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CHEMISTRY OF 2-SUBSTITUTED THIOTHIAZOLINE. III.[1)]
REACTIVITIES OF DIANION OF 2-PROPARGYLTHIOTHIAZOLINE AND RELATED 2-ALKYNYLTHIOTHIAZOLINELITHIUM DERIVATIVES

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In a previous communication we reported a new squalene synthesis using 2-alkenylthiothiazolinelithium derivative.[1b)] We now wish to report the reactivities of dianion of 2-propargylthiothiazoline and related 2-alkynylthiothiazolinelithium derivatives, and a new and versatile synthesis of 1,5-diyne systems using these alkynylthiothiazolinelithium derivatives.

2-Propargylthiothiazoline (I) [82° / 0.02 mm. IR ν_{max} (film) 3280, 2100, 1570 cm^{-1}. NMR[2)] δ 3.25-3.65 (2H, almost t.), 4.05-4.45 (2H, almost t.), 2.25 (1H, t., J=3.0 Hz, $\underline{H}$-C≡C), 3.90 (2H, d., J=3.0 Hz, -S-C$\underline{H}_2$-C≡C)] was prepared easily by treating propargyl bromide and commercially available 2-mercaptothiazoline with triethylamine in tetrahydrofuran[3)]. The dilithiation of I was smoothly effected by adding two equivalents of n-butyl-lithium at -60° in tetrahydrofuran under a nitrogen atmosphere (Chart 1). After twenty minutes one equivalent of phenylpropargyl bromide ($R=C_6H_5$, X=Br) was added to a suspension of the white precipitated dilithium salt (II) by a syringe at the same temperature. The temperature was gradually raised to 0° and then ice water was added. Extraction of the product with ethyl acetate and evaporation of the

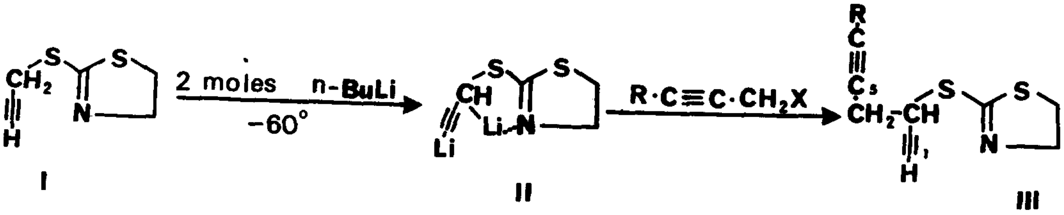
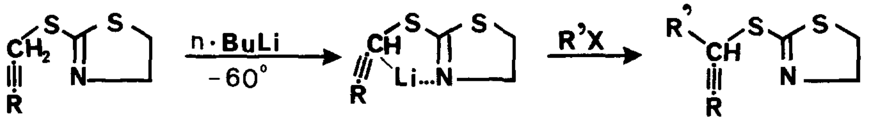


Chart 1

solvent after usual work-up gave a thiothiazoline diyne (III: R=C_6H_5) [Rf=0.54][4) in 60% yield as a mixture with some starting material (I) [Rf=0.45]. After separation of the mixture by silica-gel column chromatography the product was identified as 2-(1-phenyl-1,5-hexadiynyl-4-thio)-thiazoline (III, R=C_6H_5) by the following spectral data: IR ν_{max} (film) 3280, 2100, 1595, 1570, 756 cm^{-1}. UV λ_{max} (EtOH) 242 and 253 nm. NMR δ 3.12-3.52 (2H, almost t.), 3.95-4.35 (2H, almost t.), 2.48 (1H, d., J=2.5 Hz), 4.76 (1H, d. of t., J=2.5 and 5.9 Hz), 3.07 (2H, d., J=5.9 Hz), 7.2-7.5 (5H, arom.). M^+ at m/e 271 ($C_{15}H_{13}NS_2$).

It is noteworthy that the alkynylation occurred exclusively at the α-position with respect to the sulphur atom and that any other type of product including allenic ones could not be detected[5). This would be attributed to the five-membered chelating ring effect (*i.e.*, II) as pointed out previously[1b,6). Representative examples of the alkynylation (or alkylation) are shown in Chart 2 and Table I.



