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## Journal of Sulfur Chemistry

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### Thio-, Seleno-, and Telluroketenes

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## *Annotated Data Sheet*

# THIO-, SELENO-, AND TELLUROKETENES

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*(Received July 30, 1991)*

The CA retrievable information on the thio-, seleno-, and telluroketene substructures (1967 through mid-1991), together with pre-1967 and additional post-1967 information retrieved from reviews and handbooks of organic chemistry, is listed in this paper. This annotated data sheet mentions 335 compounds (systematized in 14 Tables) and 363 references including 19 reviews (Ref. 16, 33, 45, 46, 75-77, 103, 107, 156, 158, 161, 165, 166, 179, 224-226, 363) and thus attempts to present a complete list of title compounds, including radicals and ions as well as chemical entities only appearing as hypothetical intermediates. Polymers, dimers, and compound mixtures are not included.

*Key words:* Carbon subsulfide, selenoketenes, thiocumulenes, thioketene *S*-oxides, thioketenes.

### CONTENTS

<b>Table 1. Thioketenes</b> .....	362
<b>Table 2. Selenoketenes</b> .....	372
<b>Table 3. Telluroketenes</b> .....	373
<b>Table 4. Thiocumulenes</b> .....	373
<b>Table 5. Thioketene <i>S</i>-oxides</b> .....	373
<b>Table 6. High-energy species derived from thioketenes</b> .....	374
<b>Table 7. Thioketenes, labeled and radical species</b> .....	374
<b>Table 8. Selenoketenes, labeled and radical species</b> .....	375
<b>Table 9. Carbenic thioketenes</b> .....	375
<b>Table 10. Carbenic thiocumulenes</b> .....	375
<b>Table 11. Thioketene anion radicals</b> .....	376
<b>Table 12. Thioketene complexes</b> .....	376
<b>Table 13. Selenoketene complexes</b> .....	377
<b>Table 14. Telluroketene complexes</b> .....	377
<b>References</b> .....	377
<b>Author index</b> .....	385

Table 1. Thioketenes  $R^1R^2C=C=S$ 

$R^1$	$R^2$	Reg. no.	Ref.
H	H	18282-77-4	a
H	Me	67760-68-1	b
H	Et	131136-76-0	44, 119, 267, 268, 305, 329
H	Pr	131136-77-1	267, 329
H	<i>i</i> -Pr	-	189, 267
H	Bu	-	340, 267, 339
H	<i>t</i> -Bu	54191-76-3	c
H	<i>n</i> -C <sub>5</sub> H <sub>11</sub>	-	267
H	<i>n</i> -C <sub>6</sub> H <sub>13</sub>	-	267
H	H <sub>2</sub> C=CMe	131136-79-3	329
H	Ph	54191-75-2	d
H	<i>p</i> -MeC <sub>6</sub> H <sub>4</sub>	-	266
H	<i>p</i> -ClC <sub>6</sub> H <sub>4</sub>	-	266
H	<i>p</i> -MeOC <sub>6</sub> H <sub>4</sub>	-	151
H	<i>p</i> -NO <sub>2</sub> C <sub>6</sub> H <sub>4</sub>	96422-00-3	64
H	F <sub>3</sub> C	87721-32-2	108, 332, 263
H	HCO	-	266
H	MeCO	63791-61-7	8, 266, 357
H	EtCO	63791-62-8	8, 266
H	PrCO	63791-63-9	8, 266
H	Me <sub>2</sub> CHCO	63791-64-0	8
H	BuCO	-	266
H	<i>i</i> -BuCO	-	266
H	<i>n</i> -C <sub>7</sub> H <sub>15</sub> CO	-	266

a) 12, 43, 61, 62, 67, 74, 83, 85, 86, 93, 105, 112, 119, 121, 122, 123, 126, 131, 132, 133, 135, 157, 180, 183, 185, 190, 216, 214, 239, 256, 259, 262, 267, 283, 285, 290, 297, 296, 297, 307, 321, 323, 329, 347, 351, 352

b) 13, 40, 58, 86, 119, 151, 164, 235, 267, 296, 305, 359

c) 56, 87, 136, 189, 216, 235, 267, 268, 280, 282, 283, 305, 312, 318

d) 51, 64, 87, 102, 125, 151, 155, 159, 188, 189, 193, 195, 259, 283, 305, 310, 311, 354, 361

Table 1 (continued)


