7, 1.7)	
								O,O	93.0(5, 4)	
				CuO_3N_2	N	2.023(9, 7)	7.226(5)	N,N	81.3(5)[c]	
					O	1.960(8, 39)	not given	N,O	92.5(5, 6.3)	
						2.410(11)			172.5(5)	
								O,O	90.6(5, 4.4)	
$[Cu(mbrsalpr)(ac)]_2$	m	14.519(2)		CuO_4N_2	mbrsalprO	1.918(4)	3.506(1)	O,O	55.6(2)[i]	311
(green)	$P2_1/a$	10.859(2)	93.35(2)		N	2.006(6, 29)	96.3		84.8(2, 2.3)	
	2	9.547(3)			ac	2.604(6)	83.7(2)	O,N	83.1(2, 5.0)	
					*μ*acO	2.003(4)			97.9(2, 5.5)	
						2.665(4)			93.1(1)[f]	
									128.3(2, 11.0)	
									168.1(2, 3.3)	
								N,N	98.3(2)[f]	
$[Cu(apha)(\mu\text{-ac})]_2 \cdot 0.6H_2O$	m	9.380(3)		CuO_3N_2	N	1.981(14, 67)	3.507(3)	N,N	84.6(5, 5)[c]	328
(blue green)	$P2_1$	18.570(9)	93.99(5)		O	1.930(10, 3)	102.2(4, 9)	O,N	91.5(5, 2.5)	
	4	9.725(8)			*μ*acO	1.977(10, 4)	77.9(4, 8)		93.3(5, 8)[f]	
						2.513(10, 28)			105.8(4, 6)	
									175.6(5, 1.6)	
								O,O	91.4(4, 2.2)	
$[Cu(C_{12}H_{14}NO_2)_2]_2$	m	11.725(2)		CuO_3N_2	N	1.945(11, 5)	3.509[d]	O,N	90.2(4, 1.0)[f]	329
(green)	$P2_1$	17.404(1)	109.03(2)		O	1.911(7)	95.6(−, 1)	N,N	169.5(5)	
	2	12.062(3)			*μ*O	1.868(−, 6)	81.5(−, 9)			
						2.783(−, 21)				

$[Cu(4\text{-}MeOpyNO)_2(NO_3)_2]_2$	tr	11.466(8)	111.3(5)	CuO_5	O_2NO	1.980(7, 3)	3.529(1)	O,O	95(−, 3)	330
(not given)	P-1	10.610(8)	78.3(5)		MeOpyNO	1.930(6)	not given		86(−, 4)	
	1	7.683(9)	98.9(4)		μO	1.930(6, 0)	78			
$[Cu(pypep)(\mu\text{-}ac)]_2 \cdot 1.46H_2O$	m	17.36(2)		CuN_3O_2	N	1.991(5, 33)	3.542(2)	O,N	94.2(2, 5.3)	331
(dark blue)	C2/c	14.20(4)	112.61(1)		O	2.817(4)	not given		107.1(2)	
	4	13.418(3)			μO	1.987(4)	66.0(2)		175.1(2)	
						2.497(4)		N,N	81.9(2)[e]	
									91.4(2)[f]	
									168.7(2)	
$[Cu(mal)(1, 3\text{-}pn)]_2$	tr	6.377(2)	98.36(5)	CuO_3N_2	pnN	1.998(8, 29)	3.546(2)	N,N	92.9(3)[f]	332
(blue)	P-1	8.706(3)	77.31(4)		O	1.994(7)	103.1(3)	N,O	88.6(4, 3.5)	
	2	9.387(5)	117.89(3)		μmalO	1.988(7)	76.9(3)	O,O	89.2(3)[f]	
									106.9(3, 4)	
$[Cu(fpts)(\mu\text{-}F_3ac)_2]_2 \cdot 2F_3acH$	tr	9.6015(7)	100.71(1)	CuO_2N_2S	fptsN	1.995(3, 42)	3.557(4)	N,N	80.2(1)[e]	333
(green black)	P-1	10.837(1)	117.06(1)		fptsS	2.273(1)	104.8(1)	N,S	84.3(1)[e]	
	1	8.811(2)	80.877(7)		μF_3acO	1.955(2)	75.2(1)		163.9(1)	
						2.519(4)		N,O	94.3(1, 2.4)	
									111.0(1)	
									172.9(1)	
								S,O	98.0(1, 4)	
$[Cu\{HB(3, 5\text{-}i\text{-}Pr_2pz)_3\}_2(\mu\text{-}O_2)] \cdot 6CH_2Cl_2$	m	26.36(2)		CuN_3O_2	N	1.997(14, 4)	3.560(3)	O,N	111.1(4, 3.9)	169
	C2/c	13.290(4)	114.59(6)			2.258(8)	not given		149.6(4, 8)	
(purple)	4	29.29(2)			μO	1.915(11, 12)	43.3(4)	N,N	89.5(4, 3.2)[f]	
$[Cu(4\text{-}pyx)(bpy)(ClO_4)]_2$	m	9.782(3)		CuO_4N_2	bpyN	1.990(6, 5)	3.593(1)	O,O	91.7(2, 3.7)[f]	334
(blue green)	$P2_1/c$	14.440(4)	103.58(2)		O_3ClO	2.528(6)	not given	O,N	90.7(2, 6.5)	
	4	14.541(3)			O	1.910(3)	87.2(2)		174.4(2, 1.1)	
					μO	1.893(4)		N,N	81.6(2)[e]	
						2.964(5)				
$[Cu(C_{11}H_{13}NO_2)]_2$	m	20.700(9)		CuO_3N	N	1.979(8, 11)	3.6	O,O	91.3(3)	272
(black)	C2/c	9.555(6)	92.49(4)		O	1.922(7, 51)	104.3(3, 3)		166.8(3)	
	8	21.64(1)			μO	1.922(8, 36)	75.7(3, 3)	O,N	98.8(3)[f]	
									172.7(3)	
$[Cu(py)_2(NO_3)_2]_2 \cdot py$	m	9.79(3)		CuO_5N_2	pyN	2.001(8, 6)	3.693(3)[d]	O,O	52.7(2, 2.7)[i]	335
(not given)	$P2_1/c$	10.89(3)	98.0(2)		ONO_2	2.035(6)	106.8(1)		90.8(3, 4.2)	
	4	16.15(3)				2.618(8)	73.2(3)		133.9(3, 10.7)	
						2.906(7)			165.3(3, 2.7)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
					μO_2NO	2.042(6)		O,N	89.9(3, 8.7)	
						2.542(8)		N,N	175.7(3)	
$[Cu(pycaro)]_2 \cdot 8H_2O$	tr	6.988(2)	63.06(2)	CuO_3N_2	O	1.918(1)	3.737(0)	N,N	87.0(1)[c]	336
(violet)	P-1	11.748(2)	81.17(1)		N	1.907(2, 1)	not given	N,O	96.0(1, 4.3)[f]	
	2	12.289(2)	73.02(2)		μO	1.913(1)	80.7(1)		177.8(2, 1.3)	
						2.916(2)		O,O	82.8(1, 2.5)	
C: $Cu(\mu\text{-}NL)_2Cu$										
$[Cu(Bu^tpy)_2(N_3)]_2(ClO_4)_2$	m	12.819(3)		CuN_4	N	2.00(1, 1)	3.042(3)	N,N	93.5(9, 1.7)	337
(dark blue)	$P2_1/c$	13.76(1)	100.00(2)		μN_3	1.98(1, 1)	100.5(6)		172(4, 1)	
	2	13.65(1)					79.5(5)			
$Na[Cu(gggly)]_2 \cdot H_2O$	m	14.328(6)		CuN_4O	O	1.933(7)	3.077(2)	N,N	76.0[c]	338
(violet)	I2/c	10.556(6)	92°58′(1′)		N	1.965(8, 74)	83.7		89.2(−, 6.8)	
	8	13.175(6)			μN	1.997(8)	94.0		110.9	
						2.568(8)			165.7	
								N,O	96.2(−, 8)[f]	
									173.2	
$(PPh_4)[Cu(N_3)_3]_2$	tr	10.474(5)	101.26(3)	CuN_4	N	1.932(2, 9)	3.128	N,N	95.1(1, 4.9)	339
(brown)	P-1	11.311(7)	109.31(3)		μN	2.003(2, 17)	102.7(1)		163.0(4, 8)	
	1	11.794(6)	103.42(3)				77.3(1)			
$[Cu(2\text{-ampy})(N_3)_2(H_2O)]_2$	tr	7.142(1)	96.52(1)	CuN_4O	N	1.982(3, 20)	3.150(1)[d]	N,N	94.0(1, 2.9)	340
(black)	P-1	7.812(1)	92.52(1)		H_2O	2.371(2)	103.11(9)		165.7(1, 3.9)	
	1	9.727(1)	113.47(1)		μN_3	2.011(3, 7)	76.9(1)	O,N	94.5(1, 10.5)	
$[Cu_2([24]\text{-ane}N_2O_6)(N_3)_4] \cdot H_2O$	m	17.780(2)		CuN_4O_2	N	2.033(2)	3.162(0)	N,N	76.4(1, 2)	341
(green)	$P2_1/n$	9.719(1)	109.32(5)		O	2.609(3, 1)	103.6(9, 1.9)		94.6(1, 3.9)	
	4	17.361(2)			N_3	1.964(2)	76.4(8, 2)		171.7(1, 1.9)	
					μN_3	2.017(2, 27)		N,O	73.1(1, 2.1)	
									91.2(1, 7.3)	
									106.7(1, 3.9)	
								O,O	146.5(1, 9)	
$Na_2[Cu(hmtam)(N_3)_3] \cdot 3H_2O$	or	8.944(3)		CuN_5	N	2.327(2)	3.175(1)	N,N	98.3(1, 1.3)	342
(dark red)	Pnnm	14.534(6)			N_3	1.979(2)	103.7(1)			
	Pnn2	12.651(5)			μN_3	2.018(1)	76.3(1)			
	2									

$[Cu(Me_2en)(NCO)_2]_2$	m	12.216(2)		CuN_5	Me_2enN	2.037(5, 48)	3.2464(9)	N,N	91.7(2, 10.5)[c]	343a
(dark blue)	$P2_1/c$	10.662(1)	96.09(3)		N_3	1.956(5, 20)	94.3(2, 1.2)		167.7(2, 8.0)	
	4	14.997(4)			μN_3	2.005(5, 23)	84.3(2, 2.1)			
						2.406(15, 60)				
$[Cu(\mu\text{-cpca})(ac)(phen)]_2 \cdot 2H_2O$	tr	8.171(5)	74.33(4)	CuN_4O	acO	1.948(5)	3.247(5)	N,N	81.2(2)[c]	343b
(green)	P-1	10.060(6)	84.79(5)		phenN	2.015(5, 1)	94.3(2)		91.3(2, 1.9)	
	1	13.377(7)	72.24(4)		cpcaN	1.950(6)	85.7(2)		172.8(2)	
						2.454(6)		N,O	93.7(2, 1.3)	
									172.1(2)	
$[Cu(2\text{-bzpy})(N_3)_2]_2$	tr	7.471(2)	100.77(2)	CuN_4O	2-bzpyN	2.036(2)	3.298(1)[d]	N,N	94.2(1, 1.5)	344
(black)	P-1	10.477(3)	109.83(2)		2-bzpyO	1.999(3)	96.3(1)		105.6(1)	
	1	9.389(3)	82.21(2)		N_3	1.928(3)	83.64(12)		170.1(1)	
					μN_3	1.984(3)		O,N	79.2(1)[c]	
						2.424(3)			91.7(1, 0)	
									161.4(1)	
$[Cu(terpy)(N_3)]_2(PF_6)_2$	m	10.149(2)		CuN_5	N	1.969(7, 36)	3.313(7, 3)	N,N	81.3(3, 2.4)[c]	345
(green)	$P2_1/n$	15.593(2)	103.57(2)		μN_3	1.992(8, 38)	96.3(3)		94.2(3, 2.6)	
	4	11.694(4)					83.7(2)		104.4(3)	
									166.2(3, 7.7)	
$[Cu(impyae)(N_3)]_2(ClO_4)_2$	m	9.654(4)		CuN_5	N	2.010(4, 41)	3.391(2)	N,N	87.5(3, 6.5)[c]	346
(not given)	$P2_1/c$	11.158(3)	106.49(2)		μN_3	1.975(4)	96.7(2)		95.9(3, 7.2)[f]	
	2	14.625(6)				2.536(4)	83.3(3)			
$[Cu(terpy)(NCO)(H_2O)]_2 \cdot (PF_6)_2$	tr	9.129(1)	104.90(2)	CuN_5O	ferpyN	2.000(6, 67)	3.678(1)	N,N	79.9(2, 1)[c]	347
(green)	P-1	10.489(2)	86.61(1)		H_2O	2.210(4)	83.5(3)		99.5(2, 2)	
	2	11.106(3)	113.93(1)		μOCN	1.906(8)	96.5(2)		162.9(2, 3.3)	
								O,N	72.9(2, 3.1)	
									94.8(2, 4.2)	
									165.1(2)	
$[Cu(paphy)(\mu\text{-NCS})_2]_2$	m	15.778(3)	91.32(2)	CuN_5S	N	2.009(14, 38)	3.730(3)	N,N	78.5(6)[c]	348
(green)	$P2_1/a$	9.937(2)			NCS	2.699(5)	94.4(5)		83.2(4, 3.6)	
	4	9.795(3)			μN	1.919(13)	85.6(5)		99.8(6, 5)	
						3.054(13)			162.2(6, 4.3)	
								S,N	95.4(4, 2.8)	
									176.7(3)	
D: Cu(μ-Cl)$_2$Cu										
$[Cu(epma)Cl]_2$	tg	25.416(33)		CuN_2Cl_2	N	2.113(6, 42)	3.011(2)	N,Cl	118.9(2, 10.0)	349
(not given)	$I4_1/a$				μCl	2.327(2, 51)	80.6(2)	N,N	81.2(2)[c]	
	8	12.524(11)					99.4(2)			

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
(1,2-Me_2pyH)[$Cu_2Cl_5(H_2O)$]	tr	7.077(1)	87.63(1)	$CuCl_4$	Cl	2.236(1,40)	3.105(1)[d]	Cl,O	168.0(1)	350
(orange green)	P-1	8.308(1)	78.90(1)		μCl	2.328(1,13)	95.1(1)	Cl,Cl	173.0(1,2.30)	
	2	12.655(2)	71.37(1)				84.9(1)			
				$CuCl_3O$	Cl	2.245(1)				
					H_2O	1.990(2)				
					μCl	2.278(1,8)				
[Cu(2-Mepy)$_2$Cl]$_2$	tr	8.908(3)	95.06(3)	CuN_2Cl_2	N	2.024(5,4)	3.150(2)	Cl,N	107.6(1,6.2)	351
(yellow)	P-1	9.038(4)	117.42(3)		μCl	2.452(2,18)	79.93(5)	N,N	124.0(2)	
(at 193K)	1	9.532(3)	109.06(3)				100.07(5)			
[Cu(ipr$_3$ph)$_2$Cl]$_2$	tr	10.000(3)	66.49(3)	$CuCl_2P_2$	P	2.242(2,4)	3.207(1)	P,P	115.87(5)	352
(not given)	P-1	12.493(3)	87.89(3)		μCl	2.381(1,10)	84.69(5)	P,Cl	110.92(5,3.10)	
	1	13.037(4)	74.53(2)				95.31(5)			
[Cu(tlma)(Ph$_3$P)Cl]$_2$	tr	9.395(15)	116.07(4)	$CuCl_2NP$	N	1.993(4)	3.268(3)	Cl,N	87.32(16)	353
(not given)	P-1	13.587(6)	70.76(7)		P	2.19(2)	83.4(1)		112.32(15)	
	1	13.659(8)	106.46(8)		μCl	2.349(3)	96.6(1)	Cl,P	113.8(1,7)	
						2.558(2)				
[Cu(15-crown-5)(MeCN)Cl$_3$]$_2$·	m	14.732(5)		$CuCl_4$	Cl	2.184(2,3)	3.295(2)[d]	Cl,Cl	101.5(2,14)	354
[Cu_2Cl_6]	$P2_1/a$	11.357(4)			μCl	2.363(2,60)	90.9(7)		136.5(2,6)	
(red)	4	13.520(3)	112.25(2)				89.(2)			
[Cu(15-crown-5)(MeCN)]$_2$·	m	11.367(6)		$CuCl_4$	Cl	2.185(2,4)	3.296(2)	Cl,Cl	100.51(8,2.18)	355
[$CuCl_3$]$_2$	$P2_1/c$	13.521(7)	112.40(4)		μCl	2.318(2,10)	90.68(7)		136.46(8,64)	
(orange)	4	14.751(9)					89.32(8)			
[Na(bz-15-crown-5)]$_2$[$CuCl_3$]$_2$	m	9.805(3)		$CuCl_4$	Cl	2.195(2,1)	3.306(1)	Cl,Cl	99.0(1,1)	356
(not given)	$P2_1/c$	9.449(3)	104.84(5)		μCl	2.293(2,1)	92.2(1)		141.9(1,4)	
	2	21.382(7)					87.8(1)			
[Cu(Ph$_4$m)$_3$][$CuCl_3$]$_2$·Me_2CO	m	13.144(1)		$CuCl_4$	Cl	2.192(2,15)	3.333(1)	Cl,Cl	90.4(1,3.2)	357
(not given)	$P2_1/c$	19.701(3)	90.88(1)		μCl	2.300(3,17)	87.0(1,3)		104.7(1,5.3)	
	4	30.109(4)					87.0(1,3)		129.2(1,8.9)	
									148.4(1)	

$[Na(dbz\text{-}18\text{-}crown\text{-}6)]_2[CuCl_3]_2$	m	12.754(5)		$CuCl_4$	Cl	2.220(1,26)	3.341(1)	Cl,Cl	97.1(1,2.8)	355
(not given)	$P2_1/n$	12.006(5)	92.80(5)		μCl	2.291(1,4)	93.6(1)		147.0(1,3.0)	
	2	14.996(6)					86.4(1)			
$(etapds)_2[CuCl_3]_2$	m	13.364(2)		$CuCl_4$	Cl	2.193(3,2)	3.345(2)	Cl,Cl	94.3(1,77)	358
(brown)	$P2_1/n$	16.772(9)	92.46(2)		μCl	2.299(3,6)	93.4(1)		146.5(1)	
	4	7.493(2)					86.6(1)			
$[Cu(2,2,5,5\text{-}Me_4pyNO)Cl_2]_2$	m	12.045(5)		$CuCl_3O$	O	1.940(1)	3.347(1)[d]	Cl,Cl	155.0(1)	359
(dark brown)	$P2_1/c$	13.642(5)	98.46(2)		Cl	2.155(1)	92.8(1)			
	4	7.679(3)			μCl	2.284(1)	87.2(1)			
$(PPh_4)_2[CuCl_3]_2$	m	13.601(2)		$CuCl_4$	Cl	2.192(5,6)	3.353(4)	Cl,Cl	98.4(2,2.7)	360
(red yellow)	$P2_1/n$	19.272(3)	107.9(1)		μCl	2.310(5,18)	not given		143.2(2,4)	
	4	9.216(2)					86.9(2)			
$(PPh_4)_2[CuCl_3]_2$	m	9.226(8)		$CuCl_4$	Cl	2.190(3,11)	3.355(1)	Cl,Cl	97.1(1,3.8)	361
(red brown)	$P2_1/c$	19.301(15)	111.26(6)		μCl	2.307(2,15)	95.1(1,18)		143.5(1,1)	
	4	13.842(15)					86.7(1)			
$[Co(15\text{-}crown\text{-}5)(MeCN)]_2\cdot$	tr	7.243(2)	82.32(2)	$CuCl_4$	Cl	2.193(3,12)	3.369(3)[d]	Cl,Cl	99.6(1,2.6)	362
$[Cu_2Cl_6]$	P-1	9.383(3)	86.13(2)		μCl	2.315(3,22)	93.4(1)		144.3(1)	
(brown orange)	1	9.566(3)	83.12(2)				86.6(1)			
$(Ph_4As)_2[CuCl_3]_2$	m	13.73(1)		$CuCl_4$	Cl	2.207(3,9)	3.382(1)	Cl,Cl	95.0(1,8.7)	363
(not given)	$P2_1/a$	19.64(1)	111.55(2)		μCl	2.319(2,14)	93.7(1)		144.9(1,3)	
	4	9.290(5)					86.3(1)			
$[Cu_5(bim)_5Cl_3]Cl\cdot 2H_2O$	or	19.506(3)		CuN_3Cl_2	N	1.980(4,0)	3.386(1)	N,N	88.6(1)	364
(green)	Pnma	17.384(4)				2.010(4)	85.5(1,3.7)		175.(2)	
	4	11.940(2)			μCl	2.488(2,64)	94.6(1,7)	N,Cl	100.1(1,17.7)	
									147.0(1)	
				$CuCl_3N_2$	N	1.974(4,0)		N,N	176.7(2)	
					Cl	2.318(2)		N,Cl	89.9(1,1.3)	
					μCl	2.402(2)		Cl,Cl	133.1(1,8.7)	
						2.620(2)				
$[Cu(mor)Cl_3]_2$	tr	7.414(2)	79.16(2)	$CuCl_4O_2$	Cl	2.245(4,4)	3.389(2)[d]	Cl,O	90.(3,2.9)	365
(red violet)	P-1	8.686(2)	82.20(2)		O	2.627(1)	95.8(1)	Cl,Cl	91.9(1,7)	
	2	14.766(4)	74.19(2)		μCl	2.283(4,8)	84.1(1)		175.8(1,2)	
$(Kbz\text{-}15\text{-}crown\text{-}5)_2[CuCl_3]_2$	tr	11.224(2)	75.47(1)	$CuCl_4$	Cl	2.203(2,5)	3.389(1)	Cl,Cl	95.3(1,6)	366
(green)	P1	12.831(2)	67.44(1)		μCl	2.291(2,1)	95.4(1)		155.9(1)	
	1	13.663(2)	70.46(1)				84.6(1)			
$[Cu\{HB(pz)_3\}Cl]_2$	m	13.144(15)		CuN_3Cl_2	N	1.989(5,4)	3.394(2)	N,Cl	97.31(16,9.85)	367
(green)	$P2_1/n$	13.247(3)	96.073(14)			2.200(5)	94.51(7)		167.23(17,4.56)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
	2	7.467(13)			μCl	2.311(2, 5)	85.49(7)	N,N	89.46(22, 81)	
$(PhSb)_2[CuCl_3]_2$	m	13.412(4)		$CuCl_4$	Cl	2.201(2, 12)	3.400(3)	Cl,Cl	94.3(1, 8.9)	368
(not given)	$P2_1/n$	19.894(4)	109.6(3)		μCl	2.31(2, 23)	94.6(1)		147.7(1, 3)	
	2	9.501(2)					85.4(1)			
(1-MepyH)$[Cu_2Cl_5(H_2O)]$	m	12.050(3)		$CuCl_4$	Cl	2.267(2, 14)	3.407(2)	Cl,Cl	91.9(1, 1.5)	369
(red orange)	$P2_1/n$	7.493(2)	108.35(2)		μCl	2.329(2, 26)	94.7(1, 1)		172.9(1, 1.3)	
	4	15.211(4)					85.3(1, 6)			
				$CuCl_3O$	H_2O	1.992(3)		Cl,O	92.5(1)	
					Cl	2.261(2)			175.7(1)	
					μCl	2.303(2, 9)		Cl,Cl	90.4(1, 1.9)	
									168.1(1)	
(4-ampyH)$[Cu_2Cl_5(H_2O)]\cdot H_2O$	m	3.740(1)		$CuCl_4$	Cl	2.231(4)	3.408(2)[d]	Cl,Cl	91.4(1, 6.3)	369
(red orange)	$P2_1/n$	11.948(3)	93.76(2)			2.747(2)	95.7(1, 8)		170.6(1, 1)	
	2	15.355(4)			μCl	2.313(2, 13)	85.8(1)			
				$CuCl_3O$	H_2O	1.976(10)		Cl,O	93.1(3, 7.3)	
					Cl	2.252(2)			166.0(2)	
					μCl	2.313(2, 13)				
$[Cu(bpyo)_2Cl_2]_2$	tr	8.664(2)	95.62(2)	$CuCl_3O_2$	O	1.989(3, 25)	3.409(1)	Cl,Cl	93.7(1, 1.5)	300
(green)	P-1	8.732(2)	107.04(2)		Cl	2.626(1)	87.75(6)	Cl,O	95.1(1, 12.8)	
	1	9.099(3)	114.05(2)		μCl	2.272(1, 7)	92.2(1)		163.4(1, 9.3)	
								O,O	83.9(1)[h]	
								O,N	113.6(2)	
$(4\text{-bzpipH})_2[CuCl_3]_2$	m	28.877(8)		$CuCl_4$	Cl	2.269(3, 8)	3.415(2)	Cl,Cl	87.1(1)	370
(red orange)	C2/c	8.440(2)	101.9(1)		μCl	2.261(3, 53)	not given		91.8(1, 2.3)	
	4	12.023(2)					84.8(1)		104.4(1, 4.0)	
									151.0(1)	
									177.5(1)	
$[Cu(amoc)Cl]_2$	m	6.150(1)		CuN_2Cl_2O	O	1.926(2)	3.418(2)	N,Cl	86.8(1, 3.2)	371
(dark green)	$P2_1/c$	11.224(2)	99.08(1)		N	1.976(3, 11)	not given		112.4(1)	
	2	15.057(3)			μCl	2.329(1)	97.1(1)		150.2(1)	
						2.808(1)		O,Cl	89.4(1, 3.7)	
								N,N	89.6(1)[6]	
								O,N	92.9(1)[6]	
									169.1(1)	

$(dbztsf)_2[CuCl_3]_2$	m	9.216		$CuCl_4$	Cl	2.220(4, 0)	3.419(4)[d]	Cl,Cl	90.1(1, 6.5)	372
(dark reddish)	C2/m	24.958	108.23		μCl	2.294(3, 0)	83.64(1)		173.2(1)	
	2	7.300					96.4(1)			
$(dbztsfH)_2[CuCl_3]_2$	m	9.224(1)		$CuCl_4$	Cl	2.224(1)	3.420(1)[d]	Cl,Cl	92.7(6, 1.6)	373
(dark red)	C2/m	24.976(3)	108.28(1)		μCl	2.297(1)	96.24(6)			
	2	7.317(2)					83.76(6)			
$[Cu(pan)Cl]_2$	m	15.817(3)		CuN_2Cl_2O	N	1.978(2, 14)	3.421(1)[d]	N,N	78.53(9)[c]	374
(dark)	$P2_1/a$	8.255(1)	103.46(2)		O	1.984(2)	87.79(3)	O,N	81.50(9)[f]	
	4	10.404(3)			μCl	2.263(1)	92.21(3)		159.34(10)	
						2.677(1)		Cl,N	97.13(7, 23)	
									170.06(7)	
								O,Cl	101.50(7)	
$[Cu(msimp)Cl_2]_2 \cdot CCl_4$	m	11.027(3)		$CuCl_3N$	N	1.985(2)	3.421(1)	Cl,Cl	87.5(1, 3.5)	375
(green)	$P2_1/n$	14.073(3)	94.27(2)		Cl	2.214(1)	96.1(1)		166.0(1)	
	4	15.602(3)			μCl	2.300(1, 10)	84.0(1)	N,Cl	93.8(1, 1.6)	
									167.3(1)	
$[Cu(dzcyc)Cl_2]_2$	m	13.406(3)		$CuCl_3N_2$	N	2.003(3, 3)	3.422(0)	Cl,Cl	97.7(0, 2.3)	376
(blue)	$P2_1/c$	11.454(2)	115.01(2)		Cl	2.245(1, 8)	not given	Cl,N	94.4(1, 4.8)	
	4	12.605(3)			μCl	2.316(1, 14)	92.9(0, 2)		163.9(1, 1.3)	
						2.648(1, 6)		N,N	77.2(1, 3)[c]	
$[Cu(3\text{-}ampyH)Cl_3]_2$	m	7.623(1)		$CuCl_4N$	N	2.049(1)	3.4256(2	Cl,Cl	93.0(1, 6)	377
(red)	$P2_1/a$	14.700(2)			Cl	2.279(1)	94.9(1)		106.6(1, 4.4)	
	2	8.121(1)	93.09(1)			2.496(1)	85.1(1)		146.6(1)	
					μCl	2.235(1, 5)		Cl,N	88.3(1, 3.9)	
									175.7(1)	
$[Cu(pydiox)Cl_2]_2$	m	9.022(2)		$CuCl_3N_2O$	N	2.040(1, 16)	3.428(1)[d]	N,N	85.04(5)[c]	378
(blue)	$P2_1/c$	12.503(3)	108.50(3)		O	2.678(1)	96.68(1)	N,Cl	90.72(4, 1.53)	
	4	13.564(5)			Cl	2.269(1)	83.32(1)		167.32(4, 4.72)	
					μCl	2.273(1)		Cl,Cl	99.94(2, 4.23)	
						2.844(1)				
$(tmsfs)_2[CuCl_3]_2$	tr	8.871(3)	109.70(2)	$CuCl_4$	Cl	2.202(2, 14)	3.433(1)	Cl,Cl	92.1(1, 8.4)	379
(not given)	P-1	10.652(3)	106.10(3)		μCl	2.306(2, 14)	96.3(1)		156.(1, 3)	
	1	12.505(3)	102.63(3)				83.7(1)			
$[Cu(epthscarb)Cl]_2$	m	11.785(1)		$CuCl_2ONS$	O	2.054(5)	3.439(2)[d]	O,N	80.4(2)[c]	380
(green)	$P2_1/n$	8.202(1)	95.70(1)		N	1.975(6)	95.11(6)	S,N	84.7(2)[c]	
	4	11.057(1)			S	2.245(3)	84.89(6)	S,O	164.(2)	
					μCl	2.236(2)		Cl,N	171.0(2)	
						2.819(2)		Cl,O	95.0(2)	
								Cl,S	99.0(1)	

TABLE II (*Continued*)

Compound (color)	*Cryst. cl. space G. Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$(NH_4)_2[CuCl_3]_2$	m	4.0344(7)		$CuCl_4$	Cl	2.271(2, 10)	3.441(2)[d]	Cl,Cl	92.18(8, 67)	381
(not given)	$P2_1/c$	14.206(2)	96.43(2)		μCl	2.311(2, 3)	96.24(8)		174.17(10, 1.60)	
	—	8.992(2)					83.76(8)			
$(dma)_2[CuCl_3]_2$	m	12.09		$CuCl_4$	Cl	2.275(7, 26)	3.444(6)	Cl,Cl	92.3(2.4.7)	382
(green)	I 2/a	8.63	97.5		μCl	2.326(6, 21)	not given		106.7(2)	
	8	14.49					84.4(2)		166.0(2, 10)	
$[Cu(dmg)Cl]_2$	tr	7.6970(6)	108.135(9)	$CuCl_3N_2$	N	1.986(11, 28)	3.445(3)	Cl,N	93.08(34, 3.71)	383
(green)	P-1	8.1743(12)	69.160(6)		Cl	2.249(4)	88.0(1)		166.31(34, 38)	
	2	8.1203(7)	78.692(8)		μCl	2.238(4)	92.0(1)	Cl,O	93.14(23, 1.07)	
						2.698(4)		N,N	76.98(45)[e]	
								Cl,Cl	97.10(14, 1.52)	
$[Cu(amzh)Cl]_2$	m	6.018(1)		CuN_2Cl_2O	O	1.918(2)	3.445(1)	Cl,O	91.4(1)	384
(dark green)	$P2_1/n$	12.648(4)	101.39(2)		N	1.979(3, 20)	not given	Cl,N	90.9(1)	
	2	12.877(5)			μCl	2.315(1)	not given		159.8(1)	
						2.837(1)		O,N	94.4(1)[f]	
									175.3(1)	
								N,N	84.9(1)[g]	
$[Cu(ophsalim)Cl]_2 \cdot 2dmf \cdot H_2O$	m	8.771(1)		CuO_2Cl_2N	N	1.932(2, 7)	3.448(1)	Cl,O	90.9(1, 6.8)	385
(not given)	$P2_1/c$	13.440(2)	97.113(4)		O	1.962(2, 84)	84.6(1, 4)	Cl,N	102.9(1, 8)	
	4	29.060(4)			μCl	2.260(1)	92.9(1, 5)		162.6(1, 1.9)	
						2.841(1)		O,O	173.9(1, 1)	
								O,N	81.7(1, 1)[e]	
									93.5(1, 2)[f]	
$[Cu(N_3bz)_2Cl_2]_2 \cdot H_2O$[h]	tr	8.591(3)	110.62(5)	$CuCl_3N_2$	N	1.985(8, 5)	3.448(3)	Cl,Cl	133.8(2, 4.8)	386
(green)	P-1	11.906(4)	91.95(5)		Cl	2.260(6)	87.5(1)	N,Cl	90.0(3, 1.7)	
	2	16.183(4)	92.04(6)		μCl	2.493(4, 52)	92.5(1)	N,N	176.5(6)	
						2.011(9, 9)				
				$CuCl_3N_2$	N	2.277(4)	3.520(2)	Cl,Cl	116.4(1)	
					Cl	2.299(3)	89.3(1)		152.9(2)	
					μCl	2.694(4)	90.7(1)	N,Cl	89.6(3, 4.1)	
								N,N	173.4(2)	

$[Cu_2(mapycarb)Cl_4]$	tr	8.558(8)	89.77(5)	$CuCl_4$	Cl	2.195(1, 2)	3.454(1)		not given	387
(not given)	P-1	10.824(8)	84.47(6)		μCl	2.327(1, 62)	not given			
	2	15.335(3)	72.72(7)							
				CuN_2Cl_2O	O	1.967(3)				
					N	1.982(4, 69)				
					μCl	2.306(1)				
						2.634(1)				
$[Cu(Me_2en)Cl_2]_2$	or	9.765(9)		$CuCl_3N_2$	N	2.033(6, 42)	3.458(3)	N,N	84.1(2)[c]	388
(not given)	Pbca	8.518(6)			Cl	2.253(1)	86.13(8)	N,Cl	91.2(2, 3.9)	
	4	20.767(20)			μCl	2.309(2)	93.87(8)		170.7(2, 3.0)	
						2.734(3)		Cl,Cl	95.7(8, 2.5)	
$[Cu(prl)_2Cl_2]_2$	tr	7.278(1)	108.69(2)	$CuCl_3O_2$	O	1.971(3, 8)	3.460(1)	Cl,Cl	108.34(5)	389
(green)	P-1	8.862(2)	103.38(1)		Cl	2.238(1)	87.50(4)		159.07(5)	
	2	9.973(2)	90.72(2)		μCl	2.320(1)	92.50(4)	O,Cl	90.1(1, 4.4)	
						2.670(1)		O,O	176.5(1)	
$[Cu(S_4tpp)Cl_2]_2$	or	15.383(6)		$CuCl_3S_2$	Cl	2.234(3)	3.464(7)	Cl,Cl	98.59(12, 2.30)	390
(green)	Pbca	11.409(3)			S	2.354(3, 5)	86.87(10)	Cl,S	87.50(12, 3.75)	
	4	17.423(4)			μCl	2.321(3)	93.13(10)		171.25(12, 1.21)	
						2.702(3)		S,S	88.28(12)[c]	
$(tmsfs)_2[CuCl_3]_2$	tr	8.591(3)	63.44(3)	$CuCl_4$	Cl	2.210(1, 7)	3.467(1)	Cl,Cl	90.(1, 8.4)	379
(black)	P-1	11.314(6)	88.18(3)		μCl	2.294(1, 1)	98.2(1)		170.1(1, 1)	
	1	11.868(6)	74.28(3)				81.8(1)			
$[Cu(\beta\text{-ala})Cl_2]_2$	m	7.960(1)		$CuCl_4O_2$	O	1.955(8, 17)	3.468(2)[d]	Cl,O	90.2(2, 2.0)	391
(green)	$P2_1/c$	12.249(2)	94.10(1)		Cl	2.280(3)	87.2(1)	Cl,Cl	173.8(1)	
	4	6.875(1)			μCl	2.336(3)	93.5(1)			
						2.679(3)				
$[Cu(ehmpr)Cl_2]_2$	m	6.188(2)		$CuCl_3O_2$	O	1.984(1, 8)	3.474(1)	Cl,Cl	93.6(1, 2.1)	392a
(green)	$P2_1/c$	11.404(2)	109.60(2)		Cl	2.228(1)	not given		105.8(1, 4.4)	
	4	15.161(4)			μCl	2.271(1)	91.5(1)	Cl,O	91.0(1, 4.4)	
						2.690(1)			158.3(1)	
									173.0(1)	
								O,O	84.8(1)[c]	
$[Cu(\mu\text{-Cl})(dtic)Cl]_2$	m	9.059(1)		$CuCl_3ON$	N	1.951(2)	3.484(1)[d]	N,O	84.7(1, 3.3)	392b
(green)	$P2_1/c$	13.647(1)	92.28(1)		O	2.079(2)	85.8	N,Cl	92.3(1)	
	4	9.538(1)			Cl	2.248(2)	94.2(4)		173.3(1)	
					μCl	2.246(2)		O,Cl	91.9(1, 2)	
						2.740(2)			107.1(5)	
									161.7(1)	
								O,O	89.9(1)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(hnimet)Cl]_2 \cdot H_2O$	m	21.838(3)		CuO_2Cl_2N	O	1.986(2, 55)	3.4995(3)	Cl,O	93.0(1, 2.1)	393
(not given)	C2/c	19.936(2)	116.24(1)		N	1.931(2)	83.29(2, 3)	Cl,N	167.3(1, 6.7)	
	8	12.997(2)			μCl	2.2435(3)	not given	O,O	172.6(1)	
						2.788(1)		O,N	82.5(1)[c]	
									92.1(1)[f]	
$[Cu(salqu)Cl]_2 \cdot 2MeOH$	tr	11.951(3)	112.02(2)	CuN_2Cl_2O	O	1.904(3)	3.502(1)	O,Cl	89.5(1, 1)	394
(bright green)	P-1	8.943(2)	107.45(2)		N	1.990(3, 14)	not given	N,Cl	94.8(1, 5)	
	1	8.111(2)	79.40(2)		μCl	2.291(1)	95.0(2)	O,N	93.4(1)[f]	
						2.856(2)			174.0(1)	
								N,N	82.0(1)[c]	
$[CuCl_2(cycol)]_2(cycol)(thf)$	m	8.120(2)		$CuCl_3O_2$	O	1.996(6, 20)	3.511(1)	Cl,Cl	92.8(1, 5.6)	395
(green)	not given	34.90(2)	105.71(2)		Cl	2.212(2, 13)	88.6(1, 18)		101.5(1, 4)	
		11.132(4)			μCl	2.260(2, 13)	not given	Cl,O	91.0(2, 10.3)	
						2.680(2)			167.5(2, 5)	
						2.804(2)		O,O	80.1(2)[c]	
$[Cu(smtp)Cl_2]_2 \cdot 2H_2O$	m	7.316(3)		$CuCl_3NS$	N	1.992(4)	3.518(1)[d]	N,Cl	90.33(10, 6)	396
(brown)	$P2_1/c$	15.944(4)	117.50(2)		S	2.424(1)	91.83(2)		169.12(10)	
	4	10.391(2)			Cl	2.244(1)	88.17(2)	S,Cl	95.58(10)	
					μCl	2.301(1)			171.92(10)	
						2.737(1)		Cl,Cl	95.66(10, 3.83)	
$[Cu(pyqux)Cl_2]_2$	m	8.385(6)		$CuCl_3N_2$	N	2.064(5, 43)	3.522(1)	Cl,Cl	96.0(1)	397
(yellow)	$P2_1/n$	14.708(7)	92.5(5)		Cl	2.272(2)	95.7(1)		144.2(1)	
	2	10.44(6)			μCl	2.274(2)	84.3(1)	Cl,N	95.0(2, 8.9)	
						2.473(2)			114.1(1)	
									169.7(2)	
								N,N	79.7(2)[c]	
$[Cu_2(thf)_2(cycol)Cl_6]$	m	16.561(3)		$CuCl_4O_2$	O	1.996(4, 0)	3.525(2)	Cl,Cl	94.8(1, 5.3)	398
(brown)	C2/c	13.217(2)	134.05(1)			2.719(4, 0)	90.(1, 1)		179.9(1, 1)	
	4	13.290(3)			Cl	2.293(2, 57)	79.8(1)	Cl,O	90.1(2, 6.5)	
						2.726(3)			168.6(1)	
					μCl	2.293(2, 57)		O,O	81.9(2)[c]	
						2.726(3)			180.0(2)	

$[Cu(4\text{-}Meth)_2Cl_2]_2 \cdot 2MeOH$	m	7.506(4)		$CuCl_3N_2$	N	2.002(3, 2)	3.543(1)	Cl,Cl	89.85(3)	399
(dark blue)	$P2_1/n$	15.987(6)	96.24(4)		Cl	2.303(1)	90.15(3)		107.75(4)	
	2	12.472(5)			μCl	2.350(1)	89.85(3)		162.39(4)	
						2.645(1)		Cl,N	90.38(10, 3.12)	
								N,N	172.78(13)	
$[Cu(hemnim)_2Cl_2]_2$	m	7.075(3)		$CuCl_3N_2$	N	1.998(4, 5)	3.558(1)[d]	Cl,Cl	134.9(1, 8)	400
(green)	$P2_1/c$	19.051(7)	90.42(4)		Cl	2.358(2, 61)	89.8	Cl,N	90.1(1, 2.2)	
	4	14.161(7)			μCl	2.619(1, 0)	90.2	N,N	175.4(2)	
$[Cu(guan)Cl_3]_2 \cdot 2H_2O$	m	16.952(1)		$CuCl_4N$	N	1.977(5)	3.566(1)[d]	Cl,N	87.8(2, 3.4)	401
(yellow brown)	C2/c	10.183(1)	99.97(1)		Cl	2.365(2)	97.68(7)		168.9(2)	
	8	13.185(1)			μCl	2.288(2)	82.32(7)	Cl,Cl	94.56(6)	
						2.448(2)			109.2(1, 8.0)	
									132.9(1)	
$[Cu(guan)Cl_3]_2$	m	16.954(3)		$CuCl_4N$	N	1.976	3.572(1)[d]	Cl,Cl	103.7(−,10.6)	402
(not given)	C2/c	10.175(3)	99.87(1)		Cl	2.298(1, 29)	97.9		134.0	
	not given	13.169(3)			μCl	2.368(1, 80)	82.1			
$[Cu(pzc)Cl_2]_2$	m	12.992(1)		$CuCl_3ON$	O	1.985(4, 25)	3.58(4)	Cl,Cl	91.0(3)	403
(not given)	$P2_1/c$	9.614(1)	130.08(1)		N	2.035(4, 25)	87(4, 1)		108.0(3)	
	8	16.376(3)			Cl	2.225(4, 5)	92(4, 2)		163.0(3)	
					μCl	2.26(4)		Cl,N	167.5(3, 2.5)	
						2.80(4)		O,Cl	165.0(3)	
								O,N	80(0.3,1)[c]	
$[Cu(athal)Cl_2]_2$	m	9.777(2)		$CuCl_3N_2$	N	2.018(13, 12)	3.594(5)[d]	Cl,Cl	97.8(2, 4.2)	404
(blue)	$P2_1/c$	11.922(3)	101.98(3)		Cl	2.278(5)	90.1(2)	Cl,N	92.0(4, 3.2)	
	2	9.247(4)			μCl	2.288(5)	90.0(2)	N,N	83.0(5)[c]	
						2.767(5)				
$[Cu(cychol)_2Cl_2]_2$	m	15.318(8)		$CuCl_3O_2$	O	1.977(4, 15)	3.610(1)	O,O	78.3(1)[c]	405
(green)	$P2_1/n$	7.781(2)	105.93(4)		Cl	2.217(1)	91.75(5)	O,Cl	92.9(1, 3.6)	
	4	15.682(8)			μCl	2.245(1, 28)	88.43(5)		161.6(1, 5)	
								Cl,Cl	100.7(1, 2.7)	
$[Cu(dmf)_2Cl_2]_2$	m	13.296(4)		$CuCl_3O_2$	O	1.981(3, 8)	3.613(2)	Cl,Cl	103.49(5, 9.01)	406
(not given)	C2/c	13.254(4)	113.76(3)		Cl	2.247(2)	93.57(4)	Cl,O	91.73(10, 6.50)	
	8	14.702(6)			μCl	2.284(1)	86.43(4)		148.92(89)	
						2.661(2)			172.20(9)	
								O,O	86.75(11)	
$(bpyH)[CuCl_3]_2$	tr	10.37(2)	96.9(5)	$CuCl_4$	Cl	2.258(12, 3)	3.615(12,)	Cl,Cl	92.1(5, 4.2)	407
(brown)	P-1	10.96(2)	96.7(5)		μCl	2.358(12, 4)	100.1(6)		173.6(5, 1.9)	
	1	3.99(1)	115.9(5)				79.9(1)			

