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Synthesis of a New Carbonyl Derivative Containing Fe and W Metals

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Compounds containing metal–metal bonds between different elements offer very interesting possibilities for investigating the influence of the polarity of a metal–metal bond on its stability and reactivity. Such compounds containing the $(\eta\text{-}C_5H_5)(CO)_2Fe$ moiety: $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}Mo(CO)_3(\eta\text{-}C_5H_5)$ [1], $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}M(CO)_5$ (M = Mn [1], Re [2, 3]), $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}Co(CO)_3$ [4] and $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}Ni(CO)(\eta\text{-}C_5H_5)$ [5] have been reported so far in the literature.

We report here the synthesis of a new carbonyl derivative containing the $(\eta\text{-}C_5H_5)(CO)_2Fe$ moiety with W metal of the type $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}W(CO)_3(\eta\text{-}C_5H_5)$ by two different routes.

A THF solution of $Na(\eta\text{-}C_5H_5)(CO)_3W$ [6] (prepared with 0.5 g of $[(\eta\text{-}C_5H_5)W(CO)_3]_2$ and 1% sodium amalgam) and $(\eta\text{-}C_5H_5)Fe(CO)_2I$ [7] (0.5 g) was refluxed under inert atmosphere of dry nitrogen for 1 h. The yellow solution of $Na(\eta\text{-}C_5H_5)W(CO)_3$ immediately reacted with dark brown solution of $(\eta\text{-}C_5H_5)Fe(CO)_2I$ to yield a red–brown residue. The solvent (THF) was evaporated *in vacuo* and the residue was washed several times with hexane to remove any unreacted portion. The red compound obtained after recrystallisation in benzene was shown to be $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}W(CO)_3(\eta\text{-}C_5H_5)$ (50.4%). *Anal.* Found: C, 35.0; H, 1.7; Fe, 10.2; W, 36.0. $C_{15}H_{10}O_5FeW$ Calcd.: C, 35.2; H, 1.9; Fe, 10.9; W, 36.7%. This compound was soluble in nearly all common organic solvents except light petroleum. It decomposed at *ca.* 150 °C.

The infrared spectrum of $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}W(CO)_3(\eta\text{-}C_5H_5)$ exhibited ν(CO) stretching frequencies at 2066 ms, 2020 sh, 1985 s, 1955 ms, 1905 vw and 1885w cm^{-1}. The absence of ν(CO) stretching frequencies in the bridging carbonyl region of the spectrum indicates that only one single metal–metal (Fe–W) bond occurs. The characteristic bands due to $(\eta\text{-}C_5H_5)\text{–}M$ (M = Fe, W) [8] vibrations are also observed in the spectrum.

It is interesting to note that the same compound was synthesised by an alternative route also. The reaction of $(\eta\text{-}C_5H_5)W(CO)_3I$ [9] and $Na(\eta\text{-}C_5H_5)Fe(CO)_2$ [7] yielded $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}W(CO)_3(\eta\text{-}C_5H_5)$ but in much lower yield (20%). The elemental analysis data and i.r. spectrum are almost identical, but the most convenient synthetic route to prepare this compound is by the reaction of $(\eta\text{-}C_5H_5)Fe(CO)_2I$ with $Na(\eta\text{-}C_5H_5)W(CO)_3$.

The reaction of $(\eta\text{-}C_5H_5)Fe(CO)_2I$ with $Na(\eta\text{-}C_5H_5)Cr(CO)_3$ did not yield satisfactory evidence for the formation of $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}Cr(CO)_3(\eta\text{-}C_5H_5)$. Attempts were also performed to prepare complexes of the type $(\eta\text{-}C_5H_5)(CO)_2Fe\text{–}M(CO)_xL_n$ (M = Mo, W; L = amines; x = 3–5; n = 1–3) from the reaction of $(\eta\text{-}C_5H_5)Fe(CO)_2I$ with $NaM(CO)_xL_n$, but they failed.

Syntheses of the compounds containing Fe and group VI B metals of the type $(\eta\text{-}C_5H_5)(B)(Ph_3E)Fe\text{–}M(CO)_3(\eta\text{-}C_5H_5)$ from the reaction of $[(\eta\text{-}C_5H_5)Fe(B)\text{–}(Ph_3E)]I$ [10] (B = *o*-phen; 2,2′-bipy; E = P, As and Sb) with $Na(\eta\text{-}C_5H_5)M(CO)_3$ (M = Mo, W) are in progress.

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