IV V VI

Chart 2

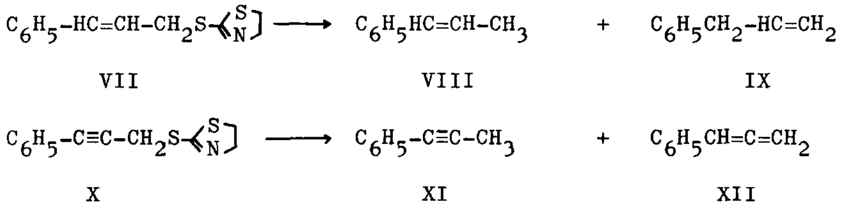
Table I

R	R'X	Yield % (isolated)	R	R'X	Yield % (isolated)
a. H	$C_6H_5C{\equiv}CCH_2Br$	60	i. C_6H_5	$C_6H_5CH_2Br$	50
b. H	$HC{\equiv}CCH_2Br$	50	j. C_6H_5	CH_3I	45
c. H	$C_6H_5C{\equiv}CCH_2Br$	50	k. CH_3	$C_6H_5C{\equiv}CCH_2Br$	48
d. H	$H_2C{=}CCH_2Br$	35	l. CH_3	$C_6H_5CH_2Br$	48
e. H	$C_6H_5CH_2Br$	65	m. CH_3	$CH_3C{\equiv}CCH_2Br$	42
f. H	CH_3I	60	n. CH_3	$H{\cdot}C{\equiv}CCH_2Br$	45
g. C_6H_5	$C_6H_5C{\equiv}CCH_2Br$	50	o. CH_3	CH_3I	54.5
h. C_6H_5	$HC{\equiv}CCH_2Br$	45			

Next step to obtain the hydrocarbons was desulfurization. As models for the desulfurization 2-cinnamylthiothiazoline (VII) and 2-phenylpropargylthiothiazoline (X) were examined by various method listed in Table 2.

Table 2

Desulfurization method



$$C_6H_5\text{-}HC{=}CH\text{-}CH_2S\text{-}\langle^{S}_{N}] \longrightarrow C_6H_5HC{=}CH\text{-}CH_3 + C_6H_5CH_2\text{-}HC{=}CH_2$$

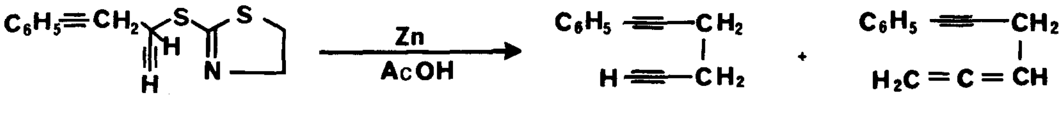
VII VIII IX

$$C_6H_5\text{-}C{\equiv}C\text{-}CH_2S\text{-}\langle^{S}_{N}] \longrightarrow C_6H_5\text{-}C{\equiv}C\text{-}CH_3 + C_6H_5CH{=}C{=}CH_2$$

X XI XII

Compound	Method	Product ratio
VII	Zn in AcOH at r.t.7)	VIII:IX = 78:22
VII	Al-Hg in 10% aq.THF at r.t.8)	VIII:IX = 42:58
VII	Raney Ni in refluxing EtOH	VIII > 95%
X	Zn in AcOH at r.t.	XI:XII = 72:28
X	Al in AcOH at 100°	XI:XII = 73:27
X	Al-Hg in 10% aq.THF at r.t.	XI:XII = 42:58
X	Raney Ni in refluxing EtOH	XI:XII = 86:14

The desulfurization of III ($R{=}C_6H_5$) was also effected by treating with zinc dust in acetic acid7) at room temperature for thirty minutes to afford in quantitative yield XIII and XIV (ratio 1:8), which were easily separated by silica-gel chromatography (solvent system : n-hexane) (Chart 3). The structures of XIII and XIV were identified as 1-phenyl-1,5-hexadiyne (XIII) and 1-phenyl-4,5-hexadien-1-yne (XIV), respectively, by following spectral data.



III XIII XIV

Chart 3

XIII: IR ν_{max} (film) 3320, 2220 (w), 2100 (w), 1600, 755 cm^{-1}, UV λ_{max} (EtOH) 240 and 251 nm. NMR δ 2.03 (1H, t., J=2.3 Hz), 2.4 - 2.8 (4H), 7.15-7.50 (5H, arom.). M^+ at m/e 154 ($C_{12}H_{10}$), 115 (C_6H_5-C≡C-CH_2). This compound was also obtained by the desulfurization of VIh (Table 1) with zinc dust in acetic acid. XIV: IR ν_{max} (film) 2200 (w), 1960, 1600, 850, 755 cm^{-1}. UV λ_{max} (EtOH) 240 and 251 nm. NMR δ 2.95 - 3.30 (2H, ≡C-C$\underline{H}_2$-C=), 4.66 - 4.95 (2H, $=C\langle^{\underline{H}}_{\underline{H}}$), 5.0 - 5.45 (1H, almost q.), 7.1 - 7.5 (5H, arom.). M^+ at m/e 154 ($C_{12}H_{10}$), 115 (C_6H_5-C≡C-CH_2).

We are now continuing a study for a more effective dusulfurization.

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