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
Cu_2(3.4-Me_2phpz)·	tr	9.071(1)	93.42(1)	$CuCl_3N_2$	N	2.004(3, 1)	3.6164(7)	Cl,Cl	88.50(3, 2.20)	408
(4, 5-Me_2phpz) Cl_2	P-1	11.008(1)	97.50(1)		Cl	2.297(1)	93.70(3)		105.82(4)	
(green)	1	11.358(1)	96.16(1)		μCl	2.3047(9)	86.30(3)	Cl,N	92.77(8, 5.90)	
						2.6420(9)			155.32(8)	
									178.44(7)	
								N,N	90.6(1)	
$[Cu(dempz)Cl_2]_2$	m	9.445(3)		$CuCl_3N_2$	N	2.00(−, 2)	3.620[d]	Cl,N	92.0(4, 6.1)	409
(not given)	$P2_1/b$	9.579(3)			Cl	2.293	94.4(2)		100.0(3)	
	4	22.253(5)	96.43(3)		μCl	2.331	85.6(2)		154.0(3)	
						2.597			176.2(3)	
								N,N	90.9(4)	
								Cl,Cl	97.6(2, 8.0)	
$[Cu(dpm)Cl_2]_2$	m	8.744(2)		$CuCl_3N_2$	N	2.034(2, 1)	3.629(1)	N,N	85.8(1)[f]	410
(dark green)	$P2_1/c$	12.124(3)	104.43(3)		Cl	2.261(1)	93.8(1)	N,Cl	90.5(1)	
	2	11.648(2)			μCl	2.315(1)	86.2(1)		150.7(1)	
						2.629(1)		N,Cl	95.6(1, 7.1)	
								Cl,C	100.2(1, 6.5)	
$[Cu(dtd)Cl_2]_2$	m	9.592(2)		$CuCl_3S_2$	S	2.335(1, 18)	3.630(1)	Cl,Cl	106.9(1, 9.8)	411
(dark green)	$P2_1/c$	17.193(4)	101.03(2)		Cl	2.274(1, 19)	93.8(1)	S,S	89.1(1, 5)	
(at 140 K)	2	7.813(2)			μCl	2.663(1)	86.1(1)	Cl,S	92.2(1, 11.2)	
								Cl,S	90.7;139.7(1)	
$[Cu(bzmh)Cl_2]_2$	tr	8.795(7)	101.24(2)	$CuCl_3ON$	O	1.974(3)	3.631(3)	O,Cl	89.89(12, 93)	412
(blue green)	P-1	11.402(9)	96.31(3)		N	2.122(4)	92.83(5)		172.61(13)	
	2	6.830(6)	106.33(3)		Cl	2.232(2)	87.17(5)	N,Cl	96.54(12, 1.56)	
					μCl	2.258(2)			151.23(12)	
						2.735(2)		Cl,Cl	91.78(5, 4.61)	
									108.78(5)	
$[Cu(dien)Cl_2]_2(ClO_4)_2$	or	7.637(1)		CuN_3Cl_2	N	2.010(20, 31)	3.643(2)	N,Cl	95.4(6, 9.2)	413
(not given)	$Pbn2_1$	13.549(3)			μCl	2.313(5)	not given		176.3(3, 3.1)	
	4	20.866(4)				2.770(5)	87.0(1)	N,N	85.4(5, 3)[c]	

$[Cu(piol)Cl_2]_2$	or	20.710(2)		$CuCl_3O_2$	O	1.967(5, 21)	3.647(1)	Cl,Cl	85.7(1, 5.0)	414
(green)	Pbcn	11.401(6)			Cl	2.230(1, 29)	97.0(1, 11)		101.7(1, 6.5)	
	8	17.469(4)			μCl	2.225(2, 7)	85.7(1, 5.0)	Cl,O	90.3(1, 5.3)	
						2.664(2)			107.6(2, 3.5)	
						3.080(2)			144.9(2)	
									167.1(1, 2.2)	
								O,O	77.4(2, 2)[e]	
$[Cu(dmf)_2Cl_2]_2$	m	11.720(5)	103.47(2)	$CuCl_3O_2$	O	1.992(2, 16)	3.673(2)[d]	O,O	88.(1)	415
(green)	$P2_1/a$	11.641(5)			Cl	2.153(2)	89.4	Cl,O	91.8(1, 3)	
	2	9.012(4)			μCl	2.302(2)	90.6		145.5(1)	
									172.0(1)	
								Cl,Cl	92.8(1)	
$[Cu(2\text{-amepy})Cl_2]_2$	tr	7.093(1)	94.25(1)	$CuCl_3N_2$	N	2.036(3)	3.683(1)	Cl,Cl	95.90(4, 3.47)	416
(blue green)	P-1	9.412(1)	103.69(2)		Cl	2.253(1)	not given	N,N	80.4(1)[e]	
	1	9.541(2)	108.32(1)		μCl	2.283(1)	89.30(3)	Cl,N	92.3(1, 3.7)	
						2.862(1)			171.5(10, 9)	
$[Cu(pypep)Cl]_2 \cdot 2H_2O$	m	10.134(2)		CuN_3Cl_2	N	1.986(3, 28)	3.693(1)	Cl,N	94.6(1, 4.6)	417
(dark blue)	$P2_1/n$	14.141(4)	95.01(3)		μCl	2.31(1)	91.1(1)		173.0(1)	
	4	9.108(4)				2.831(1)	88.9(1)	N,N	81.3(1)[e]	
									91.5(1)[f]	
									167.8(1)	
$[Cu(bzcarb)Cl_2]_2 \cdot 2MeOH$	tr	10.370(3)	117.40(2)	$CuCl_3N$	Cl	2.323(1)	3.702(1)	Cl,Cl	90.82(5)	418
(green)	P-1	11.074(4)	95.82(3)		N	2.004(4, 4)	90.22(4)		178.85(2)	
	2	11.186(4)	90.90(2)		μCl	2.279(2)	89.78(4)	Cl,N	92.2(1, 4.1)	
								N,N	166.2(1)	
$[Cu(Et_3en)Cl_2]_2$	tr	8.536(2)	93.78(3)	$CuCl_3N_2$	N	2.068(3, 53)	3.703(1)	Cl,N	94.25(10, 8.68)	419
(not given)	P-1	9.194(5)	101.43(2)		Cl	2.307(1)	94.84(4)		145.69(9)	
	1	7.766(2)	94.50(3)		μCl	2.284(1)	85.16(4)		174.91(10)	
						2.728(1)		Cl,Cl	102.84(4, 8.12)	
								N,N	84.29(11)[e]	
$[Cu(4\text{-Meth})(dmf)Cl_2]_2$	m	7.349(7)		$CuCl_3ON$	O	1.990(4)	3.721(1)	Cl,Cl	101.33(7, 7.31)	420
(not given)	$P2_1/n$	20.306(7)	112.53(6)		N	2.006(4)	not given		84.71(7)	
	2	8.909(3)			Cl	2.238(2)	84.71(7)	Cl,N	92.0(1, 1.2)	
					μCl	2.296(2)			155.0(1)	
						2.724(1)			175.2(2)	
								Cl,O	93.4(1, 3.0)	
								N,O	85.5(1)	
$[CuCl_2(tmso)_2]_2$	m	9.205(1)		$CuCl_3O_2$	O	1.948(−, 3)	3.737(2)	Cl,O	83.(1)	421
(not given)	$P2_1/c$	14.614(9)	84.62(3)		Cl	2.270	not given		92.2(1, 8)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
	4	9.660(4)			μCl	2.280 3.020	91.5(1)	Cl,Cl O,O	122.8(1) 145.7(1) 165.2(1)	
$[Cu(S_5tpp)Cl_2]_2$ (green)	m A2/a 4	12.616(1) 10.054(6) 29.180(2)	95.81(1)	$CuCl_3S_2$	Cl S μCl	2.265(4) 2.357(5, 2) 2.277(4) 2.661(4)	3.749(2) 90.94(4) 89.06(14)	Cl,Cl Cl,S S,S	96.31(17, 7.25) 93.01(16, 9.01) 153.12(17) 177.29(17) 82.67(15)[c]	390
$[Cu([12]\text{-}aneS_2)Cl_2]_2$ (not given)	tr P-1 1	9.646(3) 11.823(4) 7.934(2)	109.61(2) 79.23(2) 113.55(2)	$CuCl_3S_2$	S Cl μCl	2.339(2, 31) 2.242(2) 2.266(2) 2.825(2)	3.749(2) 94.22(5) 85.78(5)	Cl,Cl Cl,S S,S	108.90(6, 10.84) 79.34(5) 94.59(6, 6.28) 138.65(5) 165.02(5) 89.10(6)[c]	422
$[Cu(Me_4en)Cl_2]_2$ (blue)	tr P-1 1	7.713(7) 8.560(8) 9.249(8)	98.44(6) 94.39(7) 118.63(5)	$CuCl_3N_2$	N Cl μCl	2.068(4, 14) 2.259(2) 2.264(3) 3.147(4)	4.089(4) 96.8(1) not given	N,N N,Cl Cl,Cl	85.3(1)[c] 92.3(1, 4.1) 164.2(1, 6.7) 99.8(1, 6.2)	423
E:Cu(μ-SL)$_2$Cu										
$[Cu(C_{14}H_{16}N_2OS)]_2$ (not given)	m $P2_1/c$ 4	9.408(3) 15.571(4) 11.996(3)	103.42(2)	CuS_2ON	O N μS	1.893(8, 6) 1.931(8, 4) 2.249(3, 12) 2.348(3, 5)	2.656(2) 70.6(1, 3) 84.4(1, 2)	μS,S μS,N N,O	93.9(2, 6) 87.6(3, 3) 95.5(3, 4)	424
$[Cu(tba)(tbi)Br]_2$ (not given)	m $P2_1/n$ 2	9.120(2) 18.597(8) 10.062(6)	110.73(4)	CuS_3Br	Br S μS	2.491(3) 2.287(3) 2.272(3) 2.659(4)	3.049(3) 75.9(1) 104.1(1)	Br,S S,S	113.6(1, 3.3) 96.8(1) 103.5(1) 120.9(1)	425
$[Cu(hesc)_2]_2$ (brown)	tr P-1 2	11.946(3) 7.826(3) 9.789(4)	69.65(3) 83.06(3) 81.78(3)	CuS_5	S μS	2.318(5, 11) 2.335(4)	3.451(2) not given not given	S,S	76.5(2, 0)[i] 101.3(2, 1.0)	426
$[Cu(desc)_2]_2$ (green)	m $P2_1/c$	9.907 10.627	 113.52	CuS_5	S	2.307(2, 10) 2.851	3.588(1) not given	S,S	77.19(9)[i] 101.59(9, 30)	427a

	4	16.591			μS	2.320(2, 19)	76.27(9)			
$[Cu(\mu\text{-dalthc})_2]_2$	tr	10.161(4)	77.46(3)	CuS_5	S	2.316(2, 8)	3.742(2)	S,S	76.7(1, 1)[c]	427b
(black brown)	P-1	9.294(4)	77.10(3)		μS	2.328(2)	not given			
	2	10.518(3)	89.02(3)			2.888(2)	not given			
F:Cu(μ-Br)$_2$Cu										
$(NPr_4)_2[CuBr_3]_2$	m	17.460(6)		$CuBr_4$	Br	2.338(3, 8)	3.518(3)[d]	Br,Br	96.5(1, 1.3)	428
(orange)	C2/c	14.625(4)	103.82(2)		μBr	2.429(3, 12)	92.8(1)		148.(1, 7)	
	4	15.061(4)					87.2(1)			
$[Cu(ae)Br]_2 \cdot 0.3HBr$	m	6.1707(6)		$CuBr_4N_2O$	N	1.971(3, 20)	3.5445(7)	N,N	85.0(1)[c]	429
(blue)	$P2_1/n$	13.045(2)	102.237(6)		O	1.912(3)	81.04(2)	N,O	94.7(1)[f]	
	2	12.719(1)			μBr	2.469(1)	98.96(2)		175.2(2)	
						2.956(1)		Br,N	83.0(1)	
									103.2(1)	
								Br,O	92.4(1)	
$(Pr_4NH_4)_2[Cu\ Br_3]_2$	tr	9.612(2)	102.27(2)	$CuBr_4$	Br	2.337(2, 4)	3.554(2)	Br,Br	97.3(1, 1.8)	428
(green)	P-1	9.602(2)	104.30(2)		μBr	2.444(2, 4)	93.3(1)		146.4(1, 1.2)	
	1	12.006(3)	112.79(1)				86.7(1)			
$[Cu(Me_2en)Br_2]_2$	or	9.990(5)		$CuBr_3N_2$	N	2.031(6, 39)	3.570(3)	N,N	84.6(2)[c]	388
(not given)	Pbca	8.795(3)			Br	2.401(1)	83.71(5)	N,Br	91.5(2, 4.3)	
	4	20.828(1)			μBr	2.463(2)	96.29(5)		169.6(2, 3.4)	
						2.868(2)		Br,Br	94.4(4, 1.8)	
$[Cu(MeSbpy)Br_2]_2$	tr	9.040(1)	120.26(1)	$CuBr_3NS$	Br	2.356(3)	3.591(4)	Br,Br	93.3(1, 6)	430
(not given)	P-1	13.100(2)	92.80(1)		S	2.353(5)	84.5(1, 1.5)		103.4(1)	
	2	15.455(2)	111.31(1)		N	2.04(2)	86.2(1, 1.4)		125.3(1)	
					μBr	2.412(3)		Br,S	90.2(2, 7.6)	
						2.965(4)			142.1(2)	
									166.5(2)	
								Br,N	93.5(5, 9.6)	
									153.9(5)	
									171.0(5)	
								S,N	85.2(5, 1)[c]	
$[Cu(bdd)Br_2]_2$	tr	7.759(1)	71.56(1)	$CuBr_3N_2$	Br	2.372(1)	3.599(1)	N,N	76.3(4)[c]	431
(not given)	P-1	8.594(1)	69.08(1)		N	2.004(8, 10)	85.94(4)	Br,Br	96.60(4, 25)	
	2	8.273(1)	101.20(1)		μBr	2.387(1)	94.41(4)			
						2.883(1)				
$(dbztsfH)_2[CuBr_3]_2$	tr	9.982(1)	83.70(1)	$CuBr_4$	Br	2.425(1, 9)	3.603(1)[d]	Br,Br	93.37(3, 2.60)	432
(dark red)	P-1	12.122(1)	112.80(1)		μBr	2.363(1, 6)	95.98(3)		174.02(4, 76)	
	1	7.893(1)	104.97(1)				84.02(3)			

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu(4\text{-}Meox)Br_2]_2$	m	8.546(4)		$CuBr_3N_2$	Br	2.434(1)	3.626(1)	Br,Br	109.85(3)	433
(green)	$P2_1/n$	13.062(5)	96.88(4)		N	1.974(5, 1)	87.00(3)		157.15(4)	
	2	11.049(6)			μBr	2.556(1)	93.00(3)	Br,N	90.(2, 3.4)	
						2.710(1)		N,N	172.7(3)	
$[Cu(terpy)Br]_2(PF_6)$	m	20.40(2)	97.74(9)	CuN_3Br_2	N	1.97(8, 7)	3.64(4)	N,N	81(1, 1)[c]	434
(blue)	$P2_1/a$	13.35(2)			μBr	2.362(4)	89(0)	N,Br	97(1, 6)	
	4	6.453(8)				2.832(9)	91(0)		174(1)	
$(bpyH)[CuBr_2]_2$	tr	4.1018(5)	113.89(7)	$CuBr_4$	Br	2.38(1, 8)	3.653(1)	Br,Br	91.99(3, 2.45)	435
(black)	P-1	10.275(1)	94.975(8)		μBr	2.452(1, 1)	96.28(2)		173.14(3, 46)	
	1	11.0355(9)	95.935(9)				83.72(2)			
$[Cu(tmso)_2Br_2]_2$	m	9.578(3)		$CuBr_3O_2$	Br	2.429(2)	3.714	Br,Br	94.5(1)	436
(green)	$P2_1/c$	14.896(6)	94.51(3)		O	1.936(8, 4)	85.5(1)		132.5(1, 6.6)	
	2	9.727(4)			μBr	2.461(2)	94.5(1)	O,Br	89.8(2)	
						2.981(2)		O,O	169.9(3)	
$[Cu(phed)Br_2]_2$	m	7.830(2)		$CuBr_3N_2$	Br	2.351(1)	3.737(2)	Br,Br	96.(0, 1.1)	437
(not given)	$P2_1/c$	16.846(4)	102.19(2)		N	1.997(5, 10)	not given	Br,N	78.7(2, 4.5)	
	2	12.311(3)			μBr	2.358(1)	101.9(0)		92.9(1, 3)	
						3.427(1)			169.4(1, 5)	
								N,N	76.8(2)[c]	
$[Cu(cychol)_2Br_2]_2$	m	15.215(2)		$CuBr_3O_2$	O	1.979(5, 9)	3.766(2)	O,O	78.5(2)[c]	405
(brown)	$P2_1/n$	8.088(3)	106.07(1)		Br	2.398(1)	90.17(4)	O,Br	93.1(1, 3.0)	
	4	15.885(2)			μBr	2.375(1, 23)	89.83(4)		165.6(1, 4.0)	
								Br,Br	96.3(1, 6.5)	
$[Cu(dien)Br]_2(ClO_4)_2$	m	23.054(8)		CuN_3Br_2	N	2.012(4, 17)	3.790(1)	N,N	85.2(2, 1.2)[c]	438
(blue)	C2/c	7.669(1)	116.02(3)		μBr	2.424(1)	not given		160.6(2)	
	8	14.061(9)				2.887(1)	89.37(2)	N,Br	95.0(1, 9)	
									178.8(1)	
$[Cu(maepy)Br_2]_2$	tr	9.545(3)	76.13(2)	$CuBr_3N_2$	Br	2.400(3)	3.803(4)	Br,Br	93.95(8)	439
(green)	P-1	7.015(2)	76.49(2)		N	2.037(4, 9)	92.14(9)		122.21(9)	
	1	9.221(3)	102.12(3)		μBr	2.468(2)	87.86(9)	Br,N	91.8(1, 5.3)	
						2.802(4)			141.6(1)	
									172.8(2)	
								N,N	83.9(2)[f]	

$[Cu(3\text{-ampy})Br_3]_2 \cdot H_2O$	m	19.096(5)		$CuBr_4N$	N	2.070(8)	3.8205(1)	Br,Br	91.7(1, 5)	377
(dark violet)	C2/c	6.729(1)	126.89(1)		Br	2.413(2, 1)	93.4(1)		110.0(1, 8)	
	4	19.499(5)			μBr	2.451(2)	86.6(1)		139.9(1)	
						2.791(2)		Br,N	89.5(3, 3.0)	
									174.7(2)	
$[Cu(dpy)Br_2]_2$	m	8.988(8)		$CuBr_3N_2$	N	2.022(5, 6)	3.869(1)	Br,Br	101.7(3, 7.6)	440
(dark green)	$P2_1/n$	13.933(8)	98.54(4)		Br	2.391(1)	not given	Br,N	92.5(1, 3.8)	
	2	9.795(6)			μBr	2.488(1)	86.2(2)		154.8(1)	
						2.804(1)			176.5(1)	
								N,N	86.0(2)[f]	
$[Cu(4\text{-Meth})_2Br_2]_2$	tr	8.669(4)	97.98(3)	$CuBr_3N_2$	Br	2.420(1)	4.063(2)	Br,Br	93.91(3, 8.07)	441
(green)	P-1	10.985(4)	104.65(3)		N	1.984(5, 6)	94.16(3)	Br,N	91.6(2, 4.8)	
	1	7.495(3)	71.55(4)		μBr	2.492(1)	11.98(3)	N,N	169.2(2)	
						3.033(1)				
$[Cu(Me_4en)Br_2]_2$	m	8.404(2)		$CuBr_3N_2$	Br	2.41(0)	4.20	N,N	85.4(7)[c]	442
(not given)	$P2_1/c$	11.363(2)	102.34(2)		N	2.09(2, 1)	not given	N,Br	92.(6, 4.4)	
	4	11.700(3)			μBr	2.42(0)	84.4(5)		165.8(5, 7.5)	
						3.20(0)		Br,Br	91.4(5, 1.5)	
									104.4(5)	
G:Cu(μ-I)$_2$Cu										
$[Cu(qu)_2I]_2$	m	25.620(6)		CuN_2I_2	N	2.07(2, 1)	3.364(5)	I,N	108.1(6, 5.3)	443
(yellow)	A2/a	7.495(2)	111.60(1)		μI	2.686(4, 1)	77.6(1)	N,N	120.6(8)	
	8	20.314(4)					102.4(1)			
H:Cu(μ-OL)(μ-NL)Cu										
$[Cu_2(Me_4en)_2(N_3)(OH)](ClO_4)_2$	trg	9.5(2)		CuN_3O	N	1.18(4, 1)	2.988(3)		not given	444a
(dark blue)	$P4_2/mnm$	—			μHO	1.915	HO 102.5			
	2	13.94(3)			μN_3	2.015	N_3 95.7			
$[Cu_2(bzsmph)(N_3)(ClO_4)_2]$	or	14.979(8)		CuO_2N_2S	O_3ClO	2.466(9)	3.036(1)	O,S	93.4(4, 2.9)	444b
(not given)	Fdd2	26.247(1)			S	2.330(3)	O 98.4(4)	S,N	91.8(2)[f]	
	8	18.905(1)			N	1.922(8)	N 104.6(5)		162.8(1)	
					μO	2.005(6)	78.5(3)	O,O	87.2(3)	
					μN_3	1.919(7)		O,N	97.2(4, 7)	
									174.2(3)	
								N,N	97.9(3)	
$Cu_2(bzsmph)(\mu\text{-}N_3)(NO_3)_2$	or	12.605(6)		CuO_2N_2S	O_2NO	2.172(7)	3.131(3)	S,O	98.4(2, 6.5)[f]	206
(not given)	Pbcn	14.024(7)			S	2.325(2)	O 106.(4)	S,N	90.7(2)[f]	
	4	17.003(9)			N	1.918(7)	N 100.7(5)		146.3(1)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
					μO	1.960(5)	76.7(3)	O,O	91.4(2)	
					μN_3	2.033(7)		O,N	101.5(2, 5.5)	
									171.2(2)	
								N,N	96.6(3)	
$[Cu_2(C_{36}H_{39}N_6O)(NO)](PF_6)_2 \cdot CH_2Cl_2$	m	11.924(2)		CuN_4O	N	2.019(10, 60)	3.140(1)	O,N	95.9(3, 1.5)[f]	445
(not given)	P2/n	11.352(3)	108.45(2)			2.189(8)	O 108.5(5)		159.5(3)	
	2	18.347(4)			μO	1.935(6)	N 75.1(2)	N,N	94.2(4, 7.6)[f]	
					μN	2.036(10)			113.2(3)	
									151.3(2)	
$[Cu_2(pea)(N_3)](PF_6)_2$	tr	9.583(1)	87.19(1)	CuN_4O	N	2.023(10, 38)	3.185(3)	O,N	94.7(3, 1.3)[f]	446
(not given)	P-1	10.123(2)	88.83(1)			2.173(10, 32)	O 107.(3)		160.3(4, 1.4)	
	2	23.758(4)	84.85(1)		μO	1.970(8, 6)	N 103.6(5)	N,N	94.3(4, 4.4)[f]	
					μN_3	2.026(12, 2)	74.2(4, 2)		103.0(4, 3.8)	
									155.6(5, 1)	
I:Cu(μ-OL)(μ-Cl)Cu										
$[Cu(pnthpy)(OH)Cl_3]$	m	7.6949(1)		CuN_2Cl_2O	Cl	2.288(1)	3.022(1)	Cl,N	94.1(1)	447a
(yellow green)	$P2_1/m$	16.434(2)	107.974(9)		N	2.042(3)	O 101.8(2)		160.2(1)	
	2	7.921(1)			μO	1.946(1)	Cl 72.5(1)	N,N	79.4(1)	
					μCl	2.555(1)		Cl,Cl	107.7(1)	
								N,O	89.2(1)	
								Cl,O	90.8(1)	
$[Cu_2(pyimcres)Cl_3] \cdot 2H_2O$	tr	11.247(3)	90.19(2)	CuN_2Cl_2O	Cl	2.323(2)	3.167(2)	Cl,O	91.4(1, 8.2)	447b
(green)	P-1	9.300(3)	104.73(2)			2.524(2)	Cl 86.87(6)		104.6(1)	
	2	12.291(2)	103.17(2)		N	1.97(5, 43)	O 105.8(2)	Cl,N	95.5(1, 2.2)	
					μO	1.983(4, 5)	83.2(1)		159.3(2)	
					μCl	2.309(2)		O,N	92.4(2)[f]	
						2.017(5)			164.7(2)	
								N,N	82.8(2)[e]	
								Cl,Cl	101.95(8)	
$[Cu_2(sbzph)Cl_3] \cdot MeOH$	or	15.801(5)		$CuCl_2ONS$	Cl	2.350(–, 25)	3.2365[d]		not given	448
(not given)	$Pna2_1$	23.15(1)			S	2.424(–, 36)	O 113.3			
	4	8.190(3)			N	1.978(–, 6)	Cl 86.1			

					μO	1.949(−, 4)	80.0(−, 1)			
					μCl	2.385(−, 0)				
$[Cu_2(bzsmph)Cl]\cdot Cl_2$	or	15.801(5)		$CuCl_2ONS$	Cl	2.347(2, 25)	3.255(1)	Cl,Cl	116.3(1, 7.5)	206
(not given)	$Pna2_1$	23.15(1)			S	2.424(3, 38)	Cl 86.1(0)	Cl,S	107.0(1, 4.2)	
	4	8.190(3)			N	1.980(7, 8)	O 113.4(2)		135.6(0, 3.3)	
					μO	2.384(2, 2)	79.95(1, 15)	Cl,N	97.0(2, 5.6)	
					μCl	1.948(4, 7)		Cl,O	92.2(1, 6)	
								S,O	89.5(1, 7)[f]	
								S,N	88.0(2, 1.6)[f]	
								O,N	166.6(2, 9)	
$[Cu_2(hem)Cl](BPh_4)_2Me_2CO$	tr	10.986(3)	91.11(2)	CuN_3OCl	N	2.019(9, 55)	3.265(10)	O,N	92.8(4, 1.9)[f]	278
(green)	P-1	15.138(3)	99.77(2)			2.155(11, 3)	O 111.4(3)	Cl,N	88.5(2, 4)	
	2	23.292(3)	91.18(2)		μO	1.976(7, 11)	Cl 89.6(1)		103.7(3, 1.1)	
					μCl	2.316(3, 0)	79.5(2, 2)		158.2(4, 2.2)	
								N,N	96(4, 4.0)[f]	
$[Cu_2(amsbph)Cl_3]$	m	11.657(3)		$CuCl_2ONS$	Cl	2.276(2, 26)	3.311(1)	Cl,Cl	93.7(1, 8)	449
(black)	$P2_1/c$	19.647(5)	105.38(2)		N	1.992(6, 2)	O 102.6(2)	O,S	92.0(1, 2.0)[f]	
	4	8.845(2)			μO	1.925(4)	Cl 81.3(1)	O,Cl	94.3(1, 8.0)	
					S	2.355(3, 3)	88.8(1)	N,S	84.7(2, 1.9)[c]	
					μCl	2.323(2)		N,Cl	90.(2, 5.8)	
						2.735(2)			163.6(2)	
								N,O	95.7(2)	
									166.3(2)	
								Cl,S	132.5(1, 2.1)	
									179.4(1)	
J:Cu(μ-OL)(μ-Br)Cu										
$[Cu_2(pmp)Br]Br_2$	tr	7.601(7)	77.10(4)	CuN_2Br_2O	Br	2.413(2)	3.151(2)	Br,Br	96.5(5, 10)	203
(brown)	P-1	11.456(4)	83.88(6)		μBr	2.426(2)	Br 75.50(4)	Br,O	90.8(2, 3.8)	
	2	13.266(8)	76.67(4)			2.707(2)	O 106.2(3)		107.9(2)	
					N	1.977(8, 40)	83.(2, 3.3)	Br,N	93.2(2, 6.4)	
					μO	1.970(6, 25)			102.8(2, 1.3)	
									131.7(3, 2.5)	
									175.5(2)	
								O,N	90.0(3, 2)[f]	
									146.5(3)	
									163.0(3)	
								N,N	82.0(3, 6)[c]	
$[Cu_2(C_{17}H_{22}N_4O)Br]Br_2$	or	11.836(2)		CuN_2Br_2O	Br	2.677(3)	3.245[d]	Br,Br	96.06(9, 5.29)	192
(dark olive)	Pbca	16.543(4)				2.889(3)	not given	Br,O	94.1(3, 8.7)	
	8	23.021(5)			N	2.014(14, 52)	75.6(3)	Br,N	96.1(4, 5.8)	

TABLE II (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°] *μL–Cu–μL* [°]	*L–Cu–L* [°]		*Ref.*
					μBr	2.417(3, 1)			116.4(1)	
					μO	1.972(10, 16)			160.0(4, 7.9)	
								O,N	87.8(5, 1.0)[f]	
									169.8(5)	
								N,N	85.4(6)[c]	
$[Cu_2(hem)Br](PF_6)_2 \cdot 0.5CH_2Cl_2$	m	15.740(4)		CuN_3OBr	N	1.982(34, 27)	3.347(92)	N,N	95.6(14, 3.0)[f]	278
(green)	C2/c	32.033(4)	134.03(2)			2.126(19)	O 114.6(13)	O,N	94.5(14, 1.0)[f]	
	4	13.033(4)			μhemO	1.989(15)	Br 84.8(3)		166.4(10)	
					μBr	2.483(6)	80.3(7)	Br,N	88.6(8)	
									109.4(7)	
									151.9(9)	

[a] When more than one chemically equivalent distance or angle is present, the mean value is tabulated. The first number in parenthesis is the e.s.d., and the second is the maximum deviation from the mean. [b] The chemical identity of the coordinated atom or ligand is specified in these columns. [c] Five-membered metallocyclic ring. [d] The Cu–Cu distance was calculated by us. [e] There are two crystallographically independent molecules. [f] Six-membered metallocyclic ring. [g] There are four crystallographically independent molecules. [h] Seven-membered metallocyclic ring. [i] Four-membered metallocyclic ring.

distance of 2.499(1) Å is again shorter than those found for the CuO_5 and CuO_4N chromophore type (Table IA,B). In the latter a square pyramidal arrangement about each Cu(II) atom is build up by four 3-ethyl-2-pyridonate anions and an apical position is occupied by dmf molecule. The copper–copper distance between two CuO_3N_2 chromophores type is 2.550(1) Å.

In another several species[138–142] two Cu(II) atoms are held together by four bidendate N-donor; ligands in a syn–syn arrangement forming a plane about each Cu(II) atom with water,[139,140] dimethylformamide[138] or chlorine atom[141,142] in an apical position. The mean $Cu-N_{eq}$ bond distance is 2.018 Å, $Cu-O_{ap}$ 2.215 Å and $Cu-Cl_{ap}$ 2.429(6) Å.

In blue–green $Cu_2(fluf)_4(H_2O)(cof)$[143] (Table IF) two Cu(II) atoms are held together by four flufenamate anions in syn–syn arrangements and form an identical equatorial plane about each Cu(II) atom. On the other hand, the apical positions differ; in one Cu(II) is occupied by water ($Cu-OH_2 = 2.141(5)$ Å) and in another by coffeine ($Cu-N = 2.239(5)$ Å). The deviations of the Cu(II) atom from the basal plane O_4 is also different by 0.189 Å toward the water and by 0.223 Å toward to the coffeine.

There are several species[20,24,30,31,56,91,97,127] which contain two crystallographically independent molecules, differing mostly by degree of distortion. The coexistence of two or more species, within the same crystal, differing only by degree of distortion, is typical of the general class of distortion isomerism.[144]

2.2 Doubly-Bridged Cu(II) Dimers

2.2.1 *By Two Single Atom Bridges*

Crystallographic and structural data for over three hundred and sixty doubly bridged Cu(II) dimers are gathered in Table II. The structures are tabulated in the order of increasing covalent radii of a bridging atoms and of increasing distance between the two Cu(II) atoms. Structure of blue $[Cu(\mu\text{-}F)(3\text{-}Mephpz)_2]_2(BF_4)_2$[146] is shown in Figure 2 for example. Each Cu(II) atom is coordinated by two fluorine ions (bridging) and two Mephpz ligands. The mean Cu–F (bridge) bond distance is 1.923(3) Å and Cu–F–Cu bridge angle is 98.9(8)°. Each Cu(II) atom has a square-planar arrangement (CuF_2N_2). The dimeric system seems to be further stabilized by hydrogen bonding of the N-H groups to the fluorine ions. The BF_4^- ions coordinate weakly to the Cu(II) atoms [Cu–F 2.531(5) and 2.693(2) Å]. This coordination may be designated as "semi-coordination". There are six blue

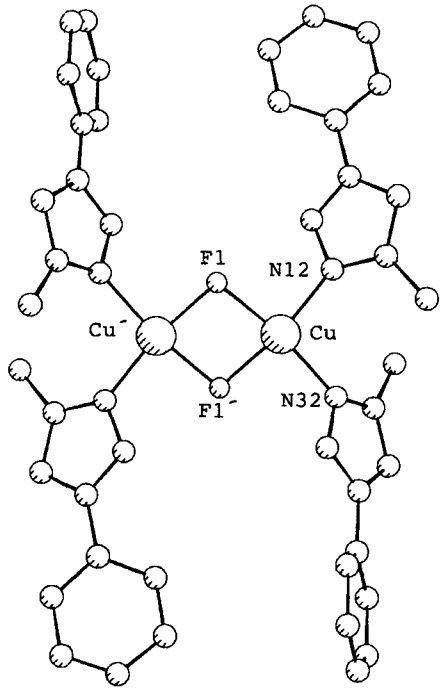


FIGURE 2 Structure of $[Cu(\mu\text{-F})(3\text{-Mephpz})_2]_2^{2+}$ (see Ref. 146).

TABLE IIK Summary of Cu–μL, Cu–L and Cu–Cu distances [Å] for doubly bridged compounds[a]

L	*Cov. rad. of L* [Å]	*Cu–μL*	*Cu–L*	*Cu–Cu*
F	0.72	1.86–2.96(2.10)		2.893–3.444
OL	0.73	1.76–2.62(2.015)	1.90–2.99(2.26)	2.830–3.737
NL	0.75	1.92–2.54(2.06)	1.79–2.33(2.01)	3.042–3.730
Cl	0.99	2.23–3.20(2.45)	2.11–2.78(2.26)	3.011–4.089
SL	1.02	2.27–2.66(2.465)	2.29–2.70(2.49)	2.656–3.588
Br	1.14	2.35–3.20(2.62)	2.24–2.74(2.40)	3.518–4.20
I	1.33	2.68	2.55–3.03(2.77)	3.364

[a] The mean values are given in parenthesis.

examples[145–149] in which the bridging involves two fluorine atoms. In each complex cation both Cu(II) atoms are identically coordinated. For example, in $[Cu(\mu\text{-F})(3\text{-Mephpz})_2]_2^+$ (see Ref. 146) a distorted square planar environment containing two *cis*-pairs atoms, nitrogen and fluorine is shown. In another four examples[145,147,148] a trigonal-bipyramidal environment containing two fluorine atoms with one nitrogen in a plane and two apical

positions are occupied by another two nitrogen donor ligands. In the remaining complex cation, $[Cu(\mu\text{-}F)(tmpa)]_2^+$ (see Ref. 149) a *pseudo*-octahedral coordination about each Cu(II) atom is built up by one tetradentate N-macrocyclic ligand and by two fluorines with the chromophore CuN_4F_2. The Cu–Cu distance in this series range from 2.893(4) Å[145] to 3.444(1) Å.[149] There are relationships between the Cu–Cu distances, the Cu–F–Cu angles and the μF–Cu–μF angles. The first increases as the second opens and the third closes, for example: 2.893(4) Å, 91.1° and 88.9(3)°,[145] 2.9962(9) Å, 93.73(8)° and 86.27(8)°,[147] 3.014(8) Å, 94.59(7)° and 85.41(7)°,[147] 3.131(1) Å, 97.19(8)° and 82.81(8)°.[148]

There are over two hundred and twenty derivatives in which two O-donor; ligands, serve as bridges between two Cu(II) atoms.[150–336] Mostly are green and blue of color, but there are also violet, purple, yellow, brown and even black. By far prevail examples, in which both Cu(II) atoms are identically coordinated; four-coordinated,[159,160,162,163,167,172,176,181,184,185,189–191,194,197,199,201,205,207–210,212,213,215,218,222,223,228–231,233,236–238,241–246,251,253,254,260,262,263,265,272–275,284,286–288,310,321] five-coordinated,[150,151,154–158,161,164–166,168,169,171,173,179,180,183,186–188,193,195,198,200,204,206,211,214,216,217,219–221,224–227,232,235,239,240,247–249,252,255–259,261,264,266–270,273,276–281,283,289–302,304,305,307–310,312,314,315,317–320,323–333,336] six-coordinated[152,153,170,174,175,250,282,303,306,311,313,316,322,334] and even seven-coordinated.[335] There are examples, which contain two non-equivalent Cu(II) atoms; one four- and the other five-coordinated,[163,172,178,182,192,196,265,185] one five- and the other six-coordinated;[203,271] one four- and the other six-coordinated.[222,234,244] There are examples[212,265] which contain two different chromophores, CuO_2N_2 and CuO_2Cl_2 in the same dimer unit. Two crystallographically independent molecules within the same crystal have been found in several species[154,195,222,234,301,327] and four such molecules are present in $[Cu_2(\mu\text{-hepra})Cl]_2$.[164] All these differ mostly by degree of distortion and are examples of distortion isomerism.[144]

The Cu–Cu distance in the series of doubly O-bridged derivatives, range from 2.830(2) Å[150] to 3.737 Å.[336] There is a cooperative effect between the Cu–Cu distance, the Cu–O–Cu and μO–Cu–μO angles. The Cu–Cu distance elongated with an opening of the Cu–O–Cu angle and at same time the μO–Cu–μO angle is closed (Table II).

There are eleven examples[337–348] in which two N-donor; ligands serve as a bridge. In two four-coordinated Cu(II) atoms two azide groups are doubly bridged.[337,339] In another six examples[338,340,342–347] there are two penta-coordinated Cu(II) atoms and in the remaining three derivatives[341,346,348] two hexacoordinated Cu(II) atoms are present. The Cu–Cu distance in this

series range from 3.042(3) Å[333] to 3.730(3) Å.[348] The Cu–N–Cu and μN–Cu–μN angles range from 83.5 to 103.7° and from 76 to 94°, respectively.

There are almost eighty examples (Table II) in which two tetracoordinated,[349–363,366,368–370,372,373,375,379,387,407,418] two pentacoordinated,[300, 317, 364, 367,371,374,376,377,380,383–386,388–390,392–397,399–406,408–417,419,423] or two hexacoordinated Cu(II) atoms are doubly bridged by two chlorine atoms. There are examples which contain two non-equivalent Cu(II) atoms, $CuCl_4$ with $CuCl_3O$[350,369] and CuN_3Cl_2 with $CuCl_3N_2$.[364] Green $[Cu(N_3bz)_2Cl_2]_2 \cdot H_2O$,[386] contains two crystallographically independent molecules, differing mostly by degree of distortion. The Cu–Cu distance ranges from 3.011(2) Å[349] to 4.089(4) Å.[423] The Cu–Cu distances and Cu–Cl–Cu and μCl–Cu–μCl are independent.

There is an example, $[Cu(C_{14}H_{16}N_2OS)]_2$[424] in which two tetracoordinated Cu(II) atoms are doubly bridged by two sulfur donor ligands, and the remaining two positions are occupied by O and N donor atoms of the same macrocyclic ligands. The Cu–Cu distance of 2.656(2) Å is the shortest found in the series of doubly-bridged Cu(II) dimers. In another three derivatives[425–427] two bridging sulfur donor ligands bring the Cu(II) atoms within 3.049(3) Å,[425] 3.451(2) Å[426] and 3.588(1) Å.[427]

When two bromine atoms serve as a bridge between two Cu(II) atoms,[377,388,405,428–442] the Cu–Cu distance ranges from 3.518(3) to 4.20 Å which ruled out metal–metal bond.

Two iodine atoms which held together two tetrahedrally coordinated Cu(II) atoms in yellow $[Cu(qu)_2I]_2$[443] bring the Cu(II) atoms within 3.364(5) Å with Cu–I–Cu angles of 77.6(1)°.

There are twelve derivatives in which pairs of pentacoordinated Cu(II) atoms are doubly bridged by two heteroligands, oxygen and nitrogen,[206,444–446] oxygen and chlorine,[206,278,447–449] and oxygen and bromine.[192,203,271] The Cu–Cu separations ranging from 3.036(1) to 3.185(3) Å in the first series, from 3.167(2) to 3.311(1) Å, in the second series, and from 3.151(2) to 3.3473(92) Å in the third one. These separations ruled out metal–metal bond. The mean Cu–L–Cu bond angle opens with a decreasing covalent radius of the L (in the parenthesis) in the order: 75.2° (L = Br, 1.14 Å) < 86.0° (Cl, 0.99 Å) < 103.0° (N, 0.75 Å) < 108.0° (O, 0.73 Å).

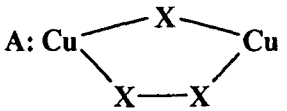
Inspection of the data in Table II reveals that the ligands involved are mono- through heptadentate, the most common being the O- and N-donor ligands. The mean Cu–L bond distance in the series of monodentate ligands increases in the sequence: 2.01 Å (NL) < 2.26 Å (OL) < 2.265 Å (Cl) < 2.40 Å (Br) < 2.77 Å (I). The multidentate ligands include both

homo- and hetero-donor atoms, with O- and N-donors being by far the most common. The Cu–L bond distances for the homo-bidentate ligands increase in the order: 2.03 Å (NL) < 2.13 Å (OL) < 2.41 Å (SL). Noticeable, in the series of hetero-bidentate ligands (O plus N, O plus S, N plus S, and O plus Cl), O donor atoms "prefer" only bridge positions with the mean Cu–L bond distances which increase in order: 1.97 Å (μ-OL) < 2.015 Å (NL) < 2.34 Å (SL) < 2.98 Å (Cl). Tridentate ligands include those with two O plus one N, one O plus N, two N plus S; O plus N plus S, three O, and those with three N-donor; sites. The mean Cu–L bond distances homo- *vs.* hetero-tridentate ligands are: 1.95 *vs.* 1.97 Å (μ-OL), 1.91 *vs.* 2.02 Å (OL), 2.06 *vs.* 2.02 Å (NL), and 2.32 Å (SL). The tetradentate are either three O plus N, one O plus three N, two O plus two N, and those with four N-donor; sites, with the mean Cu–L bond distances of 2.02 Å (OL), 2.11 Å (μ-OL), 2.04 Å (N-heteroL) and 2.15 Å (N-homoL). Pentadentate ligands include one O plus four N, and one O plus two N plus two S- donor sites, with the mean Cu–L bond distance of 1.96 Å (μ-OL), 1.99 Å (NL) < 2.36 Å (SL). The hexadentate ligand contains four O plus two N-donor; sites. The heptadentates are either one O plus six N, and one O plus N plus four S-donor sites. The effects of both electronic and steric factors are observed in the values of the L–Cu–L bond angles of the metallocyclic rings. In four-membered rings the mean L–Cu–L intra-ligand angles range from 52.7 to 56.7° (mean 55.0°, O-donor;) and 76.5 and 77.2° (S-donor). For the five-membered rings the values are: from 77.4 to 84.0° (mean 81.5°, O-donor;), 76.0 to 90° (mean 83.2°, N-donor;), 82.2 to 89.0° (mean 87.3°, S-donor), 74.1 to 96.2° (mean 83.5°, O + N-donor;), 84.0 to 85.8° (mean 85.0°, O + S-donor), and 83.2 to 88.2° (mean 85.0°, N + S-donor). For six-membered rings, the values are from 77 to 95° (mean 90.5°, O-donor;), 84 to 100.3° (mean 94.5°, N-donor;), 84.5 to 100° (mean 93.5°, O + N-donor;), 89.5 to 98.5° (mean 93.8°, O + S-donor) and 88 to 93.2° (mean 91.5°, N + S-donor).

