Platinum in Cardiac Pacemakers

MATERIALS FOR IMPLANTATION IN THE HUMAN BODY

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Articificial pacing of the heart is one of the earliest examples of electronic equipment applied to the long term treatment of patients rather than to its usual role of diagnosis. The heart pacemaker is a device which is totally implanted in the body and which provides a small electric shock to the heart to make it beat at the correct rate. This is required in patients who have a clinical condition in which the heart rate falls to 30 to 40 pulses per minute instead of the required 70 to 80 pulses per minute.

The standard method of pacing the heart is by an endocardial electrode, which is an insulated wire with a contact tip of platinum, inserted down the external jugular vein into the right ventricle of the heart. The pacemaker unit itself is inserted either over the patient's pectoral fold or in the right upper quadrant of the abdomen.

The development of a totally implanted pacemaker depends upon the ability to produce a small sterilisable unit which is inert in body tissue. The electronic circuitry presents few problems apart from the power source, which takes up about two-thirds of the volume of a pacemaker and for which mercury cells are commonly used. The only British manufacturer of an implanted pacemaker is Devices Implants Limited of Welwyn Garden City in Hertfordshire, a firm which has been developing and manufacturing them for many years. For their pacemakers, all components must pass strict mechanical, electrical and body compatibility tests.

The only metallic materials which have proved completely safe when implanted in the severe environment of the human body are platinum and 10 per cent iridium-platinum alloy, because of their remarkable resistance to corrosion. The latter is used on the pacemaker as the indifferent or earth return electrode, which can be clearly seen in the illustration.

The major problem still facing the manufacturer of any implanted active system is that of the power supply. The mercury cell produces 1.35 volts and will run for approximately $2\frac{1}{2}$ to 3 years in a pacemaker. This means that every $2\frac{1}{2}$ years the patient has to have the pacemaker removed and a new one inserted.

There are many interesting new approaches to the power supply problem. One of these is a biogalvanic cell utilising the oxygen available in the body. This oxygen is reduced

A heart pacemaker unit made by Devices Implants Limited. Not shown is the wire leading from it to stimulate the heart itself. The pacemaker unit contains the power supply. The large disc is the earth return electrode which is fabricated from 10 per cent iridium-platinum alloy in the cell using platinum black on a platinum grid as the catalyst. Another approach is the isotope battery, in which the heat generated by the radioactive isotope plutonium 238 is converted to electrical energy using a thermopile.

It is hoped that, by new methods of powering pacemakers, patients will be able to have trouble-free pacing for a period of at least five years. After discharge from hospital following an implantation the patient can lead a normal life, returning to hospital for checks from time to time to make sure that all is well with the system. Thousands of people who would otherwise be totally incapacitated are working and enjoying life again thanks to cardiac pacemakers for which the platinum and 10 per cent iridium-platinum electrode materials were supplied by Johnson Matthey Metals Limited.

Analytical Chemistry of the Platinum Metals

PROCEEDINGS OF THE SOUTH AFRICAN SYMPOSIUM

Techniques for the analysis of the platinum group metals and their alloys and compounds are receiving greater attention as the number of their applications increases and as the circle of consumers, refiners and producers widens. This was recognised by the holding in February of last year of a special symposium on "Analytical Chemistry of the Platinum-group Metals" at the National Institute for Metallurgy, Johannesburg. The symposium was attended by many of the most prominent workers in this fascinating field of modern inorganic chemistry. Fifteen of the 21 papers presented there have now been published in the Journal of the South African Chemical Institute (1972, **25**, (3), 155–319).

As an introduction J. T. Moelwyn-Hughes (University of the Witwatersrand) gives a general survey of the chemistry of platinum metals and indicated studies which should lead to improved analytical schemes.

G. H. Faye and P. E. Moloughney (Canadian Department of Energy, Mines and Resources) described techniques for the separation and collection of precious metals using tin and showed that it is an efficient collector for all eight precious metals. R. V. D. Robért et al. (National Institute for Metallurgy) showed that nickel sulphide has several advantages over lead as a collector, except in the case of gold. A comparison of fire assay, aqua regia leach and high temperature chlorination treatments of ores and concentrates was made by I. Palmer et al. (N.I.M.) showing their general agreement, except that recovery of platinum from an ore was markedly greater by the leach methods.

Chromatographic separations of the non-volatile platinum metals on cellulose columns were shown by C. Pohlandt et al. (N.I.M.) to be relatively simple and rapid. F. von S. Toerien et al. (S.A.A.E.B.) indicated a possible series of separations of some noble metals from base metals by ion exchange.

The interferences which may be encountered in atomic absorption methods were discussed by R. G. Mallett et al. (N.I.M.) together with methods to overcome them. The graphite rod furnace technique was shown by B. D. Guerin (N.I.M.) to be useful for very low levels of the noble metals (except osmium) and the technique of pressure dissolution prior to atomic absorption was shown by D. C. G. Pearton et al. (N.I.M.) to be very effective.

J. Turkstra et al. (National Nuclear Research Centre) showed that neutron activation methods they used were not too successful on ores and flotation concentrates. A spectrographic method used by R. A. Snodgrass (South West Africa Co. Ltd.) for determining platinum group metals in gold-bearing ores encountered difficulties because of the heterogeneous distribution of the osmiridium. K. Dixon and T. W. Steele (N.I.M.) found that a spectrographic technique for determining noble metals in solution using the rotating disc method had adequate sensitivity and precision when base metals were absent.

A new method presented by P. W. Gerrard and W. Westwood (Johnson Matthey & Co. Ltd.) was concerned with the application of membrane filtration and X-ray fluorescence examination of the thin layer on the filter. B. G. Russell et al. (N.I.M.) described X-ray fluorescence analysis of ore, nickel sulphide mattes, ion exchange resins, and matte leach residues. Methods for the determination of osmium and ruthenium were reviewed by G. H. Faye. W. W.