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Platinum Cladding for High Temperature Alloys

Materials which retain their strength at high temperatures and remain ductile are needed for use in hydrogen-fuelled engines for hypersonic vehicles, in heat exchange tubes operated at 1260°C and combustion chamber linings. Molybdenum-based alloys can provide the strength at temperatures up to 1300°C, and adding rhenium improves ductility and lowers the ductile to brittle transition temperature. Molybdenum-47 weight per cent rhenium alloy is suitable, but rapidly undergoes oxidation in these arduous conditions. Therefore if protection from oxidation could be provided by a non-reactive and impermeable barrier its service life might be increased.

Researchers from NASA Langley Research Center in Virginia, U.S.A., have used platinum to clad the molybdenum-rhenium alloy, relying on its high melting point (1790°C) and chemical inertness at high temperature. (R. K. Clark and T. A. Wallace, *Scr. Metall. Mater.*, 1994, **30**, (12), 1535–1540). Disk shaped alloy samples were foil diffusion bonded with platinum of thickness 0.0178 cm, by placing each sample in a platinum sandwich, wrapping in graphite foil and applying hot isostatic pressure for 10 hours at 1094°C. Platinum cladded and unprotected disks of molybdenum-rhenium then underwent high temperature dynamic and static testing.

Oxidation effects on the alloy and interactions between alloy and cladding were examined, and while unprotected disks had catastrophic oxidation under dynamic oxidation at 595°C, the platinum cladding gave good protection from oxidation under both static and dynamic conditions for moderate times of 12.5 hours at 1260°C. The cladding also remained fixed to the alloy during the dynamic testing.

Rhodium in Glucose and Lactate Sensors

Amperometric enzyme microelectrode array strips are used to monitor clinical, environmental and industrial conditions, in particular to detect physiological substances such as glucose and lactate in small volumes of blood. Disposable sensor strips are used by diabetic patients to monitor their blood sugar levels. These sensors are manufactured by microelectronic technology using screen printing or lithography, with the reactive enzymes being immobilised in the microdisk pores by gel entrapment, cross-linking or covalent binding.

Now, researchers at the New Mexico State University have fabricated amperometric enzyme strips in a one-step electrochemical immobilisation using rhodium codeposited with enzyme to fix the enzymes in the pores of the disks. Rhodium lowered the overvoltage, giving very high specificity towards glucose, and offered not only an efficient way to retain the enzyme in the micropores, but also produced strong and preferential electrocatalytic detection of the liberated hydrogen peroxide, (J. Wang and Q. Chen, *Anal. Chem.*, 1994, **66**, (7), 1007–1011).

Using rhodium particles to fix the enzyme has removed the need for the membrane barriers and offers highly selective, fast and sensitive monitoring for mass produced reliable diagnostic strips.