Noticeable, at the same Cu–Cu distance, the mean Cu–L–Cu bond angles are closed and μL–Cu–μL bond angles are open with an increased covalent radius of L. For example: 3.0141(8) Å, 94.59(7) and 85.41(7)° (L = F, 0.72 Å),[147] 3.011(3) Å, 91.1(6) and 88.9(6)° (O, 0.73 Å),[222] 3.011(2) Å, 80.6(2) and 99.6(2)° (Cl, 0.99 Å),[349] 3.049(3) Å, 75.9(1) and 104.1(1)° (S, 1.02 Å);[425] 3.557(4) Å, 104.8(1) and 75.2(1)° (O, 0.73 Å),[333] 3.558(1) Å, 89.8 and 90.2° (N, 0.75 Å),[400] 3.5445(7) Å, 81.04(2) and 98.96(2)° (Br, 1.14 Å).[429]

Summaries of the Cu–μL, Cu–L and Cu–Cu distances for doubly-bridged Cu(II) dimers are presented in Table IIK.

TABLE III Crystallographic and structural data for unsymmetrically doubly bridged copper(II) dimers[a]

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]	*L–Cu–L* [°]		*Ref.*
A: 										
$[Cu_2(\mu\text{-OH})(\mu\text{-papfs})(NO_3)_2 \cdot (H_2O)]NO_3$	tr	7.8064(11)	69.857(8)	CuO_3N_2	$(NO_3)O$[b]	1.999(7)	3.156(2)	O,N[b]	92.0(3, 1.8)	450
	P-1	12.9137(14)	80.074(10)			2.489(7)	113.7(3)		104.0(3)	
(bluish green)	2	14.8564(14)	83.659(11)		N	1.985(7, 8)			165.7(3, 6.4)	
					μHO	1.880(6)		O,O	55.6(3)[c]	
									92.5(3, 3.9)	
								N,N	89.6(3)[d]	
				CuO_4N_2	$(NO_3)O$	2.056(6)		O,N	93.7(3, 8.2)	
						2.560(7)			155.8(3)	
					H_2O	2.565(9)			176.9(3)	
					N	1.955(7)		O,O	54.3(3)[e]	
						2.012(7)			85.7(3, 6.4)	
					μHO	1.889(6)			117.0(3)	
									167.6(3)	
								N,N	89.2(3)[d]	
$[Cu_2(\mu\text{-sb})(\mu\text{-2-Opy})]$	m	23.808(7)		CuO_2N_2	sbO	1.908(9)	3.249(2)	O,O	168.1(4)	451
(green)	$P2_1/n$	8.353(2)	92.57(3)		sbN	1.937(9)	113.2(4)	N,O	86.2(3)[e]	
	4	9.548(4)			2-OpyN	2.002(9)			91.1(4, 7)	
					sbμO	1.948(7)			93.8(4)[d]	
								N,N	169.4(4)	
				CuO_3N	2-OpyO	1.939(7)		O,O	90.3(3, 2.9)	
					sbO	1.908(8)			177.9(3)	
					sbN	1.935(9)		N,O	85.9(3)[e]	
					sbμO	1.944(7)			93.8(4)[d]	
									173.1(4)	

$[Cu_2(\mu\text{-phtN}_6)(\mu\text{-OH})(H_2O)_2]\cdot(ClO_4)_2\cdot H_2O$ (brown)	m $P2_1/n$ 4	8.011(2) 24.100(5) 15.675(2)	100.24(2)	CuN_3O_2	N H_2O μHO	1.941(8, 44) 1.982(8, 48) 2.385(8, 68) 1.925(6, 25)	3.296(2) 117.8(3)	O,N N,N O,O	96.8(4, 8.56) 166.1(3, 4) 79.3(3, 1.9)[e] 157.8(3, 1.1) 91.5(4, 3.5)	452
$[Cu_2(\mu\text{-L-Et})(\mu\text{-NO}_2)](ClO_4)_2$ (green)	m $P2_1/n$ 4	14.229(3) 22.683(6) 15.913(4)	98.92(2)	CuN_4O	O_2N N μO	1.96(1) 2.07(1, 1) 1.87(1)	3.325(2) 127.1(5)	O,N N,N O,N	83.6(4)[e] 86.2(5) 123.6(5, 2) 82.3(4, 1.2) 105.1(5, 3.0) 169.6(5) 84.3(4)[e]	453
				CuN_3O_2	ONO N μO	2.02(1) 2.06(1, 5) 1.85(1)		 O,O N,N	103.3(5, 2.2) 127.0(5, 9) 170.4(5) 86.2(5) 82.6(4, 1.2)[e] 101.7(4)	
$[Cu_2(\mu\text{-sdp}_2)(\mu\text{-pz})]$ (violet)	m $P2_1/c$ 4	12.579(3) 13.970(3) 11.097(2)	104.52(2)	CuO_2N_2	pzN O N μO	1.939(−, 6) 1.870(−, 23) 1.950(−, 3) 1.918(−, 0)	3.349 121.7	O,N O,O N,N	82.6(−, 0)[e] 94.0(−, 2)[d] 95.2[d] 175.0(−, 1.5) 165.0(−, 1.3)	454
$[Cu_2(\mu\text{-sdap})(\mu\text{-pz})]\cdot H_2O$ (purple)	or Pbcn 8	14.983(2) 8.276(5) 31.163(4)		CuO_2N_2	pzN N O μO	1.937(15,24) 1.927(14,3) 1.903(13,15) 1.892(14,4)	3.359(4) 125.1(7)	N,O O,O N,N	83.3(6, 3)[e] 95.0(6, 3)[d] 94.8(6, 1.1) 174.5(7, 1.9) 169.5(7, 5)	455
$[Cu_2(\mu\text{-sdb})(\mu\text{-pz})]$ (purple)	m $P2_1/c$ 4	11.813(6) 18.049(6) 9.680(4)	105.67(4)	CuO_2N_2	pzN O N μO	1.946 1.900 1.960 1.914	3.360 121.8	O,N O,O N,N	90.1(−, 3.4)[d] 90.9(−, 2.6) 173.1(−, 7) 169.8(8, 1.8)	456

TABLE III (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-dpp})(\mu\text{-OH})(NO_3)Cl_2]\cdot$	tr	14.500(3)	84.8(1)	CuO_2N_2Cl	N	2.014(11,26)	3.361(4)	Cl,O	92.3(6, 2.4)	457
$[Cu_2(\mu\text{-dpp})(\mu\text{-OH})(NO_3)Cl_2]_2\cdot$	P-1	13.049(3)	110.1(1)		Cl	2.211(4)	124.0(5)		113.9(6)	
$1.5H_2O$[f]	2	10.874(2)	110.5(1)		O_2NO	2.72(4)		Cl,N	100.2(3)	
(green)					μHO	1.893(1)			175.4(4)	
								O,N	70.0(7)	
									89.5(8, 5.8)	
									164.0(4)	
								O,O	94.5(8, 1.3)	
								N,N	77.6(4)[e]	
				CuO_2N_2Cl	N	1.984(10,11)		Cl,O	99.7(3, 4.1)	
					Cl	2.230(4)		Cl,N	98.3(3)	
					H_2O	2.343(13)			173.4(4)	
					μHO	1.914(9)		O,N	86.3(5, 4.0)	
									162.0(4)	
								O,O	97.6(4)	
								N,N	78.8(4)[e]	
$[Cu_2(\mu\text{-dpp})(\mu\text{-OH})(H_2O)Cl_3]$	tr	10.240(7)	90.0(1)	CuO_2N_2Cl	N	2.006(7, 6)	3.376	O,Cl	94.9(2)	458
(greenish blue)	P-1	11.245(9)	114.1(1)		Cl	2.196(3)	not given		103.3(2)	
	2	8.521(6)	102.3(1)		H_2O	2.359(8)		O,N	90.6(3, 5.8)	
					μHO	1.887(7)			163.6(3)	
								N,N	78.8(3)[e]	
								N,Cl	99.0(2)	
									167.0(2)	
								O,O	88.8(3)	
				CuN_2Cl_2O	N	2.016(8, 12)		O,Cl	94.5(2, 1.2)	
					Cl	2.220(3)		O,N	85.4(3)	
						2.611(3)			162.4(3)	
					μHO	1.893(7)		N,N	78.3(3)[e]	
								N,Cl	88.8(2, 1)	
									100.1(2)	
									162.3(2)	
								Cl,Cl	109.0(1)	

$[Cu_2(\mu\text{-ppdme})(\mu\text{-OH})Cl_2]\cdot$	m	7.4942(4)		CuN_2OCl	N	2.003(7)	3.384(2)	O,N	85.6(3)	459
$[CuCl_3(H_2O)]\cdot H_2O$[g]	Am	20.418(1)	90.93(1)		Cl	2.229(2)	126.0(5)		164.4(3)	
(deep green)	2	7.5091(5)			μHO	1.898(4)		N,N	78.8(3)[e]	
						2.006(6)		N,Cl	103.1(2)	
									172.3(2)	
								Cl,O	92.4(2)	
				$CuCl_3O$	Cl	2.252(3)				
				(monomer)	H_2O	1.963(13)				
$[Cu_2(\mu\text{-ibpd})(H_2O)](ClO_4)_2$	m	11.909(4)		CuN_4O	N	1.973(7, 33)	3.390(7)	N,N	81.8(3)[e]	460
(violet)	$P2_1/c$	13.084(3)	95.4(2)		H_2O	2.721(8)	not given		93.1(3, 2.4)[d]	
	4	15.909(2)			μN	1.939(6, 23)			91.1(2)	
				CuN_3O	N	2.021(7, 30)		O,N	86.8(2, 2.8)	
					O	1.961(5)		N,N	93.4(3, 2.4)[d]	
					μN	1.906(6)				
$[Cu_2(\mu\text{-sdp}_3)(\mu\text{-pz})]$	m	19.279(5)		CuO_2N_2	pzN	1.935(–, 12)	3.401	O,N	87.9(–, 2.9)[e]	454
(green)	$P2_1/a$	9.021(2)	98.83(2)		O	1.907(–, 4)	121.3		93.0(–, 2.4)[d]	
	4	11.945(3)			N	1.937(–, 3)		O,O	168.0(–, 1.2)	
					μO	1.952(–, 10)		N,N	170.3(–, 5.4)	
$[Cu_2(\mu\text{-OMe})(\mu\text{-ONO})(NO_2)_2\cdot$	m	16.633(8)		CuO_3N_2	bpyN	2.041(6, 11)	3.403(1)	O,O	49.5(2)[c]	461
$(bpy)_2]$	C2/c	8.320(6)	114.6(1)		O_2NO	2.634(8)	123.2(3)		90.8(2, 2.6)	
(deep green)	4	18.986(9)			μMeO	1.934(3)		N,N	80.2(2)[e]	
					μONO	2.074(6)			96.3(3, 3.4)	
					μO_2N	2.177(13)		O,N	91.4(3, 3.4)	
									130.2(3, 7.3)	
									168.7(2)	
$[Cu_2(\mu\text{-ppd})(\mu\text{-OH})(H_2O)Br_3]\cdot$	tr	7.7381(20)	98.14(2)	CuO_2N_2Br	N	2.003(8, 1)	3.413(2)	O,N	87.1(2, 5.2)	462
$0.6H_2O$	P-1	10.1462(23)	93.93(3)		Br	2.334(2)	118.9(1)		167.0(2)	
(dark green)	2	11.151(4)	90.93(2)		H_2O	2.861(2)		N,N	77.7(3)[e]	
					μHO	1.983(1)		N,Br	97.4(2)	
									174.0(2)	
								Br,O	95.2(1, 4)	
								O,O	89.8(1)	
				CuN_2Br_2O	N	2.003(8, 6)		O,N	88.8(2)	
					Br	2.361(2)			163.0(2)	
						2.856(2)		N,N	77.1(3)[e]	
					μHO	1.981(1)		N,Br	92.6(2, 5.3)	
									166.0(2)	

TABLE III (*Continued*)

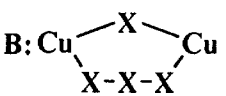
Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]	*L–Cu–L* [°]		*Ref.*
								Br,O	96.0(1, 2.0)	
								Br,Br	103.1(1)	
$[Cu_2(\mu\text{-mip})(\mu\text{-OH})(H_2O)Br_3]\cdot H_2O$ (dark green)	m $P2_1/n$ 4	10.175(7) 21.478(5) 10.198(8)	97.41(2)	CuO_2N_2Br	N	2.016(10,11)	3.420(2)	O,N	92.2(4, 6.7)	462
					H_2O	2.276(2)	124.9(4)		163.8(4)	
					Br	2.378(3)		N,N	78.6(5)[e]	
					μHO	1.936(7)		N,Br	97.3(3)	
									160.0(3)	
								O,Br	99.6(3, 3.1)	
								O,O	91.5(2)	
				CuN_2Br_2O	N	2.028(11,33)		O,N	85.5(4)	
					Br	2.380(2)			159.2(4)	
						2.843(3)		N,N	78.3(5)[e]	
					μHO	1.921(8)		N,Br	92.0(3, 7.1)	
									173.1(3)	
								Br,O	97.7(3, 7)	
								Br,Br	100.3(1)	
$[Cu_2(\mu\text{-ppd})(\mu\text{-OH})(H_2O)Cl_3]\cdot 0.8H_2$ (green)	tr P-1 2	7.6810(6) 9.9823(6) 10.7380(9)	96.83(1) 93.28(1) 91.50(1)	CuO_2N_2Cl	N	2.008(3, 15)	3.454(2)	O,N	87.4(1, 6.2)	462
					H_2O	2.783(1)	116.4(1)		167.5(1)	
					Cl	2.208(1)		N,N	77.8(1)[e]	
					μHO	2.028(1)		N,Cl	95.8(1)	
									171.5(1)	
								Cl,O	95.0(1, 1.6)	
								O,O	90.2(1)	
				CuN_2Cl_2O	N	2.009(3, 12)		O,N	89.7(1)	
					Cl	2.225(1)			165.1(3)	
						2.729(1)		N,N	77.4(1)[e]	
					μHO	2.034(1)		N,Cl	92.3(1, 3.9)	
									166.3(1)	
								Cl,O	95.6(1, 8)	
								Cl,Cl	102.6(1)	

$[Cu_2(\mu\text{-LS})(\mu\text{-pz})(MeO)]$[h] (brown purple)	m $P2_1/c$ 8	15.887(5) 12.714(4) 29.178(6)	91.81(2)	CuN_2OS	pzN O N μS	1.90(1) 1.93(1) 1.95(1) 2.227(5)	3.474(3) 101.5(2)	S,O S,N O,N N,N	168.4(1) 91.7(4, 2) 81.1(5)[e] 95.5(5) 176.5(5)	463
				CuO_2N_2S	pzN O N MeO μS	1.92(1) 1.94(1) 1.95(1) 2.39(1) 2.258(5)		S,O S,N O,N N,N O,O	105.6(3) 160.3(4) 89.7(4, 1.6) 81.9(5)[e] 93.1(5, 5.4) 179.2(6) 93.0(4)	
				CuN_2OS	pzN O N μS	1.94(1) 1.92(1) 1.95(1) 2.236(5)	3.424(3) 99.5(2)	S,O S,N O,N N,N	165.6(4) 91.9(4, 8) 80.5(5)[e] 96.8(5) 176.0(6)	
				CuO_2N_2S	pzN O N MeO μS	1.94(1) 1.91(1) 1.93(1) 2.40(1) 2.251(5)		S,O S,N O,N N,N O,O	96.0(3) 157.8(4) 90.6(4, 8) 81.5(5)[e] 93.2(6, 3.4) 176.1(5) 105.4(5)	
$[Cu_2(\mu\text{-mip})(\mu\text{-OH})(H_2O)Cl_3]\cdot H_2O$ (green)	m $P2_1/n$ 4	10.063(1) 20.967(1) 9.919(1)	96.48(1)	CuN_2Cl_2O	N Cl μHO	2.026(4, 23) 2.247(1) 2.679(2) 1.919(3)	3.425(1) 126.3(2)	O,Cl N,Cl O,N N,N	98.6(1, 2.6) 93.1(1, 6.8) 172.0(1) 84.4(1) 157.6(1) 78.4(1)[e]	464
				CuO_2N_2Cl	N Cl H_2O μHO	2.021(4, 18) 2.235(1) 2.286(4) 1.921(3)		O,Cl N,Cl O,O O,N N,N	100.7(1, 3.5) 97.5(1) 160.4(1) 91.5(1) 91.3(1, 6.5) 162.7(1) 78.3(1)[e]	

TABLE III (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-boaep})(\mu\text{-}N_3)(Me_5dien)\cdot(ClO_4)]ClO_4$ (dark green)	tr P-1 2	16.880(8) 11.488(4) 8.769(2)	106.04(2) 83.78(2) 95.99(3)	CuN_4O	N O_3ClO $N_3\mu N$	1.933(13,30) 2.39(1) 1.969(10)	3.449(3) 112.4(5)	N,N N,O	84.2(5, 5.2)[e] 101.9(5, 9.0) 166.5(5, 1.8) 94.5(5, 7.8)	465
				CuN_4O	diendtN boaepO $N_3\mu N$	2.045(13,7) 1.935(10) 2.179(10)		N,N N,O	85.2(5, 1.6)[e] 101.1(5) 148.1(5) 90.3(5, 3.2) 165.0(4)	
$[Cu_2(\mu\text{-dpp})(\mu\text{-Cl})Cl_3(H_2O)]$ (green)	m $P2_1/c$ 4	9.809(1) 9.212(1) 19.316(2)	 100.4(1)	$CuCl_3N_2$	N Cl μCl	2.022(9, 16) 2.228(3) 2.500(3) 2.239(3)	3.51 106.1(1)	Cl,Cl Cl,N N,N	97.1(1, 6.7) 96.4(3, 3.5) 161.1(3, 5.2) 78.8(3)[e]	466
				CuN_2Cl_2O	N Cl H_2O μCl	1.991(9, 15) 2.195(4) 2.313(7) 2.223(3)		O,Cl O,N Cl,N N,N Cl,Cl	99.8(2, 5.2) 91.8(3, 3) 93.3(3, 2.6) 165.4(3, 3.0) 79.2(3)[e] 92.1(1)	
$[Cu_2(\mu\text{-dpp})(\mu\text{-Cl})Cl_3(H_2O)]\cdot H_2O$ (yellow green)	tr P-1 2	11.685(6) 10.003(6) 8.570(5)	66.94(8) 78.86(8) 83.07(8)	$CuCl_3N_2$	Cl N μCl	2.200(4) 2.641(4) 2.027(19,19) 2.130(6)	3.51 109.5(2)	Cl,Cl Cl,N N,N	97.8(2, 8.9) 92.2(3, 5.1) 165.6(3, 1.1) 79.7(4)[e]	467
				CuN_2Cl_2O	N Cl H_2O μCl	2.038(10,11) 2.170(4) 2.386(9) 2.168(6)		O,Cl O,N Cl,N N,N Cl,Cl	97.4(3, 5.7) 94.0(3, 3.4) 93.2(3, 2.6) 166.8(3, 6) 80.3(4)[e] 91.0(2)	

$[Cu_2(\mu\text{-pz})(\mu\text{-Br})(dien)](ClO_4)_2 \cdot H_2O$[e]	tr	23.294(10)	92.50(2)	CuN_4Br	N	2.028(13,14)	3.752(2)	Br,N	88.3(3, 8)	468
	P-1	14.084(5)	92.07(2)		pzN	1.960(10,6)	87.1(1)		100.0(3, 2.7)	
(violet blue)	4	7.750(2)	90.98(2)		μBr	2.723(2, 33)		N,N	83.8(5, 2.4)[c]	
									94.9(5, 2.0)	
									154.4(4, 1.7)	
									173.4(4, 1.2)	
				CuN_4Br	N	2.033(16,31)	3.769(3)	Br,N	93.6(4, 3.1)	
					pzN	1.956(12,3)	89.0(1)		102.5(5, 5.1)	
					μBr	2.688(3, 15)		N,N	83.3(6, 5)[e]	
									95.0(5, 1.5)	
									152.7(6, 1.9)	
									171.9(6, 3)	



$[Cu_2(\mu\text{-OH})(\mu\text{-prop})(phen)_2] \cdot (NO_3)_2 \cdot H_2O$	m	7.981(10)		CuO_2N_2	μHO	1.918(3, 1)	3.015(2)	O,O	95.5(1, 1)	469
	$P2_1/n$	18.352(8)	97.98(7)		propO	1.938(4, 2)	103.6(2)	N,N	81.5(1, 1)[e]	
(deep blue)	4	19.247(8)			phenN	2.016(4, 5)		O,N	91.1(2, 2.3)	
									168.8(2, 5.6)	
$[Cu_2(\mu\text{-HO})(\mu\text{-ac})(phen)_2] \cdot (NO_3)_2 \cdot H_2O$	m	8.107(10)		CuO_2N_2	μHO	1.923(3, 1)	3.017(2)	O,O	95.6(1, 6)	469
	$P2_1/n$	18.554(9)	99.14(6)		acO	1.934(3, 1)	103.4(2)	N,N	81.5(2, 1)[e]	
(deep blue)	4	18.616(7)			phenN	2.028(4, 11)		O,N	91.0(1, 2.6)	
									166.0(1, 7.9)	
$[Cu_2(\mu\text{-ac})(\mu\text{-dpepd})]$	tr	13.398(8)	111.92(2)	CuO_3N	acO	1.933(6, 2)	3.129(2)	O,N	85.1(3, 3)[e]	470
(green blue)	P-1	16.024(5)	116.50(2)		O	1.915(9, 24)	109.1(3)		91.2(3, 8)[d]	
	2	11.691(3)	64.09(3)		N	1.908(6, 8)			170.5(4, 4.8)	
					μO	1.921(7, 18)		O,O	90.1(3, 4)	
									172.4(3, 4.0)	
$[Cu_2(\mu\text{-bz})(\mu\text{-deamp})]PF_6$	m	14.504(7)		CuO_3N_2	bzO	1.972(9, 23)	3.297(3)		not given	471
(green)	$P2_1/c$	13.667(6)	90.23(2)			2.123(10,16)	112.0(3)			
	4	21.563(7)			N	2.045(14,43)				
					μO	1.989(10,13)				

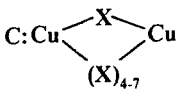
TABLE III (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]	*Ref.*
$[Cu_2(\mu\text{-ac})(\mu\text{-tp})(H_2O)]\cdot 0.5dmf$	tr	8.662(1)	83.27(1)	CuO_3N_2	acO	1.963(3)	3.416		not given	472
(blue)	P-1	10.010(1)	73.61(1)		H_2O	2.344(4)	129.2(2)			
(at 173 K)	2	12.833(2)	79.35(1)		N	1.958(4, 45)				
					μO	1.907(4)				
				CuO_2N_2	acO	1.923(4)			not given	
					N	1.946(5, 47)				
					μO	1.874(3)				
$[Cu_2(\mu\text{-ac})(\mu\text{-L-Et})](ClO_4)_2$	m	14.190(3)		CuN_3O_2	acO	1.92(2, 1)	3.459(2)	O,N	84.2(4, 0)[e]	473
(green)	$P2_1/n$	22.707(4)	97.20(2)		N	2.06(1, 7)	130.6(5)		99.1(4, 3.1)	
	4	15.883(4)			μO	1.91(1, 1)			123.0(4, 5.4)	
									178.1(4, 1.7)	
								N,N	81.1(4, 6)[e]	
									108.4(4, 5.1)	
								O,O	95.5(4, 3)	
$[Cu_2(\mu\text{-2,6-Me}_2PhCO_2)(\mu\text{-sb})]$	or	16.427(3)		CuO_3N	$phCO_2O$	1.938(6, 13)	3.469(3)	O,O	86.6(3, 1)	474
(not given)	Pbca	13.920(2)			O	1.898(7, 2)	130.8(3)		93.6(2, 1)	
	8	20.333(3)			N	1.915(8, 2)			178.7(4, 6)	
					μO	1.908(6, 1)		O,N	85.9(3, 5)[e]	
									94.2(3, 2)[d]	
									172.1(3, 1.0)	
$[Cu_2(\mu\text{-PhCO}_2)(\mu\text{-sb})]$	m	20.778(7)		CuO_3N	$PhCO_2O$	1.933(5, 3)	3.482(1)	O,O	90.5(2, 3.3)	474
(not given)	$P2_1/a$	7.486(2)	109.60(3)		O	1.901(4, 1)	132.2(3)		93.5(2, 1)	
	4	14.137(4)			N	1.912(7, 4)			172.6(2)	
					μO	1.904(4, 8)		O,N	84.9(2, 6)[e]	
									95.4(2, 1)[d]	
									170.9(3, 3.8)	

$[Cu_2(\mu\text{-}PhCO_2)(\mu\text{-dpba})]H_2O$	m	18.234(2)		CuO_3N	$PhCO_2O$	1.945(6, 9)	3.482(2)	O,N	84.5(3, 8)[e]	470
(green blue)	$P2_1/c$	11.478(2)	100.09(1)		O	1.904(6, 21)	132.7(3)		94.4(3, 6)[d]	
	4	10.327(1)			N	1.920(7, 5)			172.9(3, 1.3)	
					μO	1.901(6, 17)		O,O	89.2(2, 5.2)	
									178.4(3, 3)	
$[Cu_2(\mu\text{-ac})(\mu\text{-dpba})]MeOH$	or	18.196(5)		CuO_3N	acO	1.935(9, 16)	3.495(3)	O,N	86.1(4, 5)[e]	470
(green blue)	Pbca	22.636(5)			N	1.938(10,8)	134.5(4)		92.2(4)[d]	
	8	9.731(1)			O	1.860(10,8)			173.8(5, 2.0)	
					μO	1.895(9, 18)		O,O	89.9(4, 4.1)	
									175.0(4, 5)	
$[Cu_2(\mu\text{-}Ph_2MeSiCO_2)(\mu\text{-ac})]$	or	16.444(2)		CuO_3N	Ph_2SiCO_2	1.945(3, 30)	3.502(1)	O,O	86.2(1, 2)	474
(not given)	Pbca	27.558(3)			O	1.907(3, 6)	133.6(2)		94.5(1, 1)	
	8	12.485(2)			O	1.923(3, 11)			176.2(1, 3)	
					N	1.905(3, 2)		O,N	85.4(1, 8)[e]	
					μO				94.7(1, 2)[d]	
									175.4(1, 2)	
$[Cu_2(\mu\text{-ac})(\mu\text{-sb})]\cdot H_2O$	m	17.716(3)		CuO_3N	acO	1.938(6, 8)	3.502(2)	O,N	85.5(3, 7)[e]	475
(dark blue)	$P2_1/n$	13.147(3)	92.91(1)		O	1.898(6, 5)	133.3(3)		94.5(3)[d]	
	—	7.716(1)			N	1.961(7, 25)			171.9(3, 2.4)	
					μO	1.908(6, 6)		O,O	85.6(3, 1)	
									94.7(3, 5)	
									178.8(3, 5)	
$[Cu_2(\mu\text{-}2\text{-}MePhCO_2)(\mu\text{-sb})]\cdot$	m	26.431(1)		CuO_3N	$PhCO_2O$	1.927(9, 18)	3.514(4)	O,O	86.7(4, 1.1)	474
0.5MeOH	$P2_1/n$	7.574(1)	94.39(2)		O	1.912(9, 7)	134.8(4)		93.3(4, 3)	
(not given)	4	11.356(2)			N	1.914(10,3)			178.4(4, 9)	
					μO	1.903(9, 13)		O,N	84.9(4, 1.5)[e]	
									94.0(4, 1)[d]	
									172.6(4, 2.1)	
$[Cu_2(\mu\text{-}2,6\text{-}Cl_2PhCO_2)(\mu\text{-sb})]\cdot$	tr	11.205(2)	108.66(1)	CuO_3N	$PhCO_2O$	1.947(11,7)	3.517(3)	O,O	85.4(5, 1)	474
0.7dmf	P-1	13.285(2)	95.40(1)		O	1.869(11,7)	135.0(5)		93.6(5, 5)	
(not given)	2	9.722(2)	94.59(2)		N	1.925(8, 3)			174.6(4, 1.7)	
					μO	1.904(11,20)		O,N	85.7(5, 7)[e]	
									95.8(5, 7)[d]	
									176.4(5, 2.1)	

TABLE III (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-ac})(\mu\text{-bpmp})](PF_6)_2$	m	17.843(4)		CuN_3O_2	acO	1.939(8, 3)	3.549(2)	N,N	83.1(4, 1.1)[e]	232
(not given)	$P2_1/a$	21.226(5)	105.47(2)		N	2.034(8, 34)	119.3(4)		98.9(4)	
	4	11.206(3)				2.251(8)			157.0(4)	
					μO	1.931(7)		O,O	93.5(3, 1.5)	
						2.178(6)		O,N	94.4(3, 2)[d]	
									90.0(3, 5.9)	
									115.4(3, 5)	
									168.6(3, 6.7)	
$[Cu_2(\mu\text{-ac})(\mu\text{-pramcres})](ClO_4)_2 \cdot$	or	13.999(5)		CuN_3O_2	acO	1.1943(14,3)	3.562(3)	O,N	84.8(3, 3)[e]	476
Me_2CO	$P2_12_12_1$	23.046(9)			N	2.022(24,48)	133.2(7)		90.0(3, 4)	
(green)	4	12.523(5)				2.155(16,35)			103.8(6, 1)	
					μO	1.941(12,36)			145.9(6, 5.6)	
									173.6(7, 7)	
								N,N	94.3(7, 2.3)[d]	
									104.9(6)	
									115.6(7)	
$[Cu_2(\mu\text{-}N_3)(\mu\text{-L-Et})](BF_4)_2$	m	19.082(3)		CuN_4O	N_3N	2.04(1)	3.615(3)	O,N	85.9(5)[e]	473
(green)	C2/m	23.896(3)	116.21(1)		N	2.05(1, 6)	136.9(6)		92.3(5)	477
	4	13.230(2)			μO	1.944(8)			114.2(4)	
									143.8(4)	
								N,N	83.0(5, 4)[e]	
									98.2(5, 1.1)	
									177.8(5)	
$[Cu_2(\mu\text{-}N_3)(\mu\text{-pramcres})](ClO_4)_2 \cdot$	or	12.977(2)		CuN_4O	N_3N	2.007(9, 5)	3.765	O,N	84.8(3, 2)[e]	476
thf	$P2_12_12_1$	13.188(3)			N	2.036(9, 61)	138.2(3)		90.1(3, 3)	
(dark green)	4	22.033(6)				2.131(8, 12)			111.1(3, 5.0)	
					μO	2.015(6, 2)			136.0(3, 2.3)	
								N,N	91.4(4, 5.1)[d]	
									113.0(3, 2.8)	
									174.8(4, 0)	



$[Cu_2(\mu\text{-tcc})(\mu\text{-pN}_6O)](PF_6)_2$ (orange)	or Pbca 8	18.374(3) 18.346(3) 26.502(4)		CuN_3O	tccO N μO	1.995(9, 1) 2.068(12,73) 2.227(12,24) 1.943(8, 1)	3.248(2) 113.3(4)	O,O O,N N,N	84.8(4, 1.1) 91.0(4, 1.6)[d] 105.1(4, 2.8) 167.6(4, 9.6) 93.1(5, 2.4)[d]	478
$[Cu_2(\mu\text{-OH})(\mu\text{-botb})](BF_4)_3$ (dark green)	m $P2_1/m$ 2	14.471(4) 17.201(5) 8.835(3)	106.19(2)	CuO_2S_2N	N S O μO	2.06(5) 2.37(2, 2) 2.37(4) 1.85(2)	3.384(9) 132.2(4)	O,N O,S O,O S,S	94.8(9) 167.2(9) 95.5(8, 1) 98.1(9) 159.5(7)	479
$[Cu_2(\mu\text{-dacpd})(H_2O)(ClO_4)_2\cdot(MeCN)](ClO_4)$ (blue)	tr P-1 2	13.040(2) 12.230(2) 12.720(3)	88.85(2) 83.68(2) 62.17(1)	CuN_4O_2	N MeCN μO O_3ClO	1.950(10,25) 2.003(9) 2.276(7) 1.971(9) 3.012(2)	3.638(8) 135.0(4)	N,O N,N	82.1(4)[e] 117.6(4) 158.9(4, 6) 79.6(4, 6)[e]	480
				CuO_3N_3	N H_2O O_3ClO μO	2.054(11,50) 2.116(10) 2.346(11) 2.77(1) 1.967(11)		N,O N,N	81.9(5)[e] 121.8(4) 158.9(3) 78.0(5, 4)[e] 156.0(5)	
$[Cu_2(\mu\text{-sbN}_6O)(H_2O)(MeCN)]\cdot(ClO_4)_3$ (blue)	tr P-1 2	12.881(5) 13.173(4) 12.374(5)	118.11(3) 96.03(3) 94.44(3)	CuN_4O	N MeCN μO	1.969(9, 42) 2.271(13) 1.977(8)	3.642(2) 135.5(4)	N,N N,O	78.9(9, 5)[e] 94.6(4, 4.7) 158.4(3, 1.0) 82.7(3)[e] 118.4(3)	481
				CuN_3O_2	N H_2O μO	1.900(8) 2.050(8, 50) 2.388(18) 1.958(7)		N,N N,O O,O	77.9(4, 6)[e] 155.8(4) 82.0(4)[e] 94.0(5, 5.3) 121.8(4) 158.2(5) 91.2(4)	

TABLE III (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-OH})(\mu\text{-tpe})(dpy)]\cdot$	tr	11.685(3)	87.97(2)	CuN_4O	dpyN	1.997(11,10)	3.663(3)	N,O	83.3(4, 2.7)	482
$(ClO_4)_3\cdot 2H_2O$	P-1	14.569(2)	73.34(2)		tpeN	2.203(11,8)	137.9(4)		94.0(3, 1.0)	
(blue)	2	15.509(4)	74.15(1)		μHO	1.963(7, 1)			174.8(5, 2)	
								N,N	88.0(4, 1)[d]	
									91.4(4, 1.2)	
									102.8(5, 1.4)	
									165.6(5, 5)	
$[Cu_2(\mu\text{-hdN}_6O)(H_2O)_2]$	m	12.143(4)		CuN_3O_2	H_2O	2.01(2, 2)	3.875	N,N	81.5(7, 2.4)[e]	483
(green brown)	$P2_1/c$	21.356(5)	107.95(2)		N	2.02(2, 5)	128.4(6)		96.4(7)	
	4	21.328(3)			μO	2.10(1, 18)			165.3(8)	
								N,O	92.8(7, 6.8)[d]	
									115.3(7)	
									166.0(7, 3.0)	
								O,O	95.2(6, 5.4)	

[a] Where more than one chemically equivalent distance of angle present the mean value is tabulated. The first number in parenthesis is e.s.d., the second is a maximum deviation from the mean value. [b] The chemical indentity of coordinated atom/ligand is specified in these columns. [c] Four – membered metallocyclic ring. [d] Six membered – metallocyclic ring. [e] Five membered metallocyclic ring. [f] There are dimer and tetramer units. [g] There are dimer and monomer units. [h] There are two crystallographically independent molecules.

2.2.2 *By One Single Atom Plus Two-atom Bridges*

Crystallographic and structural data for Cu(II) dimers in which Cu(II) atoms are bridged by a single atom plus two-atoms of ligand moiety are gathered in Table IIIA, and they are listed in order of increasing Cu–Cu separation. There are over forty such derivatives, mostly green (23), but there some violet, purple (6), blue (5) and even brown (1); for others the color is not given.

The structure of bluish green $[Cu_2(\mu\text{-OH})(\mu\text{-papfs})(NO_3)_2(H_2O)]NO_3$[450] is shown in Figure 3 as an example of this class. In this dimer, the Cu–Cu separation of 3.156(2) Å is the shortest found. There are two non-equivalent Cu(II) atoms, while the stereochemistry at Cu(1) is distorted square pyramidal with the copper lying 0.105 Å above the mean plane of the four donors N(1)–N(3)–O(1)–O(5), the stereochemistry at Cu(2) is a tetragonally distorted *pseudo*-octahedron.

There are five derivatives[451,454–456,459] in which each Cu(II) atom is in a square-planar environment with different degrees of distortion. In most derivatives[452,453,457,458,461,462,464,465–467] the arrangement about Cu(II) atoms is distorted square-pyramidal. There are two examples,[460,463] which contain non-equivalent Cu(II) atoms, one is square planar and the other is a distorted square-pyramid.

The Cu–Cu separation in this class of compounds range from 3.156 to 3.769 Å. From the single bridged ligands, by far the most prominent are

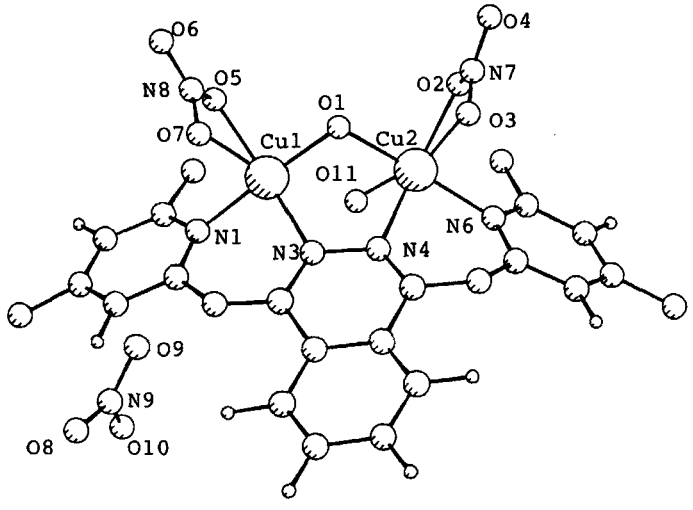


FIGURE 3 Structure of $[Cu_2(\mu\text{-OH})(\mu\text{-papfs})(NO_3)_2(H_2O)]NO_3$ (see Ref. 450).

O-donor ligands, and nitrogen donor ligands are most common as pair bridges. The Cu–L–Cu bridge angles range from 89.0° (L = Br) to 127.1° (OL). The mean Cu–L–Cu bridge angle closes with an increase of covalent radius of L; simultaneously the mean Cu–Cu separation increases: 121.5° and 3.35 Å (L–O), 112.0° and 3.42 Å (N), 107.8° and 3.51 Å (Cl), and 88° and 3.76 Å (Br).

2.2.3 By One Single Atom Plus Three-atom Bridges

In Table IIIB are summarized data for blue (7) and green (6) dimeric Cu(II) derivatives, in which a μ-oxygen ligand and one $RCOO^-$ ligand in a syn–syn arrangement[232,469–467] or a μ-oxygen ligand and one 1,3-bridging azide serve as bridges.[473,476,477] The Cu–Cu separations range from 3.015 to 3.765 Å. There is a relationship between the Cu–Cu separation and the Cu–O–Cu bridge angle, with increases in Cu–Cu separation as the Cu–O–Cu bridge angle opens. For example, 3.015 Å and 103.6 Å,[469] 3.297 Å and 112.0°,[471] 3.416 Å and 129.2°,[472] 3.514 Å and 134.8°,[474] 3.615 Å and 136.9°,[473,477] and 3.765 Å and 138.2°.[467] Cu(II) atoms are four- (a distorted square planar),[469,470,474,475] five- (a distorted square pyramid) coordinated[232,471,473,476,477] and in[472] two compounds the Cu(II) atoms are non-equivalent with one four- and the other five-coordinated.

2.2.4 By One Single Atom Plus Four-, Five-, Seven- or Eight-atom Bridges

In the remaining six dimeric Cu(II) derivatives (Table IIIC), two compounds are distorted square-pyramidal moieties held together by a μ-oxygen ligand and by a four-atom bridge,[478] one compound by a μ-oxygen ligand and by a five-atom bridge,[480–482] one compound by a μ-oxygen ligand and by a seven-atom bridge,[483] and one compound by a μ-oxygen ligand with an eight-atom bridge.[479] The Cu–Cu separations range from 3.248 to 3.875 Å. When the Cu–Cu distance increases the Cu–O–Cu bridge angle opens. For example, 3.248 Å and 113.3°,[478] 3.384 Å and 132.2°,[479] 3.638 Å and 135.0°[480] and 3.663 Å and 137.9°.[482] Inspection of the data in Table III reveals that there are two derivatives[463,468] which contain two crystallographically independent molecules within the same crystal, differing mostly by the degree of distortion.

There are mono- through octadentate ligands. The mean Cu–L(bridge) distance increases with a covalent radius (in parentheses) of donor atom in the order: 1.93 Å (O, 0.73 Å) < 2.07 Å (N, 0.75 Å) < 2.19 Å (Cl, 0.99 Å) < 2.705 Å (Br, 1.14 Å). The mean Cu–L(terminal) distance for unidentate

ligands increases in the sequence: 2.27 Å (N) < 2.34 Å (Cl) < 2.485 Å (O) < 2.525 Å (Br). In the series of multidentate N donor ligands, the mean Cu–N distance increases in the order: 1.97 Å (bi-) ~ 1.97 Å (hexa-) < 2.02 Å (tetra-) < 2.035 Å (tri-) < 2.27 Å (unidentate). The hetero-multidentate ligands, include one O plus one N atom, two O plus a N atoms, one O plus three N atoms, three O plus two N atoms, one O plus four N atoms, two O plus two N plus one S atoms, one O plus six N atoms, and two O plus two N plus four S donor sites. Noticeable, the mean Cu–L bond distance increases with coordination number and the mean value of metallocyclic ring angle closes. For example, the mean Cu–O distance for monodentate ligands are: 2.44 Å (five-coordinated) < 2.67 Å (six-coordinated); for bidentate ligands are: 1.94 Å (four-coordinated) < 2.04 Å (five-coordinated) < 2.31 Å (six-coordinated). The mean values for five-membered metallocyclic ring angles are: 80.0° (five-coordinated) < 80.5° (four-coordinated) (N + N); for six-membered rings: 92.5° (five-coordinated) < 93.2° (four-coordinated) (O + N); and 91.0° (five-coordinated) < 94.5° (four-coordinated) (N + N).

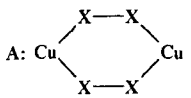
2.2.5 *By Two-atom or Three-atom Bridges*

Crystallograhic and structural data for Cu(II) compounds doubly bridged by two atoms or by three-atom bridges are gathered in Table IV. The structures are listed in order of increasing Cu–Cu separation. There are twenty-five derivatives in which two pairs of atoms serve as bridges between two Cu(II) atoms (Table IVA). The structure of black purple $[Cu_2(\mu\text{-}dmgH)_2(H_2dmg)(H_2O)](ClO_4)_2 \cdot H_2O$[484] is shown in Figure 4 as an example of this type complex. The $Cu(dmgH)_2$ fragment coordinates to the $Cu(H_2dmg)_2^{2+}$ unit through the oximate oxygens to afford a dimer skeleton doubly-bridged by oximate groups in a *cis* arrangement. The configuration about the Cu(II) atoms is a distorted square pyramid; in both complexes the apical position is occupied by a water molecule. The Cu–Cu separation of 3.526(4) Å is too long for a "real" bond.

