Pergamon

Tetrahedron 58 (2002) 2137–2146

TETRAHEDRON

Synthesis and characterisation of *N*,*N*-disubstituted 2-amino-5-acylthiophenes and 2-amino-5-acylthiazoles

Antje Noack and Horst Hartmann*

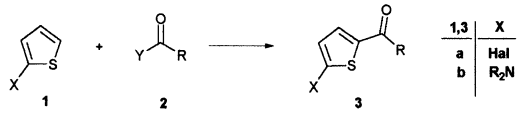
Department of Chemistry, University of Applied Sciences, Geusaer Str., D-06217 Merseburg, Germany

Received 10 September 2001; revised 7 December 2001; accepted 22 January 2002

Abstract—Starting from halomethyl-ketones **8** and *N*,*N*′-persubstituted thioacrylamides **7** or their 2-aza analogues **11** a series of *N*,*N*-disubstituted 2-amino-5-acylthiophenes **10** and 2-amino-5-acylthiazoles **12**, respectively are available. By starting from 1,3-dichloroacetone and using the same thioacrylamide derivatives **7** and **11** *N*,*N*-disubstituted 2-amino-5-(chloroacetyl)thiophenes **13** and 2-amino-5-(chloroacetyl)thiazoles **14** as well as *N*,*N*′-persubstituted bis-(2-amino-5-thienyl)ketones **15**, 2-amino-5-thienyl-(2-amino-5-thiazolyl)ketones **16**, and bis-(2-amino-5-thiazolyl)ketones **17**, respectively are available.

1. Introduction

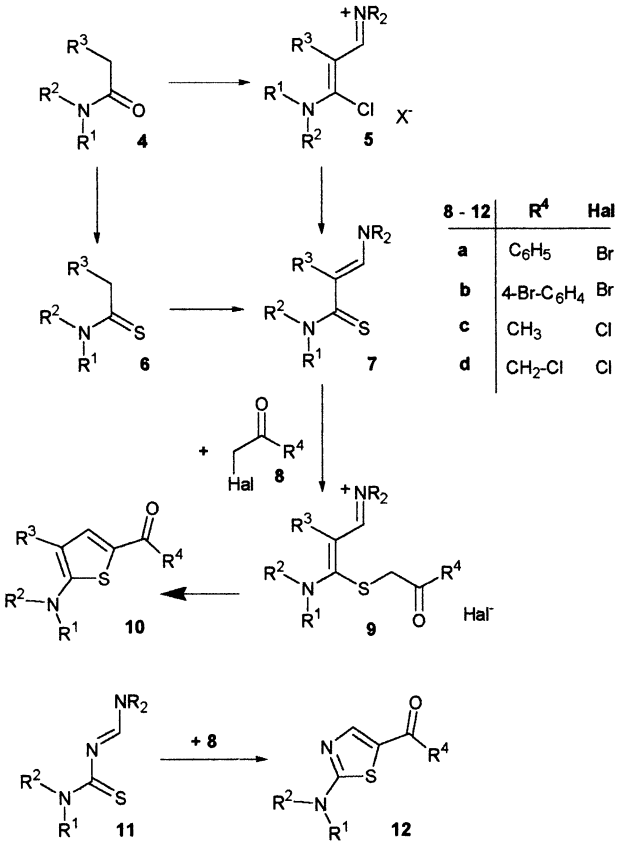
In analogy to the synthesis of acylbenzene from benzene or some of its substituted derivatives[1] the heteroanalogous acylthiophenes **3** are readily accessible from their parent compounds **1** by means of a Friedel–Crafts (FC) acylation using carbonic acid anhydrides **2** (Y=OCOR) or other reactive acyl derivatives as reagents.[2] Usually the FC reaction requires the use of Lewis acid catalysts, such as BF_3 or $ZnCl_2$, even when the starting thiophenes **1** are substituted by electron-donating groups at C(2) (Scheme 1).



Scheme 1.

As we found, the FC acylation of thiophenes fails, surprisingly, if amino-substituted derivatives, such as the 2-dialkylamino-thiophenes **1b**, are used as starting materials. This behaviour has parallels in the aniline series.[3] As reason for this, the fact that the acylation at the amino moiety of the substrate or a deactivation of the catalyst used for activating the acylating reagent by the amino group can be assumed. Therefore, *N*,*N*-disubstituted 5-acyl-2-aminothiophenes **3b** which are of interest as versatile building blocks for the preparation of other 2-aminothiophene derivatives, e.g. of those with strong non-linear optical properties,[4] cannot be prepared by means of a FC acylation of corresponding 2-aminothiophenes **1b**.

Recently a facile method for preparing *N*,*N*-disubstituted 5-acetyl-2-aminothiophenes **3b** (R=CH_3) was published.[5] It utilises 2-halo-substituted 5-acetylthiophenes **3a** (R=CH_3), easily available by a FC acetylation of



Scheme 2.

Keywords: acylthiophenes; acylthiazoles; heterocyclisation.

* Corresponding author. Tel.: +49-3461-462025; fax: +49-3461-462192; e-mail: horst.hartmann@cui.fh-merseburg.de

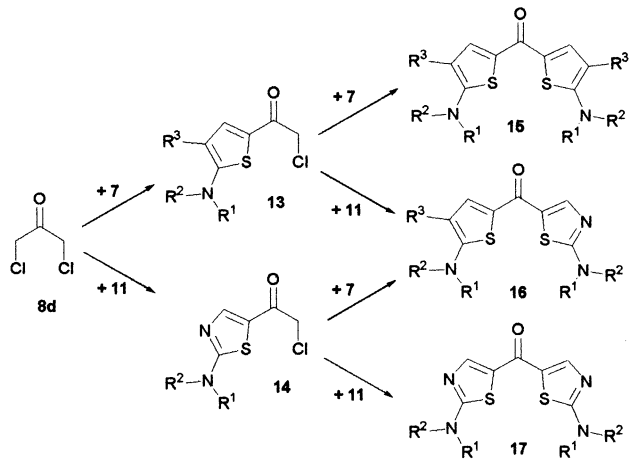
0040–4020/02/$ - see front matter
PII: S0040-4020(02)00083-2

