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Reaction of Thiobenzamides with Arylmagnesium Bromides

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Synopsis. Reactions of thiobenzamide, *p*-methylthiobenzamide, *p*-methoxythiobenzamide, and *p*-chlorothiobenzamide with 4 equivalents of phenyl-, *p*-tolyl-, *p*-methoxyphenyl-, and *p*-chlorophenylmagnesium bromides gave the corresponding diphenylmethyleneamine and thiobenzophenone as 1,2-addition produsts in good yields.

Thiones, thioesters, and dithioesters are known to react with organometallic reagents to give thioethers and their derivatives.1) However little is known of reactions of thioamides with organometallic reagents.2) *N*-Phenyl-2,2-diphenylthioacetamide does not react with excess ethylmagnesium bromide.2a) However, highly basic carbanions such as phenyllithium react with *N*,*N*-dimethylthiobenzamide to give *N*,*N*-dimethyltriphenylmethylamine, triphenylmethanol, and a small amount of benzophenone.2b) *N*,*N*-Dialkyl-α,β-unsaturated thioamides undergo the 1,4-addition reaction with organolithium and magnesium compounds.2c) We were interested in the reaction of thioamides with Grignard reagents as part of our study on thiocarbonyl compounds.3)

Treatment of *N*-substituted thioamide such as *N*-morpholino(thiobenzamide) or *N*-methyl(thiobenzamide) with excess phenylmagnesium bromide in ether at room temperature resulted in the recovery of unchanged thioamide. In contrast, the reaction of primary thioamides with arylmagnesium bromides proceeded readily under the same conditions. When thiobenzamide was allowed to react with 4 equivalents of phenylmagnesium bromide, diphenylmethyleneamine (**5a**) and thiobenzophenone (**6a**) were obtained. Hydrogen sulfide was evolved after being hydrolyzed with aqueous ammonium chloride. The results are summarized in Table 1.

The formation of **5** and **6** can be explained by the following mechanisms.

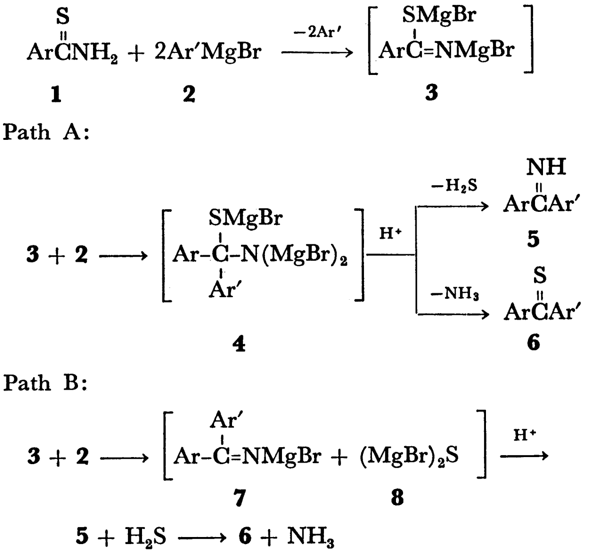
When thiobenzamide was treated with 2 equivalents of phenylmagnesium bromide, unchanged thioamide was recovered. This indicates that the reaction proceeds *via* an initial dimetallation of the thioamide affording an intermediate (**3**).4a) The reaction of **3** with **2** would give the intermediates (**4**) and/or (**7**)4b,4c) (Scheme 1).

Path A involves the addition of **2** to the carbon–nitrogen double bond of **3** to give an intermediate (**4**) which cleaves to afford **5** and **6** by hydrolysis.

Alternative path B involves the replacement of the sulfur moiety of **3** by the aryl group of **2** to give **7** and **8** which afford **5** and hydrogen sulfide by hydrolysis. In this pathway, **6** may be formed by the reaction of **5** with hydrogen sulfide.5)

If the reaction proceeds along either path A or B, the ratio of the products (Imine/Thione) in run **b** (or **c**) is approximately equal to that in run **e** (or **f**) since both runs **b** and **e** (**c** and **f**) give rise to the formation of an identical intermediate. However, the actual ratios are quite different as shown in Table 1.

An explanation is given by assuming that the reaction proceeds *via* both pathway A and B. The ratio of the products (Imine/Thione) from the intermediate **4** would not be the same as that from the intermediate **7**, the formation ratio of **4** and **7** depending on the nucleophilicity of the Grignard reagents.



