

REGIOSELECTIVITY OF METALATION OF ALKYL MERCAPTOOLEFINS ¹⁾

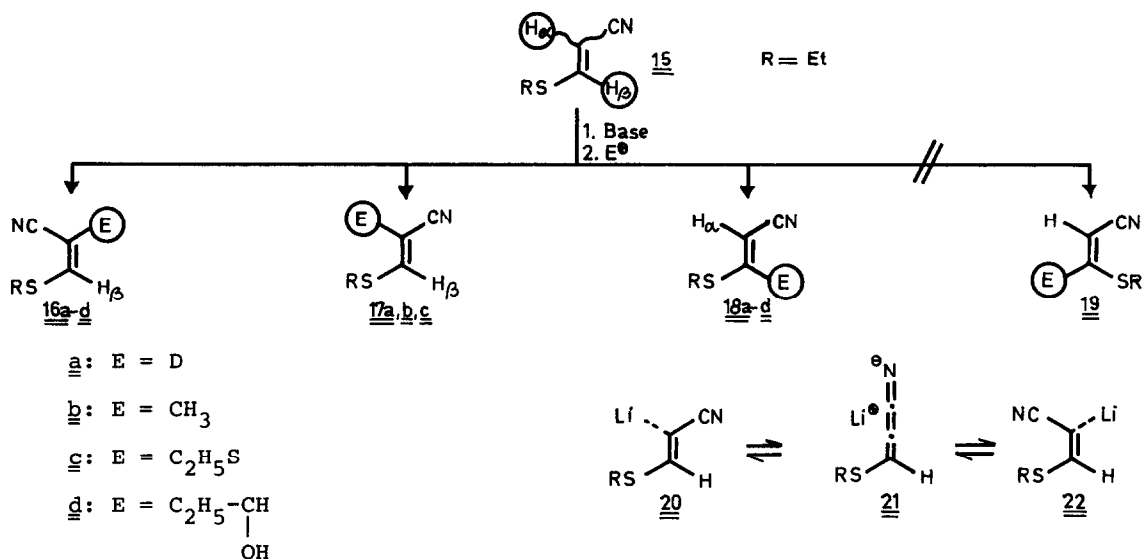
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Abstract: *The monosulfoxide of cis-dialkylmercaptoethylene 6 and the β-alkylmercapto acrylonitrile 15 deliver on deprotonation with tert.-butyllithium almost exclusively α-deprotonated species. According to reactions with electrophiles these functionally substituted vinylolithium derivatives are configurationally labile.*

Cis-1.2-dialkylmercaptoethylenes (1) are easily deprotonated at the vinylic positions; electrophiles delivering compounds 2 ²⁾. Hydrolysis experiments of 2 are aimed to show if 1 is a synthon for 4 or 5 ³⁾. Alkylmercapto enolethers and dienolethers react with strong bases to the vinylolithium-derivatives 3a, 3b, respectively ^{4,5)}. Acidification by the strong negative inductive effect of the alkoxy group is at least compensated for by the anion stabilizing effect of the alkylmercapto group in 3a ⁶⁾. Possibly, intramolecular complexation to the alkoxy group is also effective in the regioselectivity of deprotonation ⁷⁾.

Monooxidation of 1 leads to cis-monosulfoxide 6, which does not rearrange to the cyclic compound 7 according to ¹H-NMR investigations; deprotonation of 6 with tert.-butyllithium in THF and quenching with methanol-0-d shows complete mono-deprotonation at the vinylic positions (table 1). In accordance with the stronger inductive effect of the sulfoxide group α-deprotonation of 6 takes place preferentially leading to 13a via 9. In addition, small amounts of 14a via 10 are formed by β-deprotonation. Temperature dependent experiments demonstrate that 9 is configurationally labile, leading to 12a via 8. This configurational lability is supported by electronic, steric, and intramolecular complexation effects, which clearly give 8 a lower energy. As expected, vinylolithium derivative 10 does not isomerize under these reaction conditions, even though intramolecular complexation may favour the formation of 11. The deuteration experiments are supported by the reaction of lithiated 6 with methyl iodide and dimethyl disulfide as electrophiles leading to 13b, 14b and 13c, 14c, respectively. All experiments demonstrate that vinylolithium derivatives 8-10 react with electrophiles with retention of configuration.