Table 1. Characteristic substance data of compounds **10**

Number	R^1	R^2	R^3	R^4	Yield (%)	Mp (°C)	Formula calculated (m.w. found)	C	H	N	S
10a	$C_2H_4OC_2H_4$		H	CH_3	80	115–116 114–116[8d]	$C_{10}H_{13}NO_2S$ (211.3)	56.85 56.98	6.20 6.22	6.63 6.62	15.17 15.12
10b	$C_2H_4OC_2H_4$		H	C_6H_5	84	123–125 127–129[8d]	$C_{15}H_{15}NO_2S$ (273.3)	65.91 66.00	5.53 5.54	5.12 5.32	11.73 11.70
10c	$C_2H_4OC_2H_4$		H	*p*-C_6H_4Br	82	170–171 170–171[8d]	$C_{15}H_{14}BrNO_2S$ (352.2)	51.15 50.92	4.01 4.04	3.98 4.21	9.10 9.03
10d	$C_2H_4OC_2H_4$		C_6H_5	CH_3	61	119–120 119–120[8b]	$C_{16}H_{17}NO_2S$ (287.4)	66.87 66.98	5.96 6.07	4.87 4.79	11.16 10.86
10e	$C_2H_4OC_2H_4$		C_6H_5	C_6H_5	98	173–175 172[8b]	$C_{21}H_{19}NO_2S$ (349.4)	72.18 72.19	5.48 5.60	4.01 3.80	9.18 9.25
10f	$C_2H_4OC_2H_4$		C_6H_5	*p*-C_6H_4Br	56	178–179 175[8b]	$C_{21}H_{18}BrNO_2S$ (428.3)	58.88 58.81	4.24 4.54	3.27 2.89	7.49 7.65
10g	CH_3	CH_3	H	CH_3	24	56–58	$C_8H_{11}NOS$ (169.2)	56.77 56.66	6.55 6.57	8.28 8.23	18.94 18.49
10h	CH_3	CH_3	H	C_6H_5	100	111–112	$C_{13}H_{13}NOS$ (231.3)	67.50 67.48	5.67 5.66	6.06 6.03	13.86 13.83
10i	CH_3	CH_3	H	*p*-C_6H_4Br	39	129–130	$C_{13}H_{12}BrNOS$ (310.2)	50.33 50.22	3.90 4.06	4.52 4.15	10.34 10.39
10j	CH_3	C_6H_5	H	CH_3	56	103–105	$C_{13}H_{13}NOS$ (231.3)	67.50 67.30	5.67 5.91	6.06 5.67	13.86 13.84
10k	CH_3	C_6H_5	H	C_6H_5	61	78–80	$C_{18}H_{15}NOS$ (293.4)	73.69 73.61	5.15 5.27	4.77 4.88	10.93 10.96
10l	CH_3	C_6H_5	H	*p*-C_6H_4Br	54	94–95	$C_{18}H_{14}BrNOS$ (372.3)	58.07 57.82	3.79 3.84	3.76 3.85	8.61 8.53
10m	C_6H_5	C_6H_5	H	CH_3	34	70–71	$C_{18}H_{15}NOS$ (293.4)	73.69 73.64	5.15 5.11	4.77 4.86	10.93 10.94
10n	C_6H_5	C_6H_5	H	C_6H_5	84	145–146	$C_{23}H_{17}NOS$ (355.4)	77.72 77.40	4.82 4.87	3.94 3.53	9.02 8.81
10o	C_6H_5	C_6H_5	H	*p*-C_6H_4Br	18	140–141	$C_{23}H_{16}BrNOS$ (434.3)	63.60 63.59	3.71 4.01	3.23 3.17	7.38 7.53
10p	C_6H_5	C_6H_5	C_6H_5	CH_3	90	121–123	$C_{24}H_{19}NOS$ (369.5)	78.02 77.84	5.18 5.20	3.79 3.96	8.68 8.62
10q	C_6H_5	C_6H_5	C_6H_5	C_6H_5	77	165–167	$C_{29}H_{21}NOS$ (431.5)	80.71 80.54	4.91 4.92	3.25 3.35	7.43 6.93
10r	C_6H_5	C_6H_5	C_6H_5	*p*-C_6H_4Br	19	170–172	$C_{29}H_{20}BrNOS$ (510.4)	68.24 68.30	3.95 4.09	2.74 2.94	6.28 6.36
10s	C_6H_5	1-$C_{10}H_7$	H	CH_3	58	48–50	$C_{22}H_{17}NOS$ (343.4)	76.94 76.80	4.99 5.04	4.08 4.19	9.34 9.21
10t	C_6H_5	1-$C_{10}H_7$	H	C_6H_5	22	60–63	$C_{27}H_{19}NOS$ (405.5)	79.97 79.70	4.72 5.08	3.45 4.01	7.91 7.68
10u	C_6H_5	1-$C_{10}H_7$	H	*p*-C_6H_4Br	24	58–60	$C_{27}H_{18}BrNOS$ (484.4)	66.95 66.89	3.75 3.70	2.89 3.12	6.62 6.44
10v	C_6H_5	2-$C_{10}H_7$	H	CH_3	52	96–98	$C_{22}H_{17}NOS$ (343.42)	76.94 76.54	4.99 5.03	4.08 4.19	9.34 9.09
10w	C_6H_5	2-$C_{10}H_7$	H	C_6H_5	64	121–122	$C_{27}H_{19}NOS$ (405.5)	79.97 79.48	4.72 4.95	3.45 3.56	7.91 7.82
10x	C_6H_5	2-$C_{10}H_7$	H	*p*-C_6H_4Br	41	97–99	$C_{27}H_{18}BrNOS$ (484.4)	66.95 66.95	3.75 3.96	2.89 3.18	6.62 6.65
10y	C_6H_5	2-$C_{10}H_7$	C_6H_5	C_6H_5	89	168–170	$C_{33}H_{23}NOS$ (481.6)	82.30 82.09	4.81 4.98	2.91 3.06	6.66 6.78

Table 2. Characteristic substance data of compounds **12**

Number	R^1	R^2	R^4	Yield (%)	Mp (°C)	Formula calculated (m.w. found)	C	H	N	S
12a	$C_2H_4OC_2H_4$		CH_3	88	146–149	$C_9H_{12}N_2O_2S$ (212.3)	50.92 50.95	5.70 5.72	13.20 12.90	15.10 14.90
12b	$C_2H_4OC_2H_4$		C_6H_5	91	155–157 154–156[12]	$C_{14}H_{14}N_2O_2S$ (274.3)	61.29 61.31	5.14 5.31	10.21 10.07	11.69 11.48
12c	C_6H_5	C_6H_5	CH_3	75	158–160	$C_{17}H_{14}N_2OS$ (294.4)	69.36 69.40	4.79 4.86	9.52 9.01	10.89 10.74
12d	C_6H_5	C_6H_5	C_6H_5	73	164–165 153[21]	$C_{22}H_{16}N_2OS$ (356.4)	74.13 74.22	4.52 4.55	7.86 7.84	8.99 8.69
12e	CH_3	C_6H_5	CH_3	60	85–86	$C_{12}H_{12}N_2OS$ (232.3)	62.04 61.87	5.21 5.61	12.06 11.16	13.80 13.77
12f	CH_3	C_6H_5	C_6H_5	68	58–60	$C_{17}H_{14}N_2OS$ (294.4)	69.36 69.38	4.79 4.99	9.52 9.44	10.89 10.86
12g	CH_3	CH_3	CH_3	13	96–98	$C_7H_{10}N_2OS$ (170.2)	49.39 49.43	5.92 5.90	16.46 16.58	18.83 18.68
12h	CH_3	CH_3	C_6H_5	29	38–40	$C_{12}H_{12}N_2OS$ (232.3)	62.04 62.19	5.21 5.24	12.06 11.67	13.80 13.80



Scheme 3.

