

The authors point out that the pre-treatment of the refractory metal is of the utmost importance, total failures occurring when an inadequate procedure was employed. Indeed a considerable part of the report is concerned with this aspect of the problem, and a table of procedures found to be satisfactory is included. Thick, adherent deposits of platinum and palladium could be formed on some metals after a cathodic pre-treatment in an alkali cyanide fused salt mixture containing platinum ions.

Stress measurements of the deposits were taken in a number of instances, and electron probe studies on the effect of high temperature anneals on interdiffusion are reported; little diffusion of the deposit into the substrate took place but diffusion of substrate into deposit was extensive.

This investigation adds a great deal to our knowledge of heavy platinum metal deposition and is to be commended to those working in this field.

J. H.

Effectiveness of Platinum Fuel Cell Catalysts

POSSIBLE ROUTES TO IMPROVEMENTS IN ECONOMICS

Throughout the massive literature on fuel cell research and development run two consistently recurring but conflicting strains; one, the acceptance of platinum as the most effective electrocatalyst, and the other the need to increase its effectiveness—and thus to reduce the amount of metal required—on economic grounds. This problem has been discussed at almost innumerable conferences, and will doubtless remain a lively issue for a long time.

A useful restatement of the position, together with some attempts towards a solution, are contained in three papers recently emanating from the General Electric Research and Development Center, Schenectady. In one of these E. J. Cairns and E. J. McInerney (*J. Electrochem. Soc.*, 1967, **114**, (10), 980) set out the possible routes towards improving the economics of an otherwise feasible fuel cell system operating by the direct anodic oxidation of saturated hydrocarbons as:

- (1) Make more effective use of the platinum by preparing higher area blacks.
- (2) Prepare very high-area platinum on a support which can act as a current collector and perhaps also as an enhancement to the platinum activity.
- (3) Alloy the platinum with other metals in such a way that more activity per unit weight of platinum is obtained.
- (4) Replace the platinum with a less costly, but effective, electrocatalyst.

These authors discount the fourth method, primarily on grounds of resistance to corrosion, and go on to report their work along

approaches (1) and (2). Both the use of higher activity forms of unsupported platinum, particularly one reduced from Adams' catalyst, and the use of carbon-supported platinum were found to be more effective in reducing the amount of platinum required for a given amount of power. In the case of a propane-oxygen fuel cell, a carbon-supported platinum electrocatalyst was able to reduce the amount of platinum required by a factor of around 10 and the view is taken that further improvements are likely.

In the two other papers from General Electric, L. W. Niedrach, D. W. McKee, J. Paynter and I. F. Danzig (*Electrochem. Tech.*, 1967, **5**, 318 and 419), adopting approach (3), are concerned more with fuel cells operating on reformer hydrogen in which resistance to catalyst poisoning by the carbon monoxide impurity in the gas is of major importance. Ruthenium-platinum catalysts prepared by a modified Adams' procedure were found to be markedly more resistant to poisoning than platinum, particularly in the temperature range 65 to 85°C, optimum performance being obtained with catalysts containing about 30 weight per cent ruthenium. The second paper reports similar work on iridium-platinum and rhodium-platinum catalysts, these also showing an exceptional tolerance for carbon monoxide in hydrogen. Such binary mixed oxides were first prepared, and found to have exceptional catalytic properties, by G. C. Bond and D. E. Webster (*Platinum Metals Rev.*, 1965, **9**, 12; 1966, **10**, 10) in the Johnson Matthey Research Laboratories.

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