Similar results are obtained with β-ethylmercapto acrylonitrile 15 (cis:trans = 1:3); table 2. Only little β-deprotonation is observed with tert.-butyllithium in THF; quenching with methanol-

Table 2: Deprotonation of 15 and Reaction with Electrophiles ^{a)}

Compound	E-X	Temperature [°C]	Yield [%]	Reaction product [parts] ^{b)}		
				<u>16</u>	<u>17</u>	<u>18</u>
<u>a</u>	D-OCH ₃	-113	95	60	32	8
	CH ₃ -J	-113	80	80	15	5
		- 80	60	75	20	5
		- 20	30	75	20	5
<u>c</u>	C ₂ H ₅ S-SC ₂ H ₅	-113	51	16 ^{c)}	82 ^{c)}	< 2
<u>d</u>	C ₂ H ₅ -CH=O	-113	52	82	16	< 2

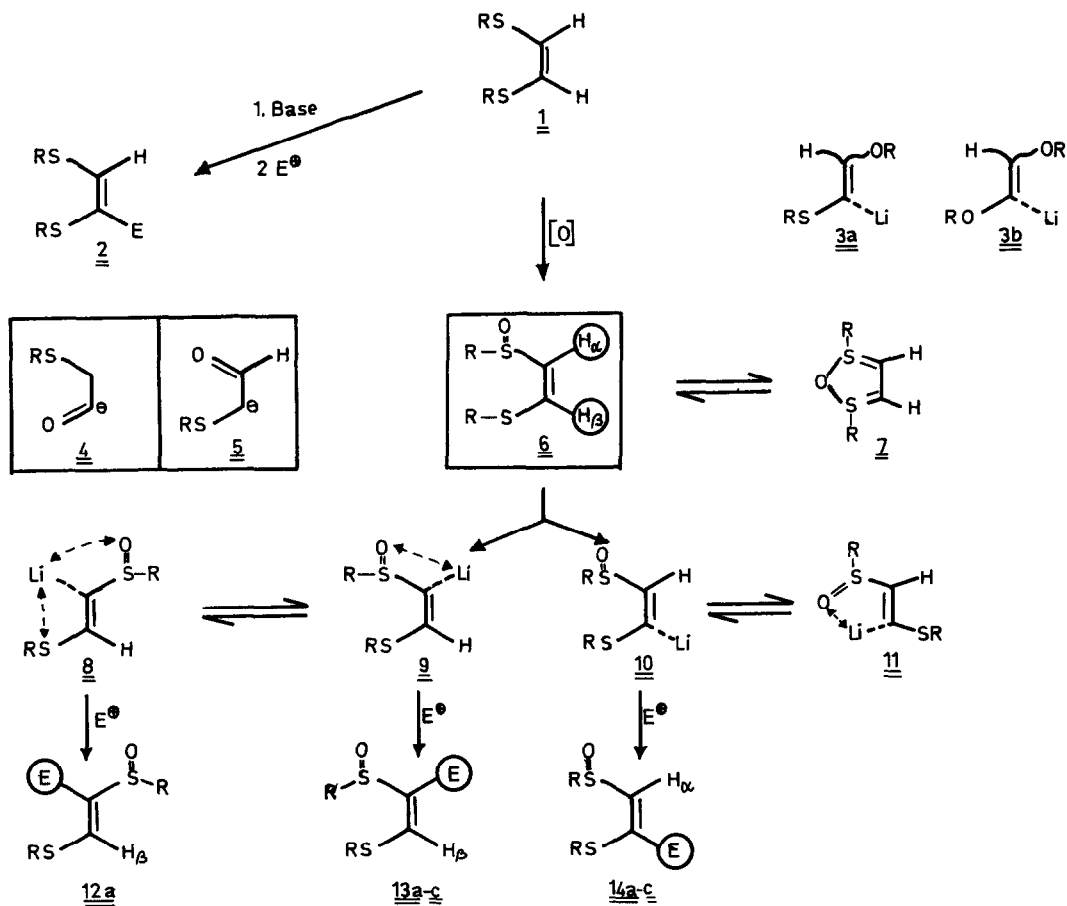
a) Solvent: THF; base 1.2 equivalents t-BuLi; addition of the electrophile after 60 min.