2-halothiophenes,[2] which were allowed to react with secondary amines. This reaction follows the earlier published synthesis of 2-dialkylamino-substituted thiophene-5-carbaldehydes **3b** (R=H) from 2-halothiophene-5-carbaldehydes **3a** (R=H) and secondary amines.[6] Earlier, 2-dialkylamino-substituted thiophene-5-carbaldehydes **3b** (R=H) were prepared by a formylation of *N*,*N*-disubstituted 2-aminothiophenes using the Vilsmeier reagent.[7]

Although the reported method for preparing *N*,*N*-disubstituted 5-acetyl-2-aminothiophenes **3b** works under mild conditions and gives high yields usually, it fails when secondary aromatic amines, such as diphenylamine or, as we found, 3-aryl-substituted 5-acetyl-2-halothiophenes are used. The reported method has not been used for the preparation of *N*,*N*-disubstituted 5-acyl-2-aminothiophenes **3b** with R=aryl or higher alkyl groups. Furthermore, this

Table 3. Characteristic substance data of compounds **13** and **14**

Number	R^1	R^2	R^3	Yield (%)	Mp (°C)	Formula calculated (m.w. found)	C	H	N	S
13a		$C_2H_4OC_2H_4$	H	23	145–150	$C_{10}H_{12}ClNO_2S$ (245.7)	48.88	4.92	5.70	13.05
							48.27	4.78	5.57	12.70
13b		$C_2H_4OC_2H_4$	C_6H_5	37	112–114	$C_{16}H_{16}ClNO_2S$ (321.8)	59.71	5.01	4.35	9.96
							59.42	4.96	4.38	9.75
13c	C_6H_5	C_6H_5	H	73	151–153	$C_{18}H_{14}ClNOS$ (327.8)	65.95	4.30	4.27	9.78
							65.83	4.20	4.49	9.63
13d	C_6H_5	C_6H_5	C_6H_5	89	56–59	$C_{24}H_{18}ClNOS$ (403.9)	71.36	4.49	3.47	7.94
							71.38	4.64	3.83	7.47
14a		$C_2H_4OC_2H_4$	–	93	164–166	$C_9H_{11}ClN_2O_2S$ (246.7)	43.81	4.49	11.36	13.00
							44.02	4.65	11.32	12.63
14b	C_6H_5	C_6H_5	–	61	75–80	$C_{17}H_{13}ClN_2OS$ (328.8)	62.10	3.99	8.52	9.75
							61.94	4.21	7.89	9.46

Table 4. Characteristic substance data of compounds **15**, **16**, and **14**

Number	R^1	R^2	R^3	Yield (%)	Mp (°C)	Formula calculated (m.w. found)	C	H	N	S
15a		$C_2H_4OC_2H_4$	H	74	286–288	$C_{17}H_{20}N_2O_3S_2$ (364.5)	56.02	5.53	7.69	17.59
							56.15	5.61	7.85	17.39
15b		$C_2H_4OC_2H_4$	C_6H_5	87	239–241	$C_{29}H_{28}N_2O_3S_2$ (516.6)	67.41	5.46	5.42	12.41
							67.56	5.45	5.52	11.43
15c	C_6H_5	C_6H_5	H	68	184–185	$C_{33}H_{24}N_2OS_2$ (528.7)	74.97	4.58	5.30	12.13
							74.50	4.75	5.52	12.19
15d	C_6H_5	C_6H_5	C_6H_5	44	66–68	$C_{45}H_{32}N_2OS_2$ (680.8)	79.38	4.74	4.11	9.42
							79.22	4.99	4.11	9.38
15e	C_6H_5	CH_3	H	45	156–157	$C_{23}H_{20}N_2OS_2$ (404.5)	68.29	4.98	6.93	15.85
							68.36	5.14	7.02	16.28
15f	CH_3	CH_3	H	57	257–260	$C_{13}H_{16}N_2OS_2$ (280.4)	55.68	5.75	9.99	22.87
							55.61	5.71	9.70	22.02
15g	C_6H_5	1-$C_{10}H_7$	H	38	100–102	$C_{41}H_{28}N_2OS_2$ (628.8)	78.31	4.49	4.46	10.20
							78.65	4.92	4.33	10.38
15h	C_6H_5	2-$C_{10}H_7$	H	51	78–80	$C_{41}H_{28}N_2OS_2$ (628.8)	78.31	4.49	4.46	10.20
							78.10	4.66	4.39	10.32
16a		$C_2H_4OC_2H_4$	H	100 (a) 13 (b)	306–307	$C_{16}H_{19}N_3O_3S_2$ (365.5)	52.58	5.24	11.50	17.55
							52.86	5.32	11.25	17.30
16b		$C_2H_4OC_2H_4$	C_6H_5	91 (a) 61 (b)	209–210	$C_{22}H_{23}N_3O_3S_2$ (441.5)	59.84	5.25	9.52	14.52
							59.80	5.47	9.42	14.67
16c	C_6H_5	C_6H_5	H	46	189–190	$C_{32}H_{23}N_3OS_2$ (529.6)	72.56	4.38	7.93	12.11
							72.29	4.76	7.08	12.41
17a		$C_2H_4OC_2H_4$	–	100	312–314	$C_{15}H_{18}N_4O_3S_2$ (366.4)	49.16	4.95	15.29	17.50
							49.24	5.04	15.09	17.45
17b	C_6H_5	CH_3	–	23	156–158	$C_{21}H_{18}N_4OS_2$ (406.5)	62.04	4.46	13.78	15.77
							62.33	4.69	13.70	16.20
17c	C_6H_5	C_6H_5	–	56	228–230	$C_{31}H_{22}N_4OS_2$ (530.6)	70.16	4.18	10.56	12.08
							70.35	4.33	10.62	12.14
17d	CH_3	CH_3	–	53	238–240	$C_{11}H_{14}N_4OS_2$ (282.4)	46.79	5.00	19.84	22.71
							46.35	5.21	19.48	22.44