There are only three types of bridging ligands, when both pairs of atoms are nitrogens,[187,491–494,496,498–502] with an oxygen plus nitrogen atom (mostly in *trans* arrangement)[484–490,495,497,504] and only one example where both pairs of atoms are oxygens.[503]

The Cu–Cu separations range from 3.396(1) to 7.678(2) Å. Cu(II) atoms are four-coordinate, in a distorted square-planar configuration,[498] five-coordinate in a square-pyramidal arrangement[187,484,485,487–489,493,494,496,497,504] or in a trigonal-bipyramidal arrangement,[495,497] and six-coordinate.[486,490–492,499–502]

TABLE IV Crystallographic and structural data for doubly bridged copper(II) dimers by pairs and by three atoms[a]

Compound	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
										
$[Cu_2([20]\text{-aneN}_4)(pz)_2(ClO_4)_2]$	m	19.680(8)		CuN_4O	N[b]	2.021(7, 17)	3.396(1)	N,N[b]	81.7(1, 6)[c]	187
(brown green)	$P2_1/c$	10.660(13)	112.5(1)		pzN	1.951(7, 15)			92.7(1, 2.2)	
	4	15.558(9)			O_3ClO	2.527(8)			172.9(1, 1.0)	
						2.761(15)				
$[Cu_2(\mu\text{-dmgH})_2(H_2dmg)\cdot$	m	15.991(3)		CuO_3N_2	O	1.93(2, 4)	3.526(4)	N,N	74.9(8)[c]	484
$(H_2O)_2](ClO_4)_2\cdot H_2O$	$P2_1/n$	11.682(1)	90.82(5)		N	2.01(2, 2)		N,O	90.9(8, 6.1)	
(dark purple)	4	14.363(4)			H_2O	2.26(2)			159.4(8, 3.6)	
								O,O	101.4(7, 3.0)	
				CuN_4O	N	1.96(2, 3)		N,N	78.9(9, 7)[c]	
					H_2O	2.32(2)			100.4(9, 3.4)	
									170.1(9, 2.6)	
								O,N	94.6(7, 7.4)	
$[Cu(\mu\text{-2,6-Mepydo})(H_2O)]_2\cdot$	tr	8.251(4)	86.62(3)	CuN_3O_2	N	1.915(4, 9)	3.545(1)	N,N	78.5(2, 1.6)[c]	485
$(BF_4)_2$	P-1	12.268(3)	83.74(3)			2.049(4, 32)			156.1(2, 1.3)	
(blue)	2	13.411(3)	81.11(3)		O	1.876(4, 1)		N,O	94.5(2, 1.7)	
					H_2O	2.283(4, 34)			106.7(1, 3.2)	
									164.0(2, 1.0)	
								O,O	93.7(1, 2.1)	
$[Cu(\mu\text{-heiob})(H_2O)(ClO_4)]_2$	m	7.868(2)		CuO_4N_2	N	1.958(5, 30)	3.581(3)	N,O	80.0(2)[e]	486a
(dark green)	$P2_1/c$	14.040(7)	112.73(4)		O	1.870(4)			108.3(2)	
	4	11.401(5)			H_2O	2.038(5)		N,N	81.1(2)[e]	
					O_3ClO	2.492(6)		O,O	90.2(2)	
						2.890(12)				
$[Cu(\mu\text{-dapo})_2(ClO)_2]\cdot$	tr	10.021(4)	91.13(2)	CuN_3O_2	dapoN	1.936(2)	3.684(1)	O,O	92.97(9)	486b
$[Cu_2(\mu\text{-dapo})_2(MeOH)_2](ClO_4)_2$	P-1	10.090(5)	109.36(3)			2.034(2, 26)		O,N	95.89(10, 9.15)	
(black)	1	21.249(8)	117.04(3)		dapoO	1.886(2)			169.49(9)	

					MeHO	2.341(3)		N,N	81.67(9, 1.30)[c]	
									162.04(2)	
				CuN_3O_2	dapoN	2.005(2)	3.582(1)	O,O	89.66(8)	
					N	1.983(2)		O,N	89.54(9, 2.67)	
					dapoO	1.887(2))			102.37(9, 5.82)	
					O_3ClO	2.551(2)			171.48(9)	
								N,N	81.78(9, 1.58)[c]	
									163.04(9)	
$[Cu(\mu\text{-}C_8H_{16}N_3O)(H_2O)]_2(ClO_4)_2$	m	13.406(9)		CuN_3O_2	N	1.936(15, 6)	3.645(3)	N,O	103.9(5, 7)	487
(black)	$P2_1/n$	12.207(7)	90.04(4)			2.043(13, 3)				
	4	17.552(7)			O	1.886(12, 4)				
					H_2O	2.60(3, 6)				
$[Cu(\mu\text{-}C_{15}H_{20}N_3O_2)(ClO_4)]_2\cdot$	tr	9.521(4)	100.72(2)	CuN_3O_2	N	2.015(8, 80)	3.684	O,N	89.6(3)	488
$[Cu(\mu\text{-}C_{15}H_{20}N_3O_2)(MeOH)]_2\cdot$	P-1	15.485(6)	96.07(2)		O	1.887(7)			105.4(3)	
$(ClO_4)_2$	1	18.074(4)	130.28(2)		O_3ClO	2.516(7)			168.1(4)	
(not given)								N,N	82.1(3, 1.4)[c]	
									163.7(5)	
				CuN_3O_2	N	2.020(8, 69)	3.686	O,O	94.3(3)	
					O	1.906(7)		O,N	89.8(3, 2)	
					MeHO	2.266(10)			102.6(3, 1.9)	
									162.3(4)	
								N,N	81.7(3, 1.7)[c]	
									162.1(4)	
$[Cu(\mu\text{-L2py})(MeCN)]_2(ClO_4)_2$	or	23.015(5)		CuN_4O	N	2.000(3, 14)	3.693(2)	O,N	92.8(1, 4.3)	489
(blue-black)	Pbcn	8.873(1)				2.075(3)		N,N	80.2(1)[c]	
	8	16.414(6)			O	1.928(2)			92.3(1, 1.3)[d]	
					MeCN	2.322(4)			103.6(1, 3.1)	
$[Cu(\mu\text{-dacado})(EtOH)(ClO_4)]_2$	tr	11.963(8)	90.69(4)	CuO_3N_3	N	1.960(9, 3)	3.725(2)	O,N	83.2(8, 5.8)	490
(red)	P-1	9.784(7)	104.53(4)			2.008(8)			97.3(7, 6.2)	
	2	7.501(6)	90.83(4)		O	1.937(8)		N,N	87.5(5)[c]	
					EtHO	2.279(9)			87.9(6)[d]	
					O_3ClO	2.706(15)		O,O	87.4(8, 1.4)	

TABLE IV (*Continued*)

Compound	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(\mu\text{-dhph})(H_2O)(ClO_4)]_2\cdot(ClO_4)_2$	tr	8.073(22)	97.357(18)	CuN_4O_2	N	1.990(8, 29)	3.728(1)[e]	N,N	81.6(3, 4)[c]	491
(pale yellow)	P-1	10.088(19)	99.960(22)		H_2O	2.351(7)			98.3(3, 9.1)	
	1	10.238(24)	106.677(18)		O_3ClO	2.615(12)			169.6(3, 3)	
								O,N	90.0(4, 12.0)	
								O,O	165.8(3)	
$[Cu(\mu\text{-pzdad})(H_2O)(ClO_4)]_2$	m	12.031(6)		CuN_4O_2	N	1.976(7, 2)	3.760(2)	N,N	80.5(4.5)[c]	492
(orange red)	$P2_1/n$	9.517(4)	100.16(4)			2.021(6, 7)			99.3(5, 6.2)	
	2	9.973(5)			H_2O	2.310(6)			126.8(7)	
					O_3ClO	2.554(6)		O,N	90.2(4, 7.9)	
									124.7(9)	
$[Cu(\mu\text{-enaoH})]_2(ClO_4)_2$	m	11.441(2)		CuN_4O_2	N	1.968(4, 44)	3.815(2)[e]	N,N	84.3(2, 3.5)[c]	493a
(red)	$P2_1/c$	12.992(2)	110.20(1)		O	2.185(4)			97.5(2)	
	2	12.640(2)				2.698(4)		O,N	96.8(2, 2.4)	
									107.2(2, 5)	
$[Cu(\mu\text{-mpzdad})Cl]_2\cdot 2H_2O$	tr	8.520(15)	75.27(15)	CuN_3OCl	N	1.948(2, 15)	3.815(1)	N,N	78.7(1)[c]	493b
(dark green)	P-1	8.607(18)	69.96(17)			2.015(2)			100.0(2)	
	1	8.671(14)	76.66(15)		O	1.924(2)		N,O	89.0(1, 1.7)	
					Cl	2.558(1)		Cl,N	97.8(1, 3.2)	
								Cl,O	96.6(1, 7)	
$[Cu(\mu\text{-mpzdad})Cl]_2\cdot 2H_2O$	m	11.490(5)		CuN_3OCl	N	1.948(2, 19)		N,N	78.6(2)[c]	493b
(brown)	$P2_1/a$	16.287(14)	97.78(4)			2.018(3)			99.8(2)	
(at 288 K)	2	6.253(4)			O	1.917(2)		N,O	89.3(2, 1.7)	
					Cl	2.605(1)		Cl,N	98.7(2, 2.4)	
								Cl,O	96.4(1, 5)	
$[Cu(\mu\text{-}C_{17}H_{30}N_6)]_2(BPh_4)_2$	tr	13.437(4)	116.38(3)	CuN_5	N	1.954(4, 48)	3.903(2)	N,N	81.0(2, 1.2)[c]	494
(pale blue)	P-1	15.192(5)	113.71(3)			2.108(4)			96.1(2, 1.6)	
	1	12.364(4)	60.48(2)			2.496(5)			101.7(2, 1.7)[f]	

$[Cu(\mu\text{-}C_{12}H_{21}N_4O_2)]_2(ClO_4)_2$	m	6.490(2)		CuN_4O	N	1.978(5, 21)	3.91(1)	N,N	80.5(2, 3)[c]	495
(dark)	$P2_1/n$	21.727(5)	96.58(3)		O	2.264(3)			102.6(2)[f]	
	4	12.398(4)							93.9(2)	
									150.2(2)	
									173.0(2)	
								O,N	94.8(2, 1.5)	
									113.1(1)	
$[Cu(\mu\text{-}4Br\text{-}3\text{-}CO_2mepz)\cdot$	m	13.470(1)		CuN_4O	O	1.982(4)	3.923(1)[e]	O,N	81.5(2)[c]	496
$(4\text{-}Brdmpz)_2]_2$	C2/c	16.005(2)	98.142(6)		N	2.083(5)			86.5(2, 3.4)	
(purple)	4	20.174(1)				2.226(5)			178.0(2)	
					Br-pzN	1.980(5, 31)		N,N	95.3(2, 4.9)	
									110.9(2, 1.8)	
									135.8(2)	
$[Cu(\mu\text{-}4\text{-}Br\text{-}3\text{-}CO_2mepz)\cdot$	tr	10.152(3)	112.38(2)	CuN_4O	O	1.992(5)	3.924(1)[e]	O,N	81.6(2)[c]	496
$(4\text{-}BrdmpzH)_2]_2$	P-1	13.068(3)	116.46(2)		N	2.027(6)			85.9(2, 1.2)	
(green)	1	10.033(3)	70.29(2)			2.273(7)			179.0(3)	
					Br-pzN	1.973(6, 26)		N,N	95.7(3, 3.5)	
									110.4(3, 6.0)	
									136.5(3)	
$[Cu(\mu\text{-}C_{14}H_{29}N_4O_2)Br]_2$	m	21.798(8)		CuN_4O	N	1.97(1)	3.949(4)	N,N	84.4(4)[c]	497
(dark green)	C2/c;Cc	11.662(4)	74.00(4)			2.07(1, 1)			92.9(5, 1.7)[d]	
	8	15.670(7)			O	2.28(9)			133.4(4)	
									174.2(4)	
								N,O	84.7(4)	
									96.4(4, 4.2)	
									125.4(4)	
$(NBu_4)_2[Cu(\mu\text{-}dcp)]_2$	tr	10.899(4)	109.51(3)	CuO_2N_2	O	1.958(3, 3)	3.978(10)	N,N	92.4(2)	498
(blue)	P-1	12.286(5)	101.88(3)		N	1.909(4, 2)		N,O	81.7(2)[c]	
	1	9.899(3)	102.69(3)					O,O	104.1(1)	
$[Cu(\mu\text{-}aamt)Br(H_2O)]_2Br_2\cdot$	tr	9.918(5)	114.42(2)	CuN_4OBr	N	1.944(3, 7)	4.0694(7)	N,N	80.9(1, 1)[c]	499
$2H_2O\cdot MeOH$	P-1	7.000(2)	94.97(3)			2.038(3, 6)			98.9(1, 6.8)	
(dark blue)	1	10.895(3)	102.20(3)		H_2O	2.647(3)			171.6(1, 3)	
					Br	2.8971(6)		N,O	87.6(1, 1.8)	
								N,Br	92.54(9, 3.79)	
								O,Br	174.22(7)	

TABLE IV (*Continued*)

Compound	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(\mu\text{-bpt})(CF_3SO_3)(H_2O)]_2$	tr	8.841(3)	112.58(3)	CuN_4O_2	N	2.087(3, 5)	4.085(1)	N,N	79.1(1, 5)[c]	500
(dark blue)	P-1	14.131(6)	92.23(3)		H_2O	2.323(4)			90.2(1, 1)	
	2	14.392(6)	102.45(3)			2.802(4)			111.2(1, 1)	
					CF_3SO_3O	2.376(3)		N,O	94.2(1, 5.9)	
						2.799(3)			86.4(1, 5.7)	
$[Cu(\mu\text{-aamt})(H_2O)_2]_2(SO_4)_2{\cdot}4H_2O$	m	19.009(8)		CuN_4O_2	N	1.96(1, 1)	4.088(3)	N,N	81.9(4, 4)[c]	501a
(dark blue)	C2/c	11.273(4)	103.50(4)			2.05(1, 1)			98.0(4, 6.1)	
	4	13.144(7)			H_2O	2.62(1, 1)			143.7(4, 6)	
								N,O	90.1(4, 6.1)	
$[Cu(\mu\text{-acm})(NH_3)_2(H_2O)]_2{\cdot}2H_2O$	tr	7.548(4)	93.59(6)	CuN_5O	acmN	2.024(4)	4.363(1)[c]		83.3(2, 2.7)	501b
(blue)	P-1	8.205(17)	108.68(3)			2.546(4)			93.8(2, 2.3)	
	1	10.797(3)	98.50(9)		H_2O	2.011(4)			168.0(2)	
					H_3N	2.012(4)			78.7(2)[c]	
						2.825(6)			92.7(2, 8.6)	
									169.3(2, 6.9)	
$[Cu_2(\mu\text{-qpy})_2(ac)](PF_6)_3{\cdot}H_2O$	tr	11.829(8)	103.0(1)	CuN_6		1.991(14, 27)	4.503(2)	N,N	77.5(6, 2.1)[c]	502
(brown)	P1	12.575(11)	82.9(1)			2.161(3, 0)			84.1(5, 4)	
	2	20.917(22)	114.4(1)			2.349(15, 30)			96.6(6, 1.5)	
									106.3(7, 4.5)	
									152.6(5, 1.3)	
									173.6(7)	
				CuN_4O_2		2.023(21, 56)		N,N	78.6(6, 7)[c]	
						2.212(15)			109.5(6, 8.4)	
						2.038(11)			165.4(7)	
						2.683(16)		N,O	88.1(5, 2.0)	
									158.6(6)	
$[Cu(\mu\text{-2-Obza})_2(H_2O)]_2{\cdot}H_2O$	m	25.726(7)		CuO_3N_2	O	1.957(3, 29)	5.138(2)[c]	O,O	94.4(1, 1)	503
(not given)	C2	9.196(2)	102.97(2)		N	1.986(3, 26)			107.5(1, 2)	
	8	12.826(2)			H_2O	2.393(2, 17)			158.3(1, 3)	
								N,N	172.1(1, 7)	

								O,N	87.5(1, 4.8)[d] 92.6(1, 3)	
$[Cu(\mu\text{-}C_8H_{16}N_3O_2)]_2(ClO_4)_2$ (black)	m $P2_1/c$ 2	7.678(2) 10.647(5) 16.568(10)	91.28(4)	CuN_3O_2	N O	1.966(5, 23) 2.044(6) 1.904(4) 2.367(6)	7.678(2)[e]	N,N N,O	81.5(2, 1.1)[c] 102.3(2) 163.0(2, 3) 79.8(2)[c] 101.1(2) 91.2(2)	504
$[Cu_2(\mu\text{-}ac)_2(H_2O)(bpy)_2](PF_6)_2$ (not given)	m $P2_1/n$ 4	16.120(2) 12.482(4) 17.467(2)	113.98(1)	CuO_3N_2	N H_2O acO	1.968(10, 25) 2.253(9) 1.948(8, 9)	2.965(3)	O,O N,O N,N	91.7(4, 3.3) 94.7(4, 2.0) 170.2(4, 2.5) 81.6(4)[c]	505
				CuO_2N_2	N acO	1.986(9, 5) 1.924(7, 10)		N,O O,O N,N	94.3(4, 9) 174.8(4, 1.5) 90.3(4) 81.2(4)[c]	
$[Cu(\mu\text{-}ac)(phi)(H_2O)]_2$ (green)	m C2/c 4	23.441(5) 9.810(1) 13.752(3)	119.60(2)	CuO_3N_2	phiN acO H_2O	1.985(8, 31) 1.961(7, 2) 2.233(6)	3.014(2)	N,N N,O O,O	81.3(3)[c] 95.3(3, 50) 170.6(3, 5.2) 91.3(3, 2.0)	506
$[Cu(\mu\text{-}phpr)(H_2O)(phen)]_2\cdot(NO_3)_2\cdot 2H_2O$ (not given)	m C2/c 8	22.876(3) 12.284(2) 16.320(2)	111.03(2)	CuO_3N_2	phprO phenN H_2O	1.954(3, 2) 2.009(4, 5) 2.201(3)	3.054(1)	N,N N,O O,O	82.74(15)[c] 92.86(15, 1.29) 101.53(15) 169.48(15, 4.62) 91.68(15, 1.36)	507
$[Cu(\mu\text{-}fm)(H_2O)(phen)]_2$ $(NO_3)_2\cdot 4H_2O$ (deep blue)	not given	not given	not given	CuO_3N_2	fmO H_2O phenN	1.961(4, 2) 2.161(5) 2.009(4, 2)	3.103(2)	O,N	168.8(2, 4.2)	508

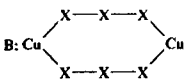


TABLE IV (*Continued*)

Compound	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-chh})_2(H_2O)](ClO_4)_2 \cdot 3.5H_2O$[h]	m	22.97(2)		CuO_3N_2	H_2O	2.02(1)	3.570(3)	O,O	104.6(4, 4)	509a
	$P2_1$	15.89(1)	100.1(1)		N	1.98(1, 1)			150.8(4)	
(blue)	4	10.00(1)			O	2.06(1)		N,O	89.7(6, 2.4)[d]	
						2.21(1)		N,N	178.1(5)	
				CuN_4	N	2.00(1, 1)		N,N	94.6(5, 3.9)	
						1.95(1)			135.3(6)	
									155.4(5)	
				CuO_3N_2	H_2O	2.07(1)		O,O	105.5(4, 2.6)	
					N	1.96(1, 1)			148.5(5)	
					O	2.01(1)		N,O	90.2(5, 4.4)[d]	
						2.20(1)		N,N	176.8(5)	
				CuN_4	N	1.98(1, 3)		N,N	95.0(5, 4.6)	
						1.97(1, 1)			145.5(5, 3.3)	
$[Cu(\mu\text{-ptp})(H_2O)]_2 \cdot 2H_2O$	tr	9.756(6)	112.44(4)	CuO_4N	N	1.940(2)	3.923(2)[e]	O,N	82.35(7)[d]	509b
(green)	P-1	9.866(5)	111.36(7)		O	1.913(2, 5)			94.50(9, 2.48)	
	2	10.115(6)	89.08(9)			2.227(2)			159.30(7)	
					H_2O	1.989(2)		O,O	91.54(9, 2.12)	
									102.80(6)	
									174.37(7)	
$[Cu(\mu\text{-}C_{12}H_{14}N_2O_4)]_2$	m	8.862(2)		CuO_3N_2	N	1.943(3, 3)	4.525(1)[e]	N,N	86.6(1)[c]	510a
(not given)	$P2_1/c$	16.014(2)	97.54(1)		O	1.920(3, 4)		O,N	94.4(1, 2)[d]	
	4	9.105(1)				2.769(4)		O,O	84.6(1)	
$[Cu(\mu\text{-cmphe})(H_2O)]_2$	or	6.017(5)		CuO_5N	N	2.006(5)	4.566(1)	O,O	54.1(2)[g]	510b
(blue)	$P2_12_12_1$	7.680(1)			O	1.944(6, 3)			84.6(2, 1.1)[c]	
	4	26.244(6)				2.023(4)			96.1(2, 1.6)	
						2.665(5)			158.1(3, 8.1)	
					H_2O	2.123(6)		O,N	89.5(2, 6.0)	
									114.2(3)	
									149.4(2)	

$[Cu(\mu\text{-}NCNH)(Me_3tac)]_2(ClO_4)_2 \cdot H_2O$ (green)	m $P2_1/n$ 4	16.458(4) 11.914(3) 16.646(4)	 92.90(3) 	CuN_5	N HNCN	2.074.(5.8) 2.221(6) 1.968(6, 9) 2.017(6)	not given	N,N	84.8(3)[c] 91.3(3, 1.7) 170(1)	511
$[Cu(\mu\text{-}NCNH)(Me_3tac)]_2$ (black)	m C2/c 8	29.64(1) 14.756(5) 15.700(4)	 117.42(2) 	CuN_5	N tacN	1.981(4, 8) 2.066(4, 22) 2.233(4, 3)	4.803(2)	N,N	84.0(2, 1.50)[c] 95.0(2, 4.2) 175.4(4, 2.0)	512
$[Cu(\mu\text{-}etaH)(\mu\text{-}eta)]_2(NO_3)_2$ (blue)	tr P-1 2	9.990(2) 11.454(1) 9.977(2)	111.10(1) 90.02(1) 119.92(1)	CuO_2N_2	N O	1.990(5, 5) 1.958(5, 3)	4.940(5)	O,N N,N O,O	85.0(2, 1)[c] 98.6(2) 91.4(2)	513
$[Cu(\mu\text{-}mepH)(\mu\text{-}mep)(H_2O)]_2 \cdot (NO_3)_2$ (violet)	m, $P2_1/c$ 2	6.232(1) 14.036(4) 17.097(4)	 105.79(2) 	CuO_3N_2	N O H_2O	1.988(5, 1) 1.957(4, 9) 2.313	4.942(5)	O,N N,N O,O	84.8(2, 1)[c] 99.4(2) 91.1(2)	513
$[Cu\{(\mu\text{-}tris)_2H\}(H_2O)]_2Cl_2 \cdot 2H_2O$ (blue)	tr P-1 4	19.785 11.798(6) 6.489(3)	90.13(5) 96.39(5) 91.84(5)	CuO_3N_2	N O H_2O	1.999(6, 1) 1.967(5, 27) 2.752(5) 2.361(5)	4.979	O,N	84.0(2, 2)[c] 86.2(2, 3)	514
$[Cu_2(mepH)_4(H_2O)(SO_4)] \cdot MeOH$ (blue)	tr P-1 2	10.808(4) 10.958(4) 12.738(5)	78.27(3) 86.61(3) 77.07(3)	CuO_3N_2	N O H_2O	1.999(4, 14) 1.945(3, 1) 2.271(4)	4.979(1)	O,N O,O N,N	84.6(1, 7)[c] 93.0(2, 5.4) 170.5(1, 1.5) 95.1(1, 8.1) 96.7(1)	515
				CuO_3N_2	N O O_3SO	2.012(4, 6) 1.945(3, 20) 2.366(3)		O,N O,O N,N	84.1(1, 2)[c] 89.6(1, 1.7) 171.7(1, 2.1) 95.2(1.6.2) 100.3(1)	
$[Cu(\mu\text{-}diimH)]_2$ (green)	tr P-1 2	9.554(3) 13.025(4) 11.662(3)	131.29(1) 98.02(3) 94.31(1)	CuO_2N_2	N O	1.818(10, 9) 1.947(9, 8)	4.99(1)	O,O O,N N,N	93.1(4) 85.8(4, 1) 95.4(4)[d]	516
$[Cu(\mu\text{-}N_3)(Me_4en)(N_3)]_2$ (dark green)	m $P2_1/c$ 2	9.581(5) 13.746(4) 8.869(1)	 101.000(5) 	CuN_5	N N_3N	2.021(7, 78) 1.961(5, 18) 2.456(6)	5.004(2)	N,N	87.7(4, 2.1)[c] 93.8(6, 5.3) 169.0(9, 6.2)	517

TABLE IV (*Continued*)

Compound	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(\mu\text{-pca})_2(phen)]_2$	m	9.625(3)		CuN_5	bpyN	2.032(5, 20)	5.009(6)	N,N	79.4(2)[d]	343b
(red)	$P2_1/c$	20.945(5)	97.10(2)		pcaN	1.940(6, 2)			95.4(2, 3.4)	
	2	9.956(3)				2.355(6)			166.2(2, 3.6)	
$[Cu(\mu\text{-}H_2atp)(phen)]_2\cdot 7H_2O$	m	11.807(3)		CuO_4N_2	phenN	2.001(10, 12)	5.028(3)[e]	N,O	90.9(4, 1.5)	518
(blue green)	$P2_1$	24.824(5)	94.98(3)		atpO	1.934(9, 8)			171.8(4, 3.1)	
	2	10.693(2)				2.284(8)		O,O	91.7(4, 5.1)[d]	
						2.878(9)				
$[Cu(\mu\text{-idaH})(imH)_2]_2\cdot 2H_2O$	tr	8.087(1)	77.80(1)	CuO_3N_3	imN	1.984(1, 3)	5.0295(3)	O,O	96.1(1, 8.4)	519
(blue)	P-1	9.334(1)	77.01(2)		idaN	2.049(1)			157.76(4)	
	1	9.817(1)	82.88(1)		O	1.939(1)		N,O	78.8(1, 5.0)[e]	
						2.424(1)			88.4(1, 5.0)	
						2.873(2)			108.45(5)	
									175.17(6)	
								N,N	93.5(6, 5)	
									172.77(6)	
$[Cu(trisH)(tris)]_2Br_2$	m	11.394(2)		CuO_2N_2	N	1.994(13, 1)	5.044	O,O	96.5(4)	520
(green)	$P2_1/c$	10.049(2)	95.89(2)		O	1.981(11, 38)		O,N	83.8(5, 1.5)[e]	
	2	12.149(2)						N,N	96.4(6)	
$[Cu(\mu\text{-}3'\text{-gmp})(H_2O)(phen)]_2\cdot$	tr	6.857(1)	108.30(2)	CuO_3N_2	gmpO	1.929(6)	5.075(1)[e]		not given	521
$7H_2O$	P1	13.888(3)	88.96(2)		phenN	2.013(7)				
(blue green)	1	14.815(2)	95.48(2)		H_2O	2.472(6)				
$[Cu(\mu\text{-ammph})(H_2O)Cl_2]_2$	tr	8.975(2)	90.32(1)	CuO_3Cl_2	O	1.938(7, 7)	5.081(2)	Cl,Cl	97.1(1)	522a
(blue green)	P-1	8.658(2)	117.34(1)		H_2O	2.014(6)		Cl,O	92.6(2, 4.9)	
	1	6.326(2)	94.37(1)		Cl	2.268(3)		O,O	89.0(3, 3.8)	
						2.637(2)			172.9(3)	
$[Cu(\mu\text{-cmp})(dpa)(H_2O)]_2\cdot 5H_2O$	m	7.724(3)		CuO_3N_2	dpaN	2.00(–, 3)	5.101(2)[e]		not given	522b
(green)	$P2_1$	18.221(6)	99.00(2)		H_2O	2.34(–, 3)				
	2	18.563(6)			cmpO	1.95(–, 2)				

[Cu(μ-5-ump)(dpa)(H_2O)]$_2$· 5H_2O (green)	m $P2_1$ 2	7.739(3) 18.248(6) 17.473(7)	90.04(2)	CuO_3N_2	umpO H_2O dpaN	1.94(1, 2) 2.32(1, 3) 1.99(1, 4)	5.122(3)[e]	N,N N,O O,O	89.3(6, 4)[d] 91.4(6, 4.0) 103.6(5, 2.7) 168.1(6, 6.8) 91.1(5, 4.1)	523a
[Cu(μ-poapH)(H_2O)]$_2$ (not given)	m $P2_1/n$ 4	9.977(7) 7.801(8) 14.615(11)	108.55(5)	CuO_4N	H_2O poapN O	1.939(5) 2.064(5) 1.963(4, 24)	5.142(4)[e]	N,O O,O	87.5(2, 3)[c] 96.3(2) 165.7(2) 93.7(3, 4.9) 173.8(2)	523b
[Cu(μ-5′-imp)(dpa)]$_2$·3.62H_2O (not given)	m $P2_1$ 2	7.828(2) 18.552(3) 17.378(3)	91.16(3)	CuO_3N_2	N O	2.024(1, 3) 1.906(1, 4)	5.157(1)[e]	N,N O,N O,O	89.87(2)[d] 88.4(2, 3.0) 168.07(4, 4.4) 91.25(2)	523c
				CuO_3N_2??	N O	2.015(1, 1) 1.942(1, 4)		N,N O,N O,O	87.86(2)[d] 93.3(2, 6.7) 100.43(3) 169.3(3, 8) 90.4(2, 1)	
β-[Cu(μ-5′-imp)(dpa)(H_2O)]$_2$· 4H_2O (dark green)	m $P2_1$ 2	7.828(2) 18.552(3) 17.378(3)	91.16(2)	CuO_3N_2	H_2O N O	2.27(2) 2.42(2) 2.02(2, 3) 1.92(2, 2)	5.157(3)[e]	O,O O,N N,N	91(1, 1) 90(1, 2) 102(1, 4) 169(1, 5) 89(1, 1)[d]	523d
[Cu(μ-N_3)(Me_5dien)]$_2$(BF_4)$_2$ (not given)	m $P2_1/n$ 2	12.798(2) 19.538(3) 13.072(2)	93.64(1)	CuN_5	N N_3N	2.052(4, 10) 1.965(4) 2.252(5)	5.2276(2)	N,N	93.2	524a
β-[Cu(μ-NCS)(NCS)(dmpt)]$_2$ (dark brown)	m $P2_1/n$ 4	10.928(3) 14.709(3) 12.804(3)	95.31(2)	CuN_4S	N SCN μNCS μSCN	2.027(2, 32) 1.937(2) 2.413(1) 2.205(2)	5.369(2)[e]	N,N N,S	92.6(1, 4.1) 102.0(1) 170.3(1) 87.5(1, 1.8) 100.5(1) 157.3(1)	524b

TABLE IV (*Continued*)

Compound	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(\mu\text{-NCS})(den)(ClO_4)]_2$	tr	11.81(2)	70.9(3)	CuN_4OS	N	2.02(1, 1)	5.51	N,N	84.3(5, 3)[c]	524c
(blue)	P-1	7.48(2)	89.7(3)		O_3ClO	2.90(1)			95.1(4, 1.0)	
	2	7.48(2)	105.4(3)		μSCN	1.95(1)		S,N	94.8(4, 5.7)	
					μNCS	2.76(1)				
$[Cu(\mu\text{-NCS})(dpr)(ClO_4)]_2$	or	13.94(2)		CuN_4OS	dprN	2.02(1, 5)	5.53	N,N	85.7(4, 7)	525
(blue)	Pbca	12.39(2)			SCN	2.00(1)			93.5(4, 2.2)[d]	
	8	15.85(2)			NCS	2.79(1)		N,S	95.2(4, 4.8)	
					O_3ClO	2.97(1)				
$[Cu(\mu\text{-NCS})(NCS)(dmtp)_2]_2$	m	19.088(7)		CuN_4S	N	2.010(8, 10)	5.552	N,N	90.0(4, 1.9)	526
(green)	C2/c	11.516(8)	104.51(4)		SCN	1.954(9, 1)		N,S	92.4(3, 7.9)	
	28	20.118(7)			NCS	2.886(4)				
$Na_4[Cu(\mu\text{-NCS})(sal\text{-}\beta\text{-}ala)]_2$	tr	6.989(3)	84.88(5)	CuO_2N_2S	O	1.924(3, 20)	5.768(1)	O,O	170.8(1)	527
$(NCS)_2{\cdot}4H_2O$	P-1	10.445(5)	70.13(4)		N	1.950(4)		N,S	92.5(1, 2.3)	
(dark green)	2	12.692(6)	86.72(6)		SCN	1.978(4)		O,S	93.0(1, 4.7)	
					NCS	2.933(2)		O,N	86.5(1, 4)	
									93.3(1, 7)[d]	
								N,N	174.8(2)	
$[Cu(tren)(CN)]_2(BPh_4)_2$	m	13.792(7)		CuN_4C	N	2.12(−, 4)	6.090(1)	N,N	82.9(2, 3)[c]	528a
(blue)	$P2_1/c$	10.338(6)	94.27		NC	1.97			118.5(2, 6.0)	
	4	20.316(14)						N,C	97.1(2, 2.2)	
									177.9(2)	
$[Cu(\mu\text{-}5'\text{-amp})(bpy)(H_2O)]_2{\cdot}$	tr	10.195(2)	88.92(1)	CuO_3N_2	bpyN	1.993(−, 28)	not given		not given	528b
$(NO_3)_2{\cdot}6H_2O$	P-1	12.305(4)	108.99(1)		H_2O	2.375(−, 15)				
(blue)	1	11.805(1)	104.41(1)		ampO	1.929(−, 14)				

$[Cu(\mu\text{-NCS})(tren)]_2(BPh_4)_2$ (green)	m $P2_1/c$ 2	14.977(5) 9.764(2) 21.226(6)	98.79(3)	CuN_5	N μSCN	2.068(6, 21) 1.946(7)	6.136(1)	N,N	83.9(2, 3)[c] 96.1(3, 7) 118.8(2, 6.5) 179.0(2)	529
$[Cu(\mu\text{-NCO})_2(tren)]_2(BPh_4)_2$ (blue)	m $P2_1/c$ 2	14.003(6) 10.339(5) 20.436(9)	94.00(3)	CuN_5	N OCN	2.08(1, 2) 1.87(1)	6.540(2)	N,N	83.8(5, 1.0)[c] 96.3(5, 3.3) 118.9(5, 7.3) 176.7(6)	529

[a] Where more than one chemically equivalent distance or angle is present the mean value is tabulated, the first number in parenthesis is e.s.d., the second is maximum deviation from the mean. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] Five-membered metallocyclic ring. [d] Six-membered metallocyclic ring. [e] Calculated by us. [f] Seven-membered metallocyclic ring. [g] Four-membered metallocyclic ring. [h] There are two crystallographically independent molecules.

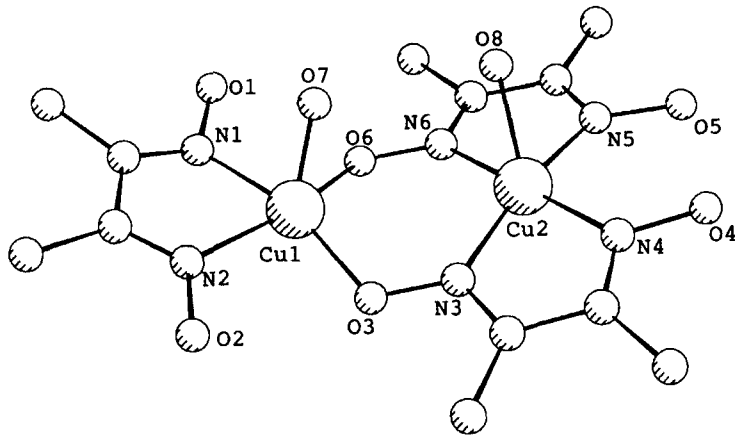


FIGURE 4 Structure of $[Cu_2(\mu\text{-dmgH})_2(dmgH_2)(H_2O)]$ (see Ref. 484).

The structure of $[Cu(\mu\text{-}C_{15}H_{20}N_3O_2)(ClO_4)_2]_2[Cu(\mu\text{-}C_{15}H_{20}N_3O_2)(MeOH)_2](ClO_4)_2$[488] consists of a relatively isolated complex cation $[Cu_2L_2(MeOH)_2]^{2+}$, a neutral $Cu_2L_2(ClO_4)_2$ molecule and unattached ClO_4^- anions. The Cu–Cu separations are almost identical, 3.684 and 3.686 Å, respectively.

The compound $Cu(\mu\text{-}4Br\text{-}3CO_2mepa)(4\text{-}Brdmpz)_2]_2$[496] exists in two isomeric forms, monoclinic and triclinic, differing mostly by the degree of distortion, with Cu–Cu separations of 3.923(1) and 3.924(1) Å, respectively.

There are thirty-six derivatives (Table IIIB) in which two Cu(II) atoms are doubly bridged by three atoms. The structure of $[Cu_2(\mu\text{-ac})_2(H_2O)(bpy)_2]^{2+}$ is shown in Figure 5[505] as an example of this class. The structure consists of a dicopper(II) unit held by two acetate ions in a syn–syn bridging arrangement. The chelating 2,2′-bipyridine ligands occupy the equatorial sites and are in syn positions stabilized by stacking interactions. The coordination geometries of the two Cu(II) centers are square planar and square pyramidal. The Cu–Cu separation of 2.965(3) Å is the shortest in this class. In another four derivatives[506–508,510] two carboxylate groups bridge two Cu(II) atoms in a similar way.[505]

In blue $[Cu_2(\mu\text{-chh})_2(H_2O)](ClO_4)_2\cdot 3.5H_2O$[509] each of the two cyclo-L-histidyl-L-histidylato ligands (chh) used three atoms (OCN) for bridging two Cu(II) atoms.

There are six compounds[513–516,520] where the dimers are held together by two cooperative O–H–O hydrogen bonds (oxygen–oxygen distances range from 2.31 to 2.52 Å). Two azide groups serve as a bridge[517,524] while several others[518,519,521–523] contain two OPO moieties in a syn–syn arrangement as

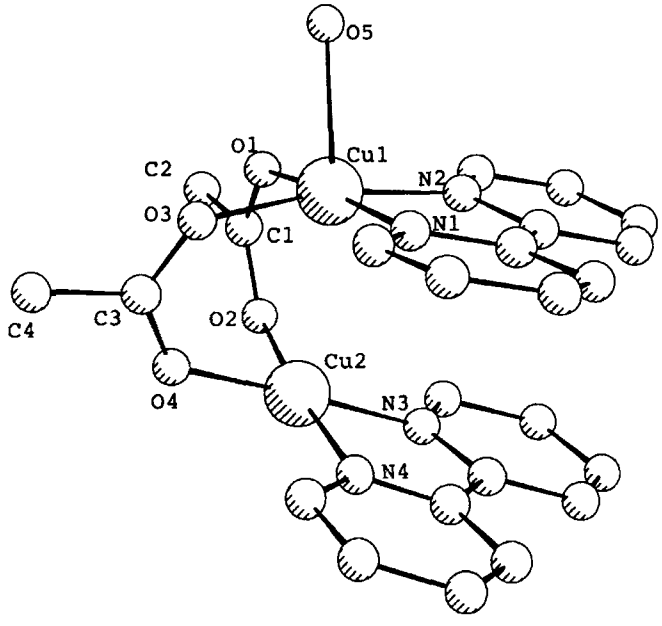


FIGURE 5 Structure of $[Cu_2(\mu\text{-ac})_2(H_2O)(bpy)_2]^{2+}$ (see Ref. 505).

bridges. Two thiocyanate groups acting as bridges between two Cu(II) atoms in five derivatives[525–529] and in the remaining example[529] two NCO groups serve as bridges.

The Cu–Cu separation in this class Table IVB ranges from 2.965(3) to 6.540(2) Å which is somewhat narrower than those found for derivatives given in Table IVA (3.396(1) to 7.678(2) Å).

The Cu(II) atoms are surrounded mostly by O and N donor atoms of the respective ligands in a square-planar,[513,516,520] square-pyramidal,[343,506–508,514,515,517,521–523,526,527] trigonal-bipyramidal,[512,528,529] intermediate square-pyramidal ↔ trigonal-bipyramidal,[524] and in a *pseudo*-octahedral arrangement.[518,519,525] There are two examples, which contain two non-equivalent Cu(II) atoms, one[505] has a square-pyramidal (CuO_3N_2) and a square-planar configuration (CuO_2N_2), and the other complex[509] has an intermediate square planar ↔ trigonal bipyramidal (CuO_3N_2) and a tetrahedral configuration (CuN_4).

Inspection of the data in Table IV reveals that in the series of over fifty examples most are blue and green, but there are quite a few black, red, purple, brown and yellow compounds.

The mean Cu–L bond distance in the series of monodentate ligands increases with coordination number, five-coordinated *vs.* six-coordinate, the values are 1.96 *vs.* 1.98 Å for N donors and 2.32 *vs.* 2.52 Å for O donors. In the series of bidentate O donor ligands, the mean Cu–O bond distance increases in the order: 1.92 Å (four-) < 1.95 Å (five-) < 2.36 Å (six-coordinated).

On the other hand, in the series of bidentate N donor ligands, the mean Cu–N bond distance increases in the sequence: 1.98 Å (four-) < 2.015 Å (six-) < 2.07 Å (five-coordinate). In the series of multidentate ligands the mean Cu–L bond distance for six coordinate increases in the order: for O donors 2.36 Å (bi-) < 2.365 Å (tetra-) < 2.5 Å (monodentate) and for N donors in the order: 1.98 Å (mono-) < 2.01 Å (tetra-) < 2.015 Å (bi-) < 2.17 Å (pentadentate). For five-coordinate compounds the mean Cu–N bond distance increases in the order: 1.98 Å (mono-) < 2.05 Å (tri-) < 2.07 Å (bi-) ~ 2.07 Å (tetra-) < 2.08 Å (hexadentate).

The multidentate ligands include both homo- and hetero- donor atoms, with O- and N-donors being by far the most common. In the series of hetero-bidentate ligands O plus N and N plus S(NCS)-donor sites are found. Tridentate ligands include those with two O plus one N, and one O plus two N-donor sites. Tetradentate ligands, include three O plus one N, two O plus two N, one O plus three N donor sites. Pentadentate ligands, include four O plus one N, two O plus three N donor sites.

The steric effect can be seen in variations of the L–Cu–L bond angles. When there is an intra-ligand metallocyclic ring, the internal L–Cu–L angle closes with increasing coordination number. For example, for five-membered rings, the mean O–Cu–N bond angles are: 83.5°(four-) > 83.0°(five-) > 79.5°(six-coordinate); and for six-membered metallocyclic rings with N–Cu–N bond angles the values are: 95.4°(four-) > 92.8°(five-) > 89.5°(six-coordinate). The intra-ligand metallocyclic bite angle opens with an increasing number of atoms, as expected. For example, the mean O–Cu–O bond angles are: 54.0°(four-) < 84.5°(five-) < 91.5°(six-membered).

2.2.6 By Carbonate Group Bridges

Crystallographic and structural data for μ-carbonate Cu(II) dimers are given in Table V. The structures are in order of increasing Cu–Cu separation. There are five derivatives (green(3), blue(2)) in which the μ-carbonate bidentate group is bound to both Cu(II) centers symmetrically.

