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# REACTIONS OF PHENYLTHIOTRIMETHYLSILYLMETHYLLITHIUM: PREPARATION OF α-PHENYLTHIOKETONES AND ADDITIONS TO 2-CYCLOHEXEN-1-ONE[1]

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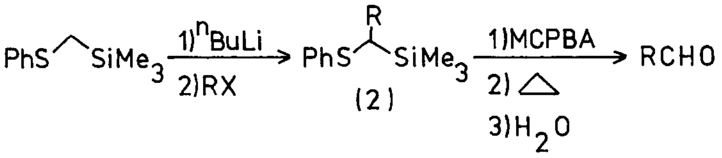
Summary: Phenylthiotrimethylsilylmethyllithium(1) was reacted with a variety of electrophiles, including some containing two functional groups. α-Phenylthioketones were obtained from the reaction with esters. The anion(1) underwent either 1,2- or 1,4-addition, depending on the conditions used, with 2-cyclohexen-1-one.

It has already been shown that phenylthiotrimethylsilylmethyllithium(1) is readily alkylated by alkyl halides. The adducts(2) may be converted to aldehydes by oxidation, thermal rearrangement and hydrolysis[2,3]:-

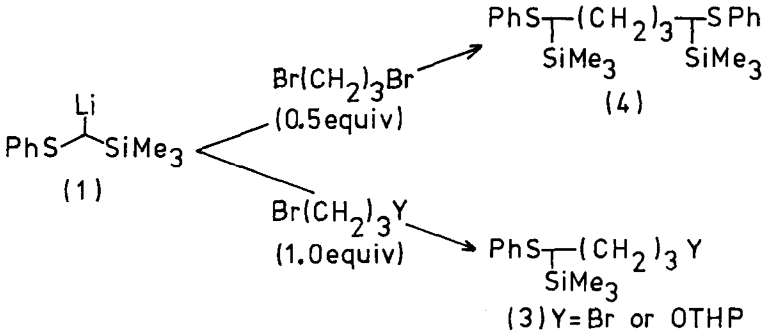


We describe in this paper, reactions of the anion(1) with other electrophiles.

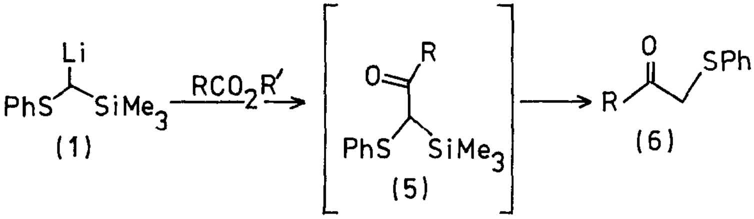
As expected, (1) reacted with deuterium oxide, chlorotrimethylsilane, chlorotri-n-butylstannane, diphenyldisulphide and phenylsulphenyl chloride to give the adducts(2) in high yield (see table).

With chloroacetone, bromoacetaldehyde diethyl acetal, methyl bromoacetate and 1,2-dibromoethane, the anion(1) acted as a base and phenylthiotrimethylsilylmethane was recovered. 1,3-Dibromopropane, however, gave the mono- or di-substituted adduct depending on whether one or two equivalents of (1) were used. Similarly, 3-bromopropan-1-ol tetrahydropyranyl ether gave (3;R=OTHP). Some reaction did occur with propargyl bromide but the yield of the adduct(2;R=$CH_2C{\equiv}CH$) was low, presumably because of (1) also acting as a base.

With esters, if the anion(1) was first dissolved in excess N,N,N',N'-tetramethylethylenediamine(TMEDA) and then added slowly to excess ester, the adducts(5) were formed in good yield (by nmr).

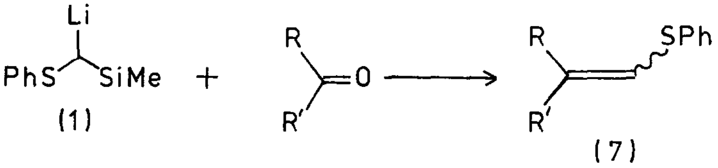


Purification of (5) by column chromatography resulted in the loss of the silyl group and the α-phenylthioketone(6) being isolated.



Acid chlorides and anhydrides gave complex mixtures with (1). Large amounts of phenylthiotrimethylsilylmethane were often recovered, especially in the case of acetyl chloride, and the α-phenylthioketones were formed in poor to moderate yield.

Phenylthiotrimethylsilylmethyllithium(1) reacted with ketones and aldehydes to give the vinylsulphides(7) via the Peterson reaction[4], confirming the results of Carey[5]; additional examples to those quoted in the original paper are given in the table. Paraformaldehyde reacted in a similar manner to give phenylthioethene(7;R=R'=H). The anion(1) added in a 1,2-manner to 2-cyclohexen-1-one(8) in tetrahydrofuran(THF) to give the vinylsulphide(7;R,R'=$^{c}C_6H_8$)[5]. Brown and Yamaichi[6] found



that hexamethylphosphorictriamide(HMPA) promotes the addition of 2-lithio-1,3-dithian to 2-cyclohexen-1-one(8) in a 1,4-manner rather than 1,2 which occurs when the HMPA is ommitted. The addition of