Table 5. Spectral data of compound **10**

Number	R^1	R^2	R^3	R^4	ν_{CO} (cm^{-1})	λ_{max} (lg ε) (nm)	^1H NMR, δ-values, in $CDCl_3$ (ppm) (assignment)	^{13}C NMR, δ-values, in $CDCl_3$ (ppm)
10a	$C_2H_4OC_2H_4$		H	CH_3	1614	356 (4.35)	2.39 (s, 3H, CH_3), 3.24 (t, 4H, CH_2), 3.80 (t, 4H, CH_2), 6.02 (d, 1H, CH), 7.43 (d, 1H, CH)	25.2, 49.5, 65.9, 104.2, 129.1, 134.8, 166.8, 189.1
10b	$C_2H_4OC_2H_4$		H	C_6H_5	1593	376 (4.37)	3.26 (t, 4H, CH_2), 3.78 (t, 4H, CH_2), 6.04 (d, 1H, CH), 7.34 (d, 1H, CH), 7.37–7.46 (m, 3H, CH), 7.71 (d, 2H, CH)	49.6, 65.8, 104.6, 128.1, 128.3, 128.5, 131.0, 137.6, 138.7, 167.2, 186.5
10c	$C_2H_4OC_2H_4$		H	*p*-C_6H_4Br	1608	380 (4.40)	3.28 (t, 4H, CH_2), 3.80 (t, 4H, CH_2), 6.05 (d, 1H, CH), 7.32 (d, 1H, CH), 7.57 (dd, 4H, CH)	49.6, 65.9, 104.7, 125.8, 127.9, 130.2, 131.5, 137.6, 137.7, 167.6, 185.3
10d	$C_2H_4OC_2H_4$		C_6H_5	CH_3	1641	358 (4.12)	2.47 (s, 3H, CH_3), 3.01 (t, 4H, CH_2), 3.73 (t, 4H, CH_2), 7.27 (t, 1H, CH), 7.39 (t, 2H, CH), 7.59 (d, 2H, CH), 7.60 (s, 1H, CH)	26.3, 52.6, 66.9, 126.9, 127.9, 128.3, 129.4, 132.3, 136.3, 136.5, 162.4, 190.2
10e	$C_2H_4OC_2H_4$		C_6H_5	C_6H_5	1618	379 (4.20)	3.05 (t, 4H, CH_2), 3.72 (t, 4H, CH_2), 7.24 (t, 1H, CH), 7.35 (t, 2H, CH), 7.41–7.56 (m, 6H, CH), 7.79 (d, 2H, CH)	51.9, 66.2, 126.2, 127.2, 127.7, 128.3, 128.7, 128.8, 130.7, 131.6, 135.7, 138.4, 138.6, 162.5, 187.1
10f	$C_2H_4OC_2H_4$		C_6H_5	*p*-C_6H_4Br	1616	383 (4.23)	3.04 (t, 4H, CH_2), 3.71 (t, 4H, CH_2), 7.24 (t, 1H, CH), 7.35 (t, 2H, CH), 7.47 (s, 1H, CH), 7.55 (m, 4H, CH), 7.66 (d, 2H, CH)	51.9, 66.1, 126.3, 127.3, 127.8, 128.8, 130.2, 130.3, 131.6, 135.6, 137.3, 138.6, 162.8, 185.7
10g	CH_3	CH_3	H	CH_3	1589	366 (4.42)	2.34 (s, 3H, CH_3), 2.99 (s, 6H, CH_3), 5.77 (d, 1H, CH), 7.38 (s, 1H, CH)	24.9, 41.9, 102.4, 127.2, 135.7, 167.1, 188.3
10h	CH_3	CH_3	H	C_6H_5	1589	385 (4.39)	3.04 (s, 6H, CH_3), 5.84 (d, 1H, CH), 7.32 (d, 1H, CH), 7.41 (m, 3H, CH), 7.69 (d, 2H, CH)	41.9, 103.1, 126.7, 128.0, 128.5, 130.7, 138.6, 139.2, 167.6, 186.4
10i	CH_3	CH_3	H	*p*-C_6H_4Br	1585	389 (4.41)	3.02 (s, 6H, CH_3), 5.81 (d, 1H, CH), 7.27 (d, 1H, CH), 7.53 (m, 4H, CH)	42.1, 103.4, 125.3, 126.1, 130.2, 131.4, 138.0, 138.9, 168.0, 184.6
10j	CH_3	C_6H_5	H	CH_3	1628	370 (4.41)	2.37 (s, 3H, CH_3), 3.38 (s, 3H, CH_3), 6.01 (d, 1H, CH), 7.20 (t, 1H, CH), 7.28 (d, 2H, CH), 7.37 (m, 3H, CH)	25.1, 42.3, 105.9, 124.3, 126.1, 128.6, 129.7, 134.8, 146.7, 165.0, 188.7
10k	CH_3	C_6H_5	H	C_6H_5	1597	391 (4.46)	3.42 (s, 3H, CH_3), 6.04 (d, 1H, CH), 7.23 (d, 1H, CH), 7.30–7.43 (m, 8H, CH), 7.72 (d, 2H, CH)	42.4, 106.2, 124.5, 126.3, 127.9, 128.1, 128.5, 129.8, 130.9, 137.8, 138.9, 146.6, 165.6, 186.5
10l	CH_3	C_6H_5	H	*p*-C_6H_4Br	1582	394 (4.47)	3.42 (s, 3H, CH_3), 6.03 (d, 1H, CH), 7.21–7.32 (m, 4H, CH), 7.37–7.42 (m, 2H, CH), 7.57 (dd, 4H, CH)	42.0, 42.5, 106.3, 124.6, 125.6, 126.6, 127.4, 129.8, 130.1, 131.4, 137.7, 146.5, 166.0, 185.1
10m	C_6H_5	C_6H_5	H	CH_3	1635	381 (4.32)	2.40 (s, 3H, CH_3), 6.34 (d, 1H, CH), 7.15 (t, 2H, CH), 7.22 (d, 4H, CH), 7.31 (t, 4H, CH), 7.40 (d, 1H, CH)	25.5, 113.2, 125.1, 125.5, 129.7, 131.8, 133.6, 146.4, 162.4, 189.4
10n	C_6H_5	C_6H_5	H	C_6H_5	1597	401 (4.41)	6.37 (d, 1H, CH), 7.18 (t, 2H, CH), 7.26–7.36 (m, 9H, CH), 7.40–7.50 (m, 3H, CH), 7.77 (d, 2H, CH)	113.4, 125.4, 125.9, 128.4, 128.9, 129.9, 131.3, 131.5, 136.7, 138.9, 146.6, 163.3, 187.2
10o	C_6H_5	C_6H_5	H	*p*-C_6H_4Br	1589	405 (4.43)	6.34 (d, 1H, CH), 7.18 (t, 2H, CH), 7.26–7.37 (m, 9H, CH), 7.59 (dd, 4H, CH)	113.0, 125.4, 126.0, 126.1, 129.8, 130.3, 130.4, 131.5, 136.5, 137.5, 146.3, 163.7, 185.6
10p	C_6H_5	C_6H_5	C_6H_5	CH_3	1641	358 (4.12)	2.51 (s, 3H, CH_3), 6.95 (t, 2H, CH), 7.03 (d, 4H, CH), 7.10–7.17 (m, 7H, CH), 7.33 (d, 2H, CH), 7.69 (s, 1H, CH)	26.0, 117.9, 122.9, 123.7, 127.3, 127.7, 128.2, 129.1, 134.2, 135.1, 137.1, 146.6, 153.7, 189.9
10q	C_6H_5	C_6H_5	C_6H_5	C_6H_5	1618	379 (4.20)	7.00 (t, 2H, CH), 7.09–7.22 (m, 11H, CH) 7.34 (d, 2H, CH), 7.48–7.55 (m, 3H, CH), 7.68 (s, 1H, CH), 7.91 (d, 2H, CH)	123.6, 124.4, 127.9, 128.3, 128.7, 129.1, 129.6, 129.8, 132.6, 134.7, 135.3, 136.6, 137.7, 138.7, 147.1, 155.1, 188.1
10r	C_6H_5	C_6H_5	C_6H_5	*p*-C_6H_4Br	1627	415 (4.22)	6.97 (t, 2H, CH), 7.05–7.10 (m, 6H, CH), 7.12–7.19 (m, 5H, CH), 7.29 (d, 2H, CH), 7.60 (s, 1H, CH), 7.61 (d, 2H, CH), 7.72 (d, 2H, CH)	123.1, 123.9, 126.7, 127.2, 127.5, 128.0, 129.1, 130.4, 131.6, 133.9, 134.3, 135.1, 136.7, 137.2, 146.3, 155.0, 186.2
10s	C_6H_5	1-$C_{10}H_7$	H	CH_3	1633	379 (4.21)	2.36 (s, 3H, CH_3), 6.23 (d, 1H, CH), 7.06 (t, 1H, CH), 7.25–7.52 (m, 9H, CH), 7.84–7.96 (m, 4H, CH)	25.5, 112.1, 122.5, 123.3, 124.5, 126.2, 126.6, 126.9, 127.2, 128.5, 128.7, 129.5, 133.6, 134.9, 135.4, 139.6, 142.3, 146.8, 163.1, 189.2

Table 5. (*continued*)