The structure of $[Cu_2(\mu\text{-}CO_3)(tmtacd)_2]^{2+}$ (see Ref. 531) is shown in Figure 6 as an example of this group. In all five derivatives[530–533] each Cu(II) atom is five coordinate (square-pyramidal[530–532] and trigonal-bipyramidal.[533] The Cu–Cu separations range from 4.044(2) to 4.601(2) Å and

TABLE V Crystallographic and structural data for μ-carbonate copper(II) dimers[a]

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–O–Cu* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-}CO_3)\{HB\text{-}(3,5\text{-}i\text{-}Pr_2pz)_3\}_2]\cdot$	or	24.058(7)		CuN_3O_2	N[b]	1.970(5,8)	4.044(2)	O,O[b]	65.9(2,10)[c]	530
2MeCN	Pbca	25.664(5)			CO_3O	2.000(5,1)	175.7(2)	O,N	101.1(2,2.7)	
(green)	8	22.844(6)			μO	2.024(4,5)			160.4(2,4.9)	
								N,N	91.2(2,2.3)[d]	
$[Cu_2(\mu\text{-}CO_3)(tmtacd)_2](ClO_4)_2\cdot$	or	16.19(1)		CuN_3O_2	N	1.970(8,9)	4.080(1)[e]	N,N	93.6(3,3)[d]	531
dmf	Iba2	16.67(1)				2.195(7)	176.6(2)		104.5(3)	
(green)	4	15.43(1)			CO_3O	2.028(5)		N,O	97.6(4,1.2)	
					μO	2.041(1)			109.0(2)	
									144.2(3)	
									160.7(3)	
								O,O	65.3(3)[c]	
$[Cu_2(\mu\text{-}CO_3)(Me_4pn)_2Cl_2]$	m	16.922(4)		CuO_2N_2Cl	N	2.054(8,28)	4.143(2)	Cl,O	97.6(2,1.5)	532
(dark green)	$P2_1/n$	7.942(2)	99.73(2)		Cl	2.360(3,1)	172.7(4)		119.2(2,1.2)	
	4	17.343(4)			CO_3O	1.975(7,3)		O,O	63.7(3)[c]	
					μO	2.076(6,7)		Cl,N	100.3(3,2.6)	
								O,N	94.4(3,3.5)	
									136.1(4,2)	
									155.1(3,2)	
								N,N	97.8(3,1)[d]	
$[Cu_2(\mu\text{-}CO_3)(Et_5dien)_2](ClO_4)_2$	m	12.037(1)		CuN_3O_2	N	2.043(4,53)	4.495(1)[e]	O,O	62.3(1,4)[c]	533
(dark blue)	$P2_1$	13.145(3)	96.85(1)		CO_3O	2.264(3,10)	165.8(1)	O,N	102.6(2,7.2)	
	2	12.519(2)			μO	1.977(3,2)			164.7(2,3)	
								N,N	87.0(2,3)[f]	
									143.9(2,1)	

TABLE V (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–O–Cu* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-}CO_3)(Et_5dien)_2](ClO_4)_2$	or	18.610(3)		CuN_3O	N	2.029(8, 49)	4.601(2)[e]	O,O	61.4(2, 3)[c]	533
(dark blue)	$Cm2_1$	15.449(3)			CO_3O	1.950(5, 4)	163.0(3)	O,N	103.6(4, 5.4)	
	4	14.499(7)			μO	2.326(6, 21)			167.4(4, 9)	
								N,N	85.9(2, 2)[f]	
									145.5(4, 1.8)	

[a] Where more than one chemically equivalent distance or angle is present the mean value is tabulated. The first number in parenthesis is e.s.d., the second is a maximum deviation from the mean value. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] Four-membered metallocyclic ring. [d] Six-membered metallocyclic ring. [e] Calculated by us. [f] Five-membered metallocyclic ring.

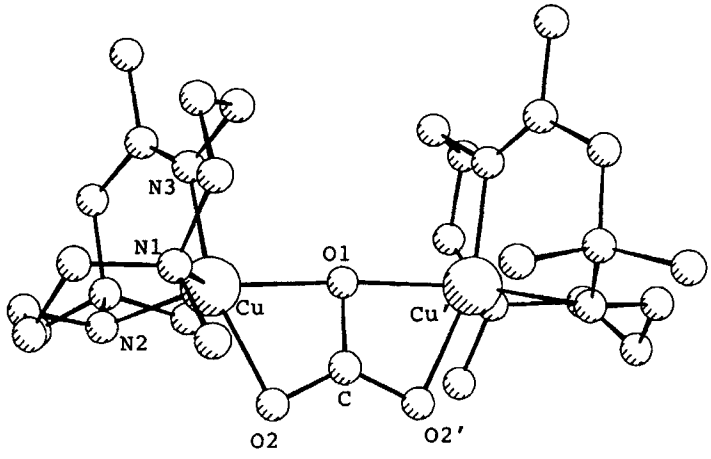


FIGURE 6 Structure of $[Cu_2(\mu\text{-}CO_3)(tmtacd)_2]^{2+}$ (see Ref. 531).

Cu–O–Cu bridge angle from 176.6(2) to 163.0(3)°. There is a relationship between these two values, when the Cu–Cu separation elongates, the Cu–O–Cu bridge angle closes. For example: 4.086(1) Å and 176.6(2)°,[531] 4.143(2) Å and 172.7(4)°;[532] 4.495(1) Å and 165.8(1)°,[533] and 4.601(2) Å and 163.0(3)°.[533]

The dark blue, $[Cu_2(\mu\text{-}CO_3)_2(Et_2dien)_2](ClO_4)_2$[533] exists in two isomeric forms, monoclinic and orthorhombic, differing mostly by degree of distortion provide another example of isomerism.[144]

The mean Cu–O and Cu–$O_{(bridge)}$ bond distances are 2.118 and 2.014 Å, respectively. The mean Cu–N bond distances for bidentate ligands of 2.05 Å is somewhat longer than those of tridentate ligands (2.025 Å).

2.2.7 Oxalate Type

Crystallographic and structural data for the Cu(II) oxalate type dimers are summarized in Table VI. The structures are tabulated in order of the increasing Cu–Cu separation. There are almost thirty derivatives and most are blue, with some green and violet. The structure of the blue compound $[(phen)(NO_3)Cu(ox)Cu(NO_3)(phen)]$[537] is shown as a representative example (Figure 7). The two $(phen)Cu(NO_3)$ moieties are bridged by an oxalato group with each Cu(II) atom being bound to two oxygens from the two different carboxylic groups. Each Cu(II) is in a square-pyramidal environment with $N_{(1)}$, $N_{(2)}$, $O_{(1)}$, and $O_{(2)}$ in the basal plane and $O_{(3)}$ from a nitrato group coordinated in the apical position. The Cu–Cu separation is 5.158(1) Å.

TABLE VI Crystallographic and structural data for copper(II) oxalate type dimers[a]

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-ox})(H_2O)_2(Me_4en)_2]\cdot$	tr	18.995(3)	98.30(3)	CuO_3N_2	μoxO[b]	1.977(4, 0)	5.147(2)	O,O[b]	84.0(2)[d]	534
$(ClO_4)_2\cdot 1.25H_2O$[c]	P-1	10.019(3)	98.37(3)		N	2.008(5, 3)			89.3(2, 1.8)	
(blue)	2	7.658(3)	88.19(2)		H_2O	2.364(5)		O,N	96.3(2, 5.3)	
									171.3(2, 4.1)	
								N,N	87.5(2)[d]	
				CuO_3N_2	μoxO	1.978(4, 3)	5.167(2)	O,O	84.0(2)[d]	
					N	2.009(5, 11)			91.8(2, 1)	
					H_2O	2.312(5)		O,N	96.1(2, 6.1)	
									169.4(2, 3.4)	
								N,N	87.6(2)[d]	
$[Cu_2(\mu\text{-ox})(NO_3)_2(mep)_2]\cdot$	m	20.073(4)		CuO_3N_2	N	1.997(7, 42)	5.149(1)	O,O	83.4(3)[d]	535
$[Cu_2(\mu\text{-ox})(NO_3)_2(mep)_2(H_2O)]_2$	$P2_1/n$	13.842(4)	119.09(3)		O_2NO	2.361(2)			95.3(3, 7)	
(green blue)	4	20.070(4)			μoxO	1.960(6, 21)		O,N	96.4(2, 2.1)	
									174.2(2, 1.5)	
								N,N	81.7(3)[d]	
				CuO_4N_2	N	2.006(7, 42)		O,O	87.7(3, 6.4)	
					O_2NO	2.541(7)			93.9(3, 5.4)	
					H_2O	2.243(7)			103.5(2)	
					μoxO	1.991(6, 20)			169.8(3)	
									172.3(3, 2)	
								N,N	81.0(2)[d]	
				CuO_4N_2	N	1.966(5)	5.268(1)	O,O	52.6(4)[e]	
						2.201(7)			84.0(3, 6)[d]	
					O_2NO	2.111(8)			90.1(3, 4.0)	
						2.44(1)			117.5(3)	
					μoxO	2.009(6, 48)			168.1(2)	
								N,O	94.5(3, 7.1)	
									105.9(3)	
									139.6(3)	
									171.1(3)	
								N,N	77.5(3)[d]	

$[Cu_2(\mu\text{-ox})(H_2O)_2(bpy)_2]\cdot$	m	21.739(2)		CuO_3N_2	bpyN	1.948(2, 3)	5.154(1)		not given	536
$[Cu(ox)(bpy)](NO_3)_2$	C2/c	10.458(1)	95.69(1)		H_2O	2.246(2)				
(blue)	–	16.023(2)			μoxO	1.979(2, 4)				
				CuO_2N_2	oxO	1.912(2)			not given	
				(monomer)	bpyN	1.956(2)				
$[Cu_2(\mu\text{-ox})(NO_3)_2(phen)_2]$	tr	9.977(6)	108.03(4)	CuO_3N_2	phenN	1.999(2, 8)	5.158(3)	N,N	82.5(1)[d]	537
(blue)	P-1	9.658(6)	95.40(4)		O_2NO	2.216(2)		O,N	96.1(1, 4.6)	
	2	7.036(3)	90.22(4)		μoxO	1.984(2, 3)			164.3(1, 2.4)	
								O,O	84.6(1)[d]	
									97.8(1, 5.5)	
									119.8(3, 1)	
$[Cu_2(\mu\text{-ox})(H_2O)_2(bpy)_2]\cdot$	m	22.706(5)		CuO_3N_2	bpyN	2.044(12, 21)	5.162	O,O	86.0(8)[d]	538
$[Cu(ox)(bpy)]SO_4$	C2/c	10.485(3)	92.63(3)		H_2O	2.301(13)			93.0(8, 4.0)	
(blue violet)	4	16.172(4)			μoxO	2.012(13, 22)		O,N	97.1(8, 2.8)	
									169.3(8, 6.0)	
								N,N	78.8(7)[d]	
				CuO_2N_2	oxO	1.911(10)		O,O	84.7(4)[d]	
				(monomer)	bpyN	2.041(22)		N,N	87.7(6)[d]	
								O,N	94.0(6)	
$[Cu_2(\mu\text{-ox})(H_2O)_2(mep)_2](PF_6)_2\cdot$	or	21.864(3)		CuO_3N_2	N	1.99(1, 1)	5.175	O,N	97.3(4, 4.9)	535
$(mep)\cdot 3H_2O$	Pnma	20.881(5)			H_2O	2.24(1)			102.1(4)	
(green blue)	8	11.451(3)			μoxO	1.972(9, 8)			166.0(4, 4.0)	
								N,N	82.1(4)[d]	
								O,O	83.9(3)[d]	
									94.2(3, 5.3)	
$[Cu_2(\mu\text{-bedao})(Me_2CO)_2](BPh_4)_2$	m	16.639(7)		CuN_3O_2	N	1.899(6)	5.189(2)	N,N	85.3(3, 2.7)[d]	539
(violet)	$P2_1/n$	18.305(9)	103.2(2)			2.001(7, 7)			170.0(3)	
	2	11.089(9)			O	1.988(5)		O,N	84.9(2)[d]	
					Me_2CO	2.609(8)			93.8(3, 10.2)	
									166.2(3)	
								O,O	97.1(2)	
$[Cu_2(\mu\text{-oxd})(ClO_4)_2(bpy)_2]\cdot 2dmf$	tr	10.079(2)	96.99(2)	CuN_3O_2	bpyN	1.994(11)	5.192(2)	N,O	86.1(4)[d]	540
(blue)	P-1	10.457(2)	91.94(2)		O_3ClO	2.433(9)			94.3(4, 4.6)	
	2	8.566(2)	100.69(1)		μoxdO	1.959(12)		N,N	83.6(4)[d]	
					μoxdN	1.944(9)			90.2(4)	
								O,O	96.2(4)	

TABLE VI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-oxd})(H_2O)_2(Me_4en)_2]\cdot(PF_6)_2$	m	25.099(4)		CuN_3O_2	Me_4enN	2.025(6, 8)	5.194(1)	O,O	85.2(2, 6)	541
(blue)	C2/c	12.419(2)	106.62(1)		H_2O	2.636(5, 35)		O,N	83.6(2, 1)[d]	
	—	20.432(4)			μoxdO	1.959(5, 4)			95.0(2, 8.2)	
					μoxdN	1.944(5, 14)			174.7(2, 1.2)	
								N,N	87.4(2, 1)[d]	
									93.9(2, 5)	
									173.9(2, 2.0)	
$[Cu_2(\mu\text{-oxpn})(bpy)(ClO_4)_2]$	m	12.548(2)		CuN_4O	bpyN	1.993(3, 4)	5.195(1)	O,N	82.9(2, 2.6)	542
(not given)	$P2_1/c$	19.314(4)	96.72(1)		μoxpnN	1.982(2, 1)			98.9(2, 2.3)	
	4	10.549(1)			O_3ClO	2.887(5)		N,N	82.84(9)[d]	
									92.4(1, 4.2)	
									176.9(1, 3)	
				CuO_3N_2	bpyN	1.967(2, 8)		O,O	86.1(3)[d]	
					μoxpnO	1.930(2, 2)			95.4(1, 1.0)	
					O_3ClO	2.482(2)		O,N	94.2(2, 6.2)	
									174.8(2, 4)	
								N,N	82.15(9)[d]	
$[Cu_2(\mu\text{-ox})(fbo)_2(Me_4en)_2]\cdot C_6H_6$	m	14.581(5)		CuO_3N_2	enN	2.033(4, 0)	5.215(3)[f]	O,N	95.3(2, 3.2)	543a
(blue)	C2/m	12.484(4)	123.05(2)		fboO	2.062(6)			160.3(2)	
	2	13.239(5)			μoxO	2.002(3)		N,N	86.4(3)[d]	
									92.1(1)	
								O,O	82.8(1)[d]	
									102.7(1)	
$[Cu_2(\mu\text{-ox})(H_2O)_2(NO_3)_2(mep)_2]\cdot 2H_2O$	m	7.559(4)		CuO_4N_2	mepN	2.010(7, 53)	5.218(8)[f]	O,O	83.4(2, 1.1)[d]	543b
(green)	$P2_1$	14.659(3)	98.6(2)		H_2O	2.276(7, 33)			87.6(3, 6.0)	
	2	16.246(3)			O_2NO	2.606(8, 30)			173.2(2, 2.3)	
					μoxO	1.994(7, 17)		O,N	93.5(3, 8.0)	
									172.8(3, 2.9)	
								N,N	81.4(3, 5)[d]	

$[Cu_2(\mu\text{-ox})(ox)(C_7H_{18}N_2)_2]\cdot H_2O$	m	8.551(8)		CuO_3N_2	oxO	1.974(5, 11)	5.226(3)	N,N	85.5(2)[d]	544
(blue)	$P2_1/c$	11.876(9)	99.37(7)			2.273(4)		N,O	94.9(2, 6)	
	4	26.353(9)			N	2.018(5, 21)			106.9(2)	
									149.8(2)	
									179.2(2)	
								O,O	85.0(2, 6)[d]	
									103.2(2)	
				CuO_2N_2	oxO	1.936(5, 15)		N,N	85.9(2)[d]	
					N	1.992(6, 18)		N,O	95.1(2, 1)	
									177.0(2, 2.3)	
								O,O	84.1(2)[d]	
$[Cu_2(\mu\text{-ox})(Me_4en)_2(H_2O)_2]\cdot$	tr	7.932(5)	96.89(9)	CuO_3N_2	Me_4enN	2.024(8, 13)	5.232(4)	O,O	83.4(2)[d]	545
$(PF_6)_2\cdot 2H_2O$	P-1	8.117(7)	97.03(8)		H_2O	2.241(7)			91.9(2, 3.7)	
(bright blue)	1	12.089(15)	102.44(6)		μoxO	2.012(6, 20)		O,N	97.1(3, 5.4)	
									168.1(3, 5.8)	
								N,N	87.2(3)[d]	
$[Cu_2(\mu\text{-oxpn})(Me_5dien)(ClO_4)_2]$	m	12.973(4)		CuN_3O_2	dienN	2.047(7, 23)	5.237(3)[f]	O,O	83.3(2)[d]	542
(not given)	$P2_1/c$	15.500(6)	108.00(3)			2.316(5)		O,N	94.7(3, 6.1)	
	4	17.241(6)			μoxpnO	1.973(5, 34)			154.3(2)	
									174.1(3)	
								N,N	85.9(3, 1.6)[d]	
									114.3(3)	
				CuN_4O_2	μoxpnN	1.971(7, 8)		O,O	159.5(6, 7)	
						2.002(6)		O,N	79.6(4, 1.7)[d]	
					O_3ClO	2.67(2, 3)			89.8(4, 4.1)	
						2.89(2)			100.8(4, 1.7)	
								N,N	84.5(3, 3)[d]	
									95.6(3, 1.0)	
									178.8(3, 5)	
$[Cu_2(\mu\text{-dmaeoxd})(H_2O)_2(NCO)_2]$	m	11.589(3)		CuN_3O_2	H_2O	2.288(3)	5.306(1)[f]	O,O	85.0(1)	546
(dark blue)	$P2_1/a$	12.456(1)	102.39(2)		OCN	1.920(3)		O,N	82.5(1)[d]	
	2	6.771(2)			μoxdO	2.046(2)			97.1(1, 2.9)	
					N	1.928(2)			164.01(9)	
						2.079(3)		N,N	82.2(1)[d]	
									97.5(1)	
									165.0(1)	

TABLE VI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$(AsPh_4)_2[Cu_2(\mu\text{-}C_2S_4)(odt)_2]$	tr	12.880(3)	97.65(2)	CuS_4	odtS	2.228(2, 1)	5.317(3)[f]	S,S	92.1(1, 3.1)[d]	547
(blue)	P-1	11.904(2)	111.16(2)		μC_2S_4S	2.234(2, 11)			91.5(1, 1.1)	
	1	11.333(2)	112.69(2)						159.5(1, 6)	
$[Cu_2(\mu\text{-ox})(Et_5dien)_2](BPh_4)_2$	m	9.776(5)		CuN_3O_2	dienN	2.049(6, 36)	5.410(1)	O,O	80.2(2)[d]	548
(green)	$P2_1/n$	25.004(12)	91.83(2)			2.196(6)		O,N	96.2(2, 3.4)	524
	2	14.551(6)			μoxO	1.972(4)			131.1(2)	
						2.174(4)			177.5(2)	
								N,N	86.2(3, 1)[d]	
									131.4(2)	
$[Cu_2(\mu\text{-ox})(Me_4en)_2(2\text{-Me-im})_2]\cdot$	tr	8.224(2)	94.63(2)	CuN_3O_2	enN	2.041(2, 16)	5.434(2)	O,O	79.64(7)[d]	534
$(PF_6)_2$	P-1	10.414(3)	108.57(2)		imN	1.991(2)		O,N	91.97(9, 3.31)	
(violet blue)	2	11.7549(3)	103.1(2)		μoxO	1.997(2)			103.40(8, 2.52)	
						2.208(2)			174.57(8)	
								N,N	86.6(1)[d]	
									96.1(1)	
									152.56(9)	
$[Cu_2(\mu\text{-ox})(bpca)_2]$	tr	7.6793(6)	83.80(1)	CuN_3O_2	bpcaN	1.976(5, 55)	5.442(1)	N,N	82.6(2, 4)[d]	549
(blue violet)	P-1	9.238(2)	68.37(1)		μoxO	1.957(3)			163.5(2)	
	2	10.007(2)	69.44(1)			2.264(4)		O,N	96.3(2, 1.9)	
									110.4(2)	
									170.1(2)	
								O,O	72.3(1)[d]	

$[Cu_2(\mu\text{-ox})(Et_5dien)_2](PF_6)_2$	m	13.436(9)		CuN_3O_2	dienN	2.078(5, 61)	5.457(3)	O,O	79.5(1)[d]	545
(dark blue)	I2/c	22.29(2)	103.68(7)		μoxO	1.971(4)		O,N	98.4(2, 5.6)	
	4	19.59(1)				2.229(4)			178.1(2)	
								N,N	86.9(2, 3)[d]	
									153.4(2)	
$[Cu_2(\mu\text{-ox})(terpy)_2]\cdot$	m	13.443(2)		CuN_3O_2	terpyN	1.990(5, 66)	5.469(2)	O,O	79.2(2)[d]	550
$[Cu_2(\mu\text{-ox})(H_2O)_2(terpy)_2]\cdot$	$P2_1/c$	23.183(4)	116.29(1)		μoxO	1.932(4)		O,N	96.8(2, 4.4)	
$(ClO_4)_2\cdot 2H_2O$	2	12.394(1)				2.2976(5)			175.6(2)	
(blue green)								N,N	80.7(5, 5)[d]	
									160.4(2)	
				CuO_3N_3	terpyN	2.005(5, 66)	5.528(2)	O,O	78.1(2)[d]	
					H_2O	2.387(6)			86.5(2)	
					μoxO	1.952(4)			163.9	
						2.327(5)		O,N	90.0(2, 1.5)	
									100.4(2, 3.5)	
									177.8(2)	
								N,N	79.8(2, 2)[d]	
									159.0(2)	
$[Cu_2(\mu\text{-ox})(ClO_4)_2(daea)_2]$	or	7.02(1)		CuO_3N_3	daeaN	2.02(1, 5)	5.488(6)[f]	N,N	83.9(8, 6)[d]	551
(not given)	$Pbc2_1$	13.25(3)				1.88(1)			162.5(7)	
	4	25.27(4)			O_3ClO	2.78(–)		N,O	94.3(7, 3.7)	
						2.96(–)			103.0(7)	
					μoxO	2.00(1, 3)			178.3(7)	
						2.26(1, 3)		O,O	77.9(6)[d]	
$[Cu_2(\mu\text{-bilm})(Me_5dien)_2](BPh_4)_2$	tr	11.265(4)	101.78(3)	CuN_5	dienN	2.061(3, 37)	5.489(1)	N,N	84.4(1, 1.7)[d]	552
(purple)	P-1	10.234(4)	104.04(3)		μbilmN	1.993(3)			93.6(1, 1.3)	
	1	15.999(5)	107.06(3)			2.324(3)			102.3(1, 2.4)	
									155.70(13)	
									174.10(12)	

TABLE VI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-ox})(ox)_2(bpy)_2]\cdot 2H_2O$	tr	9.673(3)	105.718(3)	CuO_4N_2	bpyN	2.007(4, 5)	5.566(2)[f]	N,N	80.9(2)[d]	553
(blue)	P-1	8.940(3)	110.347(3)		μoxO	1.988(4, 4)		O,N	94.4(2, 5)	
	2	9.103(3)	97.539(3)		oxO	2.320(4, 1)			101.0(2, 2.1)	
									174.7(1, 1.0)	
								O,O	88.8(2, 2.8)	
									77.7(2, 3)[d]	
									159.5(1)	
$[Cu_2\{\mu\text{-dt(metome)}_2\}Br_2]$	m	12.907(12)		CuS_2ONBr	N	1.950(7)	5.666(3)	N,Br	166.1(2)	554
(not given)	$P2_1/c$	6.701(4)	111.06(2)		S	2.265(3)		N,S	86.3(2)[d]	
	2	14.878(10)				2.405(3)			91.5(3)	
					O	2.524(7)		N,O	71.7(3)[d]	
					Br	2.332(1)		Br,S	96.7(1, 2.0)	
								Br,O	98.5(2)	
								S,S	129.2(1)	
								S,O	90.2(2)	
									135.8(2)	
$[Cu_2(\mu\text{-ia})(MeOH)_2(ClO_4)_2\cdot$	m	15.00(1)		CuO_4N_2	MeHO	2.406(6)	7.587(2)	O,O	83.2(2)[d]	555
$(Me_4en)_2]$[c]	$P2_1/n$	10.121(6)	103.07(5)		O_3ClO	2.911(10)			84.1(3, 5.3)	
(dark green)	4	24.19(3)			μiaO	1.953(5, 2)			168.0(3)	
					enN	2.009(7, 1)		O,N	93.5(3, 3.9)	
									172.1(3, 1)	
								N,N	88.3(3)[d]	
				CuO_4N_2	MeHO	2.395(6)	7.592(2)	O,O	83.0(2)[d]	
					O_3ClO	2.961(9)			86.7(2, 7.9)	
					μiaO	1.959(5, 5)			165.7(2)	
					enN	2.015(6, 1)		O,N	94.6(2, 3.9)	
									171.3(2, 6)	
								N,N	88.6(3)[d]	

$[Cu_2(\mu\text{-ca})(terpy)_2](PF_6)_2$	m	9.217(5)		CuN_3O_2	terpyN	1.993(3, 61)	7.843(1)	O,O	77.9(1)[d]	556
(not given)	$P2_1/n$	12.852(2)	101.61(2)		μcaO	1.943(2)		O,N	95.3(2, 3.1)	
	2	16.642(9)				2.268(2)			104.9(1, 6.6)	
									170.6(1)	
								N,N	80.0(2, 2)[d]	
									158.5(1)	
$[Cu_2(\mu\text{-ox})(terpy)_2](PF_6)_2 \cdot 2H_2O$	m	9.002(1)		CuN_3O_2		not given			not given	556
(green)	$P2_1/n$	12.597(2)	102.63(1)							
	2	16.538(3)								

[a] Where more than one chemically equivalent distance or angle is present the mean value is tabulated. The first number in parenthesis is e.s.d., the second is a maximum deviation from the mean value. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] There are two crystallographically independent molecules. [d] Five-membered metallocyclic ring. [e] Four-membered metallocyclic ring. [f] Calculated by us.

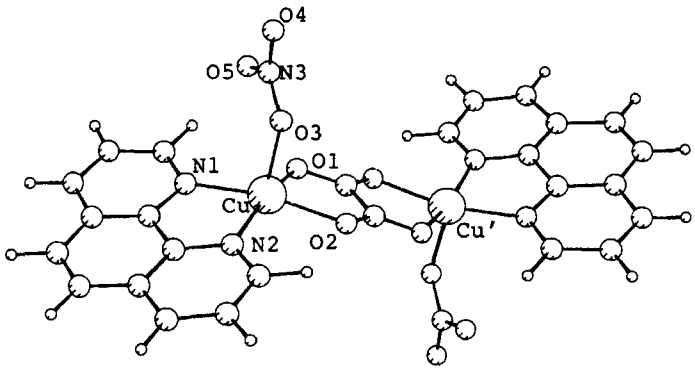


FIGURE 7 Structure of $[Cu_2(\mu\text{-ox})(NO_3)_2(pheem)_2$[537].

There are examples, in which μ-oxamidate,[539–541] μ-oxamide,[542,546] μ-tetrathiooxalate,[547] μ-biimidazole,[552] μ-N,N′(1,2-dithioxoethane-1,2-diyl)bis-(methylmethionate),[554] μ-iodanilate[555] or μ-chloranilate[556] serve as a bridge in the oxalate manner. In all remaining compounds a μ-oxalate serves as a bridge. In most derivatives[524,534–537,539–542,545,546,549,552] each Cu(II) atom is in a square-pyramidal environment with different degrees of distortion. In two examples[534,556] arrangement about Cu(II) atoms is intermediate between square pyramidal and trigonal bipyramidal. Another two derivatives[548,554] are in a trigonal-bipyramidal environment. In one example each Cu(II) atom is coordinated by four S atoms in a square-planar configuration.[547] Three examples[551,553,555] contain *pseudo*-octahedrally coordinated Cu(II) atoms. Two non-equivalent Cu(II) atoms are present in two complexes;[538,544] one has a square-pyramid and a square-planar environment; and the other one has a penta- and hexa-coordinate Cu(II).[535] The Cu–Cu separations range from 5.147(2) to 7.843(1) Å, which exclude a metal–metal bond.

Inspection of the data in Table VI reveals that there are two examples[534,555] which contain within the same crystal two crystallographically independent molecules, differing mostly by degree of distortion. Another two examples $[Cu_2(\mu\text{-ox})(NO_3)_2(mep)_2][Cu_2(\mu\text{-ox})(NO_3)_2(mep)_2(H_2O)]_2$[535] and $[Cu_2(\mu\text{-ox})(terpy)_2][Cu_2(\mu\text{-ox})(H_2O)_2(terpy)_2](ClO_4)_2\cdot 2H_2O$[550] contain two crystallographically independent dimers. The Cu–Cu separations are 5.149(1) and 5.268(1) Å[535] and 5.469(2) and 5.528(2) Å,[550] respectively. Dimer and monomer within the same crystal were also found.[536,538]

The environments about Cu(II) are built up mostly by O and N donors. The ligands involved are mono- through tetra-, hexa- and even octadentate.

In the series of homo-dentate ligands, the mean Cu–L bond distance for four-coordinated derivatives increases in the order: 1.94 Å (tetra O-donor;s) < 1.99 Å (bi-N-) < 2.23 Å (bi-S- and tetra-S-); for five-coordinated the order is: 1.95 Å (mono-N-) < 2.025 Å (bi-N-) < 2.04 Å (tri-N-) < 2.06 Å (tetra-O-) < 2.16 Å (tetra-N-) < 2.33 Å (Br) < 2.38 Å (mono-O-), and for hexa-coordinate the order is: 1.95 Å (tri-N-) < 2.03 Å (bi-N-) < 2.045 Å (tetra-O–) < 2.29 Å (bi-O–) < 2.36 Å (mono-O-donor;).

The heterobidentate ligands involved an O plus N atom; hexadentate ligands involved two O plus four N atoms; and octadentate ligands involved two O plus six N atoms and two O plus two N plus four S-donor sites.

The values of the L–Cu–L bond angles of the metallocyclic rings reflect the effects of both electronic and steric factors as well as coordination number. In five-membered rings the mean L–Cu–L intra-ligand angles, for four-coordinate derivatives, increase in the order: 84.0° (O-donor;) < 86.0°(N-donor;) < 92.0°(S-donor); for five-coordinate derivatives, the order is 81.0° (O+N-donor;) < 82.5°(O-donor;) < 83.5°(N-donor;), and for six-coordinate the values are: 81.5°(O-donor;) < 83.8°(N-donor;) < 86.0°(N+S-donor).

2.2.8 Multi-atom Bridges

Crystallographic and structural data for complexes in which two Cu(II) atoms are doubly bridged by multidentate ligands forming two four- (or more) atom bridges are gathered in Table VII. Structures are listed in the order of increasing Cu–Cu separation. The structure of the violet compound $[Cu_2(\mu\text{-tae})](ClO_4)_4$[566] is shown in Figure 8 as an example. Each Cu(II) atom is coordinated by two ring nitrogens and two pendant amino nitrogens; the two CuN_4 coordination sets face each other. Their coordination geometry is nearly square planar. The Cu(II) atom is displaced from the plane by 0.178 Å towards the center of the complex cation. The separation between the two Cu(II) atoms is 5.048(2) Å.

There are a variety of coordination geometries observed: square planar,[557,559,560,565,566,584,585,594,595] an intermediate between square planar and tetrahedral,[564] square pyramidal,[562,563,567,569,571–575,577,579,583,586,588,590–592,596,597,599–601] trigonal bipyramidal,[570] an intermediate between square pyramidal and trigonal bipyramidal,[578] and *pseudo*-octahedral.[561,568,576,581,582,589,593,598]

There is an example[558] which contains two nonequivalent Cu(II) atoms, CuN_4O (trigonal bipyramidal) and CuN_4 (tetrahedral). The Cu–Cu separations range from 2.987(1) to 8.892 Å. The ligands cover the range from

TABLE VII Crystallographic and structural data for doubly bridged copper(II) dimers by multidentate ligands forming two four- or more atom bridges[a]

Compound (*color*)	*Cryst. cl.* *space Gr.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$Na_4[Cu(\mu\text{-tart})]_2 \cdot 10H_2O$	m	9.290(4)		CuO_4	O[b]	1.947(3, 14)	2.987(1)	O,O[b]	85.5(1, 3)[c]	557
(blue)	$P2_1/n$	10.894(5)	94.85(6)			1.903(3, 13)			94.4(1, 1.8)	
	4	11.556(5)							112.9(2, 4.9)	
									176.0(1, 4)	
$[Cu_2(\mu\text{-bpden})_2(H_2O)] \cdot 4.6H_2O$	tr	9.038(6)	90.74(4)	CuN_4O	N	2.044(4, 4)	3.250(1)	N,N	80.6(2, 2)[c]	558
(green black)	P-1	11.535(6)	105.25(3)			1.975(4, 3)			99.8(2)	
	2	14.834(10)	98.84(4)		H_2O	2.250(3)			151.2(2)	
									172.5(2)	
								N,O	86.4(1, 1.0)	
									103.8(2, 2.7)	
				CuN_4	N	2.017(4, 1)		N,N	82.0(2, 1)[c]	
						1.943(4, 1)			102.7(2, 2)	
									156.8(2, 3.5)	
$[Cu(\mu\text{-enbpa})]_2$	or	23.561(3)		CuN_4	N	1.925	3.29	N,N	84.4[c]	559
(not given)	Fddd	16.723(2)				1.976			99.7	
	16	19.818(3)							158.1(–, 2)	
$[Cu(\mu\text{-dp-7})]_2$	m	15.36(1)		CuN_4	N	2.02(–, 5)	3.80	N,N	90(–, 3)[d]	560
(not given)	$P2_1/c$	9.34(1)	111.22(2)							
	2	31.05(2)								
$[Cu(\mu\text{-ppdn})(SO_4)]_2 \cdot 13H_2O$	or	15.42(1)		CuO_4N_2	O_3SO	2.3	3.9		not given	561
(deep blue)	$C222_1$	24.92(2)								
	8	25.73(2)								
$[Cu(\mu\text{-ptp})(H_2O)]_2 \cdot 2H_2O$	tr	9.756(6)	112.44(4)	CuO_4N	O	1.942(1, 47)	3.923(1)[e]	O,O	91.55(1, 2.24)	562
(green)	P-1	9.866(5)	111.36(7)		N	1.939(1)			101.95(1)	
	2	10.115(6)	89.08(9)		H_2O	2.227(1)			174.37(1)	
								N,O	82.35(1)[d]	
									94.50(1, 2.48)	
									160.08(1)	

$[Cu(\mu\text{-dppn})Cl]_2SO_4\cdot 8H_2O$	m	14.679(2)		CuO_2N_2Cl	O	1.980(6, 10)	3.948(1)	N,O	82.2(1, 1)[c]	563
(blue)	$P2_1/c$	13.070(2)	111.56(2)		N	1.968(6, 7)			95.2(1, 1.0)	
	4	23.958(6)			Cl	2.498(6, 2)				
$[Cu(\mu\text{-pbsalim})]_2$	m	17.09(5)		CuO_2N_2	O	1.90(1, 1)	4.203(5)[e]	O,O	89.8(5)	564
·(dark brown)	C2/c	14.49(4)	111.5(1)		N	1.97(1, 1)		O,N	92.8(5, 1.0)[d]	
	8	17.96(4)							149.9(7, 1.4)	
								N,N	100.2(5)	
$[Cu(\mu\text{-bbi})]_2\cdot 0.5CH_2Cl_2\cdot H_2O$	m	26.802(5)		CuO_2N_2	N/O	1.905(3, 1)	4.321(1)	O,N	90.1(2, 7)	565a
(green)	C2/m	9.887(2)	90.48(1)						177.7(1)	
	2	9.021(2)								
$[Cu(xba)]_2$	m	12.002(5)		CuO_4	O	1.893(8, 8)	4.917(2)[e]	O,O	90.00(2, 2.05)	565b
(olive green)	$P2_1/c$	7.434(2)	99.47(3)						178.69(3, 0.57)	
	2	19.431(9)								
$[Cu_2(\mu\text{-taep})](ClO_4)_4$	hx	16.022(9)		CuN_4	N	2.026(17, 39)	5.048(2)	N,N	85.9(6, 3.0)[c]	566
(violet)	P-6c2								93.2(6, 1.1)	
	6	24.400(11)								
$[Cu_2(\mu\text{-}[24]\text{-}N_6O_2)(H_2O)_2Br_2]\cdot$	m	12.702(3)		CuN_3OBr	N	2.049(5, 33)	5.16	N,N	166.5	567
$Br_2 4H_2O$	$P2_1/c$	7.885(1)	112.00(1)		H_2O	2.342		N,Br	172.6(2)	
(blue)	2	17.316(2)			Br	2.384(2)		O,N	92.4(−, 3.7)	
								O,Br	96.8	
$[Cu_2(\mu\text{-}O_2NO)(NO_3)_2(\mu\text{-nmedtb})]\cdot$	m	19.159(4)		CuO_3N_3	N	1.936(6, 5)	5.171(2)	N,N	82.3(2)[c]	568
$NO_3\cdot 4H_2O$	C2/c	15.907(2)	109.57(2)			2.118(5)			158.9(2)	
(blue)	4	16.816(3)			O_2NO	2.000(4)		O,O	53.5(2)[f]	
						2.626(5)			83.0(2)	
					μONO_2	2.41(4)			134.0(10)	
								O,N	92.0(2, 3.9)	
									106(−)	
									121.1(2)	
									174.2(2)	
$[Cu(\mu\text{-suqn})(H_2O)_2]_2$	tr	7.865(3)	108.10(2)	CuO_4N	H_2O	1.98(3, 5)	5.379(20)[e]	O,N	89(2, 2)	569
(not given)	P-1	9.140(2)	90.60(3)		N	1.99(4)			164(2)	
	2	7.646(2)	96.76(3)		O	1.99(4)		O,O	92(2, 7)	
						2.37(4)			176(2)	
									104(2)	

TABLE VII (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-bi-dptmd})(N_3)_2]$	m	18.508(5)		CuN_5	N	1.957(5, 43)	5.393(2)	N,N	79.6(2, 2)[c]	570
(dark blue)	$P2_1/n$	12.311(3)	112.65			2.082(5, 69)			88.4(2, 2.9)	
	4	20.185(6)			N_3N	2.119(7, 16)			96.6(3, 3.7)	
									131.6(3, 7.7)	
									168.5(2, 4)	
$[Cu_2(\mu\text{-}[24]\text{-ane}N_6)Br_4]$	m	9.6220(17)		CuN_3Br_2	N	2.041(12, 3)	5.432(3)	Br,Br	164.1(1, 1.5)	571
(green)	$P2_1/c$	14.0543(23)	91.700(13)			2.201(13)		Br,N	86.5(3, 3)	
	4	20.5581(29)			Br	2.536(3, 44)			92.1(4, 2.5)	
									103.5(4, 3.8)	
								N,N	95.2(5, 8)[d]	
									167.7(5, 1.4)	
$[Cu(\mu\text{-}C_{37}H_{36}N_2O_3)]_2$	tg	14.740(2)		CuO_3N_2	N	1.967(5, 7)	5.457(2)	O,O	84.7(2)	572
(green)	$I4_1/a$				O	1.923(4, 19)		O,N	91.7(3, 2)	
	16	47.512(8)				2.697(5)			167.8(3, 1.0)	
								N,N	94.1(4)[d]	
$[Cu(\mu\text{-}C_{19}H_{23}N_3O_2)(H_2O)]_2 \cdot$	tr	15.536(8)	105.97(4)	CuO_4N	O	1.975(4, 8)	5.46	O,O	95.5(2, 5.1)	573
$(ClO_4)_4$	P-1	19.587(9)	106.32(5)			2.003(5, 14)			161.5(2, 8)	
(pale green)	4	9.841(6)	104.60(4)			2.231(6, 23)		O,N	81.2(2, 4)[c]	
					N	1.896(5, 5)			99.6(2, 5.9)	
					H_2O	1.917(5, 6)			167.2(2, 3.6)	
$[Cu_2(\mu\text{-taec})(ClO_4)_2](ClO_4)_2$	or	11.709(1)		CuN_4O	N	2.033(6, 33)	5.479(1)	N,N	84.4(2, 1.0)[c]	574
(violet)	Pnnm	14.948(3)			O_3ClO	2.562(7)			93.6(2, 1.0)	
	2	9.938(2)							107.0(1)	
$[Cu_2(\mu\text{-taec})(NCS)_2](ClO_4)_2 \cdot$	or	10.926(3)		CuN_5	N	2.034(5)	5.565(1)	N,N	84.1(2)[c]	575
H_2O	Pnnm	16.005(3)				2.098(4)			92.2(2, 1.4)	
(blue)	2	9.923(2)			SCN	2.191(7)			108.1(2)	
									170.1(6)	

$[Cu(\mu\text{-hepk})(H_2O)_2(ClO_4)]_2\cdot$	m	15.132(11)		CuO_4N_2	N	1.964(18, 12)	5.6	N,N	82.2(7)[c]	576
$(ClO_4)_2$	C2/c	9.235(8)	102.32(5)		O	2.282(14)		N,O	93.9(6, 6.1)	
(blue)	4	23.030(17)			H_2O	1.989(16, 16)			171.6(7, 2.6)	
					O_3ClO	2.526(16)		O,O	86.9(6, 4.7)	
									169.7(6)	
$[Cu_2(\mu\text{-}C_{24}H_{48}N_4O_2S_4)](ClO_4)_4\cdot$	m	15.736(4)		CuN_2S_2O	N	2.037(6, 21)	5.6211(1)	N,O	80.3(1, 4)[c]	577
H_2O	$P2_1/n$	27.491(7)	100.50(2)		O	2.287(5, 4)			126.5(2, 1)	
(blue)	4	9.493(3)			S	2.319(1, 19)		N,N	153.0(2, 5)	
								N,S	88.5(1, 4)[c]	
									87.8(1, 5)	
								S,O	92.1(1, 4)	
									103.6(1, 2)	
								S,S	163.2(–, 8)	
$[Cu_2(\mu\text{-tpmta})Br_2](ClO_4)_2$	m	9.029(1)		CuN_4Br	N	2.028(4, 32)	5.74(1)	N,N	80.8(2, 5)[c]	578
(green)	$P2_1/c$	21.120(5)	111.47(1)			2.140(4, 8)			87.7(2, 2.1)	
	2	11.376(2)			Br	2.412(1)			116.3(2)	
									158.1(2)	
								Br,N	94.9(1)	
									109.5(1, 2.6)	
									131.5(1)	
$[Cu(\mu\text{-bsda})]_2\cdot 2Me_2CO$	m	12.86(1)		CuN_3O_2	O	1.956(3, 20)	5.809(5)[e]	O,O	143.7(1)	579
(green)	$P2_1/c$	16.74(2)	105.1(1)		N	1.973(3, 11)		O,N	90.6(1, 2.0)	
	2	9.86(1)				2.405(3)			124.8(1)	
								N,N	77.1(1)[c]	
									100.0(1)	
									176.2(1)	
$[Cu(\mu\text{-pdcno})(MeOH)(py)]_2$	tr	8.033(5)	96.76(3)	CuO_4N	O	1.943(7, 20)	5.832(3)[e]	O,O	88.5(3, 1.5)[d]	580
(blue)	P-1	9.056(5)	103.65(3)		MeOH	2.298(9)		N,O	90.9(3, 2)	
	1	11.013(5)	111.52(3)		py,N	2.002(9)				
$[Cu_2(\mu\text{-bpmab})(H_2O)(\mu\text{-}ClO_4)\cdot$	or	23.554(3)		CuO_3N_3	O_3ClO	2.393(5)	5.873(1)	N,N	84.0(2, 1)[c]	581
$(ClO_4)_2]ClO_4\cdot 4H_2O$	$Pmn2_1$	8.998(2)			H_2O	1.985(5)			167.9(2, 3.4)	
(green)	2	9.863(2)			N	1.969(5, 3)		N,O	78.0(2)	
						2.089(5)			90.3(2, 8.0)	
					μO_2ClO_2	2.393(5)			107.8(2)	
								O,O	86.7(2, 3.3)	
									171.7(2)	