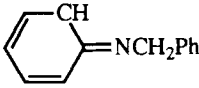
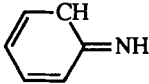
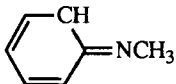
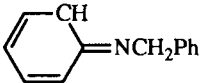
H	PhCO	63791-65-1	8, 357, 266,
H	H <sub>2</sub> NCO	-	195
H	MeCO <sub>2</sub>	-	195, 175
H	EtCO <sub>2</sub>	-	359
H	O <sub>2</sub> N	67752-92-5	58, 221, 255, 259
H	PhSO <sub>2</sub>	102862-08-8	221, 255, 259
H	HS	84601-08-1	122, 320
H	Me <sub>3</sub> Si	109639-49-8	14
H		-	266
H			15
H	S <sup>-</sup>	132198-37-9	124
Me	Me	44158-23-8	177, 238, 280, 281, 288, 328, 329,
Me	Et	131136-78-2	329
Me	<i>i</i> -Pr	-	263
Me	<i>t</i> -Bu	75540-67-9	235, 236, 252
Me	C <sub>6</sub> H <sub>11</sub>	83357-75-9	223, 252
Me	H <sub>2</sub> C=CHCMe <sub>2</sub>	72807-41-1	235
Me	H <sub>2</sub> C=C=CMe	-	163
Me	H <sub>2</sub> C=C=CEt	-	163
Me	HC≡CCH <sub>2</sub>	-	162
Me	Ph	54191-77-4	216, 234, 235, 236, 260, 280, 283
Me	MeCOC	77771-48-3	318, 322

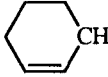
Table 1 (continued)

Me	EtCO <sub>2</sub>	89186-07-2	318, 359, 361
Me	NC	91529-49-6	258
Me	HS	84601-09-2	320
Me	( <i>t</i> -Bu) <sub>2</sub> P(S)	112392-76-4	129
Me	MeCO <sub>2</sub> C(Ph)=N-N=CMe	-	275
Me	Li	105526-20-3	47
Me		-	15
Me		-	15
Me		-	15
Et	Et	-	238
Et	H <sub>2</sub> C=C=CMe	-	163
Et	HC≡CCH <sub>2</sub>	-	162
Pr	( <i>t</i> -Bu) <sub>2</sub> P(S)	112392-75-3	130, 129
Pr	Ag(I)	131424-33-4	96
<i>i</i> -Pr	<i>t</i> -Bu	54439-99-5	e
<i>i</i> -Pr	H <sub>2</sub> C=CCMe <sub>2</sub>	72807-47-7	240
<i>i</i> -Pr	H <sub>2</sub> C=CHCH <sub>2</sub>	72807-43-3	240
<i>i</i> -Pr	H <sub>2</sub> C=CHCHMe	72807-45-5	240
<i>i</i> -Pr	Ph	75540-68-0	1, 235, 236
<i>i</i> -Pr	NC	91529-50-9	258
<i>i</i> -Pr	( <i>t</i> -Bu) <sub>2</sub> P(S)	112392-74-2	129
Bu	H <sub>2</sub> C=CHCH <sub>2</sub>	-	341
<i>t</i> -Bu	<i>t</i> -Bu	16797-75-4	f
<i>t</i> -Bu	H <sub>2</sub> C=CHCH <sub>2</sub>	72826-60-9	229, 235, 240, 243, 252,
<i>t</i> -Bu	H <sub>2</sub> C=CHCHMe	72807-49-9	235, 240

e) 126, 222, 223, 229, 230, 232, 236, 243, 246, 248, 252, 254, 257, 287

f) 4, 5, 6, 34, 73, 80, 126, 147, 173, 181, 206, 207, 222, 223, 227, 229, 231, 248, 252, 254, 257, 263, 277, 287, 288, 314, 316, 350

Table 1 (continued)