Number	R^1	R^2	R^3	R^4	ν_{CO} (cm^{-1})	λ_{max} (lg ε) (nm)	^1H NMR, δ-values, in $CDCl_3$ (ppm) (assignment)	^{13}C NMR, δ-values, in $CDCl_3$ (ppm)
10t	C_6H_5	1-$C_{10}H_7$	H	C_6H_5	1670	397 (4.28)	6.24 (d, 1H, CH), 7.10 (t, 1H, CH), 7.23–7.46 (m, 8H, CH), 7.47–7.51 (m, 4H, CH), 7.74 (d, 2H, CH), 7.86–7.98 (m, 3H, CH)	112.0, 123.0, 123.5, 125.1, 126.5, 127.0, 127.3, 127.6, 128.5, 129.0, 129.9, 130.7, 131.6, 135.6, 137.2, 139.0, 142.3, 146.8, 164.3, 187.4
10u	C_6H_5	1-$C_{10}H_7$	H	*p*-C_6H_4Br	1670	402 (4.27)	6.24 (d, 1H, CH), 7.13 (t, 1H, CH), 7.25–7.42 (m, 6H, CH), 7.47–7.64 (m, 7H, CH), 7.87–8.21 (m, 3H, CH)	112.2, 123.5, 123.8, 125.6, 126.5, 126.9, 127.3, 127.6, 128.0, 129.3, 129.4, 130.2, 130.9, 132.1, 135.5, 135.9, 137.5, 138.1, 142.5, 147.0, 165.1, 171.7, 186.3
10v	C_6H_5	2-$C_{10}H_7$	H	CH_3	1638	312 (3.98), 387 (4.33)	2.45 (s, 3H, CH_3), 6.45 (d, 1H, CH), 7.20 (t, 1H, CH), 7.29–7.39 (m, 5H, CH), 7.43–7.47 (m, 3H, CH), 7.69–7. 70 (m, 2H, CH), 7.81 (d, 2H, CH)	26.2, 114.6, 123.0, 124.6, 125.8, 126.2, 126.4, 127.3, 128.1, 128.3, 130.2, 130.4, 131.9, 132.9, 134.1, 134.7, 144.5, 147.1. 162.8, 190.1
10w	C_6H_5	2-$C_{10}H_7$	H	C_6H_5	1608	406 (4.43)	6.44 (d, 1H, CH), 7.20–7.23 (m, 1H, CH), 7.31–7.36 (m, 5H, CH), 7.40–7.51 (m, 6H, CH), 7.68–7.72 (m, 2H, CH), 7.77–7.82 (m, 4H, CH)	113.9, 122.6, 124.0, 125.3, 125.8, 125.9, 126.7, 127.5, 127.7, 128.2, 128.7, 129.7, 129.8, 131.3, 131.4, 131.6, 134.1, 136.3, 138.7, 143.9, 146.5, 162.9, 187.1
10x	C_6H_5	2-$C_{10}H_7$	H	*p*-C_6H_4Br	1582	410 (4.46)	6.43 (d, 1H, CH), 7.21–7.23 (m, 1H, CH), 7.34–7.39 (m, 6H, CH), 7.43–7.46 (m, 2H, CH), 7.57 (d, 2H, CH), 7.66 (d, 2H, CH), 7.68–7.73 (m, 2H, CH), 7.80–7.83 (m, 2H, CH)	113.6, 122.8, 124.0, 125.4, 126.0, 126.1, 126.8, 127.6, 127.7, 129.7, 129.8, 129.9 130.3, 130.8, 131.5, 131.6, 134.1, 136.4, 137.5, 143.8, 146.4, 163.4, 185.7
10y	C_6H_5	2-$C_{10}H_7$	C_6H_5	C_6H_5	1628	305 (4.21), 414 (4.30)	7.02–7.32 (m, 9H, CH), 7.37–7.39 (m, 4H, CH), 7.50–7.73 (m, 8H, CH), 7.93 (d, 2H, CH)	119.8, 122.7, 123.1, 124.0, 125.0, 126.5, 127.2, 127.3, 127.6, 128.1, 128.5, 129.0, 129.1, 129.2, 130.4, 132.0, 134.0, 134.1, 135.0, 136.2, 137.1, 138.1, 144.1, 146.4, 154.3, 187.6

Table 6. Spectral data of compound **12**

Number	R^1	R^2	R^3	ν_{CO} (cm^{-1})	λ_{max} (lg ε) (nm)	^1H NMR, δ-values, in $CDCl_3$ (ppm) (assignment)	^{13}C NMR, δ-values, in $CDCl_3$ (ppm)
12a	$C_2H_4OC_2H_4$		CH_3	1649	329 (4.32)	2.37 (s, 3H, CH_3), 3.53 (t, 4H, CH_2), 3.75 (t, 4H, CH_2), 7.74 (s, 1H, CH)	25.8, 48.3, 65.9, 129.6, 147.5, 175.5, 188.8
12b	$C_2H_4OC_2H_4$		C_6H_5	1608	347 (4.35)	3.45 (t, 4H, CH_2), 3.70 (t, 4H, CH_2), 7.39 (t, 2H, CH), 7.46 (t, 1H, CH), 7.65 (s, 1H, CH), 7.71 (d, 2H, CH)	48.2, 65.7, 128.2, 128.3, 128.9, 131.6, 138.3, 149.8, 175.2, 186.2
12c	C_6H_5	C_6H_5	CH_3	1651	343 (4.27)	2.38 (s, 3H, CH_3), 7.25–7.26 (m, 2H, CH), 7.36–7.38 (m, 8H, CH), 7.82 (s, 1H, CH)	26.0, 126.3, 127.2, 129.8, 131.0, 144.0, 147.1, 174.6, 189.3
12d	C_6H_5	C_6H_5	C_6H_5	1620	362 (4.35)	7.27–7.30 (m, 2H, CH), 7.41–7.53 (m, 11H, CH), 7.78 (s, 1H, CH), 7.79 (d, 2H, CH)	126.6, 127.5, 128.7, 128.8, 130.1, 130.8, 132.2, 138.5, 144.3, 149.5, 174.8, 187.0
12e	CH_3	C_6H_5	CH_3	1643	335 (4.29)	2.38 (s, 3H, CH_3), 3.54 (s, 3H, CH_3), 7.31–7.35 (m, 3H, CH), 7.40–7.45 (m, 2H, CH), 7.80 (s, 1H, CH)	25.9, 40.5, 125.4, 127.8, 129.6, 130.1, 145.1, 147.5, 175.2, 189.2
12f	CH_3	C_6H_5	C_6H_5	1602	354 (4.35)	3.56 (s, 3H, CH_3), 7.29–7.52 (m, 8H, CH), 7.73 (s, 1H, CH), 7.74 (d, 2H, CH)	40.6, 125.4, 127.9, 128.4, 128.5, 129.1, 130.1, 131.8, 138.4, 145.1, 149.9, 175.1, 186.8
12g	CH_3	CH_3	CH_3	1620	331 (4.35)	2.39 (s, 3H, CH_3), 3.16 (s, 3H, CH_3), 7.77 (s, 1H, CH)	25.7, 40.3, 128.9, 147.7, 175.1, 188.7
12h	CH_3	CH_3	C_6H_5	1636	349 (4.34)	3.19 (s, 6H, CH_3), 7.45 (m, 2H, CH), 7.50 (m, 1H, CH), 7.70 (s, 1H, CH), 7.74 (d, 2H, CH)	40.3, 128.4, 128.5, 128.7, 131.6, 138.5, 150.8, 175.4, 186.6

method should not be applicable for 2-halo-5-acylthiophenes **3a** with reactive groups, such as halogen, on their 5-acyl substituents.

