Increasing Applications for Iridium

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In recent years the rapid development of computer and telecommunication technology, together with North Sea oil rigs and deep space probes, has resulted in a demand for new iridium products. Iridium is unique in having a high melting point (2443°C) coupled with significant oxidation resistance, and is the only metal with good mechanical properties in air at temperatures above 1600°C.

The largest growth area has been for iridium crucibles suitable for growing oxide single crystals such as gadolinium gallium garnet (GGG) and yttrium aluminium garnet (YAG). GGG and YAG are used for computer memory devices and solid state lasers, respectively. The crystals are grown by melting presintered burdens of mixed oxides in an iridium crucible under oxidising conditions at temperatures up to 2100°C, using the Czochralski technique. The increasing demand for larger sizes of these crystals has caused the size of crucibles required to increase from a volume of 80 cc to 6280 cc necessitating a corresponding increase in wall thickness from 1.5mm to 4.0mm. Various techniques have been used to manufacture iridium crucibles such as fabrication from hot rolled sheet, hot spinning, fused salt plating on to a mandril, powder metallurgy and, in more recent times, the latter followed by hot isostatic pressing. Fabrication from hot rolled sheet is the only technique which consistently produces crucibles meeting the stringent requirements of dimensional tolerances together with a structure which contains a minimum number of defects.

The Noble Metals Group of Johnson Matthey Metals Limited has developed soft and ductile iridium sheet with a maximum metallic impurity content of 2000 ppm. The production process used can control the principle impurity elements of tungsten and iron and reduce all other non platinum group metals content to a level of 1 to 30 ppm. This sheet can be satisfactorily formed in one operation into cylinders for flat bottom crucibles, or hot pressed to produce the bases for round bottomed crucibles with

Used for melting the mixed oxides from which gadolinium gallium garnet single crystals are grown, this flat bottomed iridium crucible is one of the larger sizes, having a diameter of 180mm and a capacity of 4330 cc

diameters up to 200mm. All welds in the finished crucibles are X-rayed to check that they have no significant porosity, and are crack free.

A smaller, but growing market exists for the radioactive isotope iridium 192, used as a portable gamma ray source. These are typically used for radiographing pipe lines, rigs, and other civil engineering structures, and for radiation therapy treatment of cancers. The iridium is supplied to radiochemical companies generally as fine wires or as discs 0.5 to 3.00mm in diameter, with a thickness of 0.1mm up to 3mm. Even larger slugs of iridium, 6mm in diameter and 10mm thick, may be supplied. The isotope 192 is produced by irradiating the iridium wires, discs or slugs consisting of the natural isotopes of iridium, namely 191 and 193, in a nuclear reactor. However of the two isotopes only 30 per cent of the natural iridium occurs as 191 which produces the useful isotope 192.

A thorium-iridium alloy has been developed by Oak Ridge National Laboratory in the United States of America. Tests carried out at Johnson Matthey Metals, Wembley have shown that the addition of 60 ppm of thorium to iridium halves the rate of oxidation and increases its stress rupture life by 50 per cent at 1500°C. This alloy has been used by NASA as a containment vessel for plutonium in the thermoelectric generators used on deep space probes, while a similar alloy with a higher thorium content has been used as long life spark plug electrodes for aero piston engines. The addition of 1000 ppm of thorium to iridium prevents grain growth in the heat affected zone of welded iridium electrodes and improves the erosion resistance. Indeed the erosion resistance of iridium surpasses that of all other materials in this electrode application.

The unique combination of properties of iridium suggests that its use will increase as other new applications emerge.

Platinum Metals in Biomedical Engineering

Pacemaker Leads, Progress in Biomedical Engineering, Volume 2

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Over the past quarter of a century notable advances have been made in the performance and reliability of the electronic systems that are used to provide cardiac pacing. Problems remain, however, and to seek solutions to some of these an International Symposium on Pacemaker Leads and electrodes was held from the 5th to the 7th September 1984 at the Catholic University of Leuven, Belgium. Now fifty-nine of the invited lectures and contributed papers have been published in the Proceedings which provide a clear picture of the present state of the art. They also serve as a useful introductory guide to the subject.

Pacemaker leads have two main functions: to conduct electrical pulses to the heart and to sense intra-cardiac signals and transmit these to the pulse generator. The performance of the electrode at its interface with the cardiac tissue is crucial to the satisfactory functioning of the pacing system and many of the papers considered the size and geometrical configuration of the electrode tip, the material of construction and the condition of the surface.

On account of their biocompatibility and corrosion resistance, coupled with their electrical properties, platinum and platinum alloys became the preferred materials for electrodes during the 1970s, although carbons, titanium and multi-component base metal alloys also find application. In order to improve further the results obtained with these materials, engineering modifications to the electrodes continue. In earlier years, lead dislodgement was a problem but now this may be overcome by the use of hooked, screw-in or tined electrode tips. To improve sensing amplitudes and achieve the lowest possible threshold values a variety of electrodes have been constructed. Platinum tips may be in the form of ball-tips, discs, half domes or rings, and the surfaces may be polished, etched, porous or even laser drilled.

Amply supported by references, this book is likely to become a standard source of information on pacemaker leads. Collaboration between people from many different disciplines has enabled cardiac pacing to achieve very considerable success. This evolution must be continued, and therefore these Proceedings are commended to the readers of this journal.