

Fig. 3 The microstructure of quenched 70 at.% ruthenium-platinum alloy displays a volumetric distribution of the two phases commensurate with the position of this alloy within the two-phase area

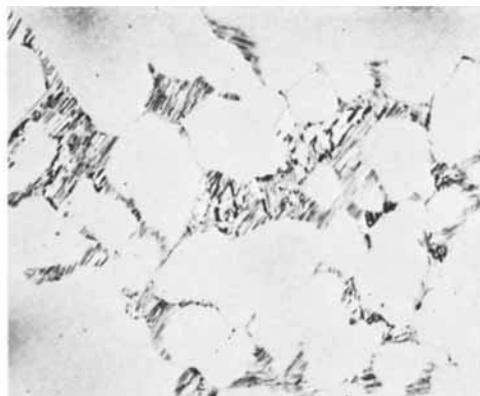


Fig. 4 The microstructure of 80 at.% ruthenium-platinum. This alloy contains only a small proportion of the platinum-rich phase, thus confirming that it is just within the duplex boundary at 1000°C

Acknowledgements are due to Mr J. H. F. Notton for the micro-probe analysis.

1 N. V. Ageev and V. G. Kuznetsov, *Izv. Akad. Nauk S.S.S.R. (Khim.)*, 1937, 753-755

2 V. A. Nemilov and A. A. Rudnitskii, *Izv. Akad. Nauk S.S.S.R. (Khim.)*, 1937, 33-40

3 R. I. Jaffee et al., AIME Metallurgical Soc. Conferences, Vol. II, Refractory Metals and Alloys, 383-463 (especially 418-420), Interscience Publishers Inc., New York, 1961

## The Electrodeposition of Osmium

Of all the platinum group of metals osmium has the highest melting point and hardness, and it is chemically very resistant although oxidised in air above 400°C. These properties make it potentially useful in the form of an electrodeposited coating where the atmosphere is not oxidising, as for example in reed relays, and in the last few years efforts have been made to develop a suitable electrolyte for this purpose.

A number of workers have reported unsatisfactory results with hexachloroosmate solutions, while other electrolytes that have been tried include molten cyanides, which gave granular deposits and were unstable, and alkaline electrolytes prepared from  $\text{OsO}_4$  and sulphuric acid. The latter showed some promise, but now further and more successful results with hexachloroosmate baths have been reported by J. M. Notley of International Nickel in a paper presented to the annual conference of the Institute of Metal Finishing held in May 1972. (*Trans. Inst. Metal Finish.*, 1972, 50, (2), 58).

The advancement described in the paper is the stabilisation of the electrolyte by addition of (i) potassium chloride to suppress hydrolysis of the hexachloroosmate to osmium

dioxide, and (ii) of potassium bisulphate to buffer the pH at  $\sim 1.5$ . Any dioxide that is precipitated is redissolved by chlorine generated at the anode. If the bath is being operated at too low a current density to produce chlorine then a short burst at high current density is usually sufficient to redissolve the dioxide.

The osmium is deposited at 1 to 4 A/dm<sup>2</sup> at 70°C with a current efficiency of 20 to 30 per cent, and plating rates up to 4  $\mu\text{m}/\text{h}$ . The deposits are bright and although cracked at thicknesses greater than 1.5  $\mu\text{m}$  may be obtained up to 10  $\mu\text{m}$  thick.

Very careful control of the electrolyte at pH 1.0 to 1.5 is necessary to prevent precipitation of  $\text{OsO}_2$  on to the cathode.

Details are given of the synthesis of the plating salt,  $\text{K}_2\text{OsCl}_6$ , and of the preparation and analysis of the bath. The kinetics of the decomposition of the electrolyte were investigated and the results were used to adjust the composition to obtain a stable system. The effects of current density and temperature on plating rate and efficiency were determined for a bath using ammonium hexachloroosmate and a sulphamic acid/ammonium sulphamate buffer. C. W. B.