A New Synthesis of Substituted 1-Methylthiabenzene 1-Oxides

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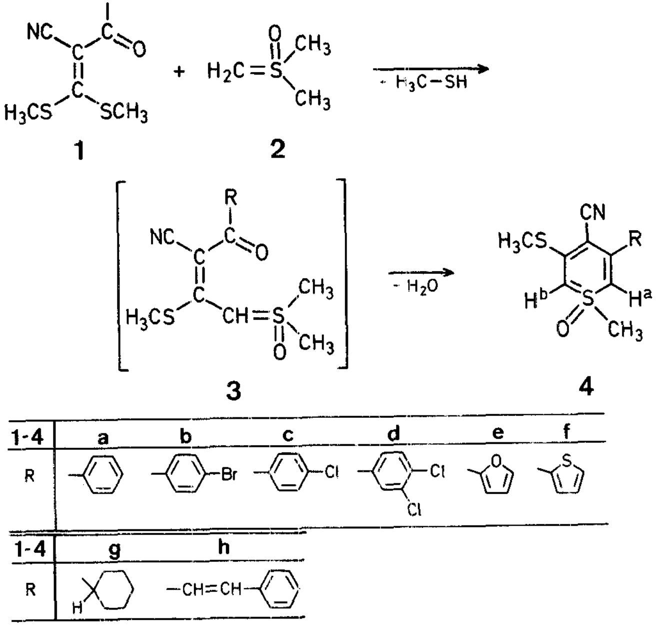
The synthesis and the properties of thiabenzene 1-oxides, characterized as 6-membered heterocycles with 6 π electrons in the ring, are of special interest[1,2]. These compounds were first prepared from acetylenic ketones[1,3] and dimethyloxosulfonium methylide or by utilization of acetylenic esters[4]. Further, it has been shown that some β-diketones[5] or β-alkoxyvinyl ketones[6] can be used in place of the acetylenic compounds. In the same way, 4-acyl-1-methylthiabenzene 1-oxides[7] were synthesized starting with 3-ethoxymethylene-2,4-pentanedione or ethyl 2-(ethoxymethylene)-acetoacetate.

Previously, we reported on a facile synthesis of 1-methyl-2-azathiabenzene 1-oxides by the reaction of *S,S*-dimethylsulfoximide with suitable push-pull alkenes[8]. In connection with our studies on acyl cyanoketene *S,S*-acetals[9] we have now prepared a series of 5-substituted 4-cyano-1-methyl-3-methylthiothiabenzene 1-oxides (**4**) by a convenient method: Adding a 2-acyl-3,3-bis[methylthio]-acrylonitrile (**1**) to a solution of 2 molecular equivalents of dimethyloxosulfonium methylide (**2**) afforded **4** in 43–73% yield. This method is quite useful in the synthesis of 1-methylthiabenzene 1-oxides because of its high selectivity and reasonable yields as well as of the simplicity of the experimental procedure. Heating is not necessary to effect complete cyclization of the intermediate allylides **3**. The yields could not be optimized under these conditions. Using equimolecular quantities of **1** and **2**, the thiabenzene 1-oxides **4** were also formed, but only in low yields. In no case could the allylides **3** be isolated.



In the ^{1}H-N.M.R. spectra, H^{a} and H^{b} differ in the δ value. The signals of these protons are split into doublets by long-range coupling. The coupling constants ($J_{a,b}$ = 3.3–4.3 Hz) observed for **4a–h** are in accordance with the values reported for other thiabenzene 1-oxides[1,7]. The chemical shifts of the protons H^{a} and H^{b} depend on the solvent.

The ^{13}C-N.M.R. spectral data of compounds **4** are characterized by relatively high shielding of the atoms C-2 and C-6, neighbouring the sulfur, as well as of C-4.

5-Substituted 4-Cyano-1-methyl-3-methylthiothiabenzene 1-Oxides (4); General Procedure:

A solution of the 2-acyl-3,3-bis[methylthio]-acrylonitrile **1** (0.02 mol) in anhydrous dimethyl sulfoxide (40 ml) is added dropwise, during 15 min, to a stirred solution of dimethyloxosulfonium methylide[10] (**2**, dimethylmethylenesulfurane *S*-oxide; 0.04 mol) in dimethyl sulfoxide (50 ml) at 18 °C under nitrogen. The temperature

Table. 5-Substituted 4-Cyano-1-methyl-3-methylthiothiabenzene 1-Oxides (**4**) prepared