<i>t</i> -Bu	Ph	75540-69-1	235, 236, 243
<i>t</i> -Bu	F <sub>3</sub> C	-	18
<i>t</i> -Bu	PhCO	-	79, 259, 260
<i>t</i> -Bu	Me <sub>2</sub> N	53352-50-4	18, 91, 193
<i>t</i> -Bu	Cl	121995-09-3	236
<i>t</i> -Bu	NC	91529-51-0	53, 255, 258, 259, 260, 354
<i>t</i> -Bu		72807-51-3	235, 240
<i>t</i> -Bu	MeOC(O)C(CH <sub>2</sub> )=CH <sub>2</sub>	86318-69-6	250
<i>t</i> -Bu	EtOC(O)C(CH <sub>2</sub> )=CH <sub>2</sub>	86318-70-9	250
C <sub>6</sub> H <sub>13</sub>	Me(Bu)OLi	-	169
C <sub>6</sub> H <sub>13</sub>	-(CH <sub>2</sub> ) <sub>5</sub> -COLi	-	169
	-CH <sub>2</sub> -CH <sub>2</sub> -	109284-45-9	323
	-CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -	128232-99-5	51, 307, 329
	-CH <sub>2</sub> -(CH <sub>2</sub> ) <sub>2</sub> -CH <sub>2</sub> -	56755-52-3	51, 113, 159, 273, 309, 328, 329
	-CH <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -CH <sub>2</sub> -	102862-09-9	51, 255, 259
	-CH <sub>2</sub> -(CH <sub>2</sub> ) <sub>4</sub> -CH <sub>2</sub> -	-	51
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>2</sub> -Me <sub>2</sub> C-	-	263
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -Me <sub>2</sub> C-	54440-00-5	g
	-CH( <i>t</i> -Bu)-(CH <sub>2</sub> ) <sub>3</sub> -( <i>t</i> -Bu)HC-	57738-75-7	34, 126, 223, 244, 252, 287, 319

g) 34, 54, 55, 63, 73, 78, 82, 126, 207, 222, 223, 227, 229, 230, 231, 243, 248, 251, 252, 254, 257, 276, 277, 278, 287, 315, 336, 337, 350, 351

Table 1 (continued)

<i>cis</i> -CH( <i>t</i> -Bu)-CH <sub>2</sub> -CH-CH <sub>2</sub> -( <i>t</i> -Bu)HC-		54440-01-6	245, 257
-CH( <i>t</i> -Bu)-CH <sub>2</sub> -CH( <i>t</i> -Bu)-CH <sub>2</sub> -( <i>t</i> -Bu)HC-		69515-07-7	126, 223, 252
-CMe <sub>2</sub> -CH <sub>2</sub> -S-CH <sub>2</sub> -Me <sub>2</sub> C-		83357-76-0	147, 173, 223, 229, 252.
-CMe <sub>2</sub> -CH <sub>2</sub> -SO-CH <sub>2</sub> -Me <sub>2</sub> C-		84662-08-8	229, 249
-CMe <sub>2</sub> -CH <sub>2</sub> -SO <sub>2</sub> -CH <sub>2</sub> -Me <sub>2</sub> C-		84662-09-9	229, 249
H <sub>2</sub> C=CMe	H <sub>2</sub> C=C=CMe	-	163
H <sub>2</sub> C=CHCH <sub>2</sub>	Ph	72807-54-6	235, 240, 243
H <sub>2</sub> C=CHCH <sub>2</sub>	Me <sub>3</sub> Si	66423-67-4	237, 241
H <sub>2</sub> C=CHCH <sub>2</sub>	Et <sub>3</sub> Si	86327-75-5	250
H <sub>2</sub> C=CHCH <sub>2</sub>	Me <sub>2</sub> ( <i>t</i> -Bu)Si	86318-66-3	250
H <sub>2</sub> C=CHCHMe	<i>t</i> -BuS	86318-83-4	250
H <sub>2</sub> C=CHCHMe	Et <sub>3</sub> Si	86318-64-1	250
H <sub>2</sub> C=CHCHMe	Me <sub>3</sub> Si	66423-68-5	237, 241, 243
H <sub>2</sub> C=CHCMe <sub>2</sub>	Me <sub>3</sub> Si	66423-69-6	229, 237, 241, 243, 313, 314,
H <sub>2</sub> C=C=CMe	MeC≡C-	-	163
H <sub>2</sub> C=C=CMe	MeS	-	163
-(HC=CH) <sub>2</sub>		-	51
Ph	Ph	54191-74-1	h
Ph	<i>o</i> -MeC <sub>6</sub> H <sub>4</sub>	-	182
Ph	F <sub>3</sub> C	-	108
Ph	NC	91529-52-1	119, 221, 255, 258, 354
Ph	MeOCHMe	-	289
Ph	MeOCHPh	-	286
Ph	EtOCHPh	92265-39-9	209
Ph	LiOCMe <sub>2</sub>	-	169
Ph	LiOCMe( <i>i</i> -Pr)	-	169

h) 51, 216, 221, 229, 234, 235, 243, 259, 260, 265, 282, 283, 354, 359, 361

Table 1 (continued)

