in the many membrane-type chlorine cells.

There is no longer justification for continued heavy expenditure on chlorine cell anode coatings. This does not mean that further worthwhile improvements cannot be made (25). Apart from the continuing desire for cost effective use of noble metals, the industry has to live with fluctuations in the noble metal base prices in deciding which coating to use for specific applications.

The concluding part of this paper will appear in the next issue of *Platinum Metals Review* and will deal with the development of oxygen electrodes for widely ranging types of electrochemical application, some of which function at very high current density – electrogalvanising – and others at extremely low values, such as impressed current cathodic protection of rebars in concrete.

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Electroless Platinum Deposition for Medical Implants

The metallisation of polymers enables such materials to be used in a wide range of industries, such as automotive, and in electronic applications. Most recently, the electroless deposition of metal onto polymers is finding use in medical applications for fabricating electrodes used in implantable medical devices. Platinum, being biologically inert, is one of the metals used to coat implantable electrodes. However, as metallic deposition only takes place on conducting surfaces, it is necessary to metallise, or seed, the non-conducting polymer prior to electroless deposition. A suitable catalyst is thus required to provide the insulating surface with conducting properties.

In commercial electroless platinum deposition a tin sensitiser and a palladium chloride, $PdCl_2$, activator are used to provide the catalytic centres, but tin is toxic and therefore unsuitable for use in medical implants.

Now, researchers based at the Royal North Shore Hospital in Sydney, Australia, describe a method for the electroless deposition of platinum onto films and fibres of polyethylene terephthalate (PET) using a new tin-free catalyst to activate the PET surface (Z. Rao, E. K. Chong, N. L. Anderson, M. G. Stevens, R. Driver and K. V. Paulose, *J. Mater. Sci., Lett.*, 1998, **17**, (4), 303–305). The catalyst was made by dissolving $PdCl_2$ into dimethylsulfoxide (DMSO).

The electroless deposition of platinum onto PET involved a number of steps with thorough rinsing in de-ionised water between each step. The PET films or fibres were first carefully washed to remove wax or oil residues, followed by etching in a hot alkaline bath consisting of sodium hydroxide and a surfactant. The etching roughened the PET surface and this allowed better adhesion for the platinum coating, by mechanical interlocking between the coating and the surface. The PET samples were then dipped into the DMSO-Pd catalyst, followed by dipping into a reducer of an aqueous solution of hydrazine at room temperature. Lastly, catalysed samples were immersed in an electroless platinum deposition bath preheated to 60°C.

The resulting electrolessly plated platinum coatings were characterised by various techniques and compared with commercially available samples. Peel tests to evaluate the adhesion showed it to be good for platinum coatings of up to 200 nm thickness, but thicker coatings were less adhesive.

Palladium was present on the PET surface in metallic form but with an irregular distribution. These very fine palladium particles or clusters may act as catalytic sites for the subsequent electroless platinum deposition. However, as platinum deposition appeared to start simultaneously over all the catalysed PET surface, the role of the palladium is unclear, and further studies are required. This tin-free catalyst may thus find use in producing adhesive platinum coatings for implantable medical applications.