To overcome these restrictions in the synthesis of the *N*,*N*-disubstituted 5-acyl-2-aminothiophenes **3b** we have developed a facile method for preparing this synthetically important class of compounds. It follows a recently published method for preparing 5-acyl-substituted 2-aminothiophenes[8] and uses α-haloketones **8** and *N*,*N*′-persubstituted 3-aminothioacrylamides **7** as starting materials. The thioacrylamides **7** are readily accessible by a variety of different methods,[9] e.g. from *N*,*N*-disubstituted acetamides **4** via the corresponding thioacetamides **6** and reaction with formamide acetals[10] or via the corresponding 1-chloro-vinamidinium salts **5** and reaction with sodium sulphide[11] (Scheme 2).

2. Results and discussion

By allowing both starting materials **7** and **8** to react in a

Table 7. Spectral data of compound **13** and **14**

Number	R^1	R^2	R^3	ν_{CO} (cm^{-1})	λ_{max} (lg ε) (nm)	^1H NMR, δ-values, in $CDCl_3$ (ppm) (assignment)	^{13}C NMR, δ-values, in $CDCl_3$ (ppm)
13a	$C_2H_4OC_2H_4$		H	1642	372 (4.16)	3.30 (t, 4H, CH_2), 3.81 (t, 4H, CH_2), 4.41 (s, 2H, CH_2), 6.07 (d, 1H, CH), 7.54 (d, 1H, CH)	44.8, 50.2, 66.5, 105.2, 125.7, 136.6, 168.7, 182.9
13b	$C_2H_4OC_2H_4$		C_6H_5	1655	373 (4.15)	3.03 (t, 4H, CH_2), 3.71 (t, 4H, CH_2), 4.47 (s, 2H, CH_2), 7.28 (t, 1H, CH), 7.38 (t, 2H, CH), 7.53 (d, 2H, CH), 7.65 (s, 1H, CH)	44.5, 51.8, 66.1, 126.2, 127.4, 127.5, 127.8, 128.9, 135.4, 137.0, 163.3, 183.0
13c	C_6H_5	C_6H_5	H	1633	393 (4.10)	4.41 (s, 2H, CH_2), 6.31 (d, 2H, CH), 7.17–7.26 (m, 6H, CH), 7.32–7.37 (m, 4H, CH), 7.49 (d, 1H, CH)	44.2, 112.2, 125.4, 126.2, 127.0, 129.8, 134.9, 145.9, 164.4, 182.7
13d	C_6H_5	C_6H_5	C_6H_5	1649	291 (4.17), 411 (4.02)	4.50 (s, 2H, CH_2), 6.97–7.15 (m, 11H, CH), 7.27–7.29 (m, 4H, CH), 7.76 (s, 1H, CH)	44.8, 122.8, 123.3, 123.6, 123.7, 124.2, 127.4, 127.7, 128.2, 129.2, 135.6, 146.3, 155.7, 183.4
14a	$C_2H_4OC_2H_4$		–	1639	343 (4.29)	3.58 (t, 4H, CH_2), 3.76 (t, 4H, CH_2), 4.36 (s, 2H, CH_2), 7.90 (s, 1H, CH)	44.4, 48.4, 65.8, 125.9, 148.7, 175.8, 182.6
14b	C_6H_5	C_6H_5	–	1649	356 (4.07)	4.37 (s, 2H, CH_2), 7.27–7.29 (m, 4H, CH), 7.38–7.40 (m, 6H, CH), 7.95 (s, 1H, CH)	44.5, 126.3, 127.5, 129.8, 129.9, 143.9, 148.3, 175.3, 183.0

Table 8. Spectral data of compound **15–17**

Number	R^1	R^2	$R^3/R^{3'}$	ν_{CO} (cm^{-1})	λ_{max} (lg ϵ) (nm)	^1H NMR, δ-values, in $CDCl_3$ (ppm) (assignment)	^{13}C NMR, δ-values, in $CDCl_3$ (ppm)
15a	$C_2H_4OC_2H_4$		H	1577	414 (4.60)	3.26 (t, 8H, CH_2), 3.82 (t, 8H, CH_2), 6.08 (d, 2H, CH), 7.59 (d, 2H, CH)	50.0, 66.1, 104.6, 128.6, 133.5, 165.4, 172.6
15b	$C_2H_4OC_2H_4$		C_6H_5	1592	411 (4.45)	3.04 (t, 8H, CH_2), 3.74 (t, 8H, NCH_2), 7.28 (t, 2H, CH), 7.40 (t, 4H, CH), 7.63 (d, 4H, CH), 7.81 (s, 2H, CH)	52.7, 66.9, 127.1, 127.8, 128.4, 129.3, 131.1, 136.0, 136.4, 161.4, 177.4
15c	C_6H_5	C_6H_5	H	1589	442 (4.57)	6.41 (d, 2H, CH), 7.14 (t, 4H, CH), 7.24 (d, 8H, CH), 7.31 (t, 8H, CH), 7.57 (d, 2H, CH)	114.6, 124.9, 125.2, 129.7, 131.6, 133.0, 146.8, 160.9, 176.7
15d	C_6H_5	C_6H_5	C_6H_5	1589	440 (4.07)	6.85–6.98 (m, 4H, CH), 7.04–7.06 (m, 10H, CH), 7.13–7.18 (m, 12H, CH), 7.33 (d, 4H, CH), 7.91 (s, 2H, CH)	117.9, 122.8, 123.6, 127.3, 127.7, 128.1, 129.0, 134.6, 135.6, 143.3, 146.6, 153.2, 177.3
15e	C_6H_5	CH_3	H	1560	433 (4.54)	3.39 (s, 6H, CH_3), 6.22 (d, 2H, CH), 7.23 (t, 2H, CH), 7.36–7.46 (m, 8H, CH), 7.65 (d, 2H, CH)	41.8, 107.1, 123.4, 125.4, 127.0, 129.5, 133.2, 146.8, 162.1, 174.3
15f	CH_3	CH_3	H	1560	364 (3.83), 427 (4.50)	3.01 (s, 6H, CH_3), 3.14 (s, 6H, CH_3), 6.00 (d, 2H, CH), 7.64 (d, 2H, CH)	41.4, 102.7, 125.4, 133.4, 164.5, 173.6
15g	C_6H_5	1-$C_{10}H_7$	H	1595	396 (4.21)	6.27 (d, 2H, CH), 7.05–7.11 (m, 2H, CH), 7.24–7.28 (m, 6H, CH), 7.36–7.59 (m, 10H, CH), 7.84–7.95 (m, 6H, CH), 8.04 (d, 2H, CH)	122.0, 123.4, 124.0, 125.8, 126.2, 1236.5, 126.9, 127.1, 128.7, 129.4, 129.5, 130.6, 130.9, 132.8, 135.3, 142.3, 147.0, 161.4, 176.6
15h	C_6H_5	2-$C_{10}H_7$	H	1599	445 (4.39)	6.48 (d, 2H, CH), 7.17–7.19 (m, 2H, CH), 7.27–7.37 (m, 10H, CH), 7.41–7.44 (m, 4H, CH), 7.60 (d, 2H, CH), 7.67 (m, 4H, CH), 7.78 (d, 4H, CH)	114.8, 121.8, 123.7, 124.7, 125.2, 125.4, 126.5, 127.2, 127.5, 129.4, 129.5, 131.0, 132.8, 133.9, 144.0, 146.6, 160.5, 176.6
16a	$C_2H_4OC_2H_4$		H	1572	337 (3.91), 401 (4.51)	3.29 (t, 4H, CH_2), 3.60 (t, 4H, CH_2), 3.80–3.86 (m, 8H, CH_2), 6.11 (d, 1H, CH), 7.61 (d, 1H, CH), 7.90 (s, 1H, CH)	48.4, 50.1, 65.7, 104.9, 133.5, 134.2, 144.1, 145.6, 151.7, 152.1, 175.9
16b	$C_2H_4OC_2H_4$		C_6H_5	1566	398 (4.42)	3.02 (t, 4H, CH_2), 3.61 (t, 4H, CH_2), 3.72 (t, 4H, CH_2), 3.80 (t, 4H, CH_2), 7.25 (t, 1H, CH), 7.34 (t, 2H, CH), 7.58 (d, 2H, CH), 7.71 (s, 1H, CH), 7.98 (s, 1H, CH)	48.5, 52.0, 65.9, 66.2, 126.5, 127.2, 127.7, 128.1, 128.7, 130.0, 135.2, 135.5, 145.5, 161.0, 174.1, 176.0
16c	C_6H_5	C_6H_5	H	1523	425 (4.27)	6.38 (d, 1H, CH), 7.15 (m, 2H, CH), 7.23–7.40 (m, 18H, CH), 7.52 (d, 1H, CH), 7.93 (s, 1H, CH)	113.5, 125.1, 125.5, 126.3, 127.0, 127.8, 128.3, 129.7, 129.8, 144.0, 144.2, 145.4, 146.4, 161.7, 173.3, 176.2
17a	$C_2H_4OC_2H_4$		–	1579	330 (3.96), 382 (4.43)	3.62 (t, 8H, CH2), 3.81 (t, 8H, CH_2), 7.91 (s, 2H, CH)	48.6, 65.9, 127.7, 144.8, 174.1, 174.9
17b	CH_3	C_6H_5	–	1573	389 (4.14)	3.54 (s, 6H, CH_3), 7.27–7.44 (m, 10H, CH), 7.90 (s, 2H, CH)	40.5, 125.4, 127.7, 128.2, 130.1, 145.1, 145.9, 174.1, 175.7
17c	C_6H_5	C_6H_5	–	1581	398 (4.57)	7.26–7.30 (m, 4H, CH), 7.37–7.43 (m, 16H, CH), 7.94 (s, 2H, CH)	126.2, 127.1, 129.5, 129.8, 144.1, 145.6, 173.7, 175.5
17d	CH_3	CH_3		1546	384 (4.43)	3.23 (s, 12H, CH_3), 7.92 (s, 2H, CH)	40.5, 127.7, 145.8, 174.2, 175.2

