

10 per cent for platinum) additional metal is progressively less fully utilised. It is clearly important to work in the region where the metal is being efficiently used, and since these critical concentrations may vary from one reaction to another, the rate dependence on metal concentration needs to be examined for each new reaction studied.

The effect of these experimental variables on the rate of the hydrogenation of nitrobenzene is typical of catalysed reactions carried out in the liquid phase. However, in this reaction only one final product is possible: the problem of catalyst evaluation becomes more severe when, as in the hydrogenation of alkynes or unsaturated aldehydes, more than one product is possible and the catalyst must be chosen for its selectivity as

well as its activity. These additional problems will be dealt with in a later article.

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References

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Hydrogen Diffusion through Silver-Palladium Foil Electrodes

For several years silver-palladium foil electrodes have played an important role in the development of certain fuel cell systems. Their use depends on the ability of hydrogen to diffuse continuously through the alloy under the action of a concentration gradient. At the same time the metal acts as an electron donor to the electrolyte on one side of the foil, thus providing an anode when coupled to a counter-electrode in a hydrogen/oxidant fuel cell.

The Research Laboratory of Siemens-Schuckertwerke AG, Erlangen, have recently reported their studies on the influence of the hydrogen concentration within the alloy on the hydrogen diffusion coefficient in a paper presented by Dr A. Küssner at the June meeting of the Deutsche Gesellschaft für Metallkunde. Circular foil electrodes, about 5 cm diameter and consisting of 23 per cent silver-palladium alloy foil 12 microns thick, were provided by Johnson Matthey and investigated in the temperature range 30 to 75°C. A potentiostatic method was used, and internal atomic hydrogen concentrations up to 40 per cent were obtained in the alloy by charging it cathodically to predetermined potentials.

It was shown that the diffusion coefficient depended strongly on the internal hydrogen

concentration; the former passed through minima and maxima at approximately 15 and 35 atomic per cent respectively throughout the temperature range in which observations were made. An explanation for this behaviour was sought by considering the state in which the hydrogen exists during its passage through the metal. This is still a controversial topic; one theory, supported by the decrease in the metal's magnetic susceptibility with increasing internal hydrogen concentration, suggests the dissociation of hydrogen into protons and electrons. Additional evidence in support of this view lies in the migration of dissolved hydrogen to the negative end of a palladium wire when an electric current is passed through it. Alternatively, it is also suggested that the dissolved hydrogen forms one or more hydrides that are strongly polarised to yield hydride ions. Their migration through the metal lattice gives rise to hydrogen transport. Thermodynamic considerations of his results led Dr Küssner to favour the hydride theory.

Experiments with silver-palladium foil electrodes containing small percentages of boron and carbon to increase their hardness gave closely parallel results when compared with the simple binary alloy.

H. C.