Ph	LiOCMe(Bu)	-	169
Ph	LiOCH(C <sub>5</sub> H <sub>11</sub> )	-	169
Ph	LiOCHPh	-	169
Ph	EtCO	102862-10-2	255, 259, 261, 262
Ph	H <sub>2</sub> NCO	-	221, 259
Ph	MeO <sub>2</sub> C	-	361
Ph	PhCS	-	18, 79, 102
Ph	EtS	-	113
Ph	Cl	-	186
Ph	-(CH <sub>2</sub> ) <sub>5</sub> -COLi	-	169
Ph	PhC(OMe)(Li)Cr(CO) <sub>5</sub>	125916-50-9	208
Ph	PhC(OEt)(Li)Cr(CO) <sub>5</sub>	125916-52-1	208
Ph	PhC(OEt)(Li)W(CO) <sub>5</sub>	92180-84-2	208, 209, 210
Ph	PhC(OEt)(N <sup>+</sup> ((CH <sub>2</sub> ) <sub>3</sub> Me) <sub>4</sub> )W(CO) <sub>5</sub>	125916-54-3	208
<i>p</i> -MeC <sub>6</sub> H <sub>4</sub>	<i>o</i> -MeC <sub>6</sub> H <sub>4</sub>	-	51
<i>p</i> -ClC <sub>6</sub> H <sub>4</sub>	<i>p</i> -ClC <sub>6</sub> H <sub>4</sub>	54191-73-0	282, 283
F <sub>3</sub> C	F <sub>3</sub> C	7445-60-5	i
F <sub>3</sub> C	Cl	-	66
Cl	Cl	102862-11-3	1, 66, 146, 221, 255, 256, 259, 262
Cl	CCl=CCl <sub>2</sub>	126281-62-7	66, 330
Cl	MeCO <sub>2</sub>	-	36
Cl	MeC(S)O	-	36
NC	NC	54856-36-9	70, 243, 247, 270, 358
NC	H <sub>2</sub> NCO	-	358
NC	PhCS	-	102

i) 20, 21, 84, 100, 127, 167, 196, 197, 198, 199, 200, 201, 202, 203, 204, 279



Table 1 (continued)

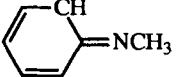
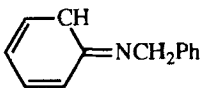
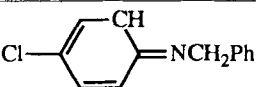
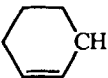
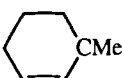
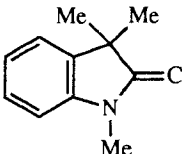
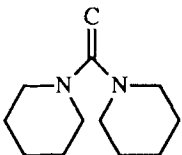
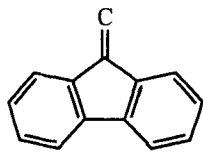
NC	MeCO <sub>2</sub>	54856-37-0	52, 53, 70, 243, 247, 358
NC	EtCO <sub>2</sub>	-	52, 70, 358
NC	<i>t</i> -BuCO <sub>2</sub>	-	52
MeOCO	MeOCO	89186-09-4	318
MeOCO	Ph <sub>3</sub> P=C(C(O)OMe)	53352-55-9	28
MeOCO	(OEt) <sub>2</sub> P(O)	77872-84-5	243
EtOC(O)C(Me)=CH <sub>2</sub>	<i>t</i> -BuS	86318-74-3	250
EtOC(O)C(Me)=CH <sub>2</sub>	Me <sub>3</sub> Si	86318-62-9	250
MeOC(O)C(Me)=CH <sub>2</sub>	<i>t</i> -BuS	86318-73-2	250
MeOC(O)C(Me)=CH <sub>2</sub>	Me <sub>3</sub> Si	86327-74-4	250
MeOC(O)C(Me)=CH <sub>2</sub>	Et <sub>3</sub> Si	86318-65-2	250
MeOC(O)C(Me)=CH <sub>2</sub>	Me <sub>2</sub> ( <i>t</i> -Bu)Si	86318-67-4	250
EtCO <sub>2</sub>	EtCO <sub>2</sub>	-	52, 216, 359, 218
PhCHC(CO <sub>2</sub> Me)=CH <sub>2</sub>	<i>t</i> -BuS	86318-75-4	250
PhCHC(CO <sub>2</sub> Me)=CH <sub>2</sub>	Me <sub>3</sub> Si	84662-13-5	229
PhCHC(NC)=CH <sub>2</sub>	<i>t</i> -BuS	86318-76-5	250
PhCHC(NC)=CH <sub>2</sub>	Me <sub>3</sub> Si	86318-63-0	250
PhNMe	PhNMe	66065-79-0	331
MeS	<i>unspecified</i>	-	306
Me <sub>2</sub> HSi	Me <sub>3</sub> Si	109639-48-7	14
Me <sub>3</sub> Si	PhCH=CH <sub>2</sub>	75541-03-6	237
Me <sub>3</sub> Si	Me <sub>3</sub> Si	62827-97-8	5, 6, 21, 14, 109, 168, 216, 246, 311
Me <sub>3</sub> Si	Me <sub>2</sub> ( <i>t</i> -Bu)Si	-	87
Me <sub>3</sub> Si	Et <sub>3</sub> Sn	68506-43-4	87, 168
Me <sub>3</sub> Si	Cl <sub>3</sub> Sn	62785-78-8	109
Me <sub>3</sub> Si	Et <sub>3</sub> Ge	68528-48-3	168
Me <sub>3</sub> Si		-	15

