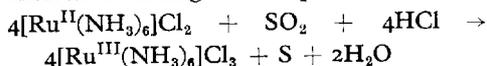


by hexammineruthenium(II) chloride which is itself oxidised to the tervalent ruthenium ammine according to the equation



However, the reaction in the absence of hydrochloric acid is far more complex resulting in an intermediate step, in the formation of a deep red thiosulphate complex,  $[\text{Ru}^{\text{III}}(\text{NH}_3)_5(\text{S}_2\text{O}_3)]\text{Cl}_2 \cdot \text{H}_2\text{O}$  in which the  $\text{S}_2\text{O}_3$  group acts as a unidentate ligand. The final product, and that which results from boiling an aqueous solution of the thiosulphato compound, is a deep purple, extremely stable sulphito complex, the structure of which has not been elucidated but which is probably polynuclear.

Treatment of hexammineruthenium(II) chloride with hydrochloric or sulphuric acid results in the evolution of hydrogen, deposition of a little ruthenium and a deep blue solution from which crystallises the chloride or sulphate, depending upon the acid used, of a cation which may be formulated  $[\text{Ru}^{\text{III}}(\text{H}_2\text{O})(\text{NH}_3)_3\text{Cl}_2]^+$ . It is difficult to suggest a reason for such a compound having an intensely blue colour and it could be that, rather than being a simple aquodichlorotriammine, the compound has a polynuclear structure. Support for such a view stems from the fact that the ethylenediamine (en) complex  $[\text{Ru}^{\text{II}}(\text{en})_3]\text{ZnCl}_4$  prepared by Lever

and Bradford (3) behaves similarly to the ammine compound when boiled with hydrochloric acid; it is, however, not possible to formulate an ethylenediamine compound analogous to a simple triammine.

Boiling hexammineruthenium(II) chloride with nitric acid results in the evolution of nitrous fumes and finally a colourless solution from which crystallises on cooling hexammineruthenium(III) nitrate  $[\text{Ru}^{\text{III}}(\text{NH}_3)_6](\text{NO}_3)_3$ . This compound is one of but few ruthenium compounds which contain neither alkali metal nor halogen. In the preparation of some supported ruthenium catalysts the presence of these radicals is considered to be undesirable and this ammine may well have application in this field.

Of the many reactions described in the original paper, these which have here been briefly considered have been selected not only because some of the products may be of commercial significance, but also to indicate where further investigations could be most fruitful and lead to the isolation and characterisation of ruthenium complexes so far unknown.

### References

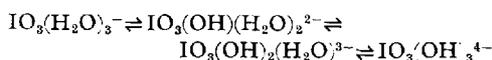
- 1 F. M. Lever and A. R. Powell, *J. Chem. Soc., A*, 1969, 1477
- 2 For instance, J. F. Endicott and H. Taube, *J. Am. Chem. Soc.*, 1962, **84**, 4984; *idem*, *Inorg. Chem.*, 1968, **4**, 437
- 3 F. M. Lever and C. W. Bradford, *Platinum Metals Rev.*, 1964, **8**, 106

## Iridium Iodate: A New Complex

The iodates of quadrivalent elements such as cerium, zirconium and thorium have, as would be expected, a stoichiometry of  $\text{M}(\text{IO}_3)_4$ . A short paper by Professor G. Wilkinson and D. Rose of the Inorganic Chemistry Laboratories, Imperial College, and F. M. Lever and A. R. Powell of the Johnson Matthey Research Laboratories (*J. Chem. Soc. (A)*, 1969, 1690) describes the preparation and characterisation of iridium (IV) iodate, produced by the reaction of sodium iodate with a perchloric acid solution of iridium. The reaction yields a quantitative precipitate of an amorphous bluish-black complex. This seems to be a unique compound and entirely different from the iodates

of other quadrivalent elements, having only one iodate radical for each iridium atom.

It is suggested that the compound is a polymeric bridged iodate complex  $\text{IrIO}_3(\text{OH})_3$  formed by the following mechanisms:



and