TABLE VII (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu(\mu\text{-glygly})(H_2O)_2]_2 \cdot 2\{P(Ph_2O_2)O_2\} \cdot 2H_2O$ (blue)	or $Pca2_1$ 4	16.994(4) 5.953(2) 41.537(8)		CuO_5N	H_2O	1.996(3, 12)	6.139(1)[e]	O,O	89.3(2, 7.3)	582
						2.247(4)			99.3(2, 4.1)	
					O	1.976(3, 26)			137.9(1)	
						2.800(4, 64)			163.4(2, 94)	
					N	2.008(4, 8)		O,N	84.1(2, 70)[c]	
									113.5(2)	
									125.9(1)	
$[Cu(\mu\text{-poh})(NO_3)]_2 \cdot 6H_2O$ (dark green)	tr P-1 1	8.727(1) 10.308(1) 12.845(2)	110.00(1) 78.94(1) 114.35(1)	CuO_3N_2	O	1.925(2, 32)	6.217(1)[e]	O,O	88.8(1, 1.5)	583
					N	1.977(2, 30)			105.2(1)	
					O_2NO	2.643(2)		O,N	88.8(1, 2.8)[d]	
									169.8(1, 4.0)	
								N,N	93.6(1)[d]	
$[Cu(\mu\text{-hxa})]_2$ (blue)	m $P2_1/c$ 2	14.538(2) 10.454(2) 11.177(2)	95.03(1)	CuO_4	O	1.885(2, 4)	6.256(1)	O,O	84.24(8, 22)[c]	584
									95.76(8, 12)	
									178.16(8, 1.74)	
$[Cu_2(\mu\text{-por})]tol \cdot 2H_2O$ (not given) (at 83 K)	m $P2_1/c$ 2	11.878(6) 13.304(7) 23.725(13)	114.60(2)	CuN_4	N	1.987(5, 8)	6.332(4)	N,N	90.0(2, 2.5)[d]	585
									179.5(2, 2)	
$[Cu(\mu\text{-penas})(H_2O)]_2 \cdot 7H_2O$ (blue)	m C_2 4	12.266(5) 19.769(5) 15.698(5)	92.14(5)	CuO_3N_2	O	1.96(2, 2)	6.399(5)	N,O	84.2(9, 1.2)[c]	586
					N	2.00(2, 5)			95.8(9, 3.3)	
					H_2O	2.43(3, 5)		N,N	171(1)	
								O,O	89.0(8, 1.3)	
									175.6(9, 6)	
$[Cu_2(\mu\text{-tabm})(NO_3)_4] \cdot 6H_2O$ (purple)	m $P2_1/a$; $P2_1/c$ 4	12.656(3) 15.411(6) 16.426(5)	100.05(2)	CuN_4O_2	N	2.02(1, 5)	6.4	N,N	85.6(5, 8)[c]	587
					O_2NO	2.51(1, 5)			94.4(6, 1.4)	
									178.0(6, 1.4)	
								N,O	84.2(5, 9.6)	
								O,O	175.0(5, 6)	

$[Cu_2(\mu\text{-tcoa})(tos)_2](ClO_4)_2\cdot 4H_2O$	tr	11.811(3)	106.23(1)	CuN_4O	tcoaN	2.028(10, 11)	6.876(3)	O,N	96.7(3, 3)	588
(blue violet)	P-1	12.448(1)	113.45(1)			2.140(4)			109.2(3)	
	1	9.994(2)	76.98(1)		tosO	2.153(6)				
$Na_4[Cu(pdta)_2]\cdot 18H_2O$	tr	9.977(1)	80.37(1)	CuO_4N_2	O	1.948(7, 21)	6.931(8)	O,O	92.9(3, 5.1)	589
(dark green)	P-1	10.533(1)	73.41(2)			2.293(7)		O,N	75.2(3, 2.4)[c]	
	1	12.453(1)	88.13(1)		N	2.075(8)			87.2(3, 3.0)	
						2.509(8)			158.2(3, 4.0)	
								N,N	120.4(3)	
$[Cu_2(\mu\text{-}[24]\text{-aneN}_2S_4)Cl_4]\cdot 2H_2O$	m	7.943(2)		$CuCl_2S_2N$	N	2.024(5, 9)	7.228(1)	N,Cl	92.5(1, 6)	590
(dark green)	$P2_1/c$	22.481(6)	100.97(2)		Cl	2.250(1, 10)			166.5(2, 3.6)	
	4	17.538(5)				2.476(1, 23)		N,S	85.5(2, 1.6)[c]	
					μS	2.293(1, 57)		Cl,Cl	101.0(1, 2.9)	
						2.421(1, 24)		Cl,S	92.6(1, 3.2)	
									102.4(1, 5.3)	
								S,S	157.3(1, 4)	
$[Cu_2(\mu\text{-}[28]\text{-mN}_8)(HNCS)_2]\cdot$	tr	14.695(11)	111.5(1)	CuN_5	N	1.990(23, 82)	7.25[e]	N,N	78.5(10, 9)[c]	591
$(BPh_4)_2\cdot 1.5MeCN$	P-1	14.051(11)	98.8(1)		μN	2.047(19, 54)			89.5(8, 4.3)	
(green)	2	20.721(11)	100.3(1)		SCN	2.322(20, 8)			97.8(8, 1.8)	
									104.5(7, 2.2)	
									158.5(8, 3.4)	
									171.2(6)	
$[Cu_2(\mu\text{-}[30]\text{-aneN}_{10})HCl_2]\cdot$	m	21.491(5)		CuN_4Cl	N	2.04(2, 2)	7.26(1)	Cl,N	99.5(6, 8.7)	592
$(ClO_4)_3\cdot 4H_2O$	P2/n	7.696(4)	103.04(5)		Cl	2.43(1)		N,N	85.3(6, 6)[c,d]	
(blue)	2	12.210(4)							97.8(6)	
$[Cu(\mu\text{-arg})(ac)]_2\cdot 6H_2O$[g]	m	15.948(2)		CuO_4N_2	acO	2.570(15)	7.312(2)[e]	N,O	84.6(6, 1.6)[c]	593
(blue)	$P2_1$	16.878(2)	108.47(1)		O	1.937(12, 1)			96.2(5, 2.4)	
	4	10.378(2)				2.884(14)		O,O	86.2(6, 2.5)	
					N	1.991(13)			93.8(6, 2.8)	
									177.2(5, 5)	
								N,N	173.3(4)	
				CuO_4N_2	acO	2.563(16)	7.312(2)[e]	N,O	85.6(7, 3.8)[c]	
					O	1.943(15, 2)			92.6(7, 3.3)	
						2.944(16)		O,O	85.4(7, 4)	
					N	1.991(14, 5)			94.7(7, 3.1)	
									176.0(6, 1.3)	
								N,N	178.4(5)	

TABLE VII (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]	*Cu–Cu* [Å]	*L–Cu–L* [°]	*Ref.*
$[Cu(\mu\text{-nba})]_2 \cdot 2CHCl_3$	m	19.942(5)		CuO_4	not given	7.349(1)	not given	594
(not given)	C2/c	10.371(2)	116.85(2)					
	4	26.656(9)						
$[Cu_2(\mu\text{-}C_{17}H_{20}F_{12}N_2O_2)_2]$	m	20.008(2)		CuO_2N_2	O 1.864(9, 12)	7.356(3)[e]	O,O 167.0(4, 6.0)	595
(deep blue)	$P2_1/c$	9.009(1)	118.86(1)		N 2.014(9, 17)		N,N 160.7(4, 4.1)	
	4	29.296(3)					O,N 91.2(4, 5.0)[d]	
$[Cu(\mu\text{-btim})(NCS)]_2(NCS)_2$	m	14.381(4)		CuN_5	N 1.994(9, 10)	7.472(10)	N,N 89.1(3, 2.5)	596
(blue)	$P2_1/n$	10.834(3)	108.988(20)		SCN 2.190(10)		97.4(9, 1.4)	
	2	15.824(4)					165.1(4, 1.7)	
$[Cu(\mu\text{-bpmb})(H_2O)]_2(ClO_4)_4 \cdot$	tr	11.871(4)	108.45(9)	CuN_5O	N 2.018(13, 53)	7.520(2)	N,N 77.4(5, 6)[c]	581
$2H_2O$	P-1	12.313(7)	102.98(8)		2.513(13)		90.0(6, 7.4)	
(green)	1	10.441(14)	91.23(4)		H_2O 2.706(15)		105.4(5, 2.5)	
							174.6(6, 1.6)	
							N,O 88.7(5, 8.5)	
							169.2(4)	
$[Cu(\mu\text{-denc})_2Cl_2]_2$	tr	10.563(1)	98.77(1)	CuN_2Cl_2O	N 2.007(4)	7.701(1)[e]	Cl,Cl 149.4(1)	597
(blue)	P-1	13.123(1)	116.05(1)		2.012(3)		Cl,N 105.3(1, 5)	
	2	9.829(2)	100.34(1)		O 2.475(3)		N,N 171.7(1)	
					Cl 2.268(1, 14)		N,O 86.1(1, 2.5)	
$[Cu(\mu\text{-glu})(Et_4en)]_2$	m	9.365(4)		CuO_4N_2	Et_4enN 2.066(9, 7)	7.758(6)[e]	N,N 86.4(3)[c]	598
(blue)	$P2_1/n$	15.211(15)	105.33(5)		gluO 1.955(7, 18)		O,N 95.3(3, 6.3)	
	2	12.738(11)			2.780(10, 66)		123.2(3, 2)	
							O,O 52.6(3, 1.6)[f]	
							87.6(3, 3.3)	
							122.2(2)	
$[Cu(\mu\text{-pmaH})(ClO_4)]_2 \cdot 2H_2O$	m	10.956(4)		CuN_4O	N 1.99(1, 4)	7.824	N,O 90.4(6, 8.8)	599
(deep blue)	$P2_1/c$	8.907(4)	93.95(3)		O_3ClO 2.51(1)		N,N 82.9(4, 1.3)[c]	
	4	23.252(9)					97.2(4, 1.8)	
							169.2(5, 3.5)	

$[Cu_2(\mu\text{-dpce})Cl_4]$	tr	12.918(5)	102.08(3)	CuN_2Cl_2O	N	1.946(10)	8.892[e]		not given	600
(yellow green)	P-1	12.816(5)	99.12(3)			2.049(10)				
	2	18.576(7)	118.14(2)		O	2.123(9)				
					Cl	2.319(7)				
$[Cu(\mu\text{-dfpp})]_2$[g]	m	16.076(5)		CuO_2N_2	O	1.87(6, 1)	not given	O,O	158(2)	601a
(not given)	$P2_1/c$	33.709(4)	91.34(5)		N	1.96(7, 5)		N,N	156(3)	
	4	20.094(5)								
				CuO_2N_2S	O	1.96(5, 2)		O,O	156(2)	
					N	1.91(8, 4)		N,N	174(3)	
					S	3.00(3)				
				CuO_2N_2	O	1.89(4, 2)	not given	O,O	154(2)	
					N	2.02(6, 1)		N,N	152(2)	
				CuO_2N_2S	O	1.96(5, 1)		O,O	154(2)	
					N	1.95(6, 0)		N,N	178(2)	
					S	2.90(3)				
$[Cu(\mu\text{-car})(H_2O)]_2\cdot 2H_2O$	trg	8.641(9)		CuN_3O_2	N	1.97(−, 4)	not given		not given	601b
(blue)	$P3_12$				O	1.93				
	6	30.576(15)			H_2O	2.48				

[a] Where more than one chemically equivalent distance or angle is present, the mean value is tabulated. The first number in parenthesis is e.s.d., the second is a maximum deviation from the mean value. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] Five-membered metallocyclic ring. [d] Six-membered metallocyclic ring. [e] Calculated by us. [f] Four-membered metallocyclic ring. [g] There are two crystallographically independent molecules.

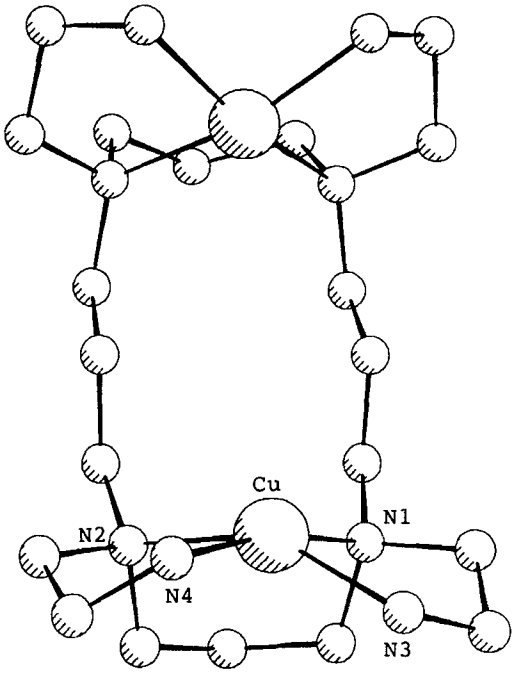


FIGURE 8 Structure of $[Cu_2(\mu\text{-taeo})]^{4+}$ (see Ref. 566).

mono- to octadentate. The mean Cu–L bond distances formed for monodentate ligands in the series of five-coordinated derivatives increases in the order: 2.14 Å (N) < 2.38 Å (Cl) < 2.44 Å (Br). In the series of multidentate O-donor; ligands the mean Cu–O bond distance increases in the order: 1.885 Å (octa-) < 1.94 Å (tri-) < 2.15 Å (tetra-) < 2.32 Å (mono-) < 2.40 Å (bidentate); and Cu–N bond distance in the order: 1.98 Å (tetra-) < 2.06 Å (hexa-) < 2.07 Å (bi-) < 2.14 Å (mono-) < 2.17 Å (octa-) < 2.265 Å (pentadentate).

The hetero-donor ligands are: bidentate with O plus N atom donors; tridentate with two O plus one N atom donors, and one O plus two N atom donors; tetradentate with three O plus one N atom donors, two O plus two N atom donors, and one O plus three N atom donors; pentadentate with three O plus two N atom donors, hexadentate with four O plus two N atom donors, and two O plus four N-donor; sites.

Both steric and electronic factors associated with the donor atom appear to influence the L–Cu–L bond angles of the various metallocyclic rings. The mean values for the angles are: five-membered rings, 82.2°(O+N-donor;) < 83.0° (N-donor;) < 85.0° (O-donor;) < 87.0° (N+S-donor); six-membered rings, 88.0° (O+N-donor;) < 88.5° (O-donor;) < 92.0° (N-donor;).

Two independent molecules differing by degree of distortion and coexisting in the same crystal have been found in blue $[Cu_2(\mu\text{-arg})_2(ac)_2]\cdot 6H_2O$.[593] The compounds given in Table VII are blue and green, but there are some violet/purple, red and even brown compounds.

2.3 Triply Bridged

Crystallographic and structural data for triply bridged Cu(II) dimers are summarized in Table VIII. The structures are tabulated in order of increasing Cu–Cu separation. Triply-bridged derivatives can be divided into several groups.

There is only one example,[162] in which two $Cu(dpyam)^{2+}$ moieties are triply bridged by single oxygen atoms of monodentate ligands, two μ-OH groups and one μ-OH_2 molecule. The Cu–Cu distance of 2.799(1) Å is the shortest in this series. Each Cu(II) atom is in a square-pyramidal environment with a CuO_3N_2 chromophore. In another three examples[203,604] two Cu(II) atoms are bridged by one single atom of monodentate ligands (μ-OH,[203] μ-N_3 or μ-NCO),[604] by the oxygen atom of a pentadentate ligand (pmp, N_4O;[203] $C_{17}H_{27}N_4O$, N_4O[604]) and by one bidentate ligand (ClO_4;[203] acetate[604]) in syn–syn arrangement. The Cu–Cu distances are 2.947, 2.978(2) and 2.995(1) Å. Each Cu(II) atom is in a square-pyramidal environment (CuO_3N_2[203] and CuN_3O_2[604]).

In several examples[602,605,607,609] two Cu(II) atoms are held together by two monodentate ligands (μ-OH and μ-Cl,[602] μ-OH and μ-OH_2,[605,607] μ-1, 1-$N_3(\times 2)$[609]) and by bidentate ligands (μ-$RCOO^-$,[602,605,607] μ-O_2NO[609]) in syn–syn arrangement. While in other examples[602,605,607] each Cu(II) atom is five-coordinate (square pyramidal) or six-coordinate.[609] Each five-coordinate Cu(II) atom deviates slightly from the basal plane, the mean values are 0.245 Å,[602] 0.15 and 0.14 Å[605] and 0.126 Å.[607]

In several other derivatives, a pair of distorted square-pyramidal[603,610,611,613,617,621] or distorted trigonal bipyramidal[606] units are held together by two monodentate ligands and by two nitrogen atoms of a tetradentate ligand (N_4) (Table VIII). The Cu(II) atom deviates from a basal plane toward an apical ligand. The mean values of the deviations are: 0.3 Å,[603] 0.142 and 0.162 Å,[610] 0.52 Å,[613] 0.139 and 0.293 Å[617] and 0.185 Å.[621]

In green $[Cu_2(\mu\text{-hphen})_2(\mu\text{-ac})]PF_6$[608] as can be seen in Figure 9 a pair of distorted square-pyramidal units are triply bridged by the phenolic oxygen atoms of two tridentate 2-(2-hydroxyphenyl)-1,10-phenanthroline anions(ON_2) and by an acetate group in syn–syn arrangement with a Cu–Cu separation of 3.073(2) Å and mean Cu–O–Cu bridge angles of 89.2°.

TABLE VIII Crystallographic and structural data for triply bridged copper(II) dimers[a]

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-}OH)_2(\mu\text{-}H_2O)(dpyam)]\cdot Cl_2\cdot 2H_2O$	or	15.675(3)		CuO_3N_2	N[b]	1.993(5, 20)		2.799(1)	O,O	79.1(2, 1.7)	162
	$Cmc2_1$	8.563(1)			μH_2O	2.419(5)	HO	91.6(3, 2)	N,N	91.5(2, 0)[d]	
(orange red)	4	18.115(3)			μHO	1.952(4, 3)	H_2O	70.7(2)	O,N	97.5(2, 7.1)	
										173.9(2, 1.0)	
$[Cu_2(\mu\text{-}pmp)(\mu\text{-}OH)(\mu\text{-}ClO_4)]\cdot ClO_4$	m	21.167(4)		CuO_3N_2	μO_3ClO	2.519(1, 69)		2.947	O,O	90.3(6, 4.2)	203
	$P2_1/n$	8.836(4)	109.22(2)		pmpN	1.942(2, 28)	HO	99.8(7, 6)	O,N	91.6(6, 2.4)[d]	
(green)	4	13.834(3)			μpmpO	1.938(1)	O	78.8(6, 1)		103.9(7, 9)	
					μHO	1.920(1)				171.5(7, 4.2)	
									N,N	84.6(6)[c]	
$[Cu_2(\mu\text{-}OH)(\mu\text{-}Cl)(\mu\text{-}ac)(bpy)_2]\cdot (ClO_4)\cdot H_2O$	m	8.434(1)		CuO_2N_2Cl	N	2.005(4, 7)		2.957(1)	Cl,N	99.6(1, 3.2)	602
	$P2_1/n$	16.074(2)	98.09(1)		μCl	2.557(1)	Cl	70.6(1)	Cl,O	85.0(1)	
(violet blue)	2	9.430(1)			*μHO*	*1.920(3)*	*HO*	*100.7(2)*		*105.0(1)*	
					μacO	1.971(3)			N,N	80.6(2)[c]	
									N,O	92.3(2, 2.6)	
										151.4(1)	
										175.4(2)	
									O,O	94.2(2)	
$[Cu_2(\mu\text{-}OH)(\mu\text{-}Cl)(\mu\text{-}bpap)Cl_2]\cdot 1.5H_2O$[e]	m	12.950(1)		CuN_2Cl_2O	N	1.982(4, 4)		2.972(1)[g]	O,Cl	92.1(1, 6)	603
	$P2_1/c$	14.262(1)	96.07(1)			2.019(4, 19)	HO	100.1(2)	Cl,N	94.6(1, 1.4)	
(dark green)	8	22.773(2)			Cl	2.289(2, 5)	Cl	not given	N,N	86.4(2, 1)[d]	
					μHO	1.939(3, 3)			N,O	82.9(2, 5)	
					μCl	2.572(2, 6)					
				CuN_2Cl_2O	N	1.987(4, 1)		3.001(1)[g]	O,Cl	91.8(1, 6)	
						2.014(4, 7)	HO	101.8(2)	Cl,N	94.4(1, 7)	
					Cl	2.282(2, 3)	Cl	not given	N,N	85.3(2, 1.7)[d]	
					μHO	1.943(4, 5)			N,O	83.7(2, 2)	
					μCl	2.598(2, 37)					
$[Cu_2(\mu\text{-}N_3)(\mu\text{-}ac)\cdot (\mu\text{-}C_{17}H_{27}N_4O)]\cdot PF_6$	tr	13.973(2)	74.97(2)	CuN_3O_2	μN_3N	2.09(1, 4)		2.978(2)		not given	604
	P1	11.289(1)	74.22(2)		acO	2.034(7)		not given			
(not given)	2	9.224(2)	77.88(2)			2.200(6)					
					μO	1.968(8, 12)					

$[Cu_2(\mu\text{-NCO})(\mu\text{-ac})\cdot$	m	10.352(9)		CuN_3O_2	μOCN	2.024(5)		2.995(1)		not given	604
$(\mu\text{-}C_{17}H_{27}N_4O)]\cdot PF_6$	$P2_1/c$	26.44(1)	109.28(3)			2.266(5)		not given			
(not given)	8	10.459(1)			μacO	1.982(5)					
						2.182(6)					
					μO	1.954(4, 3)					
$[Cu_2(\mu\text{-OH})(\mu\text{-}OH_2)(\mu\text{-pr})\cdot$	m	7.981(10)		CuO_3N_2	phenN	2.017(4, 5)		3.015(2)	O,N	91.1(2, 2.5)	605
$(phen)_2](NO_3)_2$	$P2_1/n$	18.352(8)	97.98(7)		μHO	1.918(3, 1)		103.6(2)		168.8(2, 6.0)	
(deep blue)	4	19.247(8)			μH_2O	2.348(4, 15)		95.5(1, 1)	N,N	81.5(2, 1)[c]	
					μprO	1.938(4, 2)					
$[Cu_2(\mu\text{-OH})(\mu\text{-}OH_2)(\mu\text{-ac})\cdot$	m	8.107(10)		CuO_3N_2	phenN	2.024(4, 7)		3.017(2)	O,N	91.0(2, 2.6)	605
$(phen)_2](NO_3)_2$	$P2_1/n$	18.554(9)	99.14(6)		μHO	1.933(3, 1)		103.4(2)		168.8(1, 6.7)	
(deep blue)	4	18.616(7)			μH_2O	2.349(4, 7)		95.6(1, 6)	N,N	81.5(2, 10)[c]	
					μacO	1.934(3, 1)					
$[Cu_2(\mu\text{-OH})(\mu\text{-Cl})(\mu\text{-Etbitp})Cl_2]\cdot$	tr	8.9198(5)	105.318(5)	CuN_2Cl_2O	N	2.551(1, 19)		3.017(1)	N,N	86.6(1, 2)[d]	606
dmf	P-1	13.5738(8)	105.255(5)			2.144(3, 14)	HO	104.7(1)	O,N	83.8(1, 4)	
(green)	2	13.7178(7)	99.461(5)		μHO	1.906(3, 5)	Cl	72.50(3)		169.1(1, 7)	
					μCl	2.551(1, 13)			N,Cl	94.1(1, 1.4)	
					Cl	2.260(1, 2)				135.4(1, 1.7)	
									O,Cl	91.0(1, 9.1)	
$[Cu_2(\mu\text{-OH})(\mu\text{-}OH_2)(\mu\text{-ac})\cdot$	tr	11.286(2)	97.31(1)	CuO_3N_2	bpyN	2.008(5, 2)		3.035(2)	O,O	96.6(2, 2.4)	607
$(bpy)_2](ClO_4)_2$	P-1	16.414(4)	103.78(1)		μHO	1.929(4, 1)	HO	103.8(2)	O,N	94.9(2, 5.6)	
(deep blue)	2	8.047(2)	72.59(1)		μH_2O	2.392(4, 13)	H_2O	78.7(1)		169.9(2, 8.3)	
					μacO	1.938(4, 7)			N,N	81.1(2, 1)[c]	
$[Cu_2(\mu\text{-hphen})_2(\mu\text{-ac})]PF_6$	m	18.180(5)		CuO_3N_2	μacO	1.942(2)		3.073(2)[g]	O,N	91.7(1, 1.6)	608
(green)	C2/c	13.570(3)	119.65(2)		N	1.990(3, 11)	O	89.2		171.2(1, 2.9)	
	4	15.818(4)			μphenO	1.889(3)			O,O	92.3(1)	
						2.449			N,N	83.4(1)[c]	
$[Cu_2(\mu\text{-}1, 1N_3)_2(\mu\text{-}NO_3)(NO_3)\cdot$	m	8.330(5)		CuN_4O_2	μN_3	1.992(9, 6)		3.087(3)	N,N	94.0(4, 2.0)	609
$(3\text{-Mepy})_4(H_2O)]$	$P2_1/c$	20.506(9)	98.04(3)		pyN	1.983(10,3)		101.7(4)		168.5(4, 4.5)	
(black)	4	18.818(8)			μO_2NO	2.691(8)			O,O	172.6(4)	
					O_2NO	2.465(12)			N,O	90.0(4, 13.7)	
				CuN_4O_2	μN_3	2.003(9, 9)			N,N	78.8(4, 3)	
					pyN	1.998(9, 10)				93.6(4, 1.8)	
					μO_2NO	2.670(8)				170.2(4, 8)	
					H_2O	2.338(8)			O,O	168.6(3)	
									N,O	89.8(4, 9.4)	

TABLE VIII (*Continued*)

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]	*Ref.*
$[Cu_2(\mu\text{-}OH)(\mu\text{-}ONO_2)\cdot$	m	14.136(5)		CuO_3N_2	N	1.969(10,17)		3.134(2)	O,O 53.8(4, 7)[f]	610
$(\mu\text{-pap6me})(NO_3)_2]\cdot 0.5H_2O$[e]	$P2_1/a$	19.865(14)	96.319(4)		O_2NO	2.031(10,18)	HO	112.6(5)	75.5(4, 2.1)	
(green)	8	18.259(11)				2.591(12,25)			93.6(4, 5.6)	
					μHO	1.987(9, 10)			117.7(3, 8.9)	
					μO_2NO	2.594(10,94)			167.6(3, 5.1)	
									O,N 78.9(3)	
									90.3(4, 6.8)	
									104.9(4, 5.8)	
									158.7(4, 5.7)	
									173.2(5, 3.5)	
									N,N 89.0(4, 1.1)[d]	
				CuO_3N	N	1.961(12,5)		3.134(3)	O,O 53.4(4, 1.9)[f]	
					O_2NO	2.004(10,28)		114.1(5)	75.3(4, 4.7)	
						2.611(14,57)			91.0(5, 3.9)	
					μHO	1.994(10,12)			122.6(3, 3.4)	
					μO_2NO	2.5192(19)			168.8(2)	
						2.8703(20)			O,N 92.2(5, 7.9)	
									155.0(5, 1)	
									173.6(5, 5.5)	
									N,N 90.0(4, 7)[d]	
$[Cu_2(\mu\text{-}OH)(\mu\text{-}Cl)(\mu\text{-pa})Cl_2]\cdot$	m	21.139(6)		CuN_2Cl_2O	μHO	1.890(7, 4)		3.137(2)[g]	not given	611
$3H_2O$	C2/c	12.797(1)	111.37(2)		μCl	2.682(6, 4)	HO	112.2(4)		
(green)	8	20.312(7)			N	2.012(8, 9)	Cl	not given		
$[Cu_2(\mu\text{-}OH)(\mu\text{-}O_2NO)\cdot$	m	27.078(1)		CuO_4N_2	H_2O	2.007(3)		3.138(1)	O,O 51.3(1)[f]	612
$(\mu\text{-pap4me})(NO_3)(H_2O)_2]NO_3$	$P2_1/a$	13.4451(4)	105.575(4)			2.620(3)	HO	115.3(1)	79.8(1, 1)	
(deep blue)	4	7.3744(6)			O_2NO	2.035(3)			95.3(1, 4.4)	
						2.738(3)			129.8(1)	
					μO_2NO	2.379(3, 49)			168.9(1)	
					μHO	1.558(2, 1)			O,N 88.5(1, 8.6)	
					N	1.995(3, 47)			114.8(2, 3.1)	
									172.0(1, 3.2)	
									N,N 89.1(1, 1)[d]	

$[Cu_2(\mu\text{-}N_3)(\mu\text{-}Br)(\mu\text{-}dptd)Br_2]\cdot$ MeCN (brown)	m $P2_1/n$ 4	8.437(5) 25.146(8) 11.858(4)	92.68(3)	CuN_3Br_2	Br N μBr μN_3	2.374(4, 11) 1.97(2, 2) 2.15(2, 17) 2.596(4, 25) 1.98(2)	Br N_3	3.138(3) 74.7(1) 105.0(8)	Br,N N,N	142.2(4, 3.5) 175.6(7, 3.9)	613
$[Cu_2(\mu\text{-}OH)(\mu\text{-}ac)(\mu\text{-}him)]\cdot (ClO_4)_2\cdot 1.5thf\cdot MeOH$ (blue)	m $P2_1/m$ 2	8.529(4) 27.883(4) 11.133(5)	102.81(2)	CuO_2N_2	N μHO μacO	1.976(8, 3) 1.934(5) 1.937(7)	HO	3.156(3) 109.3(4)	O,N N,N	90.3(4, 2.4) 89.1(3)	614
$[Cu_2(\mu\text{-}OH)(\mu\text{-}O_2IO)(\mu\text{-}pap)\cdot (IO_3)_2]\cdot 4H_2O$ (turquoise-blue)	m $P2_1/c$ 4	7.266(1) 15.269(1) 25.870(1)	96.40(1)	CuO_3N_2		not given	HO	3.165(1) 113.8(2)		not given	615
$[Cu_2(\mu\text{-}OH)(\mu\text{-}fm)_2(bpy)_2]BF_4$ (blue green)	m C2/c 8	33.260(8) 10.614(14) 13.776(10)	95.32(4)	CuO_3N_2	bpyN μHO μHCO_2	2.014(5, 13) 1.928(4, 1) 1.999(5, 31) 2.165(5, 25)	HO	3.171(1) 110.7(2)	O,N	147.2(2) 167.9(2, 5.1)	616
$[C_2(\mu\text{-}Cl)_2(\mu\text{-}bptp)(Cl)_2]\cdot EtOH$ (red)	m C2/c 8	33.9022(8) 9.1626(5) 15.4885(5)	114.853(2)	$CuCl_3N_2$	N Cl μCl	2.039(7, 37) 2.227(9, 1) 2.269(1, 1) 2.652(1, 47)	Cl	3.198(1) 80.7(1, 1.00)	Cl,N Cl,Cl N,N	90.94(8, 7.6) 154.08(8) 173.30(8) 89.13(8, 2.59) 121.45(4) 86.8(1)[d]	617
$[Cu_2(\mu\text{-}OH)(\mu\text{-}ac)(\mu\text{-}pdnm)\cdot (pdnm)(bpy)_2]$[c] (not given)	or $Pna2_1$ 8	9.738(10) 32.142(5) 23.673(5)		CuO_4N_2	O bpyN acO μHO μacO	2.68(1) 2.03(2, 1) 2.28(1) 1.93(1) 1.96(1)	HO	3.231(2) 113.5(6)	N,N O,O N,N 	80.4(6)[c] 90.7(5, 4.2) 108.6(5) 85.1(6, 5.9) 96.9(6, 8)	618
				CuO_3N_2	bpyN acO μHO μacO	2.00(1) 2.23(1) 1.93(1) 1.97(1)			N,N O,O O,N	82.3(6)[c] 97.1(6, 1.0) 103.3(5) 90.0(6, 4.6)	
				CuO_4N_2	O bpyN acO μHO μacO	2.87(2) 2.03(2, 1) 2.41(2) 1.96(1) 1.91(1)	HO	3.240(4) 114.1(7)	N,N O,O O,N	79.8(8)[c] 83.4(5, 4.2) 93.4(6, 1.4) 113.0(6) 84.2(7, 5.3) 99.0(7, 2.8)	

TABLE VIII (*Continued*)

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]		*Ref.*
				CuO_3N_2	bpyN	2.04(2, 1)			N,N	81.0(7)[c]	
					acO	2.25(1)			O,O	96.6(6, 4)	
					μHO	1.90(1)				107.2(6)	
					μacO	1.97(1)			O,N	89.4(7, 6.0)	
$[Cu_2(\mu\text{-}Cl)_2(\mu\text{-}pap46Me)(Cl)_2]$	m	15.795(3)		$CuCl_3N_2$	N	2.019(2, 3)		3.251(1)	Cl,N	90.94(8, 7.61)	617
(green)	C2/c	10.661(3)	113.82(3)		Cl	2.267(1)	Cl	83.57(4)		154.08(8)	
	4	16.155(4)			μCl	2.277(1)				173.30(8)	
						2.589(1)			Cl,Cl	89.13(8, 2.59)	
										121.45(4)	
									N,N	86.8(1)[c]	
$[Cu_2(\mu\text{-}ac)_2(\mu\text{-}bmpc)]ClO_4 \cdot$	m	20.127(7)		CuO_3N_2	N	2.035(8, 11)		3.263(2)		not given	619
$3H_2O$	$P2_1/n$	14.480(4)	92.88(3)		μO	1.949(8, 7)	O	113.7(3)			
(dark green)	4	11.263(2)			μacO	1.929(7, 6)					
						2.169(7, 0)					
$[Cu_2(\mu\text{-}Cl)(\mu\text{-}bptp)_2](ClO_4)_3 \cdot$	or	10.325(3)		CuN_4Cl	N	1.998(6, 4)		3.269(2)	N,N	87.5(2, 1.7)[d]	620
MeCN	Pmcn	17.917(5)				2.018(6)	Cl	84.2(1)		92.8(2, 3)	
(green)	8	22.458(4)			μCl	2.439(5, 9)				163.3(2, 1)	
									Cl,N	98.0(2, 3.2)	
$[Cu_2(\mu\text{-}N_3)(\mu\text{-}O_2ClO_2)(\mu\text{-}baaep) \cdot$	tr	20.86(3)	105.35(9)	CuN_4O_2	N	1.972(18,32)		3.295(4)	N,N	85.0(7, 27)[c]	465
$(bpy)_2(ClO_4)]$[e]	P-1	15.028(16)	95.86(11)		O_3ClO	2.76(3)	N_3	112.6(8)		169.3(7, 2.6)[c]	
(dark green)	4	9.466(9)	94.98(8)		O	2.545(16)			N,O	85.0(7, 6.4)	
					N	1.980(15)				94.9(8, 4.6)	
					μN_3N	1.979(16)			O,O	167.6(6)	
				CuN_3O_2	N	1.981(16)			N,N	83.7(7)[c]	
					O	1.895(14)				96.9(6)[d]	
					μN_3N	1.981(16)				161.7(7)	
					O_3ClO	2.380(17)			N,O	93.2(7, 6.3)	
										172.1(7)	
									O,O	90.8(6)	
				CuN_4O_2	N	2.002(19,15)		3.367(4)	N,N	78.3(8)[c]	
					O_3ClO	2.60(2)	N_3	117.9(9)		95.8(7)[d]	
					O	2.664(16)				93.4(7, 6.5)	
					N	1.956(17)				166.6(8, 3.2)	

					μN_3N	1.932(17)			N,O	86.9(7, 8.2)	
										100.7(7, 5)	
									O,O	163.8(6)	
				CuN_3O_2	N	2.010(17,29)			N,N	85.0(7, 4.8)[c]	
					O	1.927(16)				102.2(7)	
					μN_3N	1.998(17)				166.3(7)	
					O_3ClO	2.436(18)			N,O	87.7(7, 3.9)	
										102.4(7)	
										169.7(7)	
									O,O	96.6(7)	
$[Cu_2(\mu\text{-}Br)_2(\mu\text{-bptp})Br_2]$	m	11.1042(18)		$CuBr_3N_2$	N	2.048(13,39)		3.318(3)	Br,N	90.3(4, 8.6)	621
(green)	$P2_1/c$	15.6554(10)	113.485(11)		Br	2.387(3, 12)	Br	79.3(8, 6)		169.3(4, 5.5)	
	4	12.6058(14)			μBr	2.397(3, 17)			Br,Br	95.1(1, 1.1)	
						2.784(3, 18)				112.2(1)	
									N,N	86.2(5)[d]	
$(PPh_4)[Cu_2(\mu\text{-}Cl)(\mu\text{-}pz)_2\cdot$	m	17.598(7)		CuN_4Cl	N	2.01(1, 1)		3.387(6)	Cl,N	95.3(3, 3.5)	622
$[H_2B(pz)_2\}_2]\cdot 0.5Me_2CO$	C2/c	19.681(9)	117.1(2)		μpzN	2.00(1, 1)	Cl	82.6(2)	N,N	89.5(4, 1.7)[d]	
(not given)	4	15.324(6)			μCl	2.566(4)				169.2(4, 8)	
$[Cu_2(\mu\text{-ac})_3(bpy)_2]ClO_4$	tr	11.973(2)	103.96(1)	CuO_3N_2	bpy	2.011(2, 22)		3.392(1)	O,N	89.8(1, 3.9)	607
(blue)	P-1	18.576(4)	65.92(1)		μacO	1.956(2, 26)	O	109.8(1)		99.2(1, 3.3)	
	2	7.745(1)	119.58(1)			2.169(2)				122.6(1)	
						2.238(2)				140.1(1)	
										165.9(1)	
									N,N	80.7(1, 1)[c]	
$[Cu_2(\mu\text{-}OH_2)(\mu\text{-}Cl_3ac)_2(Cl_3ac)_2\cdot$	tr	11.804(3)	84.39(16)	CuO_5	Cl_3acO	1.919(10,1)		3.529	O,O	86.8(4, 11.1)	623
$(proxyl)_2]$	P-1	12.262(3)	86.65(16)		O	1.939(9, 11)	H_2O	108.4(4)		107.1(4)	
(deep green)	2	15.675(3)	77.75(17)		μH_2O	1.994(9)				166.0(4, 6.8)	
						2.351(9)					
					μCl_3acO	1.919(10,1)					
$[Cu_2(\mu\text{-}OH)(\mu\text{-}[30]\text{-}mN_6O_4)\cdot$	tr	12.634(9)	88.3(1)	CuN_3O_2	N	2.002(16,15)		3.57	O,N	88.6(5, 8)	624
$(ClO_4)(H_2O)][ClO_4)_2$	P-1	14.103(8)	118.4(1)		O_3ClO	2.485(22)	HO	141.7(7)		98.4(5, 1.9)	
(blue green)	2	14.689(8)	115.6(1)		μHO	1.966(13)				174.2(5)	
									N,N	79.6(5, 5)[c]	
										158.9(6)	
									O,O	96.6(5)	
				CuO_3N_3	N	2.021(14,96)			O,N	96.0(5, 3.0)	
					O	2.740(22)				103.2(5)	
					H_2O	2.455(20)				178.4(3)	
					μHO	1.912(10)			N,N	78.9(5, 1.0)[c]	
									O,O	87.2(1)	

TABLE VIII (*Continued*)

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]	*Ref.*
$[Cu_2(\mu\text{-OH})(\mu\text{-tpmc})](ClO_4)_3 \cdot 2H_2O$ (green)	m Cm 2	11.048(1) 22.318(3) 9.459(1)	111.95(1)	CuN_4O	N μHO	2.065(4, 66) 2.093(4, 7) 2.012(4)	 HO	3.712(1) 134.5(2)	O,N N,N	107.8(2, 1.8) 96.1(2) 127.2(2) 82.2(2, 1.7)[c] 92.8(2) 123.2(2) 157.9(1)	625
$[Cu_2(\mu\text{-OH})(\mu\text{-bistren})]Br_3 \cdot 6H_2O$ (not given)	m C2/c 4	15.793(3) 11.100(5) 24.506(6)	90.92(2)	CuN_4O	N μOH	2.059(5, 19) 2.239(5) 1.928(2)	 HO	3.767(1) 155.5(4)	O,N N,N	94.1(2, 6) 100.7(2) 175.6(2) 84.2(2, 6)[c] 107.8(2, 3.5) 141.4(2)	626
$[Cu_2(\mu\text{-mepH})(\mu\text{-}H_2O)] \cdot 2\text{-Clbz} \cdot 2\text{-PrOH}$ (blue)	tr P-1 2	11.919(7) 15.063(4) 15.648(9)	117.82(3) 98.95(4) 97.48(4)	CuO_3N_2	N μO μH_2O	1.995(9, 22) 1.967(7, 20) 2.349(6, 10)		3.893(2)	O,N O,O N,N	84.0(3, 1.5)[c] 100.9(2, 3.4) 91.8(3, 2.5) 97.7(3, 5)	515
$[Cu_2(\mu\text{-F})(\text{tpmc})](ClO_4)_3 \cdot 2MeCN$ (not given)	m $P2_1/a$ 4	21.543(4) 18.020(4) 11.987(2)	91.13(2)	CuN_4F	N μF	2.041(13,37) 2.074(8, 6)	 F	3.993(2) 148.6(4)	F,N N,N	91.3(4, 2.9) 111.0(4, 8.6) 83.2(5, 2.6)[c] 103.6(5, 3) 156.4(5, 10.5)	627
$[Cu_2(\mu\text{-taec})(\mu\text{-}N_3)](ClO_4)_3$ (blue)	or $Pmn2_1$ 2	8.875(4) 8.076(1) 21.756(9)		CuN_5	N μN_3N	2.043(6, 18) 2.107(5) 2.252(12,12)		4.312(1)	N,N	85.3(2, 1.3)[c] 95.3(2, 3.2) 108.8(2, 1.2)	575
$[Cu_2(\mu\text{-taec})(\mu\text{-NCO})](ClO_4)_3$ (blue)	or $Pmn2_1$ 2	8.885(2) 8.047(1) 21.847(4)		CuN_5	N μNCO	2.066(7, 32) 2.274(17,14)		4.340(2)	N,N	85.2(3, 2.2)[c] 95.5(3, 3.4) 108.9(2, 1)	575

$[Cu_2(\mu\text{-Cl})(\mu\text{-tpmc})](ClO_4)_3 \cdot H_2O$ (blue)	m $P2_1/n$ 4	15.054(2) 22.452(2) 12.895(1)	92.48(1)	CuN_4Cl	N μCl	2.042(8, 35) 2.528(2, 26)	Cl	4.470(2) 124.3(1)	N,N	83.7(3, 2.2)[c] 104.5(3, 4)	627
$[Cu_2(\mu\text{-}O_2NO)(\mu\text{-tpmc})](PF_6)_3$ (blue)	m $P2_1/n$ 4	18.685(4) 25.563(5) 9.393(1)	92.59(2)	CuN_4O	N μO_2NO	2.006(14.43) 2.059(14,34) 2.231(15) 2.007(12) 2.456(11)		4.651	O,N N,N	84.4(5) 95.5(5, 5.6) 123.0(5) 85.5(6, 8.3)[c] 105.0(6, 2.1)	625
$[Cu_2(\mu\text{-Br})(\mu\text{-taec})](ClO_4)_3$ (blue)	or $Pca2_1$ 4	15.590(1) 14.460(1) 14.602(1)		CuN_4Br	N μBr	2.050(20,62) 2.688(4) 2.730(3)	Br	4.656(3) 118.5(1)	N,N Br,N	85.3(11,1.4)[c] 90.3(10,5.3) 147.3(8, 2) 163.4(10,1.8) 91.3(9, 9) 104.6(5, 9) 122.1(6, 5)	574
$[Cu_2(\mu\text{-}N_3)(\mu\text{-tach})](ClO_4)_3$ (deep blue)	m $P2_1/a$ 4	25.909(2) 14.093(1) 9.418(2)	94.28(2)	CuN_5	N N_3N	2.052(5, 52) 2.104(4, 1) 2.212(4, 17)		5.541(1)	N,N	83.9(2, 3)[c] 90.3(2, 4.9) 107.8(2, 5.3) 120.3(1)	566
$[Cu_2(\mu\text{-im})(\mu\text{-}[24]\text{-aneN}_6O_2)\cdot(imH)_2](ClO_4)_3$ (blue)	m C2/c;Cc 4	15.008(3) 10.186(2) 26.062(3)	100.48(1)	CuN_5	N imN μimN	2.08(4, 5) 2.25(1) 2.133(1) 1.946(1)		5.866(2)[g]	N,N	83.1(4, 1)[c] 91.5(4, 7.4) 130.5(4, 2.6) 171.5(4)	628 629
$[Cu_2(\mu\text{-im})(\mu\text{-sbm})](CF_3SO_3)_3 \cdot H_2O.3thf$ (green)	tr P-1 2	18.016(6) 18.287(6) 9.704(4)	99.99(2) 92.74(2) 73.79(2)	CuN_4O	N O imN	2.025(4, 97) 2.248(2) 2.442(3) 1.953(4, 8)		5.918(1)	N,N N,O	78.5(1, 3)[c] 101.3(1, 1.1) 156.2(2, 5) 171.4(1, 6.4) 97.2(1, 1.3)	630

TABLE VIII (*Continued*)

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]	*Ref.*
$[Cu_2(\mu\text{-}N_3))(\mu\text{-}[30]\text{-}mN_6O_4)\cdot$	m	17.891(7)		CuN_5	N	1.99(2, 6)	6.02		not given	631
$(N_3)_2]ClO_4$	$P2_1/n$	10.939(11)	106.10(8)			2.04(3, 12)				
(not given)	4	20.361(13)			N_3N	1.93(3)				
					μN_3N	2.23(3, 2)				
$[Cu_2(\mu\text{-im})([24]\text{-ane}N_6O_2)\cdot$	or	16.670(4)		CuN_5	N	2.03(3)	6.579(7)[g]	N,N	84.8(15, 6.3)[c]	629
$(Meim)_2](ClO_4)_3$	Pnma	28.112(18)				2.11(4, 2)			96.2(13, 2.6)	
(blue)	3	9.195(9)			imN	2.08(3)			107.0(11)	
					μimN	1.95(2)			126.1(15, 5.9)	
									165.1(12)	
$[Cu_2(\mu\text{-nba})_2(\mu\text{-dabco})]\cdot$	or	22.771(6)		CuO_4N		not given	7.403(4)		not given	594
$2CH_2Cl_2\cdot 2H_2O$	Pnma	22.326(5)								
(not given)	4	11.621(3)								

[a] Where more than one equivalent distance of angle is present the mean value is tabulated. The first number in parenthesis is e.s.sd., the second is maximum deviation from the mean value. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] Five-membered metallocyclic ring. [d] Six-membered metallocyclic ring. [e] There are two crystallographically independent molecules. [f] Four-membered metallocyclic ring. [g] Calculated by us.