Table 1 (continued)

Me <sub>3</sub> Si		-	15
Me <sub>3</sub> Si		-	15
Me <sub>3</sub> Si		66423-70-9	241
Me <sub>3</sub> Si		75549-47-2	237
Me <sub>3</sub> Sn	Me <sub>3</sub> Sn	63135-93-3	110
Et <sub>3</sub> Ge	Et <sub>3</sub> Ge	63135-92-2	110
	H <sub>2</sub> C	83797-23-3	39, 48, 49, 50, 307, 323, 328, 329
	<i>t</i> -BuMeC	-	184
	H <sub>3</sub> P	27607-20-1	3
	Ph <sub>3</sub> P	17507-47-0 73818-56-1	j
		-	211
		-	211
		-	260, 354

j) 3, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 35, 65, 101, 114, 143, 144, 145, 152, 153

Table 1 (continued)

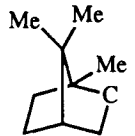
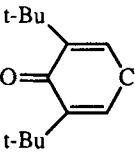
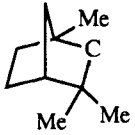
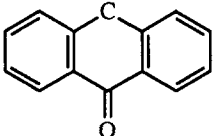
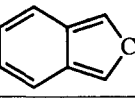
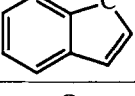
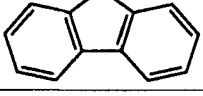
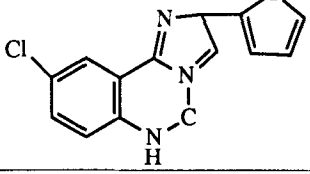
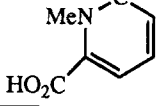
	-	56
	-	259, 354
	-	260
	-	259
	85601-47-4	333, 334, 335
	85601-45-2	333, 335
	63114-06-7	259, 283
	105848-03-1	88, 89
	74451-18-6	141

Table 1 (continued)

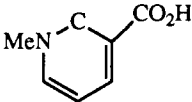
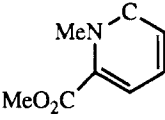
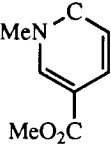
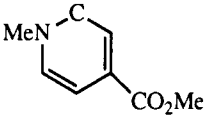
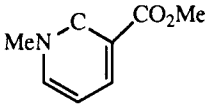

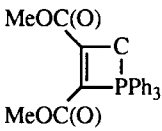
	74451-17-5	141	
	74450-83-2	141	
	74450-82-1	141	
	74450-81-0	141	
	74450-80-9	141	
	54191-78-5	272, 274, 317	
	53352-52-6	28	
Cr(CO) <sub>5</sub>	Ph <sub>3</sub> P <sup>+</sup>	53230-87-8	143, 144
Mo(CO) <sub>5</sub>	Ph <sub>3</sub> P <sup>+</sup>	53230-85-6	143, 144
W(CO) <sub>5</sub>	Ph <sub>3</sub> P <sup>+</sup>	53230-86-7	143, 144

