cent of their magnetisation at 200°C. Initial coercivity is, however, between five and ten times greater than other highly stable magnets such as the Alnico and Vicalloy types, and this advantage should be maintained with magnetisation losses of this order, or even higher. Moreover, their high coercive force allows short cobalt-platinum magnets to be used in applications where the limitations imposed by poor geometry would override the effects of stability at temperature. In these circumstances, the arbitrary fixing of a maximum utilisation temperature at 200°C would almost certainly give a pessimistically low figure.

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The Surface State of Platinum Electrodes

The surface of platinum was long thought to owe its great inertness entirely to the thermodynamic stability of the metal. It is now known to carry—in certain conditions—oxide films of the same type that confer passivity on less noble metals. For some important uses of platinum—such as for the preparation of reversible oxygen electrodes and for both anode and cathode in certain types of fuel cell—the presence or absence of such films is of vital importance. Fortunately a clear knowledge of the surface state to be expected in various conditions can now be obtained by modern electrochemical and other physico-chemical techniques.

J. P. Hoare of the General Motors Corporation has shown, in a series of papers (1), that the theoretical reversible oxygen electrode potential of 1.229 V, nhe, can only be attained by platinum if it has on its surface a chemically inert but electron-conducting oxide film. Previously, workers in this field have extrapolated anodic and cathodic logarithmic polarisation curves back to their point of intersection in order to obtain values of the exchange current density, and reversible potential (2,3). This graphical solution assumes that the rate constants for both the forward (evolution of oxygen) and reverse (ionisation) reactions are similar. This in turn implies that the substrates which catalysed the reaction are similar, and in this case oxidised.

Two recent communications from the Electrochemical Laboratory of the University of Pennsylvania have helped to clarify the problem and provide some experimental evidence to show that, under controlled conditions, it is legitimate to extrapolate the logarithmic polarisation lines to obtain useful information about the reversible oxygen-electrode. Reddy, Genshaw and Bockris (4) have confirmed, by an ellipsometric technique, that a phase oxide does not form on a platinum electrode in acid solution until the surface has attained a potential of +0.98 V, nhe, in good agreement with previously coulometric measurements. Below this potential, and down to about 0.40 V, oxygen is adsorbed to give a layer probably less than a monolayer thick. It can be appreciated that this restricts the cathodic polarisation measurements that may be made on an oxidised surface, and that below about 1.0 V, the surfaces may or may not be oxidised.

More recently Damjanovic and Bockris (5) have shown that it is possible to obtain measurements at an oxidised cathode if they are made quickly. The reproducibility is not very good, even under the most stringent experimental conditions, but the cathodic curves obtained at oxidised surfaces do, when extrapolated to meet the extrapolated anodic curves, give the reversible potential as earlier found by Hoar (2). The cathodic polarisation curve obtained at a bare (pre-reduced) surface, however, was found to be quite different, with different parameters, showing a considerably greater current at the same potential. These authors conclude that the surfaces at which T. P. Hoar (2) and Bockris and Huq (3) obtained their cathodic polarisation data were indeed oxide covered, as were the surfaces under anodic polarisation.

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References

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