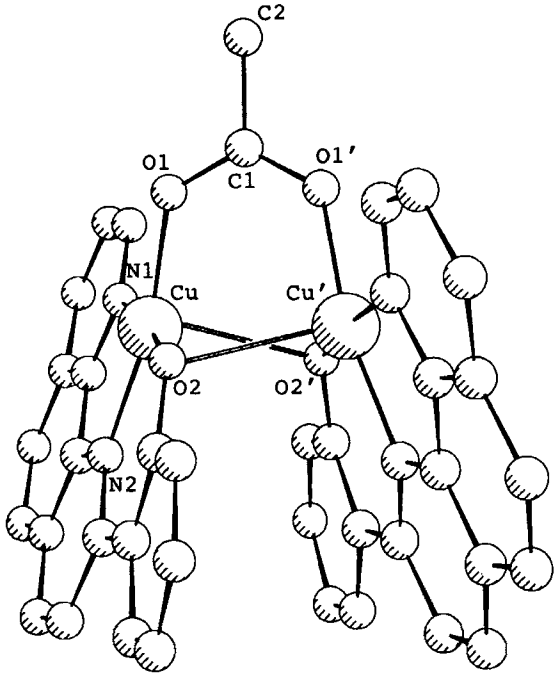


FIGURE 9 Structure of $[Cu_2(\mu\text{-hphen})_2(\mu\text{-ac})]^{2+}$ (see Ref. 608).

There are three blue examples[612,614,615] in which a pair of tetragonal-bipyramidal,[612] a square-pyramidal[614] and an intermediate between square-pyramidal and trigonal bipyramidal[615] units are triply bridged by an oxygen atom of μ-OH group, by bidentate anions (μ-O_2NO,[612] μ-O_2IO[615]) in syn–syn arrangements and by the two nitrogen atoms of a tetradentate (N_4) ligand with Cu–Cu separations of 3.138(1), 3.156(3) and 3.165(1) Å.

Two Cu(II) atoms in several other derivatives[465,607,616,618,622,623] are triply bridged by one single atom ligand and by two bidentate ligands. In blue green $[Cu_2(\mu\text{-OH})(\mu\text{-HCOO})_2(bpy)_2]BF_4$,[616] two nonequivalent Cu(II) atoms (one a distorted square-pyramid and the other a distorted trigonal bipyramid) are held together by a μ-OH group and by two μ-HCOO groups in *syn–syn* arrangements with a Cu–Cu separation of 3.171(1) Å.

Two non-equivalent Cu(II) atoms (five- and six-coordinate) are triply bridged by a μ-OH group and by two bidentate ligands (μ-acetate and μ-pdnm) in syn–syn arrangements.[618] There are two crystallographically independent molecules with Cu–Cu separations of 3.231(2) and 3.240(1) Å, respectively.

In dark green $[Cu_2(\mu\text{-}N_3)(\mu\text{-}O_2Cl)_2\ (\mu\text{-baaep})(bpy)_2(ClO_4)]$[465] two crystallographically independent dimers are found, in both of which the five- and six-coordinated Cu(II) atoms are held together by a μ-1,1-azide, μ-O_2ClO_2 (syn–syn arrangement) and by μ-baaep, with Cu–Cu separations of 3.295(4) and 3.367(4) Å, respectively.

The two square-pyramidal units in one example[622] are bridged by a single chlorine atom and by two bidentate pyrazole molecules, which brings the Cu(II) atoms to within 3.387(6) Å. The mean value of the displacement of Cu(II) atoms from the basal plane towards the apical ligand is 0.15 Å.

In blue $[Cu_2(\mu\text{-ac})_3(bpy)_2]ClO_4$[607] two types of acetate group are present, one bridging only through one O atom and the remaining two as bidentate in a syn–syn arrangement. The Cu(II) atoms are different from the stereochemical point of view, one square-pyramidal and the other an intermediate between square-pyramidal and trigonal-bipyramidal configurations with a Cu–Cu separation of 3.392(1) Å.

Two square pyramidal units in a deep green derivative[623] are triply bridged by a single O atom of water and by two bidentate trichloroacetate groups in syn–syn arrangements. The mean value of the displacement of Cu(II) atoms from the basal plane is 0.435 Å and Cu–Cu separation is 3.529 Å.

In dark green $[Cu_2(\mu\text{-ac})_2(\mu\text{-bmpc})]ClO_4\cdot 3H_2O$[619] two square pyramidal (CuO_3N_2) units are bridged by the phenolic oxygen of a pentadentate bmpc ligand (ON_4) and by two acetate groups in syn–syn arrangements, which bring the Cu(II) atoms to within 3.263(2) Å.

Green $[Cu_2(\mu\text{-Cl})(\mu\text{-ptp})_2(ClO_4)_3\cdot MeCN$[620] involving a triple-bonding arrangement between the two square-pyramidal Cu(II) centers (a chlorine bridge and two pair of nitrogen atom bridges of two tetradentate ptp molecules (N_4). Each Cu(II) atom is raised above the mean plane of the four equatorial nitrogen donors (0.282 and 0.286 Å) with a Cu–Cu separation of 3.269(2) Å. In blue $[Cu_2(mepH)_4(H_2O)](2\text{-cebez})\cdot 2PrOH$,[515] the dimeric complex cation comprises two very simple building blocks, each of which has copper in square-pyramidal coordination with a mepH–Hmep ligand pair defining the basal plane. The basal planes of the building blocks are joined by two hydrogen bonds (oxygen–oxygen distances of 2.446(7) and 2.494(8) Å) the building blocks share a water ligand at the apices of their square pyramids. The Cu–Cu separation is 3.893(2) Å. The mean value of displacement of copper from the basal plane toward the water molecule is 0.204 Å.

There are several derivatives[566,574,57,594,625–631] in which two Cu(II) atoms are "sitting" in the cavity of macrocyclic hexa- or octadentate N donor

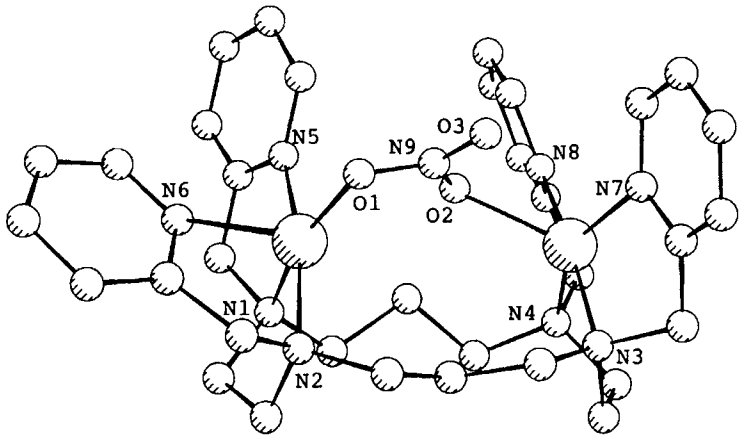


FIGURE 10 Structure of $[Cu_2(\mu\text{-}O_2NO)(\mu\text{-tpmc})]^{3+}$ (see Ref. 625).

ligands, serving as a double bridge and an additional bridge is created or by a single μ-1,1-N_3,[575] μ-OH,[624–626] μ-F,[627] μ-Br,[574] atom; or by a bidentate ligand; μ-1,3-N_3,[566,631] μ-O_2NO,[625] μ-imidazole.[94,628–630] The structure of the green complex $[Cu_2(\mu\text{-}O_2NO)(\mu\text{-tpmc})])PF_6)_3$[625] is shown in Figure 10 as an example. The two Cu(II) atoms "sitting" in the cavity of macrocyclic tpmc ligand are additionally bridged by the nitrate group in syn–syn arrangements. Each Cu(II) atom has a distorted square-pyramidal environment. The Cu1 and Cu2 atoms are pushed from the basal planes toward the apices by 0.07 and 0.24 Å, respectively. The Cu–Cu separation for this series ranges from 3.57 to 7.403(4) Å. There is one derivative[624] in which one Cu(II) atom is six- and the other one is five-coordinate. Two derivatives[625,626] contain Cu(II) atoms in distorted trigonal bipyramidal arrangement and in all remaining examples[66,574,575,594,625,627–631] each Cu(II) atom has a distorted square-pyramidal geometry. The mean values of the displaced Cu(II) atoms from the basal planes toward the apical ligands increases in the order: 0.14 Å[594] < 0.16 Å[605] < 0.26 Å[629] < 0.28 Å[631] < 0.31 Å[628,629] < 0.339 Å[566] < 0.34 Å[627] < 0.38 Å[627] < 0.43 Å[574] < 0.45 Å.[575]

Inspection of the data in Table VIII reveals that these derivatives are predominantly green and blue with some examples of red, brown and black. The ligands involved are mono- through hexa- and octadentate with N and O donors being by far the most common. The mean $Cu\text{–}L_{(terminal)}$ bond distances are shorter than those of $Cu\text{–}L_{(bridge)}$ when L are N, Cl or Br, with the values 1.97 *vs.* 2.05 Å (N), 2.33 *vs.* 2.535 Å (Cl) and 2.38 *vs.* 2.64 Å (Br), but the opposite pattern is observed when L is an O donor, 2.435 *vs.*

2.00 Å. One reason is the "small" size of the μ-OH group which mostly serves as a bridge.

The mean Cu–N bond distance increases in the order: 1.97 Å (mono-) < 2.015 Å (tetra-) < 2.020 Å (bi-) < 2.08 Å (octa-) < 2.165 Å (hexadentate). There are three types of hetero-donor ligands: tridentate including those with one O plus two N-donor; sites; pentadentate containing one O plus four N-donor; sites, and octadentate with two O plus six N-donor; sites.

The mean L–Cu–L bond angles of the metallocyclic rings open with decreasing coordination number. For example, in four-membered rings the mean O–Cu–O intra-ligand angles are 51.3°(six-) and 53.5°(five-coordinate); in five-membered rings (N–Cu–N) are 80.5°(six-) and 83.0°(five-coordinate).

There are four derivatives[465,603,610,618] which contain two crystallographically independent dimers, differing mostly by degree of distortion and are further examples of distortion isomerism.[144]

2.4 Quadruply Bridged

Crystallographic and structural data for the quadruply-bridged Cu(II) dimers are given in Table IX. There are several types of bridging, the distorted double edge-shared bi-octahedral structure with two types of bridge involving a pair of monodentate O-donor; ligands and of bidentate perchlorate groups. The structures are tabulated in the order of increasing Cu–Cu distance.

A crystal structure of $Cu_2(\mu\text{-}Cl)_2(\mu\text{-npthd})_2Cl_2$[632] is shown in Figure 11. The molecular structure includes two types of bridge between the Cu(II) atoms: two asymmetric bridges involving chlorine atoms and two symmetric bridges involving npthd molecules and terminal chlorine atoms completed a square-pyramidal arrangement about each Cu(II) atom. There are two crystallographically independent molecules differing by degree of distortion with Cu–Cu distances of 2.659(4) and 2.664(5) Å, respectively.

There are several examples[271,633,635–638] in which two Cu(II) atoms are bridged by two μ-OL groups and two intramolecular bidentate perchlorate groups. The geometry at each copper atom is distorted octahedral.

Another three examples[633,636] involve bridges formed by μ-OL, μ-N_3 in an end-end fashion and by two perchlorate groups. Each copper is six-coordinate.

In dark brown $Cu_2(\mu\text{-OMe})(\mu\text{-ac})(\mu\text{-ttc6})$,[639] two Cu(II) atoms are coordinated to two bidentate aminotropone iminate portions of the macrocycle (tetradentate N_4) and additionally bridged by both a methoxide (μ-OMe)

TABLE IX Crystallographic and structural data for quadriply bridged copper(II) dimers[a]

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]		*Ref.*
[Cu(μ-Cl)(μ-nthy)Cl]$_2$[c]	m	9.171(5)		$CuCl_3N_2$	N[b]	2.007(22)		2.659(4)	Cl,Cl[b]	98.3(5)	632
(not given)	C2/c	14.931(5)	90.2(1)		Cl	2.275(14)	Cl[b]	115.7(5)		146.0(6)	
	8	25.324(5)			μCl	2.299(14)			N,N	171.1(10)	
						2.667(14)			Cl,N	89.9(1.2, 4.7)	
				$CuCl_3N_2$	N	2.043(21,3)		2.664(5)	Cl,Cl	98.7(6)	
					Cl	2.253(16)	Cl	115.9(6)		145.2(7)	
					μCl	2.322(18)			N,N	171.3(8)	
						2.667(20)			Cl,N	89.7(9, 7.8)	
[Cu_2(μ-OH)(μ-fdmen)	m	9.124(2)		CuO_4N_2	N	1.969(6, 44)		2.924(1)	N,N	85.9(3, 3)[d]	633
(μ-O_2ClO_2)]	$P2_1/c$	30.950(8)	99.01(3)		μO	1.947(4, 5)	HO	97.4(2)	N,O	90.7(2, 4)[e]	
(dark green)	4	9.174(5)			μO_2ClO_2	2.505(6)	O	99.3(2)		101.7(2, 1)	
						2.693(6)			O,O	81.7(2, 2)	
						2.787(6)					
						3.07(1)					
					μHO	1.919(5, 4)					
[Cu_2(μ-OCN)(μ-fdmen)·	m	8.814(2)		CuO_4N_2	N	1.974(9, 44)		2.933(2)	N,N	86.0(4, 2)[d]	633
(μ-O_2ClO_2)]	$P2_1/c$	31.645(6)	81.19(4)		μO	1.942(7, 3)	O	98.1(3)	N,O	91.0(3, 3)[e]	
(dark green)	4	9.233(5)			μO_2ClO_2	2.483(9)	NCO	99.3(4)		102.0(4, 1)	
						2.655(9)			O,O	81.2(4, 2)	
						2.710(10)					
						3.080(10)					
					μNCO	1.925(10,5)					
α-[Cu(μ-OH)(μ-O_2ClO_2)·	tr	9.164(5)	82.30(2)	CuO_4N_2	N	2.037(2, 20)		2.938(1)	O,O	85.2(1, 4.6)	634
(dmaep)]$_2$	P-1	10.049(5)	56.72(2)		μHO	1.942(2, 6)	HO	98.35(9)		167.05(7)	
(blue)	1	8.953(5)	68.52(2)		μO_2ClO_2	2.749(3, 33)			O,N	93.4(1, 5.4)	
									N,N	95.0(1)[e]	
[Cu_2(μ-OH)(μ-O_2ClO_2)$_2$·	tr	13.366(13)	95.04(2)	CuO_4N_2	μO_2ClO_2	2.679(11,94)		2.957(2)	O,O	84.5(3, 5.5)	635
(μ-amazph)]	P-1	9.430(9)	109.51(3)			2.940(9)	HO	99.3(3)		165.9(3, 5.7)	
(black purple)	2	11.760(9)	111.245(8)		N	1.975(9, 28)	O	98.3(3)	O,N	91.2(3, 2.0)[e]	
					μO	1.940(6, 12)				102.9(3, 1.2)	
					μHO	1.955(6, 1)				170.2(3, 9)	
									N,N	98.2(3, 1.7)[e]	

TABLE IX (*Continued*)

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-}N_3)(\mu\text{-fdmen})\cdot$	m	8.797(3)		CuO_3N_3	N	1.967(8, 75)		2.972(2)	N,O	80.5(3, 1)	633
$(\mu\text{-}O_2ClO_2)]$	$P2_1/c$	31.84(2)	98.97(3)		μO	1.959(5, 8)	O	98.7(2)		90.8(3, 1)[e]	
(green)	4	9.253(5)			μO_2ClO_2	2.468(6)	N	100.0(4)	N,N	86.2(3, 1)[d]	
						2.595(6)				102.7(3, 1)	
						2.720(7)			O,O	80.5(3, 1)	
						3.074(7)					
					μN_3N	1.940(8, 7)					
$[Cu_2(\mu\text{-EtOH})(\mu\text{-}O_2ClO_2)_2\cdot$	m	9.346(2)		CuO_4NS	μEtHO	1.907(6, 4)		2.985(2)	S,O	100.6(2, 1)	636
$(\mu\text{-mmfp})]\cdot H_2O$	$P2_1/c$	32.517(4)	97.04(3)		μO	1.943(6, 15)	O	100.4(3)	N,O	92.0(3, 3)[e]	
(dark green)	4	8.866(6)			S	2.311(3, 10)	HO	103.1(3)	N,S	89.2(3, 1)[d]	
					N	1.932(8)			O,O	77.9(3, 1.2)	
						2.924(8)					
					μO_2ClO_2	2.708(10,3)					
						2.379(7)					
						2.836(9)					
$[Cu_2(\mu\text{-}C_{24}H_{36}N_4O_2)\cdot$	or	16.985(2)		CuO_4N_2	N	1.986(5)		2.993(2)	O,O	76.1(1, 1.2)	637
$(\mu\text{-}O_2ClO_2)]$	Fddd	17.180(3)			μO	1.915(3)	O	102.8(2)		89.9(1)	
(deep blue)	8	20.558(4)			μO_2ClO_2	2.821(3)				160.7(1)	
									O,N	95.5(2, 1.9)	
										166.9(2)	
									N,N	96.9(2)[e]	
$[Cu_2(\mu\text{-}N_3)(\mu\text{-}O_2ClO_2)_2\cdot$	m	9.669(2)		CuO_3N_2S	μO_2ClO_2	2.729(1, 68)		3.007(2)	S,N	94.5(3, 5.0)[e]	636
$(\mu\text{-mmfp})]\cdot H_2O$	$P2_1/c$	30.860(4)	98.08(2)			2.354(8)	O	100.4(3)	O,N	92.4(3, 3)[e]	
(not given)	4	8.717(3)			μN_3	1.924(9, 26)	N	102.8(4)	O,O	78.1(3, 9)	
					N	1.924(9, 6)					
					S	2.319(3, 9)					
					μO	1.957(7, 12)					
$[Cu_2(\mu\text{-OCN})(\mu\text{-}O_2ClO_2)_2\cdot$	m	12.773(5)		CuO_4N_2	μO_2ClO_2	2.609(8, 3)		3.017(2)	N,N	95.0(4, 1.2)[e]	636
$(\mu\text{-mmfp})]\cdot H_2O$	Cc	32.167(5)	130.35(5)			2.73(1, 10)	O	98.5(3)	O,N	93.0(4, 3.1)[e]	
(dark green)	4	8.980(4)			μNCO	1.945(8, 19)	NCO	101.7(4)	O,O	79.8(3, 9)	
					N	1.989(9, 26)					
					μO	1.991(7, 18)					

$[Cu(\mu\text{-pyaa})(\mu\text{-}O_2ClO_2)]_2 \cdot 2H_2O$	tr	10.522(6)	102.38(12)	CuO_4N	μO_2ClO_2	1.871(4)		3.022(2)	O,N	95.5(2, 5.8)[e]	638
(dark green)	P-1	9.132(5)	121.86(14)		N	1.961(4)		102.0(2)	O,O	78.0(2)	
	1	8.346(5)	93.75(10)		μO	1.945(3, 9)				84.7(2, 3.1)	
										96.8(2, 3.7)	
$[Cu_2(\mu\text{-ubm})(\mu\text{-}O_2ClO_2)_2]$	m	8.6653(3)		CuO_4N_2	μO_2ClO_2	2.522(3)		3.0354(7)	O,O	78.2(1)	271
(dark khaki)	$P2_1/c$	16.717(1)	97.273(4)			2.790(3)		101.8(1)		84.0(1, 8.2)	
	8	9.9714(6)			N	1.957(3, 22)				162.55(9)	
					μO	1.956(2, 13)			N,N	100.36(1)[f]	
									O,N	91.8(1, 2.2)[e]	
										97.4(1, 4.7)	
										168.1(1, 8)	
$[Cu_2(\mu\text{-}N_3)(\mu\text{-}O_2ClO_2)(\text{mmfp})]$	m	12.723(9)		CuO_3N_3	μO_2ClO_2	2.67(1, 12)		3.035(2)	N,N	96.2(5, 2)[e]	636
(dark green)	Cc	32.125(7)	130.39(5)		μN_3	1.90(1, 2)	O	99.4(5)	O,N	91.0(5, 2)[e]	
	4	8.987(7)			N	1.97(1, 1)	N_3	106.1(6)	O,O	77.3(5)	
					μO	1.99(1, 2)					
$[Cu_2(\mu\text{-MeO})(\mu\text{-ac})(\mu\text{-ttc6})]$	or	18.352(3)		CuO_2N_2	N	1.92(1, 0)		3.100(3)	N,N	82.7(5)[d]	639
(dark brown)	$Cmc2_1$	15.841(3)			μacO	1.975(8)		105.6(5)	N,O	97.5(5, 3.4))	
	4	9.912(2)			μMeO	1.945(8)				159.1(5, 3.5)	
									O,O	89.4(5)	
$[Cu_2(\mu\text{-OH})(\mu\text{-}H_2O)\cdot$	tg	15.20(1)		CuO_3N_3	N	2.014(13,98)		3.145(4)	O,O	92.6(5, 6.4)	640
$(\mu\text{-}[20]\text{-}mN_6)(\mu\text{-}O_2ClO_2)_2]\cdot$	$P4_2/n$				μO_2ClO_2	2.480(13)	H_2O	77.3(4)		174.9(3)	
$ClO_4 \cdot H_2O$	4	14.50(1)			μHO	1.916(9)	HO	110.3(7)	O,N	88.9(5, 2.6)	
(blue)					μH_2O	2.519(12)				100.9(4, 1.0)	
										170.8(5)	
									N,N	79.4(5, 1.0)[d]	
										158.2(5)	
$[Cu_2(\mu\text{-OH})(\mu\text{-}O_2ClO_2)(\mu\text{-hadt})]$	m	14.487(2)		CuN_3O_2	N	2.033(5, 40)		3.642	O,N	83.8(3, 3.5)	641
$\cdot(ClO_4)_2 \cdot CHCl_3$	$P2_1/c$	15.282(2)	91.79(1)		μO_2ClO_2	2.554(8, 14)	HO	143.6(2)		96.1(2, 6)	
(not given)	4	15.573(2)			μHO	1.917(4, 5)				108.9(3, 6)	
										171.3(2, 7)	
									O,O	91.2(3, 6)	
									N,N	85.2(2, 6)[d]	
										159.4(2, 1.1)	

TABLE IX (*Continued*)

Compound (*color*)	*Cryst. cl.* *Space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-}N_3)_2(\mu\text{-}[24]\text{-}aneN_2S_4)\cdot(N_3)_2]$	m	10.126(2)		CuN_4S_2	N	2.072(3)	5.145(1)	N,N	90.0(1, 3.7)	590
	C2/m	13.246(3)	93.47(1)		S	2.919(1)			177.7(2, 6)	
(dark yellow)	2	11.156(2)			N_3N	1.987(3)		N,S	79.03(7)[d]	
					μN_3N	2.004(3, 10)			85.33(8)	
									97.5(1, 3.4)	
								S,S	156.58(4)	
$[Cu_2(\mu\text{-}N_3)_2(\mu\text{-}[24]\text{-}aneN_2O_6)\cdot(N_3)_2]$	m	9.533(1)		CuN_5	N	2.023(3, 60)	5.973(1)	N,N	89.7(10,4.8)	341
	C2/m	12.305(1)	107.25(4)			2.181(4)			107.8(1)	
(not given)	2	11.913(1)				2.999(4)			142.0(1)	
									175.0(1, 9)	

[a] Where more than one chemically equivalent distance or angle is present the mean value is tabulated. The first number in parenthesis is e.s.d., the second is a maximum deviation from the mean value. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] There are two crystallographically independent molecules. [d] Five-membered metallocyclic ring. [e] Six-membered metallocyclic ring. [f] Seven-membered metallocyclic ring.

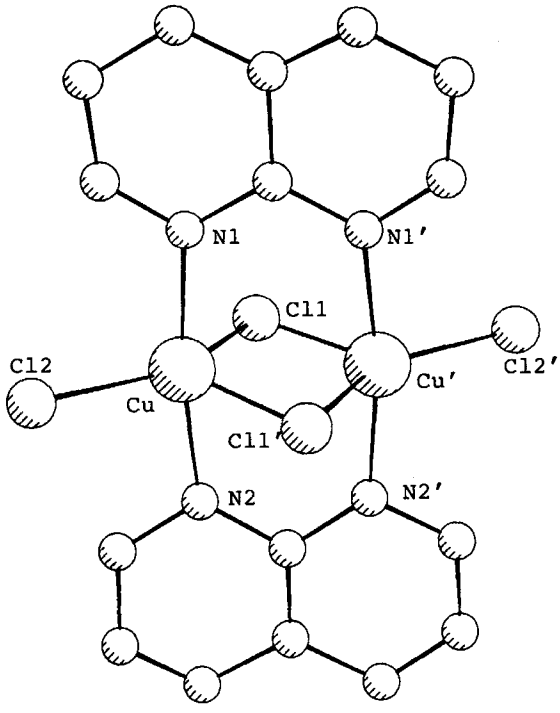


FIGURE 11 Structure of $[Cu(\mu\text{-}Cl)(\mu\text{-npthd})Cl_2]^{2+}$ (see Ref. 632).

and a bidentate acetate ligand in a syn–syn arrangement. In the center are two tetrahedrally distorted Cu(II) atoms separated by 3.100(3) Å.

Each Cu(II) atom in the blue derivative[640] is bonded to the three nitrogen atoms of a hexadentate macrocycle and additional bridged by a OH group and a water molecule. The sixth position about each Cu(II) atom is occupied by a perchlorate group.

A square pyramidal arrangement about each Cu(II) atom[641] is built up by a hexadentate N_6 macrocycle (to three N atoms about each copper), an oxygen atom of bridged OH-group and by a bidentate perchlorate group which also serves as a bridge between two Cu(II) atoms.

Finally, there are two other examples[341,590] where two Cu(II) atoms are located in the cavity of a macrocycle and additionally bridged by two azide groups in an end-to-end fashion. The Cu–Cu separations of 5.145(1)[590] and 5.973(1) Å[341] are much longer than found in all other quadruply bridged derivatives (Cu–Cu separations range from 2.659(4) to 3.642 Å) (Table IX).

Eighteen derivatives which are summarized in Table IX are mostly green and blue, but there are examples of purple, brown and yellow, one of each.

The mean Cu–$L_{(bridge)}$ bond distance increases in the order: 1.92 Å (N_3) < 1.93 Å (OH) < 2.49 Å (Cl). In the series of multidentate ligands, the mean Cu–L bond distance increases in the sequence: 1.975 Å (tetra-N-) < 2.02 Å (bi-N-) < 2.03 Å (hexa-N-) < 2.67 Å (bi-O-donor;). There are some multidentate ligands including hetero-donor atoms; tridentate ligands with two O-plus one N atom; pentadentate ligands with one O plus four N atoms or one O plus two N and plus two S atoms, and hexadentate ligands with two O plus four N-donor; sites. The mean N–Cu–N bond angles of the macrocyclic rings, increases with ring size as expected in the order: 85.0°(five-) < 96.0° (six-) < 100.3°(seven-membered ring).

2.5 By Single Atom Bridges

Structural data for twenty (blue and green) Cu(II) dimers bridged by a single atom are summarized in Table X. The structures are tabulated by increasing Cu–Cu distance. The most common bridging ligands are O-donor;.[232,239,619,642–647,649] In four derivatives[648,650,651,653] a chlorine atom, in another two[652] a sulfur atom of a ligand and in one[654] a bromine atom serve as a bridge. The stereochemistry about Cu(II) atoms is four-,[644,646,653] five-[232,239,619,643,647,650,652,654] and six-coordinate.[619,642,645] Two non-equivalent Cu(II) atoms are found; four- and five[619,648] and five- and six-coordinate.[649,651] The Cu–Cu distances range from 2.657(3) to 5.604(2) Å and Cu–L–Cu bridge angle from 107.5 to 180.0°.

The mean Cu–$L_{(bridge)}$ bond distance increases in the order: 1.92 Å (OH) < 1.96 Å (OL) < 2.47 Å (SL) < 2.48 Å (Cl) < 2.80 Å (Br). The multidentate ligands include both homo- and hetero-donor atoms, with N- and O-donor;s being by far the most common. The mean Cu–N bond distances increase in the order: 2.005 Å (tetra-) < 2.015 Å (tri-) < 2.04 Å (mono-) < 2.12 Å (bidentate). Hetero donor ligands are tridentate (include two O plus one N), tetradentate (O+3N), (2N+2S), pentadentate (3O+2N; O+4N), hexadentate (4O+2S) and heptadentate (O+6N). Notice only O-atoms are used for bridges.

There are two examples[643,644] which contain two crystallographically independent molecules differing mostly by degree of distortion.

2.6 By Single Multi-Atom Bridges

Crystallographic and structural data are summarized in Table XI. The structures of sixty derivatives are tabulated. The bridge systems are complex and therefore it is difficult to classify them. For example, in dark green

$Cu_2(pmk)Cl_4$[655] a bridge connecting the two Cu(II) centers consists of an azine linkage. There is a rotation about the N–N bond, which results in a Cu–N–N–Cu torsion angle of 70.8°. The Cu–Cu separation of 3.67 Å excludes a metal–metal bond, but is the shortest in this group.

In a dark red derivative[656] each Cu(II) is approximately square planar, a coordinated to three nitrogen atoms of the tridentate bmpi ligand and to one oxygen atom of the bridging carbonate group.

In a purple complex[657] a *trans* μ-1,2-O_2^{2-} group bridges the two CuN_4 moieties and completes a distorted trigonal bipyramidal configuration about each Cu(II) atom. The Cu–Cu separation is 4.359(1) and the O–O bond length is 1.482(6) Å.

In a cofacial dimer,[658] two Cu centers are separated by 4.625(1) Å and each Cu(II) atom is in a square planar environment, CuN_4.

Two structurally distinct types of Cu(II) atoms (CuN_3O and CuN_2Cl_2O) are held together by a -N–N- bridge in a further example.[659]

The structure of $[Cu_2(im)(dtma)_2]^+$ (see Ref. 671) is shown in Figure 12. Two pentacoordinate Cu(II) atoms are bridged by a deprotonated imidazole. Each Cu(II) atom has a distorted square-pyramidal configuration. The mean value of displacement for Cu(II) atoms from the plane toward the apical ligand is 0.235 Å and Cu–Cu separation is 5.984 Å.

The structure of blue $Cu_2(\mu\text{-bdta})(im)_2(H_2O)_2$[696] is shown in Figure 13. In this centrosymmetric complex, the 1,4-butanediaminetetraacetate anion bridges two Cu(II) atoms with separation of 7.942(2) Å. Each Cu(II) atom has a distorted square pyramidal environment.

In a dark green compound $[Cu_2(\mu\text{-}F_2SiF_4)(spca)_2]\cdot 4H_2O$,[697] two distorted square-pyramidal Cu(II) atoms are linked by a single hexafluorosilicato bridge (Cu–F–Si–F–Cu). The Cu(II) atoms are located 0.0075(1) Å above the O_2N_2 plane with Cu–Cu separation of 7.950(7) Å.

There are two examples, $[Cu_2(\mu\text{-1,3-pn})(1,3\text{-pn})_4]X_4$ ($X = BF_4$,[698] ClO_4[700]) in which two distorted square-pyramidal moieties are bridged by 1,3-propanediamine (Cu–N–C–C–C–N–Cu) with Cu–Cu separations of 8.07(7) and 8.104 Å, respectively.

Inspection of the data in Table XI reveals that there are four-, five- and six-coordinate Cu(II) atoms. In several examples[655,656,658,666,672] each Cu(II) atom has a square-planar environment with a different degree of distortion and in one case[680] are tetrahedrally coordinated. The most common coordination number is five, distorted square-pyramidal environments are present in many complexes[346,661–663,667–671,675,678,680–685,687–690,693–698,700,701] and trigonal bipyramidal in some.[657,664,665,684,703,704] An intermediate between a square pyramide and trigonal bipyramide are present in a few

TABLE X Crystallographic and structural data for copper(II) dimers bridged by a single atom (Cu–X–Cu)[a]

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]	*Ref.*
$[Cu(topcb)(H_2O)(ClO_4)]_2 \cdot$ 3EtOH (blue)	tr P-1 2	10.160(1) 13.014(1) 15.934(2)	74.18(1) 84.83(1) 71.54(1)	CuO_4N_2	O^b	not given	2.657(3)[f] O^b not given	O,O[b]	not given	642
$[Cu_2(\mu\text{-}OH)(tacac)_2] \cdot$ $2NaClO_4 \cdot 2H_2O$[c] (not given)	m $P2_1/c$ 4	8.423(7) 22.737(3) 17.926(3)	92.90(3)	CuN_3O_2	N O μHO	2.032(8,9) 2.217(6) 2.016(6) 1.937(6)	3.17 HO not given	N,N N,O	83.1(3,1.1)[d] 165.6(3) 105.3(3,4.9) 167.4(3)	643
				CuN_3O_2	N O μHO	2.031(9,16) 2.200(9) 1.965(6) 1.931(6)	3.17 HO not given	N,N N,O	82.5(4,3)[d] 171.0(3) 111.0(3,5.2) 156.8(3)	
$[Cu_2(\mu\text{-bmpc})(NO_2)_2(H_2O)_2] \cdot$ $ClO_4 \cdot H_2O$ (green black)	or Pbca 8	20.654(1) 20.087(2) 13.873(3)		CuO_4N_2	H_2O NO_2 N μO	1.99(1,1) 2.00(1,1) 2.57(2,3) 2.04(2,3) 1.99(1,1)	3.603(4) O 130.1(6)		not given	619
$[Cu_2(\mu\text{-bmpc})(N_3)_2] \cdot$ $[Cu_2(\mu\text{-bmpc})(N_3)_3]ClO_4 \cdot 2H_2O$ (green black)	tr P-1 2	19.250(4) 13.405(3) 12.873(3)	121.77(1) 98.88(1) 95.86(1)	CuN_3O	N N_3N μO	2.04(1,2) 1.95(1,1) 1.98(1,1)	3.605(2) O 132.3(5)		not given	619
				CuN_3O	N N_3N μO	2.03(1,1) 1.98(1) 1.98(1)	3.655(3) O 134.5(4)		not given	
				CuN_4O	N N_3N μO	2.04(1,0) 2.11(1,5) 1.98(1)				
$[Cu_2(\mu\text{-}C_{36}H_{39}N_6O)]$[c] (not given)	m $P2_1/n$ 8	13.861(4) 31.482(8) 16.956(5)	98.20(2)	CuN_3O	N μO	1.967(12,14) 2.157(12,1) 2.013(9,18)	3.619 O 128.0(4)	O,N N,N	91.8(4,1.1)[e] 115.0(4,5.5) 102.0(4,1.6) 123.0(5,68)	644

				CuN_3O	N	1.936(10,18)		3.715	O,N	94.7(4, 2.1)[e]	
						2.077(11)	O	130.0(4)		105.4(4, 2.7)	
						2.187(11,9)				140.8(4)	
					μO	2.050(9, 76)			N,N	98.4(4, 2.7)[e]	
										104.1(4, 2.7)	
										142.5(5)	
$[Cu_2(\mu\text{-OH})(H_2O)(terpy)_2 \cdot (ClO_4)_3]$ (blue)	tr	8.825(5)	88.24(2)	CuO_3N_3	N	2.005(5, 82)		3.642(1)	N,N	79.5(2, 8)[d]	645
	P-1	10.391(10)	99.27(3)		H_2O	2.424(7)	HO	145.7(3)		157.9(2)	
	2	19.258(8)	96.63(4)		O_3ClO	2.564(7)			N,O	85.1(2, 3.3)	
					μHO	1.902(4)				97.7(2, 6.4)	
										177.7(2)	
									O,O	83.1(2)	
										169.3(2)	
				CuO_3N_3	N	2.008(6, 85)			N,N	79.4(2, 7)[d]	
					O_3ClO	2.541(8)				159.5(2)	
						2.821(7)			N,O	83.8(2, 1.3)	
					μHO	1.909(4)				94.8(2, 7.4)	
										173.6(2)	
									O,O	92.1(2, 1.0)	
										174.8(2)	
$[Cu_2(\mu\text{-dpma})(MeO)_2]$ (not given)	m	28.45(1)		CuO_3N	MeO	1.915(9, 1)		3.644(2)	O,N	86.2(4, 6)[d]	646
	$P2_1/a$	6.952(4)	110.96(4)		O	1.927(10,4)	O	137.7(5)		94.1(5, 2)[e]	
	4	10.128(8)			N	1.909(10,12)				173.7(5, 5)	
					μO	1.954(9, 10)			O,O	90.1(5, 6)	
										176.2(4, 3)	
$[Cu_2(\mu\text{-OH})(bpy)_4](ClO_4)_3$ (blue)	m	14.839(8)		CuN_4O	N	2.024(7, 55)		3.645(2)	O,N	92.5(2, 9)	647
	$P2_1/n$	18.197(9)	92.87(3)			2.186(16,61)	HO	141.6(3)		103.2(2)	
	4	16.491(8)			μHO	1.930(5, 0)				120.3(2, 2.7)	
										132.9(2)	
										162.4(2, 8.2)	
									N,N	78.7(2, 2.1)[d]	
										93.5(2, 5.4)	
										100.9(2, 3.2)	
										174.7(2, 1.1)	
$[Cu_2(\mu\text{-Cl})(mnthc)Cl_3]$ (dark green)	or	18.045(6)		CuN_4Cl	N	2.014(4, 8)		3.928(2)	Cl,N	100.01(11,8.7)	648
	Pnam	9.551(5)			μCl	2.507(2)	Cl	110.67(9)	N,N	85.59(15,1.04)[d]	
	4	11.142(3)								95.32(12)	
										159.33(14)	

TABLE X (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å] *Cu–L–Cu* [°]		*L–Cu–L* [°]	*Ref.*
				$CuCl_4$	Cl	2.230(2, 16)			Cl,Cl	98.66(4, 19)
					μCl	2.266(2)				134.28(8, 2.22)
$[Cu_2(\mu\text{-bimp})(MeOH)](ClO_4)_3$	m	17.855(3)		CuN_3O_2	N	1.947(5, 7)		4.09(2)	N,N	83.0(2, 6)[d]	239
(green)	$P2_1/n$	13.377(3)	105.78(2)			2.107(4, 2)	O	142.9(2)		152.2(2, 2.4)
	4	18.054(4)			μO	2.157(3, 1)			O,O	92.3(2, 6.6)
					MeHO	2.012(4, 10)			O,N	98.3(2, 7.0)
										172.6(2, 6.4)
$[Cu_2(\mu\text{-bpmp})Cl_2](ClO_4)_2$	m	12.065(4)		CuN_3OCl	N	1.99(2, 1)		4.128(3)	N,N	82.8(7, 1.1)[e]	232
(not given)	Pn	12.592(5)	102.85(3)			2.07(2, 2)	O	140.2(5)		160.0(7, 1.4)
	2	12.006(4)			μO	2.19(2, 3)			N,O	95.6(7, 6.8)
					Cl	2.263(7, 8)			N,Cl	95.6(5, 6)
										169.9(5, 1.7)
									O,Cl	96.5(6)
$[Cu(\mu\text{-pydca})(bpy)]_2 \cdot 4H_2O$	m	13.103(6)		CuO_4N_2	O	2.063(3, 15)		4.176(2)[f]	O,N	77.9(1, 4.4)[d]	649
(blue)	$P2_1/c$	17.815(7)	90.8(2)			2.296(3)	O	not given		103.2(4, 2.1)
	4	15.302(7)			N	1.940(3, 36)			O,O	92.5(1, 9.1)
					μO	2.447(3)				155.4(1, 4.2)
									N,N	176.6(1)
				CuN_4O	bpyN	2.037(4, 78)			N,N	80.4(4, 6)[d]
					μO	2.029(4)				98.2(4, 6)
										108.7(4)
									N,O	93.1(4)
										138.9(4)
$[Cu_2(\mu\text{-Cl})(tetb)](ClO_4)_3$	m	28.03(8)		CuN_4Cl	N	2.03(4, 4)		4.200(4)[f]	Cl,N	122.4(6, 1.3)	650
(blue)	C2/c	9.334(9)	116.9(1)		μCl	2.501(4)	Cl	174.2			
	4	20.96(5)									
$[Cu_2(\mu\text{-Cl})(aett)_2Cl](ClO_4)_2$	m	12.323(2)		$CuN_2S_2Cl_2$	Cl	2.312(6)		4.268(4)[f]	N,Cl	89.8(5, 4.3)	651
(not given)	$P2_1/c$	10.426(3)	101.53(2)		S	2.445(6)	Cl	107.5(1)	N,S	85.7(5, 7)[d]	
	8	27.689(6)				2.609(6)				94.2(5, 1.8)	
					N	2.006(16,15)			S,Cl	80.8(2)	
					μCl	2.966(6)				106.0(2)	
									S,S	83.7(2)[d]	
									Cl,Cl	90.0(2)	

				CuN_2S_2Cl	S	2.431(6)			Cl,N	90.2(5, 1.4)	
						2.565(6)			N,S	85.3(5, 7)[d]	
					N	1.980(16,4)				94.9(5, 2.3)	
					μCl	2.304(6)			S,Cl	120.1(2)	
									S,S	85.6(2)[d]	
$[Cu_2(\mu\text{-4-mpt})(fbb)_2]ClO_4$	tr	12.329(6)	94.45(5)	CuN_4S	N	1.968(18,41)		4.453(5)[f]	S,N	95.0(6, 1.8)	652
(not given)	P-1	15.447(6)	92.22(5)		μS	2.471(7, 35)	S	128.6(3)		106.8(8, 5.6)	
	2	11.018(7)	96.13(4)						N,N	80.8(7, 2.6)[d]	
										92.8(7, 4.0)	
										152.0(7, 10.8)	
$[Cu_2(\mu\text{-4-Clpt})(bbo)_2]PF_6$	tr	11.230(3)	97.04(2)	CuN_4S	N	1.964(7, 18)		4.454(2)[f]	S,N	95.4(2, 2.4)	652
(dark green)	P-1	14.079(3)	101.59(2)		μS	2.472(3, 13)	S	128.6(1)		105.4(2, 2.1)	
	2	12.540(3)	72.95(2)						N,N	80.1(3, 1)[d]	
										96.1(3, 2.9)	
										159.2(3, 2.9)	
$[Cu(\mu\text{-tacac})]_2(ClO_4)_2$	or	7.802(2)		CuN_3O_2	N	2.045(10,18)		4.950[f]	O,N	110.1(4, 3.5)	643
(not given)	$P2_12_12_1$	7.921(2)				2.195(7)	O	not given		164.0(3, 5.9)	
	4	21.187(3)			O	1.952(7)			N,N	83.1(4, 3)[d]	
					μO	1.982(7)					
$[Cu_2(\mu\text{-Cl})(pea)_2](PF_6)_3$	m	16.428(4)		CuN_3Cl	N	2.034(8, 5)		5.060(1)[f]	N,N	89.5(3, 4)[e]	653
(not given)	C2/m	12.721(3)	114.53		μCl	2.530(1)	Cl	180.0		168.4(3, 2.7)	
	2	12.526(6)									
$[Cu_2(\mu\text{-Br})(bpip)_4](ClO_4)_3$	m	22.336(2)		CuN_4Br	N	2.049(84,8)		5.604(2)[f]	Br,N	87.5(2, 3)	654
(blue)	C2/c	9.370(1)	109.6(1)		μBr	2.802(1)	Br	78.16(5)		100.1(2, 6)	
	4	25.842(3)							N,N	84.8(3, 4)[d]	
										96.2(3, 3)	
										167.5(3, 7.6)	

[a] Where more than one chemically equivalent distance or angle is present the mean value is tabulated. The first number in parenthesis is e.s.d., the second is a maximum deviation from the mean value. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] There are two crystallographically independent molecules. [d] Five-membered metallocyclic ring. [e] Six-membered metallocyclic ring. [f] Calculated by us.