Table 2. Selenoketenes  $R^1R^2C=C=Se$ 


$R^1$	$R^2$	Reg. no.	Ref.
H	H	61134-37-0	10, 37, 42, 62, 111, 118, 132, 140, 151, 269
H	Me	71452-09-0	118, 151, 305
H	Et	-	267, 305
H	Pr	-	267
H	<i>i</i> -Pr	-	139
H	<i>t</i> -Bu	71452-10-3	22, 118, 139, 305
H	Ph	-	95, 139, 151, 305
H	<i>p</i> -MeOC <sub>6</sub> H <sub>4</sub>	-	151
H	<i>p</i> -NO <sub>2</sub> C <sub>6</sub> H <sub>4</sub>	-	151
H	EtO <sub>2</sub> C	-	160
Me	Li	105526-20-3	47
<i>t</i> -Bu	<i>t</i> -Bu	126440-86-6	22
<i>t</i> -Bu	H <sub>2</sub> C=CHCH <sub>2</sub>	69773-60-0	304
	-CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>2</sub> -	94324-19-3	219
	-CH <sub>2</sub> -(CH <sub>2</sub> ) <sub>2</sub> -CH <sub>2</sub> -	96010-00-3	273
	-CH <sub>2</sub> -(CH <sub>2</sub> ) <sub>4</sub> -CH <sub>2</sub> -	96010-01-4	273
Ph	Li	105526-18-9	47
Ph	PhC(Li)W(CO) <sub>5</sub>	125916-51-0	208
<i>p</i> -MeOC <sub>6</sub> H <sub>4</sub>	K	137901-78-4	362
<i>p</i> -ClC <sub>6</sub> H <sub>4</sub>	K	137901-79-5	362
<i>p</i> -NO <sub>2</sub> C <sub>6</sub> H <sub>4</sub>	K	137901-80-8	362
H <sub>2</sub> C=CHCHMe	SiMe <sub>3</sub>	77298-13-6	242
H <sub>2</sub> C=CHCMe <sub>2</sub>	SiMe <sub>3</sub>	77298-14-7	242, 313
SiMe <sub>3</sub>	SiMe <sub>3</sub>	69773-63-3	304
	H <sub>2</sub> C	94324-18-2	219
		72443-10-8	41, 269, 271

Table 3. Telluroketenes  $R^1R^2C=C=Te$ 

$R^1$	$R^2$	Reg. no.	Ref.
H	Ph	-	3, 19, 137, 138

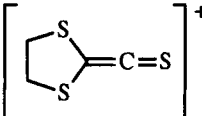
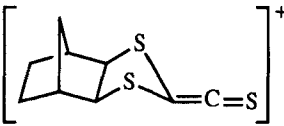
Table 4. Thiocumulenes  $X=(C=)_nC=C=S$ 

Compound	Reg. no.	Ref.
$O=C=C=C=S$	2219-62-7	2, 38, 71, 115, 154, 176, 180, 215, 302, 324, 325, 342, 343, 344, 345, 346, 348
$O=C=C=C=C=S$	131104-95-5	302
$O=C=C=C=C=C=S$	131104-96-6	302
$S=C=C=S$	83917-77-5	81, 104, 148, 150, 180, 192, 205, 300, 303
$S=C=C=C=C=S$	126504-67-4	149
$S=C=C=C=C=S$	122293-58-7	301
$S=C=C=C=S$	627-34-9	16, 68, 99, 116, 117, 171, 172, 180, 220, 264, 274, 284, 291, 292, 293, 294, 298, 308, 323, 142, 295
$(O=C=C=C=S)^+$	131176-70-0	301
$(O=C=C=C=C=S)^+$	131104-98-8	302
$(O=C=C=C=C=C=S)^+$	131176-71-1	301
$(O=C=C=C=C=S)^{\cdot\cdot}$	131104-97-7	302
$(S=C=C=S)^+$	116952-95-5	298, 299, 300, 303
$(S=C=C=C=S)^+$	128329-04-4	299
$(S=C=C=C=C=S)^+$	122293-59-8	299, 301
$(S=C=C=C=C=C=S)^+$	128329-05-5	299
$(S=C=C=C=C=C=C=S)^{\cdot\cdot}$	128329-06-6	299
$(C=C=C=C=S)^+$	-	301
$(O=C=C=C=C=C=S)^{\cdot\cdot}$	131104-99-9	302

Table 5. Thioketene  $S$ -oxides  $R^1R^2C=C=S=O$ 

$R^1$	$R^2$	Reg. no.	Ref.
<i>i</i> -Pr	<i>t</i> -Bu	66124-42-3	228, 233, 248, 253
<i>t</i> -Bu	<i>t</i> -Bu	16797-76-5	80, 206, 207, 227, 228, 248, 253
	$-CMe_2-CH_2-CH_2-CH_2-Me_2C-$	63702-87-4	54, 55, 57, 207, 227, 228, 230, 248, 253,
	$-CH(t-Bu)-CH_2-CH_2-CH_2-(t-Bu)HC-$	72880-76-3 71285-17-1	57, 245
	$-CMe_2-CH_2-SO_2-CH_2-Me_2C-$	88008-20-2	249

