Platinum Technology Transfer

JOHNSON MATTHEY CONTINUES LONG TRADITION

For almost 150 years Johnson Matthey has promoted fabricated platinum products at industrial exhibitions in many parts of the world. Earlier this year this long established tradition continued when senior technical staff from Johnson Matthey Metals Limited took part in "Technology '86" an international exhibition specialising in the application of modern technology in industry, which was held in Moscow during March.

In addition to exhibiting products manufactured from platinum metals, technical papers were presented by A. E. Heywood, R. A. Benedek and J. Stokes. These were concerned, respectively, with the development and application of high strength zirconia grain stabilised platinum alloys, the recovery of platinum from ammonia oxidation plants and the deposition of platinum from fused salt electrolytes, and glass fibre bushings.

Zirconia grain stabilised platinum, platinum-rhodium and gold-platinum alloys manufactured by a proprietary process possess outstanding high temperature strengths due to uniformly distributed, extremely fine particles of zirconia. These prevent grain growth and other deleterious changes in the microstructure. In addition the elongate grains produced during the thermomechanical operations impart an improved resistance to contamination, while the presence of zirconia does not adversely affect the corrosion resistance or the mechanical working properties of the alloys, which can still be formed by the usual techniques. Grain stabilisation with zirconia enables the rhodium content of alloys to be reduced, or even eliminated for applications in the optical glass industry where the possibility of rhodium contamination must be avoided. Thus substantial cost savings can result from the use of these ZGS materials.

For the producer of continuous glass fibre the zirconia grain stabilised alloys offer significant advantages. Working in partnership with glass plant designers, Johnson Matthey Metals has developed an advantageous method of fabricating bushing base plates. These may contain up to 2000 jets, with bore diameters as small as 1.1 millimetres, giving fibre diameters as fine as 6 micrometres. This proprietary process is used by Johnson Matthey companies throughout the world and it has also been licensed to a number of other organisations, the most recent being a glass fibre production plant in Polotsk, U.S.S.R. To date in excess of 30,000 base plates have been made by this process.

A thorough understanding of the needs of the nitric acid manufacturer has enabled Johnson Matthey Metals to develop an improved system for recovering platinum metals lost from catalyst gauzes during the ammonia oxidation reaction. The gold-free Plus-Pac™ recovery system enables customers to achieve a combination of metal recovery and costs which best suits their particular needs. Depending upon the type of plant, recoveries of 70 to 85 per cent may be achieved, a marked improvement on the 50 to 60 per cent recovery which is typically obtained with the early gold-palladium catchment systems. Plus-Pac™ is generally supplied in the form of hinged quadrants, so reducing both transport and installation difficulties.

The Electroplating of Platinum

Platinum deposited from aqueous electrolytes is generally brittle, it may be poorly bonded to the substrate and highly stressed. As a consequence coatings can suffer from spalling and delamination, so deposits are usually restricted to thicknesses of 12 micrometres or less. In contrast the deposition of platinum from fused salt electrolytes enables thick, ductile coatings to be produced on a variety of metals and alloys including nickel, niobium, palladium, stainless steel and tantalum. These coatings are of high purity, adherent and notably free from porosity. Where necessary they may be up to 150 micrometres thick, and the surface finish can either be matt or drawn bright. Fused salt platinum plated molybdenum and tungsten wires are used in the manufacture of halogen lamps and electronic valves, where a combination of high temperature refractoriness and oxidation resistance is required. The remarkable throwing powers of the fused salt electrolyte also enables complex shaped superalloy turbine blades to be coated to a high degree of uniformity. In addition the fluxing action of the electrolyte overcomes the adhesion problems frequently associated with plated titanium, so enabling soundly bonded platinum titanium composites to be produced for use as cathodic protection electrodes.

Since platinum first began to excite the interest of the world's scientists, gifts and loans of metal and the ready exchange of experimental results have facilitated the determination of its properties, and the identification of applications. A continuation of this co-operation will ensure that the valuable properties of platinum and its allied metals are further employed to satisfy the growing needs of the high technology industries. I.E.C.

Polymer-Protected Platinum Metals Catalysts

Tailored Metal Catalysts, Catalysis by Metal Complexes

EDITED BY Y. IWASAWA, Reidel, Dordrecht, 1986, 333 pages, Dfl. 155,000/£42.95

Catalysis has been described as a technological field involving an enormous number of empirical facts intermixed with some general theories. The tailored design of metal catalysts is therefore a topic having an enormous scientific and technological potential, which has become an area of intense research activity since the early work on polymer-attached homogeneous metal complexes began in 1969.

This useful book reviews several topics involving the tailored design of metal catalysts, and the section dealing with polymer-protected colloidal catalysts reviews how polymer-protected colloidal dispersions of platinum group metals can be prepared, characterised and used to make tailored metal catalysts.

Polymer-protected colloidal catalysts not only have the advantages that dispersed metal particles on an inorganic support have over metal powders—these being good dispersion through the use of the support, large surface area and a homogeneous system—but they also have important additional advantages. Colloidal dispersions readily transmit light, allowing them to be used as catalysts in photochemical investigations. The polymer also protects the metal colloid catalyst from deactivation by catalytic poisoning.

Since 1856 when Faraday first worked with gold to prepare monodispersed colloidal metal hydrosols, numerous reducing agents have been employed for the chemical reduction of metal ions. The chemical preparation of polymer-protected colloidal metals leads to three classes of product: a polymer wrapped around each individual colloid, a colloid distributed on or near the surface of the polymer, and the metal colloid distributed inside a polymer resin. In this volume typical examples are presented for the preparation of colloidal dispersions of platinum, palladium and rhodium protected by soluble polymers. Both water-based and alcohol-based reductions are discussed. By altering the reducing conditions the colloidal particle size can be controlled, allowing the activity of the catalyst as well as its selectivity in chemical reactions to be engineered.

In addition to protecting the colloid against aggregation and poisoning, the presence of the polymer provides a means of introducing multifunctionality into the catalyst, by the use of functionalised polymers. One example is the use of colloidal platinum protected by polystyrene resin containing sulphonic acid groups to act as a catalyst for both hydration and dehydrogenation processes. The sulphonated polystyrene acts both as the support for the platinum and as an acid catalyst for hydrogenation.

Continuing research in the field of polymer-protected colloidal catalysts will increase our understanding of these catalysts, and can be expected to lead to new and novel applications for them. M.A.J.P.