presence of *cis*-$[Pt(Et_2S)_2Cl_2]$ in the *trans* isomer causes a lowering in melting point, making this a sensitive criterion in this case, more so than the far infra-red spectrum. In catalysis applications chloride is often undesirable and strict limits are placed on its presence.

References

1 B. R. James, "Homogeneous Hydrogenation", Wiley-Interscience, 1973

2 J. A. Osborn, F. H. Jardine, J. F. Young and G. Wilkinson, *J. Chem. Soc., A, Inorg. Phys. Theor.*, 1964, 1711

3 M. J. Cleare and W. P. Griffith, *J. Chem. Soc., A, Inorg. Phys. Theor.*, 1969, 372

4 W. S. Knowles, M. J. Sabacky and B. D. Vineyard, *Chem. Technol.*, 1972, (Oct.), 590

5 W. S. Knowles, M. J. Sabacky and B. D. Vineyard, *Chem. Commun.*, 1972, 10

6 D. Evans, J. A. Osborn and G. Wilkinson, *J. Chem. Soc., A, Inorg. Phys. Theor.*, 1968, 3133

7 F. Bonati and G. Wilkinson, *J. Chem. Soc.*, 1964, 3156

8 D. Evans, G. Yagupsky and G. Wilkinson, *J. Chem. Soc., A, Inorg. Phys. Theor.*, 1968, 2660

9 C. K. Brown and G. Wilkinson, *J. Chem. Soc., A, Inorg. Phys. Theor.*, 1970, 2753

10 S. Takahashi, K. Sonagashira and N. Hagihara, *J. Chem. Soc. Japan*, 1966, **87**, 610

11 E. W. Stern, *Chem. Commun.*, 1970, 736

12 A. Fusi, R. Ugo, F. Fox, A. Pasini and S. Cenini, *J. Organomet. Chem.*, 1971, **26**, 417

13 Imperial Chemical Industries Ltd., *British Patent* 1,023,797; *French Patent* 1,437,798

14 C. W. Bradford, M. J. Cleare and H Middleton, *Platinum Metals Rev.*, 1969, **13**, (3), 90

15 E. C. Marboe, *U.S. Patent* 2,430,520

16 "Vapour Deposition", ed. C. F. Powell, J. H. Oxley and J. M. Bloeher, Wiley, New York, 1966

17 B. Rosenberg, *Platinum Metals Rev.*, 1971, **15**, (2), 42; M. J. Cleare and J. D. Hoeschele, *Platinum Metals Rev.*, 1973, **17**, (1), 2

18 M. J. Cleare and J. D. Hoeschele, *Bioinorg. Chem.*, 1973, **2**, 187

19 B. Rosenberg, T. Krigas and L. Van Camp, *Nature*, 1965, **205**, 698

20 M. J. Cleare, *Coord. Chem. Rev.*, 1974, **12**, (4), 349

21 M. J. Cleare, T. A. Connors, J. D. Hoeschele, B. Rosenberg and L. Van Camp, presented at 2nd Internat. Conf. on Platinum Complexes in Cancer Chemotherapy, Oxford, 1973, to be published

22 E. Gil-Av and V. Schurig, *Anal. Chem.*, 1971, **43**, (14), 2030

Ruthenium as a Binder for Cemented Carbides

A potential means of improving the performance of cemented carbides is to raise the melting point of the binder constituent, thereby increasing the hardness and reducing the amount of wear at the high temperatures involved in machining operations. Whereas conventional binder phases are based on nickel, cobalt or iron, which form eutectics with the carbides at melting points between 1300 and 1400°C, suitable binders for higher melting points must be chosen from refractory transition or platinum metals. Most platinum metals, however, decompose transition metal carbides but ruthenium has been shown to form an eutectic with titanium carbide at 1840°C.

Two papers giving a deeper insight into the TiC-Ru system were presented recently at the 8th International Plansee Seminar on "Refractory and Wear Resistant Materials". J. S. Jackson of Production Tool Alloys Ltd., Sharpenhoe, Bedford and R. Warren and Professor M. B. Waldron of the University of Surrey studied the sintering behaviour, microstructure, hardness, and resistance to cracking over the whole TiC-Ru composition range. They found that titanium carbide did not decompose to form graphite during sintering and that after sufficient milling alloys of almost full density were produced below the 1840°C eutectic temperature. Good sinterability is partly the effect of good adhesion between the carbide and ruthenium. These alloys are harder than cemented carbides incorporating a nickel binder but ruthenium is less effective than either cobalt or nickel in preventing cracking of TiC.

The studies also showed that TiC-Ru is particularly promising as a potential cutting tool material. Small amounts of nickel, cobalt or iron picked up during milling assist full densification of TiC-Ru at 1500°C, which is a convenient sintering temperature. Nickel, for example, does not seriously affect the properties of TiC-Ru and the melting point of a binder phase containing both ruthenium and nickel remains higher than that of conventional cemented carbides.