**Table 6: High-energy species derived from thioketenes**

$(C=C=S)^+$	122312-93-0	301,302
$HC=C=S$	81566-82-7	134, 157
$(H_2C=C=S)^+$	64203-51-6	122, 214
$[(H_2C=C=S)\cdot H]^+$	66202-72-0	128, 212, 213
$(Ph_2C=C=S)^+$	-	360
	-	191
	-	191

**Table 7. Thioketenes  $R^1R^2C=C=S$ , labeled and radical species**

Compound	Reg. no.	Ref.
$DHC=C=S$	70231-70-8	12, 74, 131, 321, 133
$D_2C=C=S$	93953-85-6	74, 321
$H_2C=^{13}C=S$	61134-39-2	12, 74, 133, 140
$H_2^{13}C=C=S$	61134-38-1	12, 74, 133, 140
$DHC=^{13}C=S$	76596-44-6	133
$DH^{13}C=C=S$	61134-40-5	133, 140
$H_2C=C=^{32}S$	71598-77-1	94
$DHC=C=^{32}S$	71598-78-2	94
$D_2C=C=^{32}S$	71598-79-3	94
$H_2C=C=^{34}S$	70231-71-9	12, 74, 94
$H_2C=^{13}C=^{32}S$	71623-87-5	94
$H_2^{13}C=C=^{32}S$	71598-80-6	94
$DHC=C=C=S$	112196-90-4	48
$D_2C=C=C=S$	112196-89-1	48
$^{13}CH_2=C=C=S$	112196-92-6	48
$CH_2=^{13}C=C=S$	112196-91-5	48
$CH_2=C=C=^{34}S$	112196-93-7	48
$O=C=C=C=^{32}S$	95115-67-6	345
$O=C=C=C=^{34}S$	95115-68-7	345
$O=^{13}C=C=C=^{32}S$	95115-71-2	345

**Table 7** (continued)

$O=C=^{13}C=C=^{32}S$	95115-70-1	345
$O=C=C=^{13}C=^{32}S$	95115-69-8	345
$S=C=C=^{34}S$	116952-98-8	300
$C=^{13}C=S$	130662-82-7	356
$^{13}C=C=S$	130662-81-6	356
$C=C=^{32}S$	109545-33-7	217
$C=C=C=^{32}S$	109545-36-0	355
$C=C=^{34}S$	109545-34-8	217, 356
$C=C=C=^{34}S$	109545-37-1	355
$(S=C=C=^{34}S)^+$	116952-97-7	300

**Table 8.** Selenoketenes  $R^1R^2C=C=Se$ , labeled and radical species

Compound	Reg. no.	Ref.
$(H_2C=C=Se)^+$	76246-36-1	37
$H_2C=^{13}C=Se$	77955-70-5	9
$H_2^{13}C=C=Se$	77955-69-2	9
$H_2^{13}C=C=^{80}Se$	67264-16-8	9, 11
$H_2C=^{13}C=^{80}Se$	67264-15-7	9, 11
$H_2C=C=^{76}Se$	67312-27-0	11
$H_2C=C=^{77}Se$	67264-12-4	11
$H_2C=C=^{82}Se$	67264-11-3	11
$DHC=C=^{78}Se$	67264-14-6	11
$DHC=C=^{80}Se$	67264-13-5	11

**Table 9.** Carbenic thioketenes  $R^1R^2C=C=S$ 

$R^1$	$R^2$	Reg. no.	Ref.
Ph	MeC	-	327
Ph	EtC	-	327
Ph	PrC	-	327
Ph	<i>i</i> -PrC	-	327
Ph	PhC	-	286, 289

**Table 10.** Carbenic thiocumulenes  $(C=)_nC=C=S$ 

Compound	Reg. no.	Ref.
$C=C=C=S$	109545-35-9	7, 59, 60, 90, 120, 174, 178, 187, 355
$(C=C=S)^{2-}$	126857-38-3	194
$C=C=S$	109545-32-6	170, 178, 187, 217, 301, 302, 356
$C=C=C=C=S$	121180-87-8	349



Table 10 (continued)

(C=C=S) <sup>2-</sup>	126857-38-3	194
(C=C=S) <sup>+</sup>	122312-93-0	301

Table 11. Thioketene anion radicals (R<sup>1</sup>R<sup>2</sup>C=C=S)<sup>-</sup>

