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Platinum-Modified Coatings on Gas Turbine Blades

PROMISING TRIALS ON LONG-RANGE MARITIME PATROL AIRCRAFT

First-stage high pressure blades on advanced gas turbine engines must operate at elevated temperatures under highly stressed conditions in extremely oxidising environments which, in many cases, contain fuel contaminants such as sulphur and vanadium, and also ingested salts. Under such conditions the blades may be degraded by the phenomenon known as hot corrosion. One way of maintaining the properties of such blades is to coat the base metal superalloy with a protective outer layer, and aluminide coatings are widely used for this purpose. Platinum aluminides offer improved corrosion resistance, however (1).

Having experienced an unacceptable rejection rate of high pressure turbine blades, the Australian Department of Defence initiated a programme to find a protective layer which was more durable than the conventional aluminide coating applied to first-stage blades by engine manufacturers, and the results of a metallographic examination of platinum-modified aluminide coatings after 750 hours of engine operation have been reported (2). The same researchers have now presented a comparative study of the behaviour of various coating systems on the first-stage high pressure blades in the engines of two long-range maritime patrol aircraft (3).

In their experience, approximately 60 per cent of the first-stage turbine blades coated with conventional nickel aluminide were rejected after 2000 hours due to failure of the coating, and almost all of the remainder were discarded after a further 2000 hours. With the aim of finding a coating that would serve for 4000 engine operating hours they have assessed: nickel aluminides supplied by two different vendors, platinum-modified aluminide, platinum-plus-rhodium-modified aluminide, silicon-modified aluminide, and manganese-plus-chromium-modified aluminide layers. After 1000 hour trials certain behavioural trends were evident, and the condition of the blades coated with the noble metal-modified aluminides was generally better than that of the others. Only minor degradation was apparent on the blades coated with the two noble metal-modified aluminides, and it was concluded that they may be able to achieve the required lifetime of 4000 hours.

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New Sensor for Carbon Dioxide

None of the traditional methods of determining carbon dioxide in atmospheres is particularly applicable to development in cheap, portable sensors. However, a recent paper describes an amperometric sensor which offers these desirable features. Based upon a porous electrode in a three-electrode cell, the electrolyte consists of a copper diamine complex in aqueous potassium chloride (J. Evans, D. Pletcher, P. R. G. Warburton and T. K. Gibbs, *Anal. Chem.*, 1989, **61**, (6), 577).

The working and counter electrodes consist of porous polytetrafluoroethene disks spray coated with a platinum layer. The cathode is held at a constant potential; when the solution is contacted by a carbon dioxide-containing atmosphere its pH decreases, this results in the formation of Cu^{2+}, and a current which is strongly dependent on carbon dioxide concentration is observed from the sensor.