stoichiometric ratio in a polar solvent, such as acetonitrile or methanol, 1-acylmethylmercapto-substituted vinamidinium salts of the structure **9** are formed as intermediates. These salts, whose isolation was not encouraged, can be converted in situ by addition of a suitable base, such as triethylamine or sodium methoxide, and refluxing into the 5-acyl-substituted 2-aminothiophene derivatives **10**. As demonstrated with a series of differently substituted 3-amino-thioacrylamides **7**, especially with several *N*(1),*N*(1)-diarylamino- and/or *C*(2)-aryl substituted derivatives, as well as with a variety of haloketones **8**, such as 1-aryl-2-bromoethanones **8a** and **8b**, this heterocyclisation method usually gives high yields of products of the structure **10** (see Table 1).

The reported method for preparing 5-acyl-substituted 2-aminothiophenes **10** can be extended, as exemplified recently,[12] to the synthesis of 5-acyl-substituted 2-aminothiazoles **12** (see Table 2). In this case *N*,*N*-di-substituted *N'*-(dialkylaminomethylidene)thioureas **11**, the aza analogues of the *N*,*N'*-persubstituted 3-amino-thioacrylamides **7**, have to be used as educts. These compounds are easily available, e.g. from *N*,*N*-disubstituted thioureas[13] by reaction with formamide acetals or trialkyl

orthoformates and secondary amines,[14] and are able to react, under the same conditions as their CH-analogous 3-aminothioacrylamides **7**, with the same halomethylketones **8**.

An interesting result was obtained when 1,3-dichloro-2-propanone **8d** was used as starting material in the described heterocyclisation reaction with the 3-aminothioacrylamides **7** or *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene)-thioureas **11**. Depending on the stoichiometric ratio of the reactants used and the reaction conditions applied, different types of products were obtained (Scheme 3).

Thus, by starting from a *N*,*N*′-persubstituted thioacrylamide **7** and 1,3-dichloro-2-propanone **8d** the *N*,*N*-disubstituted 2-amino-5-chloracetylthiophenes **13** or the *N*,*N*′-persubstituted bis-(2-amino-5-thienyl)ketones **15** were obtained. Whereas the first mentioned compounds **13** have been obtained by allowing the *N*,*N*′-persubstituted thioacylamides **7** to react with an excess of **8d** under the same conditions used for the synthesis of the 5-acyl-substituted 2-aminothiophenes **10**, the bis-(2-amino-5-thienyl)ketones **15** were obtained by allowing the starting materials **7** and **8d** to react in a 2:1 ratio under the same conditions.

Furthermore, by starting from a *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene)thiourea **11** and 1,3-dichloro-2-propanone **8d**, *N*,*N*-disubstituted 2-amino-5-chloracetylthiazoles **14** or *N*,*N*′-persubstituted bis-(2-amino-5-thiazolyl)ketones **17** were obtained.[15] Whereas the 5-(chloroacetyl)-substituted 2-aminothiazoles **14** were obtained by allowing the *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene) thioureas **11** to react with an excess of **8d**, the *N*,*N*′-persubstituted bis-(2-amino-5-thiazolyl)ketones **17** were obtained by allowing the educts **11** and **8d** to react in a 2:1 ratio under the same conditions as mentioned before (see Tables 3 and 4).

The availability of the 5-(chloracetyl)-substituted 2-aminothiophenes **13** and 2-aminothiazoles **14** allows to synthesise *N*,*N*′-persubstituted 2-amino-5-thiazolyl-(2-amino-5-thienyl)ketones **16** too. These compounds are available, as documented in Table 4 also, either by reaction of a *N*,*N*-disubstituted 2-amino-5-chloroacetylthiophene **13** with a *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene)thiourea **11** (Method A) or by reaction of a *N*,*N*-disubstituted 2-amino-5-chloracetylthiazole **14** with a *N*,*N*′-persubstituted thioacylamide **7** (Method B).

Most of the heterocyclic ketones **10** and **12**–**17** described here are new compounds. Their structures were unambiguously confirmed by elemental analysis and NMR spectroscopic data. Whereas the former are compiled in Tables 1–4, the NMR data, together with the UV/vis and the characteristic IR data for the CO-frequency of the compounds described, are summarised in Tables 5–8.

All compounds are more or less deeply yellow coloured, crystalline solids which can be used, owing to their reactive carbonyl moiety, as starting materials for preparing 2-aminothiophene or 2-aminothiazole based dyes[16] or new materials with a high charge generation and transport tendency,[17] useful for applications in modern technologies.[18] Details on these subjects will be published in a forthcoming paper separately.

