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Preliminary communication

BIS(PENTAFLUOROPHENYL)YTTERBIUM: A TRANSMETALLATION SYNTHESIS OF A σ-BONDED LANTHANIDE ORGANOMETALLIC COMPOUND

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Summary

Bis(pentafluorophenyl)ytterbium has been isolated as the highly air-sensitive complex $(C_6F_5)_2Yb(THF)_4$ (THF = tetrahydrofuran) from a transmetallation reaction between bis(pentafluorophenyl)mercury and ytterbium metal in tetrahydrofuran.

No fluorocarbon lanthanide organometallics are known [1], and only one fluorocarbon actinide derivative has been prepared, viz. $(\eta^5\text{-}C_5H_5)_3UC_6F_5$ [2]. We now report the synthesis of bis(pentafluorophenyl)ytterbium by a transmetallation reaction. This method has not previously been used to give σ-bonded organo-lanthanides or -actinides [1], though unsuccessful attempts have been reported [3,4].

On stirring approximately equimolar amounts of bis(pentafluorophenyl)mercury and ytterbium metal in dry tetrahydrofuran at room temperature under rigorously purified nitrogen, an exothermic reaction occurred. Mercury was deposited and a deep orange solution of bis(pentafluorophenyl)ytterbium formed.

$$(C_6F_5)_2Hg + Yb \rightarrow (C_6F_5)_2Yb + Hg\downarrow$$ **

Addition of petroleum ether and cooling gave deep orange-red crystals of bis(pentafluorophenyl)tetrakis(tetrahydrofuran)ytterbium(II) in 29% yield. Satisfactory analyses (C, H, Yb) were obtained, and hydrolysis of the compound gave pentafluorobenzene. The crystals are exceptionally sensitive to oxygen and water, and decompose on being heated to 75°C in a sealed tube (explode at

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[**] A conceptually related reaction is known [3], viz. conversion of $ClHgCr(CO)_3(\eta^5\text{-}C_5H_5)$ by ytterbium metal into $ClYb[Cr(CO)_3(\eta^5\text{-}C_5H_5)]_y$ (y = 1 or 2).

78°C), on storage for 48 h at room temperature (become black), or on treatment with hexachlorobutadiene in an attempt to prepare a mull in this medium. The ^{19}F NMR spectrum of the compound in tetrahydrofuran showed no abnormal broadening or shifts of the resonances, consistent with the expected diamagnetism of a divalent ytterbium compound, and the chemical shifts, 108.3 (*o*-F) and 161.4 (*m*- and *p*-F) ppm upfield from external $CFCl_3$, are in the range [5] for σ-bonded pentafluorophenyl organometallics. In the infrared spectrum (Nujol mull), intense features attributable to the pentafluorophenyl group [6] (1626, 1295, 1036 and 920 cm^{-1}) and to coordinated tetrahydrofuran [7] (1013 and 876 cm^{-1}) were observed. The visible spectrum (350—700 nm; tetrahydrofuran solution) showed maxima at 370 (log ϵ 2.76), 399 (log ϵ 2.73), and 444 (log ϵ 2.74) nm.

Preliminary experiments (transmetallation reactions and analyses of resulting solutions and precipitates) have shown that bis(2,3,5,6-tetrafluorophenyl)- and bis(2,3,4,5-tetrafluorophenyl)-ytterbium can be prepared by the same method, but the compounds have not yet been isolated. Further investigations to establish the scope of transmetallations as a route to σ-bonded lanthanide and actinide organometallics are in progress. In view of the paucity of synthetic methods for these compounds [1], the prospect of a new route, even of limited generality, is of considerable interest.

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