## TABLE

| Electrophile | Yield(%) | | Product[a] |
|---|---|---|---|
| | TMEDA[b] | THF[c] | |
| $D_2O$ | 100 | –[d] | (2) R=D |
| $Me_3SiCl$ | 97 | 96 | (2) $R=SiMe_3$ |
| $^{n}Bu_3SnCl$ | 81 | 85 | (2) $R=Sn^{n}Bu_3$ |
| PhSSPh | 65[e] | – | (2) R=SPh |
| PhSCl | 75 | – | (2) R=SPh |
| $Br(CH_2)_3Br$(0.5equiv) | 70 | – | (4) |
| $Br(CH_2)_3Br$(1.0equiv) | 63[f] (82[f,g]) | 61 | (3) Y=Br |
| $Br(CH_2)_3OTHP$ | 72 | 79 | (3) Y=OTHP |
| $BrCH_2C{\equiv}CH$ | 37 | 20 | (2) $R=CH_2C{\equiv}CH$ |
| $MeCO_2Et$ | 73[f,g] | h | (6) R=Me |
| $MeCO_2{}^{t}Bu$ | 55[f,g] | – | (6) R=Me |
| $PhCO_2Me$ | 79[f,g] | – | (6) R=Ph |
| $Me_2CHCO_2Me$ | 76[f,g] | – | (6) $R=CHMe_2$ |
| $PhCH_2CO_2Me$ | 51[f,g] | – | (6) $R=CH_2Ph$ |
| $(MeCO)_2O$ | 34[f,g] | 32 | (6) R=Me |
| $(PhCO)_2O$ | 29[f,g] | 25 | (6) R=Ph |
| MeCOCl | 10[f,g] | h | (6) R=Me |
| PhCOCl | 21[f,g] | – | (6) R=Ph |
| $^{n}C_5H_{11}CHO$ | 71 | – | (7) $R={}^{n}C_5H_{11}$;R'=H |
| PhCHO | 74 | 71[5] | (7) R=Ph;R'=H |
| $Ph_2CO$ | 78 | 82[5] | (7) R=R'=Ph |
| PhCOMe | 69 | 63 | (7) R=Ph;R'=Me |
| $^{c}C_6H_{10}O$ | 68 | 65[5] | (7) $R,R'={}^{c}C_6H_{10}$ |
| $(HCHO)_n$ | 63 | 65 | (7) R=R'=H |
| $^{c}C_6H_8O$[i] | 76 | 75[5] | (7) $R,R'={}^{c}C_6H_8$ |

[a] All new compounds have been characterised.

[b] (1) was prepared in TMEDA-hexane as described in reference 2.

[c] (1) was prepared in THF as described in references 3 and 5.

[d] Denotes the reaction was not carried out.

[e] THF was used as cosolvent.

[f] Inverse addition.

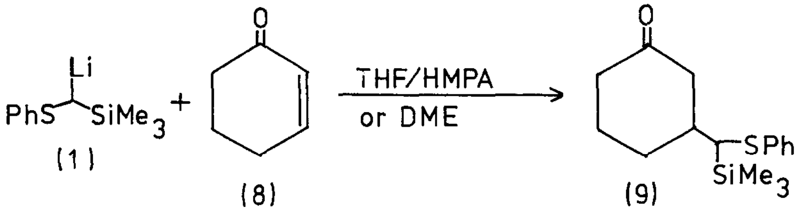
[g] Yield when an excessof the electrophile was used.

[h] (1) acted as a base and phenylthiotrimethylsilylmethane was recovered.

[i] See text.

HMPA to a THF solution of (1) followed by the enone(8) gave only the 1,4-addition product(9). The anion(1) with THF as solvent, in the presence of TMEDA, gave both 1,2- and 1,4-addition[7].

The anion(1) can be prepared quantitatively with n-butyllithium in 1,2-dimethoxyethane(DME)[8]. Use of this solvent gave exclusively 1,4-addition even in the absence of HMPA. 2-Lithio-1,3-dithian gave 1,2-addition in DME. Phenylthiotrimethylsilylmethyllithium(1) is, therefore, preferable to 2-lithio-1,3-dithian in carrying out this conjugate addition as it avoids the use of HMPA[9].



(1) (8) (9)

Phenylthiotrimethylsilylmethyllithium(1) is, therefore, a useful reagent for preparing aldehydes (by alkylation or by reaction with an aldehyde or ketone[5] and hydrolysis of the resulting vinylsulphide[10]) and regioselectively α-phenylthioketones (by reaction with an ester).

References and Notes.

1)Part of this work was carried out at the Department of Chemistry, The University, Southampton, SO9 5NH. The help and advice of Professor Richard Cookson FRS and an SRC Postdoctoral Fellowship are gratefully acknowledged.

2)D.J. Ager and R.C. Cookson, Tetrahedron Letters, 1980,21,1677.

3)P.J. Kocienski, Tetrahedron Letters, 1980,21,1559.

4)D.J. Peterson, J.Org.Chem., 1968,33,780.

5)F.A. Carey and A.S. Court, J.Org.Chem., 1972,37,939.

6)C.A. Brown and A. Yamaichi, J.Chem.Soc.,Chem.Commun., 1979,100.

7)The method of preparation of (1) was not a factor influencing the mode of addition; preparation by the method described in reference 2 followed by dilution with THF or by the method of reference 3 followed by the addition of TMEDA gave the same results. The product ratio is temperature dependant. A full discussion will be presented in the full paper. 2-Lithio-1,3-dithian gave exclusively 1,2-addition under these conditions.

8)D.J. Ager, Unpublished results.

9)Work is being carried out at present on the addition of the anion(1) to other enones.

10)B.-T. Grobel and D. Seebach, Synthesis, 1977,357

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