R <sup>1</sup>	R <sup>2</sup>	Reg. no.	Ref.
<i>i</i> -Pr	<i>t</i> -Bu	69515-08-8	126
<i>t</i> -Bu	<i>t</i> -Bu	69515-09-9	126
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -Me <sub>2</sub> C-	69515-10-2	126
	-CH( <i>t</i> -Bu)-(CH <sub>2</sub> ) <sub>3</sub> -( <i>t</i> -Bu)HC-	69575-93-5	126
	-CH( <i>t</i> -Bu)-CH <sub>2</sub> -CH( <i>t</i> -Bu)-CH <sub>2</sub> -( <i>t</i> -Bu)HC-	69515-11-3	126

Table 12. Thioketene complexes (R<sup>1</sup>R<sup>2</sup>C=C=S)R<sup>3</sup>

R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	Reg. no.	Ref.
H	H	( <i>i</i> -Pr <sub>3</sub> P)(Ph)Rh	-	338
CF <sub>3</sub>	CF <sub>3</sub>	(Ph <sub>3</sub> P) <sub>2</sub> Pt	-	106
CF <sub>3</sub>	CF <sub>3</sub>	(CO)(Cl)(Ph <sub>3</sub> P) <sub>2</sub> Ir	-	106
CF <sub>3</sub>	CF <sub>3</sub>	(CO)(Cl)(Ph <sub>2</sub> PMe) <sub>2</sub> Ir	-	106
<i>t</i> -Bu	<i>t</i> -Bu	<sup>-</sup> C(MeOC(O)) <sub>2</sub>	122806-02-4	316
<i>t</i> -Bu	<i>t</i> -Bu	Cr(CO) <sub>5</sub>	82421-80-5	352
<i>t</i> -Bu	<i>t</i> -Bu	Ge <sup>2+</sup> +Ph <sub>2</sub>	122967-98-0	4
<i>t</i> -Bu	<i>t</i> -Bu	Ge <sup>2+</sup> +Me <sub>2</sub>	122967-97-9	4
<i>t</i> -Bu	<i>t</i> -Bu	W(CO) <sub>5</sub>	82421-81-6	352
<i>t</i> -Bu	<i>t</i> -Bu	Mn <sup>+</sup> (CO) <sub>2</sub> (C <sub>5</sub> H <sub>5</sub> )	82421-82-7	352, 353
<i>t</i> -Bu	<i>t</i> -Bu	(Mn(CO) <sub>2</sub> (C <sub>5</sub> H <sub>5</sub> ) <sub>2</sub> ) <sub>2</sub>	109799-40-8	353
<i>t</i> -Bu	2,4,6-Me <sub>3</sub> C <sub>6</sub> H <sub>2</sub>	Ge <sup>2+</sup> +R' <sub>2</sub>	120058-70-0	4, 5
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -CMe <sub>2</sub> -	Cr(CO) <sub>5</sub>	61300-79-6	17, 72, 352
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -CMe <sub>2</sub> -	Mn <sup>+</sup> (CO) <sub>2</sub> (C <sub>5</sub> H <sub>5</sub> )	82421-83-8	72, 352
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -CMe <sub>2</sub> -	W(CO) <sub>5</sub>	82421-79-2	352
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -Me <sub>2</sub> C-	(Fe(CO) <sub>3</sub> PPh <sub>3</sub> ) (Fe(CO) <sub>3</sub> )	-	326
	-CMe <sub>2</sub> -(CH <sub>2</sub> ) <sub>3</sub> -Me <sub>2</sub> C-	(Fe(CO) <sub>3</sub> PPh <sub>3</sub> ) <sub>2</sub>	-	326
	S=C	((Ph) <sub>2</sub> PCH <sub>2</sub> CH <sub>2</sub> P(Ph) <sub>2</sub> ) <sub>2</sub> (Cl)Ir	40635-59-4 23777-42-6	97, 98
	S=C	(Ph <sub>3</sub> ) <sub>2</sub> Ir(CO)Cl	23777-41-5	98
	S=C	(Ph <sub>3</sub> P) <sub>2</sub> Pt	23732-89-0	98

Table 13. Selenoketene complex (R<sup>1</sup>R<sup>2</sup>C=C=Se)R<sup>3</sup>

R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	Reg. no.	Ref.
H	H	(i-Pr <sub>3</sub> P)(Ph)Rh	-	338

Table 14. Telluroketene complex (R<sup>1</sup>R<sup>2</sup>C=C=Te)R<sup>3</sup>

R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	Reg. no.	Ref.
H	H	(i-Pr <sub>3</sub> P)(Ph)Rh	-	338

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