The Structure of Bis(triphenylphosphine)(ethylene)nickel

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THE dissociation in solution of tris- and tetrakis-(triphenylphosphine)platinum(0) into the bis-(phosphine) species is now widely accepted,[1] and the complex $(PPh_3)_2Pt$ has been isolated under appropriate conditions.[2] We have recently expressed the view[3] that the behaviour in solution of the two-co-ordinated platinum complex (and the analogous nickel derivative) is essentially that of a solvated metal atom. The chemical evidence for such a suggestion is now extensive, and the "free atom" concept is a reasonable one in terms of the extreme "softness" of phosphine-substituted d^{10} ions.[4] Formation of acetylene,[5] ethylene,[6] oxygen,[6] and sulphur dioxide[3,7] adducts of the general formula $(PPh_3)_2Pt$(adduct) can, we feel, be compared directly with adsorption of these molecules on platinum surfaces, and it is evident that a more complete understanding of the mode of bonding of such adducts, coupled with mechanistic information concerning their reactions with, *e.g.*, oxygen, and hydrogen, would have a considerable bearing on more conventional studies of heterogeneous catalytic reactions.

In order to obtain structural information concerning these various related adducts of the Group VIII metals, we have initiated *X*-ray

analyses of the nickel complex,[8] $(PPh_3)_2Ni(C_2H_4)$, and the platinum derivatives, $(PPh_3)_2PtO_2$, $(PPh_3)_2PtSO_2$, and $(PPh_3)_2Pt(C_2H_4)$.

The three-dimensional *X*-ray analysis of the nickel–ethylene complex $(PPh_3)_2Ni(C_2H_4)$ is virtually complete and is currently in the last stages of refinement; crystal data: triclinic, $a = 10{\cdot}2$, $b = 10{\cdot}5$, $c = 18{\cdot}5$ Å, $\alpha = 104°$, $\beta = 109°$, $\gamma = 62{\cdot}5°$, $Z = 2$, space group $P\bar{1}$, $R = 0{\cdot}124$. No significant dimensional changes are now expected, and the nickel atom environment is illustrated in Figures 1 and 2.

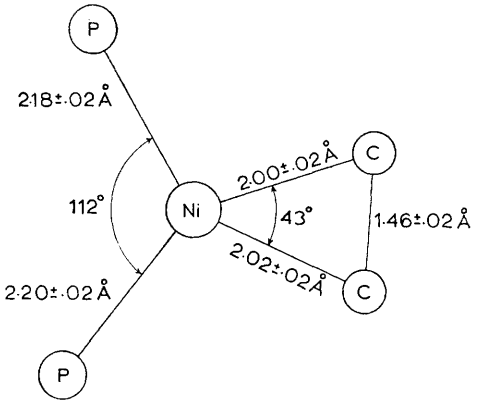

FIGURE 1

We are unable at this stage to make pertinent comments on the deviation from strict planarity other than to point out that small deviations have also been observed in related complexes. Thus, in the adducts $(PPh_3)_2Pt(PhC_2Ph)$ and $(PPh_3)_2Pt(CS_2)$ the CPtC and CPtS planes are inclined at angles of 14° and 6°, respectively, to the PPtP plane.[9,10] A low-energy barrier to ligand out-of-plane torsion is indicated by these data; and it is probable, by analogy with Cramer's study[11] of the complex π-$C_5H_5Rh(C_2H_4)_2$, that in solution $(PPh_3)_2Ni(C_2H_4)$ exhibits rotation of the ethylene about the co-ordinate bond.

A fuller discussion will be given on completion of the structure of the analogous platinum–ethylene derivative.

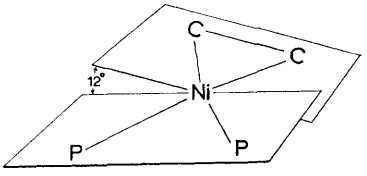

FIGURE 2

(*Received, March 28th*, 1967; *Com.* 297.)

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