TABLE XI Crystallographic and structural data for copper(II) dimers bridged by a single ligand ($Cu-(X)_n-Cu$)[a]

Compound (color)	*Cryst. cl. space G. Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-pmk})Cl_4]$	m	9.058(2)		CuN_2Cl_2	N[b]	2.016(4, 8)	3.67	Cl,Cl[b]	94.3(6, 6)	655
(dark green)	$P2_1/n$	14.115(3)	106.26(2)			2.052(4, 6)		Cl,N	93.8(1, 1.2)	
	4	14.892(3)			Cl	2.254(1, 4)			168.7(1, 1.2)	
								N,N	77.3(2, 3)[c]	
$[Cu_2(\mu\text{-}O_2CO)(bmpi)_2]$	tr	11.420(1)	90.98(1)	CuN_3O	N	1.885(6, 4)	4.293(1)[g]	O,N	92.2(2, 1.8)	656
(dark red)	P-1	16.479(1)	113.83(1)			2.020(6, 8)			167.1(2, 2)	
	2	10.954(1)	101.71(1)		μO_2CO	1.921(4, 9)		N,N	90.0(2, 7)[d]	
									160.8(4, 1.7)	
$[Cu_2(\mu\text{-}O_2)(tpma)_2](PF_6)_2\cdot 5Et_2O$	tr	11.062(3)	96.72(3)	CuN_4O	N	2.078(7, 54)	4.395(1)	O,N	92.4(3)	657
(purple)	P-1	12.758(4)	110.57(3)		μO_2	1.852(5)			103.7(3, 1.1)	
(at 178 K)	1	13.280(5)	103.73(3)						173.7(3)	
								N,N	80.3(3, 1.1)[c]	
									117.2(3, 8.1)	
$[Cu_2(\mu\text{-}C_{74}H_{88}N_8)]\cdot CH_2Cl_2\cdot$	m	19.208(7)		CuN_4	N	1.998(8, 4)	4.625(1)[g]	N,N	90.0(1, 1.0)[d]	658
MeOH	$P2_1/n$	14.672(5)	111.5(3)						178.1(1, 4.4)	
(not given)	4	24.170(7)								
$[Cu_2(\mu\text{-pkph})Cl_2]\cdot H_2O$	m	9.644(1)		CuN_3O	O	1.959(4)	4.659(1)	O,N	81.0(2)[c]	659
(green)	$P2_1/n$	16.345(5)	90.52(1)		N	1.877(4)			106.5(2)	
	4	14.438(3)				1.970(4, 19)			161.1(2)	
								N,N	80.9(2)[c]	
									91.9(2)	
									87.2(2)	
				CuN_2Cl_2O	O	2.068(4)		O,N	78.8(2)[c]	
					N	1.954(4)		N,N	79.1(2)[c]	
						2.025(4)			155.9(2)	
					Cl	2.230(2)		Cl,N	98.5(1, 2.3)	
						2.443(2)			156.4(1)	
								Cl,O	94.3(1, 2.9)	
								Cl,Cl	107.4(1)	
$[Cu_2(\mu\text{-dapsc})(H_2O)Cl_2]Cl\cdot H_2O$	m	6.9706(6)		CuN_3OCl	N	1.953(8, 23)	4.716(1)[g]		not given	660
(green)	$P2_1/c$	41.927(5)	101.959(7)		O	2.023(6)				
	4	7.1097(7)			Cl	2.556(3)				

				CuO_3NCl	O	1.947(6, 1)			not given	
					N	1.945(8)				
					Cl	2.241(3)				
					H_2O	2.393(8)				
$[Cu_2(\mu\text{-}C_{14}H_{26}N_6)Cl_4]$	m	9.265(2)		CuN_3Cl_2	N	2.045(1, 13)	5.206(1)[g]	N,N	81.3(1, 2.3)[c]	661
(blue green)	$P2_1/c$	9.865(1)	118.33(1)			2.474(1)		Cl,N	91.6(1, 7)	
	2	12.145(3)			Cl	2.252(1, 5)			123.4(1)	
									162.7(1, 8.6)	
								Cl,Cl	96.6(1)	
$Na_4[Cu_2(\mu\text{-glth})]\cdot 6H_2O$	m	27.876(19)		CuN_3OS	N	1.95(3, 6)	5.21[g]	S,N	73.0(1, 6)[c]	662
(violet)	C2	12.338(9)	107.414(9)		O	1.95(2, 0)			98.0(1, 1)	
	4	13.414(9)			S	3.22(1, 6)		S,O	110.0(1, 1)	
								N,N	81.0(1)[c]	
									101.0(1)	
									173.0(1, 2)	
								N,O	85.0(1, 1)[c]	
									94.0(1, 1)	
$[Cu_2(\mu\text{-}O_2CO)(tpma)_2](ClO_4)_2\cdot$	tr	13.174(3)	108.08(2)	CuN_4O	N	2.074(9, 51)	5.375(1)	O,N	98.0(3, 8)	663
2EtCN	P-1	13.994(4)	92.01(2)			2.218(10)			178.8(3)	
(not given)	2	13.978(4)	101.49(2)		μO_2CO	1.920(7)		N,N	81.8(4, 1.2)[c]	
									100.9(3, 4.7)	
									150.6(4)	
$[Cu_2(\mu\text{-CN})\cdot$	m	24.040(8)		$CuN_4(CN)$	N	2.05(−, 3)	5.4	N,N	83.8(2, 7)[c]	664
$([14]\text{-}4,11\text{-}dieneN_4)_2](ClO_4)_3$	C2/c	15.062(5)	98.51(2)		μCN	2.12			93.5(2, 8)	
(blue)	4	12.525(4)							112.7(2, 1.0)	
									134.6(1)	
									174.0(1)	
$[Cu_2(\mu\text{-bztz})(tmbma)_2](NO_3)_2$	m	16.880(2)		CuN_5	tmbmaN	2.073(5, 32)	5.536(2)	N,N	80.4(2, 1)[c]	665
(green)	C2/c	26.011(1)	100.585(7)		bztzN	1.959(5)			93.9(2)	
	4	14.686(1)							101.4(2)	
									124.3(2, 2.4)	
									174.1(2)	
$[Cu_2(\mu\text{-2-Me-im})(Me_5dien)_2]\cdot$	or	14.226(2)		CuN_4	N	2.010(8, 46)	5.6619(7)	N,N	86.9(2)[c]	666
$(ClO_4)_3$	Imm2	16.214(3)			μimN	1.923(7)			96.1(2)	
(brown)	2	7.970(2)							160.3(3, 3.8)	

TABLE XI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-ttc})(5\text{-Me-imH})_2]\cdot 2H_2O$	m	22.503(5)		CuO_2N_2S	imN	1.947(3)	5.707(1)	O,S	88.44(9)	667
(not given)	C2/c	7.491(2)	110.76(1)		ttcO	1.944(3, 3)			101.6(1)	
	4	17.367(2)			N	2.009(3)		O,O	165.0(1)	
					S	2.798(1)		N,S	91.4(1, 6.5)	
								N,O	84.9(1, 4)[c]	
									94.9(1, 1.4)	
								N,N	177.0(1)	
$[Cu_2(\mu\text{-megtb})Cl_2]Cl_2\cdot 6H_2O$	tr	14.066(3)	105.97(3)	CuN_3OCl	N	1.93(2, 2)	5.760(4)	Cl,O	106.9(5, 1.2)	668
(green)	P-1	15.204(6)	110.89(2)			2.12(2, 2)		Cl,N	97.9(6, 1.4)	
	2	15.756(3)	96.72(3)		O	2.44(2, 3)			173.5(6, 1.4)	
					Cl	2.226(6, 6)		O,N	79.6(7, 3)[c]	
									83.8(6)	
									102.9(6, 3.7)	
								N,N	81.6(8, 6)[c]	
$[Cu_2(\mu\text{-megtb})F_2](BF_4)_2\cdot 2H_2O\cdot$	or	12.159(2)		CuN_3FO	N	1.950(9, 5)	5.834(2)	F,O	106.9(4, 8)	668
H_2OBF_3	Pccn	16.909(2)				2.107(8)		O,N	80.2(4, 8)[c]	669
(green blue)	4	25.654(5)			O	2.38(2, 3)			94.7(5, 7.7)	
					F	1.861(6)		N,N	81.7(4, 1)[c]	
									159.3(4)	
$[Cu_2(\mu\text{-edta})(H_2O)_4]$	m	16.26(3)		CuO_4N	O	2.04(1, 4)	5.89(7)[g]	O,N	80.9[c]	670
(grey)	B2/b; Bb	18.45(3)			N	2.00(6)			93.9	
	4	6.72(2)	120(0.5)		H_2O	1.92(3)		O,O	92.5(−,4.8)	
						2.63(3)			174.1	
$[Cu_2(\mu\text{-bim})(Me_5dien)_2(ClO_4)]\cdot$	or	17.443(5)		CuN_4	N	2.03(2, 2)	5.930(4)[g]	N,N	86.6(9)[c]	666
$ClO_4\cdot H_2O$	Iba2	37.510(17)			μimN	1.93(2)			95.2(9, 1.9)	
(brown)	8	12.468(5)							164.6(9, 2.1)	
				CuN_4O	N	2.070(16,31)		N,N	85.6(7, 9)[c]	
					O_3ClO	2.321(17)			93.0(8)	
					μimN	1.984(17)			169.8(7, 5.8)	
								N,O	94.6(7, 4.7)	

$[Cu_2(\mu\text{-im})(dtma)_2]ClO_4{\cdot}2.5H_2O$ (blue)	m $P2_1/a$ 4	13.133(2) 14.224(3) 15.788(3)	114.22(2)	CuN_4O	N O μimN	2.049(7, 38) 2.184(6, 4) 1.966(5, 4)	5.984[g]	N,N N,O 	84.3(2, 3)[c] 94.9(2, 1.2) 155.6(3, 2.5) 175.3(3, 2.6) 81.2(2, 1)[c] 95.6(3, 4) 103.7(3, 3.1)	671
$[Cu_2(\mu\text{-sata})]$[f] (brown)	tr P-1 4	16.691(1) 17.106(1) 15.641(1)	117.25(1) 117.95(1) 88.83(1)	CuO_2N_2	O N	1.883(12,4) 1.929(11,8) 1.927(13,6)	6.118(3)[g]	O,O O,N N,N	87.6(6, 6) 94.4(6, 6)[d] 84.6(5, 3)[c]	672
				CuO_2N_2	O N	1.879(20,4) 1.947(17,3) 1.943(13,7)		O,O O,N N,N	88.2(7, 5) 94.4(6, 1.3)[d] 84.1(6, 1)[c]	
$[Cu_2(\mu\text{-}NO_3)(bpy)_4](PF_6)_3$ (dark blue)	tr P-1(P1) 2	11.918(6) 14.250(4) 15.013(5)	85.51(2) 68.81(2) 76.67(2)	CuN_4O_2	bpyN μO_2NO	2.030(6, 89) 2.120(5) 2.788(6)	6.123[g]	O,O O,N N,N 	49.0(2)[e] 88.2(2, 2.5) 104.1(2) 143.6(2, 4.8) 81.1(3, 9)[c] 101.1(3, 4.5) 120.0(2) 174.2(3)	673
				CuN_4O	bpyN μO_2NO	1.992(6, 50) 2.505(5)		O,N N,N 	79.0)2,3) 102.5(2, 6.3) 87.7(3, 2)[c] 102.2(3, 1.4) 156.2(2, 1.3)	
$[Cu_2(\mu\text{-bpim})(NO_3)_2(ClO_4){\cdot}$ $(H_2O)]{\cdot}H_2O$ (dark blue)	tr P-1 2	12.673(2) 13.919(2) 8.086(2)	102.64(1) 96.22(1) 94.25(1)	CuO_3N_3	NO_3O H_2O N	2.012(6) 2.566(7) 2.356(8) 2.015(7) 1.964(7, 3)	6.137(2)	N,N N,O O,O 	86.8(3, 5.3)[d] 173.6(3) 87.8(3, 1.5) 93.6(3, 3.0) 106.9(3, 5.2) 166.0(3) 54.7(3)[e] 91.9(3) 146.1(3)	674

TABLE XI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
				CuO_3N_3	NO_3O	2.011(6)		N,N	87.6(3, 6.1)[d]	
						2.408(7)			174.1(3)	
					O_3ClO	2.610(12)		N,O	92.5(4, 2.5)	
					N	1.989(7)			106.8(3)	
						1.999(7, 11)			161.0(3, 2.5)	
								O,O	57.5(3)[e]	
									101.0(4)	
$[Cu_2(\mu\text{-fum})(C_{14}H_{33}N_3)_2](ClO_4)_2$	m	8.6808(9)		CuN_3O_2	N	2.052(7, 44)	6.313(2)	O,N	96.2(2, 1.5)	675
(blue violet)	$P2_1/n$	14.892(2)	90.52(1)		fumO	1.969(5)			169.5(2)	
	2	16.679(3)				2.424(6)		N,N	86.4(3)[c]	
									150.0(3)	
$[Cu_2(\mu\text{-trienMe}_6)(F_6pd)_2]$	m	10.268(3)		CuO_4N_2	O	1.990(23.9)	6.424(6)[g]	O,O	85.1(9, 2.9)[d]	676
(green)	$P2_1/a$	25.255(8)	119.29(2)			2.287(22,68)			164.1(8)	
	2	10.392(3)			N	2.065(25,15)		O,N	94.5(10,5.0)	
									176.9(10.1.7)	
								N,N	87.7(9)[c]	
$[Cu_2(\mu\text{-ebdta})(H_2O)_2]\cdot 2H_2O$	m	20.988(6)		CuO_4N	H_2O	1.941(4)	6.549(2)[g]	O,O	94.5(2, 2.4)	677
(blue)	C2/c	7.537(2)	90.86(2)		N	2.005(1)			103.8(2)	
	4	13.560(4)			O	1.935(4, 6)			163.0(2)	
						2.408(4)		O,N	84.5(2, 5.2)[c]	
									176.8(2)	
$[Cu_2(\mu\text{-tped})(NO_3)_2(H_2O)_2]\cdot$	m	12.683(4)		CuN_3O_2	O_2NO	2.063(3)	6.563(1)	N,O	90.0(1, 2.4)	678
$(NO_3)_2\cdot 2MeOH$	$P2_1/n$	10.374(2)	111.92		H_2O	1.947(3)			106.6(1)	
(blue green)	4	19.229(4)			tpedN	2.003(4, 10)			157.6(1)	
						2.303(3)			173.1(1)	
								N,N	93.8(1, 3.8)[d]	
								O,O	85.5(1)	
$[Cu_2(\mu\text{-}C_{13}H_{32}N_4S_4)](S_2O_6)_2\cdot$	tr	8.227(2)	68.68(2)	$CuO_2N_2S_2$	N	2.010(3, 5)	6.591	S,S	93.4[d]	679
$4H_2O$	P-1	13.103(3)	86.68(2)		S	2.314(1, 8)		N,N	95.2(1)	
(dark blue)	2	16.423(4)	75.50(2)		H_2O	2.428(2)		N,S	85.8(1, 3)[c]	
						2.587(2)			175.6(1, 3.3)	
								O,S	88.6(1, 3.7)	
								O,N	95.1(1, 2)	

				CuN_2S_2O	N	2.011(2, 9)		S,S	85.5[c]	
					S	2.321(1, 1)		N,N	96.2(1)	
					H_2O	2.213(2)		N,S	87.4(1)[c]	
									164.9(1, 1)	
								O,S	94.7(1, 5.4)	
								O,N	99.1(1, 6.1)	
$[Cu_2(\mu\text{-megtb})Br_2](CF_3SO_3)_2\cdot$	tr	13.954(5)	78.16(3)	CuN_3OBr	N	1.964(9, 19)	6.665(2)	Br,O	104.7(2, 1.7)	668
EtOH	P-1	14.420(5)	75.90(3)			2.103(10,60)		Br,N	97.8(3, 1.7)	
(blue)	2	15.539(6)	61.85(3)		O	2.423(7)			177.1(3, 1.1)	
						2.584(8)		O,N	78.1(3, 7)[c]	
					Br	2.378(2, 8)			83.5(3, 3.1)	
									101.5(3, 1.2)	
								N,N	82.0(4, 8)[c]	
$[Cu_2(\mu\text{-bpep})](ClO_4)_2$	tr	10.264(6)	89.92(2)	CuN_4	N	2.06(3, 3)	6.743(7)	N,N	83.6(10)[c]	680
(red)	P-1	12.473(5)	113.19(2)			2.17(3)			100.6(10,1.1)[d]	
	1	9.213(2)	113.74(3)						108.9(9, 3.9)	
									140.3(9)	
$[Cu_2(\mu\text{-}N_3)(N_3)_2(impyae)_2]Cl\cdot$	tr	21.770(9)	112.50(3)	CuN_5	N	1.966(4, 1)	6.786(2, 2)	N,N	80.2(2, 1)[c]	345
$2H_2O$	P-1	9.910(3)	90.03(3)			2.026(5, 4)			91.6(2)[d]	
(not given)	2	7.582(3)	98.02(3)		N_3N	1.979(5, 5)			93.9(2, 6.6)	
						2.468(5, 3)				
$[Cu_2(\mu\text{-bpep})Cl_2](ClO_4)_2\cdot$	tr	13.140(3)	101.43(4)	CuN_4Cl	Cl	2.281(1)	6.793(2)	Cl,N	90.7(8, 4)	680
4MeCN	P-1	13.541(4)	87.44(3)		N	2.013(2, 14)			100.96(6)	
(blue)	1	8.217(2)	117.50(2)			2.149(3, 52)			161.45(8)	
								N,N	80.59(9)[c]	
									95.9(10, 2.6)[d]	
									165.63(11)	
$[Cu_2(\mu\text{-}O_2ClO_2)(Me_2bcen)_2]\cdot$	or	10.367(1)		CuO_3N_2	N	1.994(6, 17)	6.830(1)[g]	O,O	87.9(2)	681
$(ClO_4)_3$	Pnma	27.545(5)			O	1.949(5, 4)		N,N	87.3(3)[c]	
(blue)	4	12.876(2)			O_3ClO	2.483(13)		N,O	92.4(2, 6)[d]	
									173.3(2, 6.1)	
$[Cu_2(\mu\text{-}C_{34}H_{34}N_4O_2)(ac)_2]\cdot$	tr	10.034(3)	92.93(2)	CuO_3N_2	acO	1.974(6)	6.881(5)	O,O	51.8(3)[e]	682
2MeOH	P-1	14.057(3)	97.47(2)			2.795(9)			86.3(3)	
(blue green)	1	6.897(2)	89.64(2)		O	1.895(6)		O,N	94.3(3, 2.5)[d]	
					N	1.945(7)			170.3(3, 3.8)	
								N,N	86.4(3)	

TABLE XI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-ddd})(H_2O)_2]\cdot 8H_2O$	tr	7.669(2)	79.57(3)	CuN_4O	N	2.020(3, 3)	6.9	N,N	84.5(1, 1)[c]	683
(purple)	P-1	8.757(3)	83.36(2)			1.948(2, 6)			94.5(1, 5)[d]	
	1	10.596(2)	89.17(3)		H_2O	2.460(3)			169.4(1, 6)	
								O,N	87.9(1, 1.6)	
									102.6(1, 2.3)	
$[Cu_2(\mu\text{-bpmpp})Cl_2](ClO_4)_2\cdot$	or	14.895(2)		CuN_4Cl	Cl	2.239(2)	6.917(2)[g]	N,N	81.2(2, 2.0)[c]	684
2MeOH	Pcab	19.559(3)			N	2.041(6, 15)			109.1(2, 4.0)	
(green)	4	13.263(2)				2.169(5)			134.9(2)	
								Cl,N	98.7(2, 5)	
									177.9(2)	
$[Cu_2(\mu\text{-taet})(H_2O)_2]\cdot 8H_2O$	tr	8.775(5)	96.67(6)	CuN_4O	N	2.021(5, 2)	6.927	O,N	87.7(1, 1.6)	685
(purple)	P-1	10.621(8)	90.81(5)			1.945(4, 3)			103.0(1, 2.6)	
	1	7.684(5)	79.66(5)		H_2O	2.477(3)		N,N	84.5(2, 2)[c]	
									94.5(2, 7)	
									169.3(2, 8)	
$[Cu_2(\mu\text{-dbta})(H_2O)_2]\cdot 4H_2O$	m	28.547(5)		CuO_5N	H_2O	1.924(4)	6.977(2)[g]	O,N	83.9(2, 2.2)[c]	686
(blue)	C2/c	7.630(2)	134.08(2)		N	1.998(4)			95.0(1)	
	4	14.580(4)			O	1.945(4, 4)			175.1(2)	
						2.369(3)		O,O	80.8(1)[c]	
						2.870(4)			93.0(2, 5.0)	
									103.4(1)	
									167.9(2, 6.5)	
$[Cu_2(\mu\text{-}C_{32}H_{46}N_8)(H_2O)_2]\cdot$	tr	14.894(2)	91.04(1)	CuN_4O	N	1.976(10,72)	6.985(2)	N,N	80.0(4, 3)[c]	687
$(ClO_4)_4\cdot 2H_2O$[f]	P-1	15.144(2)	108.80(1)			1.988(6)			99.1(3, 1)[d]	
(not given)	2	10.734(1)	87.22(1)		H_2O	2.237(8)				
				CuN_4O	N	1.977(8, 62)	7.081(2)	N,N	80.0(3, 3)[c]	
						2.010(7)			99.3(3, 1.2)[d]	
					H_2O	2.255(8)				
$[Cu_2(\mu\text{-dabco})(F_6pd)_4]$	m	22.854(6)		CuO_4N	O	1.953(7, 34)	7.097(3)[g]	O,N	97.5(2, 5.5)[d]	688
(green)	I2/c	25.548(4)	92.26(2)		N	2.254(11,21)		O,O	89.1(–, 4.3)[d]	
	8	12.601(2)							165.0(–, 9.1)	

$[Cu_2(\mu\text{-egta})(H_2O)_2]\cdot 2H_2O$	m	20.962(5)		CuO_4N	H_2O	1.938(2)	7.513(2)[g]	N,O	85.6(1,4)[c]	689
(blue)	C2/c	7.513(2)	90.85(2)		N	1.992(2)			177.2(2)	
	4	13.545(2)			O	1.934(2,6)		O,O	94.4(1,5.1)	
						2.408(2)			163.1(1)	
$[Cu_2(\mu\text{-}C_4O_4)(H_2O)_4(bpy)_2]\cdot$	tr	9.021(2)	98.58(2)	CuO_3N_2	H_2O	1.964(4)	7.536(3)[g]	O,N	92.7(2,4.3)	690
$(C_4O_4H)_2\cdot 4H_2O$	P-1	9.017(2)	106.81(2)			2.186(4)			167.2(2,1.2)	
(green)	2	12.581(4)	106.03(2)		bpyN	2.005(4,4)		O,O	95.5(2,8)	
					O_3C_4O	1.965(4)		N,N	80.9(2)[c]	
$[Cu_2(\mu\text{-}C_4O_4)(H_2O)_2(bpy)_2Br_2]$	m	10.480(4)		CuO_2N_2Br	H_2O	2.004(7)	7.607(2)[g]	O,N	91.3(3,2.4)	690
(dark green)	$P2_1/n$	8.503(1)	99.75(2)		bpyN	1.997(7,6)			108.0(2)	
	4	14.590(2)			Br	2.632(2)			161.5(3,6.9)	
					O_3C_4O	1.963(6)		O,O	95.7(3,8)	
								N,N	80.7(3)[c]	
$[Cu_2(\mu\text{-ttha})(H_2O)_2]$	m	7.165		CuO_4N_2	H_2O	1.988(8)	7.655(2)	N,O	163.6(4,8.6)	691
(pale blue)	$P2_1/c$	13.137	112.6		O	1.955(9,6)		O,O	177.3(4)	
	2	17.079				2.512(9)				
					N	2.065(8)				
						2.262(9)				
$[Cu(\mu\text{-rib})(H_2O)_2]_2\cdot 8H_2O$	tr	7.701(2)	101.85(2)	CuO_6	O	1.97(2)	7.701(2)[g]		not given	692
(dark orange)	P1	11.230(3)	96.41(2)			2.40(2,10)				
	1	17.336(4)	89.90(2)		H_2O	1.96(2,1)				
				CuO_4N_2	O	2.00(2,0)			not given	
					N	2.22(2,22)				
					H_2O	2.00(2,0)				
$[Cu_2(\mu\text{-tcb})(tetac)_2]$	or	14.400(4)		CuN_3O_2	N	2.035(4)	7.811(4)		not given	693
(turquoise blue)	Pbca	16.963(5)				2.188(4)				
	4	15.879(7)			tcbO	1.946(3,3)				
$[Cu_2(\mu\text{-}C_4O_4)(H_2O)_2(bpca)]$	tr	7.222(2)	82.85(1)	CuN_3O_2	N	1.978(2,56)	7.833(1)	N,N	82.0(1,2)[c]	694
(green)	P-1	10.272(1)	70.89(2)		H_2O	2.178(3)			158.8(1)	
	1	10.362(2)	69.94(2)		O_3C_4O	1.923(2)		N,O	97.0(1,1.6)	
									166.7(1)	
								O,O	96.3(1)	
$[Cu_2(\mu\text{-bpmpp})Cl_2](ClO_4)_2$	tr	10.004(1)	100.99(1)	CuN_4Cl	Cl	2.233(1)	7.838(1)[g]	N,N	81.2(1,2.5)[c]	684
(blue)	P-1	12.212(2)	86.26(1)		N	2.031(2,31)			101.6(2,7.5)	
	1	7.791(1)	112.76(1)			2.257(3)			149.2(1)	
								Cl,N	96.6(1,1.0)	
									105.7(1)	
									175.4(1)	

TABLE XI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	α [°] β [°] γ [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
$[Cu_2(\mu\text{-ca})(Me_5dien)_2](BPh_4)_2$	m	23.432(5)		CuN_3O_2	N	2.023(6, 35)	7.858(2)	O,O	78.9(2)[c]	695
(not given)	$P2_1/a$	9.933(2)	98.00(2)		caO	1.956(4)		O,N	92.8(2, 5)	
	2	15.039(3)				2.196(4)			103.9(2, 2.1)	
									177.3(2)	
								N,N	86.6(2, 2)[c]	
									151.8(2)	
$[Cu_2(\mu\text{-dd})(ClO_4)_2](ClO_4)_2$	trg	13.671(2)		CuN_4O	N	2.007(5, 9)	7.9[g]	N,N	86.2(2)[c]	683
(purple)	$P3_221$				μN	2.006(4, 2)			93.8(2, 2.7)[d]	
	3	13.929(2)			O_3ClO	2.543(7)			172.6(2, 4.8)	
$[Cu_2(\mu\text{-bdta})(im)_2(H_2O)_2]$	m	7.071(1)		CuO_3N_2	O	1.951(6, 6)	7.942(2)[g]	O,O	88.6(3, 1.4)	696
(blue)	$P2_1/c$	15.486(4)	110.15(2)		N	1.995(4)		N,N	168.2(3)	
	4	12.290(3)			imN	1.947(6)		O,N	84.5(3, 1.1)[c]	
					H_2O	2.379(6)			95.9(3, 3.8)	
$[Cu_2(\mu\text{-}F_2SiF_4)(spca)_2]\cdot 4H_2O$	m	10.000(2)		CuO_2N_2F	O	1.940(2, 11)	7.9507(6)	N,N	81.12(8)[d]	697
(dark green)	$P2_1/n$	8.8510(2)	92.0583(1)		N	1.883(2)		O,O	99.41(7)	
	2	18.1899(2)				2.001(2)		N,O	80.19(7)[c]	
					μF_4SiF_2	2.528(1)			98.96(8)	
									167.7(1, 6.5)	
								O,F	93.99(6)	
								N,F	96.8(1, 5.0)	
$[Cu_2(\mu\text{-}1,3\text{-pn})(1,3\text{-pn})_4](BF_4)_4$	or	14.573(11)		CuN_5	N	2.03(2, 3)	8.07(7)	N,N	88.9(9, 2.2)[d]	698
(dark blue)	Pbca	15.761(13)				2.24(2, 1)			95.6(8, 3.6)	
	8	30.669(13)							109.6(7, 3.1)	
									161.8(8, 12.1)	
$[Cu_2(\mu\text{-dhnq})(dien)_2](BPh_4)_2$	m	15.505(4)		CuN_3O_2	dienN	2.018(7, 11)	8.075(3)[g]	O,O	91.7(2)[d]	699
(blue)	$P2_1/n$	17.700(4)	92.56(2)			2.233(8)		O,N	94.4(2, 4.7)	
	2	10.533(3)			dhnqO	1.912(5, 16)			149.2(3)	
									177.2(2)	
								N,N	83.6(3, 1.2)[c]	
									114.1(3)	

$[Cu_2(\mu\text{-}1,3\text{-pn})(1,3\text{-pn})_4](ClO_4)_4$ (blue)	or Pbca 8	30.882(9) 14.664(6) 15.737(6)		CuN_5	N	2.04(1, 2) 2.26(1, 1)	8.104	N,N	88.9(6, 1.5)[d] 93.0(6, 6.9) 109.0(6, 3.1) 161.6(7, 11.3)	700
$[Cu_2(\mu\text{-pdtb})(H_2O)_4](ClO_4)_2 \cdot 4H_2O$ (bluish green)	m C2/c 4	17.581(12) 11.604(10) 25.90(2)	107.22(5)	CuN_3O_2	N H_2O	1.954(7, 1) 2.102(7) 1.990(7) 2.236(9)	8.956[g]	O,O O,N N,N	84.3(3, 2.8) 167.7 79.7(–, 2.2) 95.0(3, 3.6) 105.0(3, 5.0) 162.8(3) 81.4(3, 5)[e] 161.5(3)	701
$[Cu_2(\mu\text{-tpt})(Et_5dien)_2](ClO_4)_2 \cdot H_2O$ (blue violet)	or Pbca 8	28.48(1) 26.363(2) 12.591(5)		CuN_3O_2	N tptO	2.033(9, 61) 1.972(6, 1) 2.363(6, 16)	10.710(2)	N,N O,N O,O	86.7(4, 5)[e] 147.2(4, 5.0) 97.0(3, 1.2) 104.6(3, 4.6) 166.7(3, 2.1) 59.4(4, 6)[e]	702
$[Cu_2(\mu\text{-tpt})(H_2O)_2(Me_5dien)_2] \cdot (ClO_4)_2$ (blue violet)	m $P2_1/c$ 4	8.42(5) 14.40(4) 15.99(5)	100.65(10)	CuN_3O_2	N H_2O tptO	2.049(4, 20) 2.225(4) 1.931(3)	11.129(1)	N,O N,N	94.0(2, 5.1) 103.0(2, 3.0) 167.1(2) 85.8(2)[e] 154.7(2)	702
$[Cu_2(\mu\text{-tpt})(H_2O)_2 \cdot (Me[9]\text{-}aneN_4)_2(ClO_4)_2]$ (not given)	m $P2_1/c$ 4	8.619(4) 14.059(3) 15.156(9)	96.25(4)	CuO_3N_3	N H_2O tptO O_3ClO	2.034(5) 2.217(5) 2.009(4) 1.972(4) 2.992(6)	11.252(4)		not given	693
$[Cu_2(\mu\text{-}C_{36}H_{40}N_3)Cl_4] \cdot 2H_2O$ (green)	m $P2_1/c$ —	8.752(4) 15.149(9) 14.468(5)	98.52(3)	CuN_3Cl_2	N Cl	2.008(6, 4) 2.214(5) 2.394(2, 52)	11.71	Cl,Cl Cl,N N,N	118.9(1) 102.9(1) 138.0(1) 89.8(2, 4.1)[d] 178.1(2)	703
$[Cu_2(\mu\text{-bzd})(tren)_2](NO_3)_4$[f] (dark green)	m $P2_1/c$ 8	29.799(4) 13.960(2) 18.732(3)	106.49(1)	CuN_5	trenN bzdN	2.044(11,21) 2.125(11,92) 2.038(8, 5)	12.273(2)	N,N	84.4(4, 1.6)[e] 94.9(4, 2.4) 108.9(4, 7.5) 135.6(4, 6) 176.0(4, 9)	704

TABLE XI (*Continued*)

Compound (*color*)	*Cryst. cl.* *space G.* *Z*	*a* [Å] *b* [Å] *c* [Å]	*α* [°] *β* [°] *γ* [°]	*Chromophore*	*Cu–L* [Å]		*Cu–Cu* [Å]	*L–Cu–L* [°]		*Ref.*
				CuN_5	treN	2.043(11,17)	12.083(2)	N,N	84.4(4.1,5)[c]	
						2.155(10,22)			93.6(4, 1.2)	
					bzdN	2.034(8, 2)			107.2(4, 6.7)	
									136.6(4, 4.6)	
									175.4(4, 1)	
$[Cu_2(\mu\text{-pprz})(NO_3)_2(H_2O)_4]$	m	8.554(1)		CuO_3N_2	O_2NO	1.990(3)	not given		not given	705
(green)	$P2_1/n$	15.768(4)	96.14(1)		H_2O	1.958(3)				
	2	8.916(1)				2.182(3)				
					pprzN	2.017(3, 5)				

[a] Where more than one chemically equivalent distance or angle is present the mean value is tabulated. The first number in parenthesis is e.s.d., the second is a maximum deviation from the mean value. [b] The chemical identity of coordinated atom/ligand is specified in these columns. [c] Five-membered metallocyclic ring. [d] Six-membered metallocyclic ring. [e] Four-membered metallocyclic ring. [f] There are two crystallographically independent molecules. [g] Calculated by us.

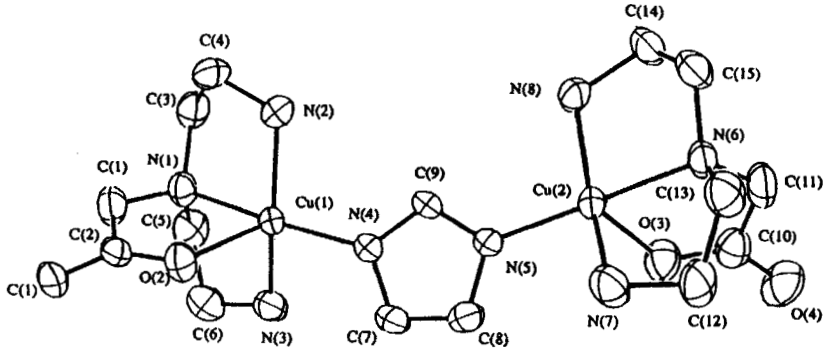


FIGURE 12 Structure of $[Cu_2(\mu\text{-im})(dtma)_2]$ (see Ref. 671).

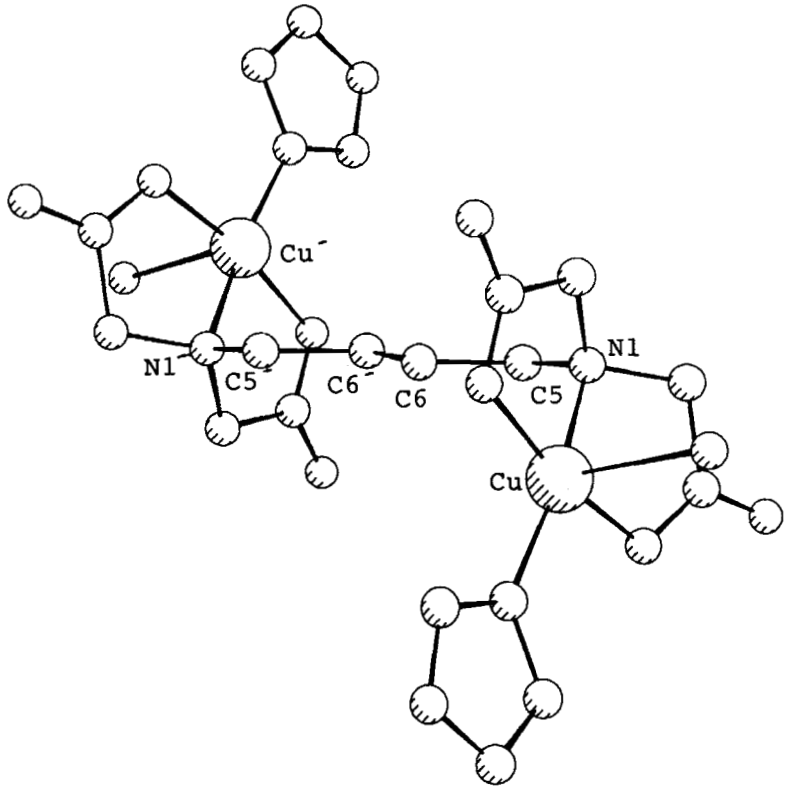


FIGURE 13 Structure of $Cu_2(\mu\text{-bdta})(im)_2(H_2O)$ (see Ref. 696).

cases.[673, 695,699,702] A *pseudo*-octahedral coordination about each Cu(II) atom was found.[674,676,686,691,693] There are also four derivatives, which contain non-equivalent Cu(II) atoms, four- and five-coordinate,[659,666] or five- and six-coordinate.[673,679] In the series of a square pyramidal configurations the displacement of Cu(II) from the basal plane toward an apical ligand range from 0.016 to 0.35 Å.

In three cases two crystallographically independent molecules, differing by degree of distortion, have been found to be present in one crystal.[672,687,704]

The Cu–Cu separation in this series ranges from 3.67 to 12.273(2) Å. The mean Cu–L bond distance, in the series of monodentate ligands, increases in the order: 1.86(F) < 1.95 Å (NL) < 2.23 Å (OL) < 2.29 Å (Cl) < 2.505 Å (Br). The multidentate ligands include both homo- and heterodonor atoms, with N- and O-donor;s being by far the most common. The mean Cu–O bond distance increases in the order 1.85 Å (O_2, bidentate) < 2.06 Å (OL,bi-) < 2.12 Å (OL,tetra-) < 2.47 Å (OL,tridentate) and Cu–N bond distances: 2.05 Å (bi-, tri-, octa-) < 2.10 Å (tetra-) < 2.11 Å (hexadentate).

3. CONCLUSIONS

This review has classified nine hundred Cu(II) dimers for which crystallographic and structural data are available. Copper(II) compounds are for the most part green and blue. There are several types of bridges, of which a double bridge of the Cu–$(X)_2$–Cu type is the most common.[360] The most common mono- and multidentate ligands are O- and N-donors. From a stereochemical point of view, a square planar arrangement, with different degrees of distortion about the Cu(II) atom, is the most common. The Cu–Cu distances range from 2.44 to 12.27 Å.

Several relationships were found, between the Cu–Cu distance, the Cu–L–Cu bridge angle and the type of bridging, and between the intraligand L–Cu–L ring angles and coordination number. These have been discussed separately in each section. Some Cu(II) compounds occur in two isomeric forms which differ mostly by degree of distortion in both the Cu–L distances and L–Cu–L angles. Two independent molecules differing by degree of distortion have been found in several cases. The coexistence of two or more species differing only by degree of distortion is typical of the general class of distortion isomerism.[144]

A summary of the copper-ligand(atom) bond lengths for Cu(II) dimers with different geometries is given in Table XII. In general, the Cu–L bond

TABLE XII Summary of the mean Cu(II)–L [Å] bond distances[a]

Coord. atom[a]	*Cov. rad.* [Å]	4-*coordination*	5-*coordination*	6-*coordination*
LO	0.73	1.915	2.27	2.46
L^2O		1.93	2.03	2.37
L^3O			1.99	2.47
L^4O		1.93	2.09	2.26
LN	0.75	1.97	2.06	2.08
L^2N		1.98	2.04	2.07
L^3N			2.05	1.95
L^4N		1.99	2.06	1.98
L^5N				2.21
L^6N		1.975	2.08	2.015
L^8N		2.05	2.15	
Cl	0.99	2.23	2.37	2.31
L^2S	1.02	2.23	2.41	
Br	1.14		2.50	
I	1.33		2.77	

[a] L^x = X-dentate.

distances increase with increasing coordination number and covalent radius of the respective donor atoms. The mean Cu–L bridge distance for five-coordination increases with covalent radius (in parenthesis) in the order: 2.02 Å (O,0.73 Å) < 207 Å (N,0.75 Å) < 2.32 Å (Cl,0.99 Å) < 2.465 Å (S, 1.02 Å) < 266 Å (Br, 1.14 Å) < 2.69 Å (I, 1.133 Å).

This review, together with its precursor for monomeric Cu(II) compounds,[14,15] represents the first overview of structural data for Cu(II). A related review of the structural chemistry of trimeric to polymeric Cu(II) complexes is currently in progress. During the collection and organization of the data it became clear that, despite the increasing availability of data retrieval systems, the tracing of relevant material is not always a straightforward task. Some of the data are only available as supplementary material, and some are not mentioned at all. This can lead to overlooking of relevant structural features which should be compared with other derivatives. In view of such limitations in information retrieval, we believe it is necessary to make a systematic overall review, and that such reviews serve the useful purpose of delineating areas of both interest and weakness.

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