4	Yield [%]	m.p. [°C]	Molecular Formula[a]	M.S. m/e (M$^+$)	I.R. (KBr) ν [cm^{-1}]	U.V. (C_2H_5OH) λ_{max}[nm] (log ε)	^{1}H-N.M.R. (DMSO-d_6) δ [ppm]
a[b,c]	73	212–214.5°	$C_{14}H_{13}NOS_2$ (275.4)	275	1170 (SO); 2210 (CN)	249.5 (4.49); 282.0 sh (3.93); 332.0 (3.93)	2.52 (s, SCH_3); 3.73 (s, SO—CH_3); 6.17 (d, CH, J = 3.3 Hz); 6.26 (d, CH, J = 3.3 Hz); 7.46 (m, 5H$_{arom}$)
b	57	236–238°	$C_{14}H_{12}BrNOS_2$ (354.3)	355[d]	1165 (SO); 2200 (CN)	251.5 (4.57); 285.0 sh (3.92); 337.0 (3.95)	2.53 (s, SCH_3); 3.75 (s, SO—CH_3); 6.20 (d, CH, J = 3.8 Hz); 6.29 (d, CH, J = 3.8 Hz); 7.38–7.70 (m, 4H$_{arom}$)
c	61	261–264°	$C_{14}H_{12}ClNOS_2$ (309.8)	309[e]	1165 (SO); 2200 (CN)	251.0 (4.54); 285.0 sh (3.98); 336.0 (3.93)	2.53 (s, SCH_3); 3.75 (s, SO—CH_3); 6.20 (d, CH, J = 3.7 Hz); 6.29 (d, CH, J = 3.7 Hz); 7.44–7.57 (m, 4H$_{arom}$)
d	67	250–252°	$C_{14}H_{11}Cl_2NOS_2$ (344.3)	343[e]	1160 (SO); 2205 (CN)	247.5 (4.51); 285.0 sh (3.95); 337.0 (3.91)	2.53 (s, SCH_3); 3.74 (s, SO—CH_3); 6.27 (d, CH, J = 3.7 Hz); 6.31 (d, CH, J = 3.7 Hz); 7.45 (m, 1H$_{arom}$); 7.73 (m, 2H$_{arom}$)
e[f]	72	229–232°	$C_{12}H_{11}NO_2S_2$ (265.4)	265	1155 (SO); 2205 (CN)	270.5 (4.52); 306.0 sh (3.90); 352.0 (3.95)	2.52 (s, SCH_3); 3.77 (s, SO—CH_3); 6.28 (d, CH, J = 3.8 Hz); 6.49 (d, CH, J = 3.8 Hz); 6.69 (m, CH$_{furan}$); 7.20 (m, CH$_{furan}$); 7.89 (m, CH$_{furan}$)
f	71	244–246°	$C_{12}H_{11}NOS_3$ (281.4)	281	1160 (SO); 2200 (CN)	261.0 (4.36); 344.0 (3.88)	2.53 (s, SCH_3); 3.76 (s, SO—CH_3); 6.31 (d, CH, J = 3.7 Hz); 6.34 (d, CH, J = 3.7 Hz); 7.18 (m, CH$_{thiophene}$); 7.48 (m, CH$_{thiophene}$); 7.23 (m, CH$_{thiophene}$)
g	44	226–228.5°	$C_{14}H_{19}NOS_2$ (281.4)	281	1175 (SO); 2215 (CN)	248.0 (4.46); 276.0 (3.99); 325.0 (3.89)	1.31 (m, 5H$_{cyclohexyl}$); 1.78 (m, 5H$_{cyclohexyl}$); 2.46 (s, SCH_3); 2.60 (m, CH$_{cyclohexyl}$); 3.65 (s, SO—CH_3); 6.04 (d, CH, J = 3.7 Hz); 6.08 (d, CH, J = 3.7 Hz)
h[c]	43	235.5–238.5°	$C_{16}H_{15}NOS_2$ (301.4)	301	1170 (SO); 2200 (CN)	235.5 (4.40); 286.5 (4.49); 320.0 sh (4.24); 362.0 (3.83)	2.51 (s, SCH_3); 3.74 (s, SO—CH_3); 6.27 (d, CH, J = 3.7 Hz); 6.52 (d, CH, J = 3.7 Hz); 7.11 (d, CH, J = 16 Hz); 7.34 (d, CH, J = 16 Hz); 7.35–7.61 (m, 5H$_{arom}$)

[a] Satisfactory microanalyses obtained: C ±0.24; H ±0.19; N ±0.20; S ±0.27; Hal ±0.32. Exception **4e**: C +0.45.

[b] ^{13}C-N.M.R. (DMSO-d_6 as solvent and internal standard, 50.327 MHz, Bruker WP-200): δ = 14.88, 46.61, 81.22, 86.19, 89.83, 118.14, 128.33, 129.18, 137.96, 148.54, 149.48 ppm.

[c] ^{1}H-N.M.R. ($CDCl_3$): δ = 2.52 (s, SCH_3); 3.55 (s, SO—CH_3); 5.52 (d, CH, J = 4.3 Hz); 5.59 (d, CH, J = 4.3 Hz); 7.46 (m, 5H$_{arom}$) ppm.

[d] Based on ^{81}Br.

[e] Based on ^{35}Cl.

[f] ^{13}C-N.M.R. (DMSO-d_6 as solvent and internal standard, 50.327 MHz, Bruker WP-200): δ = 15.30, 46.70, 78.23, 86.41, 87.03, 112.78, 113.03, 118.95, 136.07, 145.13, 148.57, 150.52 ppm.

of the mixture does not rise above 27 °C. Stirring of the dark yellow mixture is continued for 3 h at room temperature. The mixture is then poured into ice water (400 ml) and the precipitated product isolated by suction and recrystallized from ethanol.

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