Organometallic Compounds of Bivalent Ytterbium

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Summary Ytterbium metal reacts with alkyl and aryl iodides in tetrahydrofuran at low temperatures to give solutions of $RYb^{II}I$, which undergo typical Grignard-type reactions.

The only organometallic compounds of the rare-earth elements so far reported† are the mono-, bis-, and tris-cyclopentadienyl derivatives,[1] and the recently reported tris-indenyl compounds.[2] In their bivalent states samarium, europium, and ytterbium resemble calcium, and hence they might be expected to form organometallic derivatives analogous to Grignard reagents and the alkyl- and aryl-calcium halides.[3]

Ytterbium metal readily reacts with alkyl and aryl iodides in tetrahydrofuran at −15° or below to give brown solutions in which the ytterbium to iodine ratio is approximately unity. Magnetic susceptibility measurements by an n.m.r. method[4] showed that 75—92% of the ytterbium is present in the bivalent state. Similar values were obtained by hydrolysis of the solutions with dilute acetic acid and immediate iodimetric titration of the Yb^{2+} ion. The highest proportion of bivalent ytterbium was found using 2,6-dimethyliodobenzene. Acidometric titration of the resulting solution (which may give slightly high results) indicated a *ca.* 90% yield of organo-ytterbium. All these solutions give a positive test with Michler's ketone, and undergo typical Grignard-type reactions with water, aldehydes, ketones, and isocyanatobenzene. Thus, phenylytterbium iodide with benzophenone gave a 72% yield (based on the iodobenzene taken) of triphenylmethanol.

(*Received, January* 12*th*, 1970; *Com.* 046.)

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† Hart has reported the preparation of triphenylscandium (F. A. Hart, *Chem. Comm.*, 1968, 1614), and has also obtained triphenylyttrium and phenyl derivatives of some other rare-earth elements (personal communication and *J. Organometallic Chem.*, 1920, **21**, 147).

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[2] M. Tsutsui and H. J. Gysling, *J. Amer. Chem. Soc.*, 1969, **91**, 3175.

[3] (a) D. Bryce-Smith and A. C. Skinner, *J. Chem. Soc.*, 1963, 577; (b) R. Masthoff and C. Vieroth, *J. prakt. Chem.*, 1968, **38**, 182.

[4] D. F. Evans, *J. Chem. Soc.*, 1959, 2003.