

Organolithium-induced Ring-opening of 3-Halo-2,5-dimethylthiophen-1,1-dioxides

J. OLLE KARLSSON, SALO GRONOWITZ and ANDERS HALLBERG*

Division of Organic Chemistry 1, Chemical Center, University of Lund, P.O. Box 740, S-220 07 Lund, Sweden

Thiophen-1,1-dioxides have in recent time attracted the attention as interesting precursors in organic synthesis¹⁻⁶ and the research in this field is increasing. However, to our knowledge the reactions of thiophen-1,1-dioxides with organo-

lithium reagents have not been investigated. It can be mentioned that 2,5-dihydrothiophen-1,1-dioxides react with Grignard^{7,8} and organolithium reagents⁹ giving 1,3-butadienes. We now wish to report our results concerning the reactions of 3-bromo-2,5-dimethylthiophen-1,1-dioxide (1) and 3-chloro-2,5-dimethylthiophen-1,1-dioxide (2)¹⁰ with butyllithium and phenyllithium.

Compounds 1 and 2 were both treated with two equivalents of butyllithium (*vide infra*) at -70°C (Fig. 1). A considerable amount of butyl bromide (61% GLC) was formed starting from 1 but no butyl chloride could be found starting from 2 (GLCMS). This can be rationalized by a halogen-metal exchange, since vinyl bromides undergo this kind of reaction at low temperature, while vinyl chlorides react much slower. The vinyl lithium derivative 3 could not be trapped however, neither with carbon dioxide nor with methanol at -70°C . After

* Author to whom correspondence should be addressed.

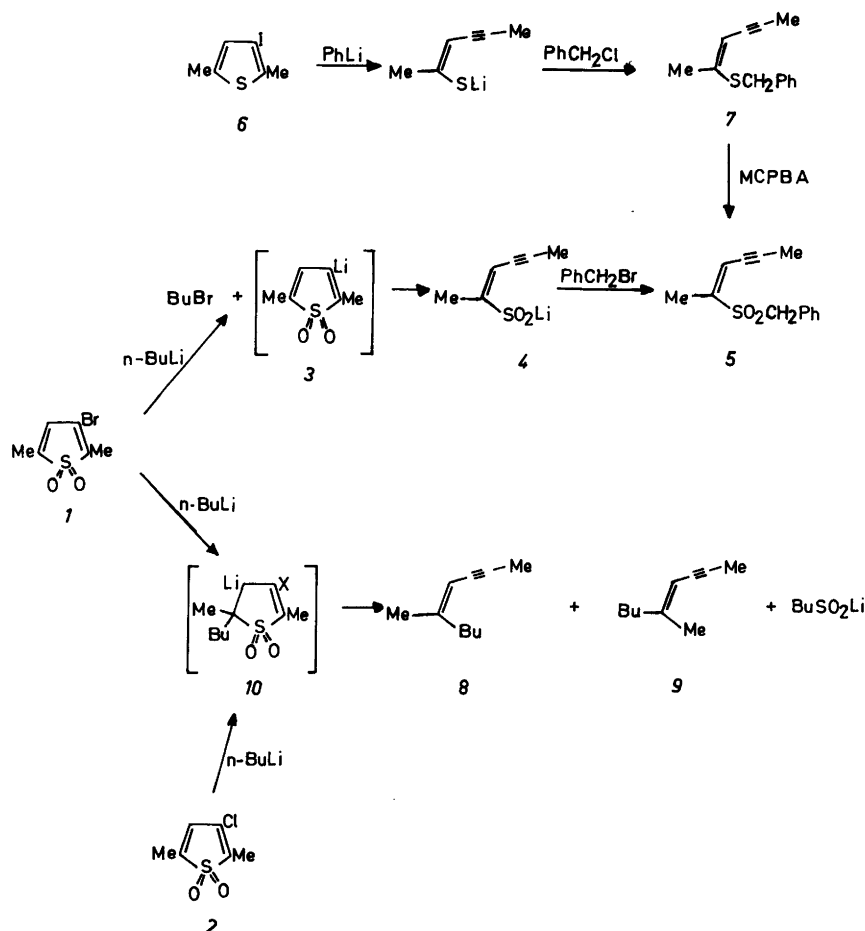


Fig. 1.

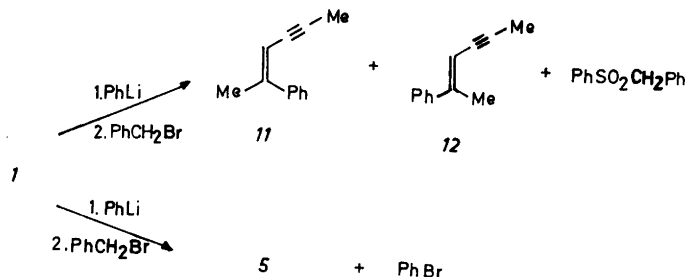


Fig. 2.

evaporation of the solvent from the reaction mixture and subsequent reflux of the residue in a mixture of methanol and excess benzyl bromide, the benzyl hexenyne sulfone 5 was obtained (GLC-MS). To confirm its structure, 5 was also prepared from (*Z*)-2-benzylthiohex-2-en-4-yne (7) which in turn was obtained from 2,5-dimethyl-3-iodothiophene (6) by a ring-opening reaction.¹¹ The formation of 5 is presumably due to a fast E1cB type reaction of 3 to give the lithium sulfinate 4 leading to 5 after benzylation.

More interesting though was the formation of two isomeric hexenyynes, 8 and 9, in the same ratio (1.0:1.7) from both 1 and 2 although in different yields, 35 and 80% (GLC), respectively. The hexenyynes were formed rapidly, within 5 min at -70°C .

When 1 or 2 was treated with only one equivalent of butyllithium, much of the starting material remained, especially of compound 2 (~50%), suggesting that some of the butyllithium was consumed in another reaction.

Considering these facts, we propose that 8 and 9 were formed *via* a nucleophilic attack on the 5-carbon of 1 and 2 leading to a carbanionic species, 10. This is rapidly equilibrated and ring-opens to give 8 and 9 and lithium halide, the sulfur dioxide portion of the molecule being trapped by a second equivalent of butyllithium. The resulting butylsulfinate could not be trapped with benzyl bromide under the conditions mentioned above, but alkanesulfonates are known to be rapidly polymerized, whereas arenesulfonates are more stable.^{12,13}

After treatment of 1 with two equivalents of phenyllithium and subsequent benzylation (Fig. 2), benzyl phenyl sulfone could be identified together with 5 by GLC-MS and coinjection of authentic materials. Also, bromobenzene was formed (57% GLC) together with the hexenyynes 11 and 12 (25%) in a 0.77:1.00 ratio. The structures of 8 and 9 together with 11 and 12 were deduced from MS, IR, NMR (360 MHz) and elemental analyses of the isolated compounds.

The last experiment clearly illustrates the conclusion of this report, namely that the bromo-substituted thiophen-1,1-dioxide (1) is attacked by two competing

processes: a, *via* halogen-metal exchange, and b, *via* nucleophilic attack on the 5-carbon. The chloro derivative, however, follows path b virtually exclusively giving a high yield of enynes.

We are currently working at developing a versatile and stereoselective enyne synthesis based on this reaction by modifying the substitution pattern of the starting materials.

Elemental analyses and spectral data for all new compounds were in accordance with the proposed structures.

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