b) ¹H-NMR-determination. c) see table 3.Table 3: ¹H-NMR-Data ^{a)}

Compound	<u>a</u>	<u>b</u>	<u>c</u>	<u>d</u>
<u>12</u>	H _β : 6.98 (t)	-	-	-
<u>13</u>	H _β : 6.80 (t)	H _β : 6.37 (s)	H _β : 7.28 (s)	-
<u>14</u>	H _α : 6.02 (t)	H _α : 5.99 (s)	H _α : 6.37 (s)	-
<u>16</u>	H _β : 7.10 (t)	H _β : 6.71 (q)	H _β : 7.10 (s) ^{b)}	H _β : 7.17 (s)
<u>17</u>	H _β : 7.27 (t)	H _β : 7.21 (q)	H _β : 7.21 (s) ^{b)}	H _β : 7.27 (s)
<u>18</u>	H _α : 5.07 (t)	H _α : 4.87 (q)	-	-

a) 80 MHz, CDCl₃, δ-values, Tetramethylsilan internal.

b) These assignments can be interchanged.

Table 1: Deprotonation of **6** and Reaction with Electrophiles ^{a)}

Compound	E-X	Temperature [°C]	Yield [%]	Reaction product [parts] ^{b)}		
				12	13	14c)
a	D-OCH ₃	-120	100	-	95	5
		-100	100	31	59	10
		- 80	100	73	17	10
b	CH ₃ -J	-120	89	-	95	5
		c	CH ₃ S-SCH ₃	-120	100	-

a) Solvent: THF, base: 1.1 equiv. t-BuLi; addition of the electrophile after 10 min.

b) NMR-determination.

c) Compounds **14** were not isolated.

0-d leads to little 18a; cis-compound 19 was not found at all. Even though the anion stabilizing effect of an α -alkylmercapto group is very important in "Umpolung" reactions ⁸⁾, it is outweighed by the electronic effect of the cyano group: deprotonation mainly occurs at the α -position. However, the intermediate trans-vinyl lithium derivative 20 is even at -113°C in equilibrium with the cis-compound 22 or the cumulene anion 21, leading not only to 17a but also to 16a. An influence of temperature on this behaviour was not observed with methyl iodide as electrophile; 16b, 17b and 18b were formed in the same proportion. Accordingly, with diethyl disulfide and propionaldehyde 16c, 17c and 16d, 17d were received; 18c and 18d were present only in trace amounts. ¹H-NMR-Data are compiled in table 3.

Theoretical calculations with trans- β -aminoacrylonitrile support preferential α -deprotonation, if electronic effects, intramolecular complexation and solvation are included ⁷⁾. Acidity of the β hydrogen atom depends greatly on the inductive effect, which is lower for the alkylmercapto group than for the amino group; therefore, the kinetically and thermodynamically preferred α -deprotonation of 15 is in agreement with the experimental findings, if compared with the β -aminoacrylonitrile system ^{7,9)}.

References and Footnotes

- 1) Vinyl Anions, Part 8. This work was supported by the Deutsche Forschungsgemeinschaft and the Fonds der Chemischen Industrie. - Part 7: see ref. 7.
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