3. Experimental

Melting points were determined on a Boetius heating-table microscope and are uncorrected. The IR spectra were recorded in potassium bromide pellets with a Philips FTIR spectrometer PU 9624, the UV/vis spectra in dichloromethane with a Perkin–Elmer spectrometer Lambda 900, and the NMR spectra with a Varian 300 MHz spectrometer Gemini 300. The extinctions in the UV/vis spectra were measured in the dimension $m^2\,mol^{-1}$ and for shortness recorded as logarithmic values. The elemental analytical data were obtained by means of a LECO analyser CHNS 932.

The following starting materials were prepared according to literature procedures cited and used as described:

N,*N*,*N*′,*N*′-(Tetramethyl)3-aminothioacrylamide **7a**, mp 116–120°C;[11] 4-[3-(*N*,*N*-dimethylamino)2-propene-1-thione]morpholine **7b**, mp 132–134°C;[11] 1,3-bis-(4-morpholino)2-phenylpropene-3-thione **7c**, mp 156–157°C;[19] [*N*(1)-phenyl-*N*(1),*N*(3),*N*(3)-trimethyl]3-aminothioacrylamide **7d**, mp 61–63°C;[11] [*N*(3),*N*(3)-dimethyl-*N*(1),*N*(1)-diphenyl]3-aminothioacrylamide **7e**, mp 212–215°C;[11] 1-(*N*,*N*-diphenylamino)3-(4-morpholino)2-phenyl-2-propene-1-thione **7f**, mp 182°C, from *N*,*N*-(diphenyl)-phenylthioacetamide, triethyl orthoformate, and morpholine according to Ref. 19, [*N*(3),*N*(3)-dimethyl-*N*(1)-(1-naphthyl)-*N*(1)-phenyl]3-aminothioacrylamide **7g**, mp 228–231°C, from 1-chloro-3-dimethylamino-1-(*N*-phenyl-1-naphthylamino)propeniminium perchlorate and sodium sulfide according to Ref. 11, [*N*(3),*N*(3)-dimethyl-*N*(1)-(2-naphthyl)-*N*(1)-phenyl]3-aminothioacrylamide **7h**, mp 150–153°C, from 1-chloro-3-dimethylamino-1-(*N*-phenyl-2-naphthylamino)propeniminium perchlorate and sodium sulfide according to Ref. 11, [*N*(3),*N*(3)-dimethyl-*N*(1)-(2-naphthyl)-*N*(1)-phenyl]3-amino-2-phenylthioacrylamide **7i**, mp 110–112°C, from 1-chloro-3-dimethylamino-1-(*N*-phenyl-2-naphthylamino)2-phenyl propeneiminium perchlorate and sodium sulfide according to Ref. 11, 1,1-dimethyl-3-(dimethylaminomethylene)thiourea **11a**, mp 92–93°C;[19] 1-methyl-1-phenyl-3-(morpholinomethylene)thiourea, **11b**, mp 98–100°C, from 1-methyl-1-phenyl-thiourea,[13] triethyl orthoformate, and morpholine according to Ref. 19, 1,1-diphenyl-3-(morpholinomethylene)thiourea **11c**, mp 224–226°C, from 1,1-diphenyl-thiourea,[20] triethyl orthoformate, and morpholine according to Ref. 19, 1-morpholino-3-(morpholinomethylene)thiourea **11d**, mp 154–155°C, from morpholino thiourea,[13] triethyl orthoformate, and morpholine according to Ref. 19.

3.1. *N*,*N*-Disubstituted 2-amino-5-acylthiophenes 10 (general procedure)

A mixture of a *N*,*N*′-persubstituted 3-aminothioacrylamide **7** (10 mmol) and a halomethyl ketone **8** (10 mmol) in acetonitrile or methanol (25 mL) was refluxed for 3 h and subsequently mixed with triethylamine (10 mL). After cooling and dilution the reaction mixture with water

(100 mL) the precipitate formed was isolated by filtration and recrystallised from ethanol or aqueous methanol. The products so obtained are compiled in Table 1.

3.2. *N*,*N*-Disubstituted 2-amino-5-acylthiazoles 12 (general procedure)

In analogy to the previous procedure an equimolar mixture of a *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene)thioureas **11** and a halomethyl ketone **8** was allowed to react in acetonitrile or methanol. The products so obtained are compiled in Table 2.

3.3. *N*,*N*-Disubstituted 2-amino-5-(chloroacetyl)thiophenes 13 (general procedure)

A mixture of a *N*,*N*′-persubstituted 3-aminothioacrylamide **7** (10 mmol) and 1,3-dichloro-2-propanone **8d** (50 mmol, 6.6 g) in acetonitrile or methanol (25 mL) was refluxed for 5 min. After cooling the reaction mixture, triethylamine (5 mL) was added at room temperature. The reaction mixture was refluxed again for 2 h, cooled to room temperature, mixed with water (100 mL), and filtrated. Oilic products were extracted with dichloromethane from which they can be precipitated after evaporating the solvent and addition of methanol. The products so obtained are compiled in Table 3.

3.4. *N*,*N*-Disubstituted 2-amino-5-(chloroacetyl)thiazoles 14 (general procedure)

In analogy to the previous procedure a mixture of a *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene)thiourea **11** (10 mmol) and 1,3-dichloro-2-propanone **8d** (50 mmol, 6.6 g) was allowed to react and subsequently handled as described earlier. The products so obtained are compiled in Table 3.

3.5. *N*,*N*′-Persubstituted bis-(2-amino-5-thienyl)ketones 15 (general procedure)

A mixture of a *N*,*N*′-persubstituted 3-aminothioacrylamide **7** (20 mmol) and 1,3-dichloro-2-propanone **8d** (10 mmol, 1.3 g) in acetonitrile or methanol (50 mL) was refluxed for 2 h and subsequently mixed with triethylamine (10 mL). After cooling and diluting the reaction mixture with water (100 mL) the precipitate formed was isolated by filtration and recrystallised from DMF. The products so obtained are compiled in Table 4.

3.6. *N*,*N*′-Persubstituted 2-amino-5-thienyl-(2-amino-5-thiazolyl)ketones 16 (general procedure)

Method A. A mixture of a *N*,*N*-disubstituted 2-amino-5-chloroacetylthiophene **13** (10 mmol) and a *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene)thiourea **11** (10 mmol) was refluxed for 2 h and subsequently mixed with triethylamine (10 mL). After cooling and diluting the reaction mixture with water (5 mL) the precipitate formed was isolated by filtration and recrystallised from DMF. The products so obtained are compiled in Table 4.

Method B. In analogy to the previous procedure a mixture of a *N*,*N*-disubstituted 2-amino-5-(chloroacetyl)thiazoles **14** (10 mmol) and a *N*,*N*′-persubstituted 3-aminothioacrylamide **7** (10 mmol) was allowed to react and subsequently handled as described. The products so obtained are compiled in Table 4.

3.7. *N*,*N*′-Persubstituted bis-(2-amino-5-thiazolyl)-ketones 17 (general procedure)

A mixture of a *N*,*N*-disubstituted *N*′-(dialkylaminomethylidene)thiourea **11** (20 mmol) and 1,3-dichloro-2-propanone **8d** (10 mmol, 1.3 g) in acetonitrile or methanol (50 mL) was refluxed for 2 h and subsequently mixed with triethylamine (10 mL). After cooling and diluting the reaction mixture with water (100 mL) the precipitate formed was isolated by filtration. The products so obtained are compiled in Table 4.

Acknowledgements

The authors thank the Deutsche Forschungsgemeinschaft and the SIEMENS AG, Erlangen, for generous financial support as well as Mrs C. König for recording the NMR spectra.

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