Scheme 1. Reaction route.

Experimental

Thiobenzamide (**1a—d**)6) and *N*-morpholino(thiobenzamide)7) were synthesized by the methods reported. *N*-Methyl(thiobenzamide) was prepared by the reaction of methyl isothiocyanate with phenylmagnesium bromide.4)

A Typical Procedure for the Reaction of Thiobenzamides with Arylmagnesium Bromides. Thiobenzamide (0.1 mol) was added gradually to a solution of phenylmagnesium bromide (0.4 mol) in 300 cm^3 dry ether at room temperature under nitrogen atmosphere. After being allowed to stand overnight, the reaction mixture was quenched with saturated aqueous ammonium chloride at −10 °C and filtered, the solvent then being evaporated. The deep blue residue was dissolved in 150 cm^3 petroleum ether. Dry hydrogen chloride was bubbled into the solution until precipitation was complete. Precipitated diphenylmethyleneamine hydrochloride (13.56 g) (sublimed at 230—270 °C (230—250 °C)8b)) was filtered off and the filtrate was evaporated. The deep blue residue was distilled to give thiobenzophenone (2.97 g) (120 °C/1 Torr (120—125 °C/1 Torr)8a)).

The products (Table 1) were identified by comparing their boiling points, IR spectra, and/or GLC (Silicone Gum SE-30) with those of authentic compunds.8)

Table 1. Reaction of thiobenzamides with arylmagnesium bromides

Run No.	Thioamide Ar	Grignard reagent Ar′	Yield/%[a]		Imine/Thione
			Imine	Thione	
a	C_6H_5	C_6H_5	66	15	4.4
b	*p*-CH_3O-C_6H_4	C_6H_5	58	12	4.8
c	*p*-Cl-C_6H_4	C_6H_5	63	26	2.4
d	*p*-CH_3-C_6H_4	C_6H_5	56	22	2.5
e	C_6H_5	*p*-CH_3O-C_6H_4	87	6	14.5
f	C_6H_5	*p*-Cl-C_6H_4	52	6	8.7

a) Yields of diphenylmethyleneamines and thiobenzophenones were determined by conversion into their hydrochlorides and oximes, respectively.

References

1) D. Paquer, *Bull. Soc. Chim. Fr.*, **1975**, 1439; K. Nakamura and A. Ohno, *Kagaku No Ryoiki*, **32**, 74 (1978).

2) a) T. Fujinami, N. Otani, and S. Sakai, *Nippon Kagaku Kaishi*, **1978**, 265; b) P. Beak, J. Yamamoto, and C. J. Upton, *J. Org. Chem.*, **40**, 3052 (1975); c) Y. Tamaru, T. Harada, H. Iwamoto, and Z. Yoshida, *J. Am. Chem. Soc.*, **100**, 5221 (1978); d) H. Wuyts and A. Lacourt, *Bull. Soc. Chim .Belg.*, **45**, 445 (1936).

3) T. Karakasa and S. Motoki, *J. Org. Chem.*, **43**, 4147 (1978).

4) a) G. Alliger, G. E. P. Smith Jr., E. L. Carr, and H. P. Stevens, *J. Org. Chem.*, **14**, 962 (1949); b) H. Gilman and C. R. Kinney, *J. Am. Chem. Soc.*, **46**, 493 (1924); T. Yamaguchi, Y. Shimizu, and T. Suzuki, *Chem. Ind. (London)*, **1972**, 380.

5) Actually, **6a** was formed by the reaction of **5a** with hydrogen sulfide in ether at room temperature; D. S. Tarbell and V. P. Wystrock, *J. Am. Chem. Soc.*, **68**, 2110 (1946). Since the reaction is carried out under acidic conditions, the reaction of thiobenzophenones with ammonia can be ruled out.

6) A. E. S. Fairfull, J. L. Lowe, and D. A. Peak, *J. Chem. Soc.*, **1952**, 742.

7) R. N. Hurd and G. DeLaMater, *Chem. Rev.*, **61**, 52 (1961).

8) a) K. Kimura, H. Niwa, and S. Motoki, *Bull. Chem. Soc. Jpn.*, **50**, 2751 (1977); b) A. Lachman, *Org. Syn.*, Coll. Vol. II, 234 (1943); c) P. L. Pickard and T. L. Tolbert, *Org. Syn.*, Coll. Vol. V, 520 (1973).