

and Rempel for maleic acid hydrogenation also involved an alkyl intermediate. At the moment it cannot be firmly stated that isomerisation is associated with hydrogenation, and it may proceed quite independently; but several observations suggest that it requires (or at least is facilitated by) molecular hydrogen.

### Oxidation

The partial oxidation of olefins catalysed by Pd<sup>II</sup> salts received surprisingly little attention at this meeting, only the paper by D. Clark, P. Hayden and R. D. Smith (I.C.I. Heavy Organic Chemicals Division) treating this area. It is now well appreciated that oxidation of olefins in the presence of acetic acid and Pd<sup>II</sup> gives rise to a variety of products whose concentration can be varied over

a wide range by altering reaction conditions. The authors reported for example that, when oxidising ethylene with Pd(OAc)<sub>2</sub> as catalyst in the presence of acetic acid, increasing the chloride ion concentration from zero to 2M decreased the yield of vinyl acetate from 85 to 1 per cent, and increased the yield of diacetoxyethane from zero to 80 per cent (based on total products). Much further work is required before we can hope to understand this extremely complex system.

### Conclusion

Both the areas of hydrogenation and oxidation continue to receive the keen attention of academic and industrial scientists alike. Much new and fascinating chemistry is appearing, although the day of its industrial exploitation may not be yet at hand.

## Electrochemistry and Heterogeneous Catalysis

A symposium on "Electrocatalysis" was held at the Technological University, Eindhoven, on November 21st and 22nd, and was attended by some 120 people, mainly from continental Europe. The purpose of the meeting was to bring together workers from the fields of electrochemistry and of heterogeneous catalysis for, although both are intimately concerned with the behaviour of surfaces and of adsorbed intermediates, there are all too few opportunities for the exchange of ideas and information in this area. Work performed in recent years on surface morphology at the atomic scale using techniques such as field-emission microscopy and low-energy electron diffraction has greatly influenced thinking about catalysis but seems not to have much influenced electrochemists. Conversely recent work on the mechanism of electrode processes and the influence of electrode structure on efficiency has not yet been received into the canon of heterogeneous catalysis.

Each author designed his paper to instruct persons not of his discipline concerning some aspect of his subject: some were inevitably more comprehensible and helpful than others. The one theme which ran through many of the papers and much of the discussion was that of the relation between bulk properties

and surface reactivity. Professor W. M. H. Sachtler (Leiden) argued on the basis of his own work on the behaviour of Group VIII<sub>3</sub> - IB alloys that each atom in the surface acts independently and that therefore the collective electron model is not the right one to use. Dr J. N. Butler (Tyco Laboratories, Waltham, Mass.) produced results which showed some of the limits of the "chemical" approach to alloy properties. He with his associates had studied the hydrogen evolution reaction on dilute amalgams of palladium and platinum, and had found they behaved just as mercury. A platinum amalgam containing 0.03 per cent platinum should have increased the exchange current density by more than 10<sup>6</sup> fold, and Dr Butler concluded that the absence of surface structure might have been responsible for the lack of effect. Reporting on an extensive study of platinum black as a fuel cell catalyst, Dr Butler said their results indicated particle size to be the most important factor, and that stored energy had no effect on electrocatalytic efficiency.

The symposium served a useful purpose, but more frequent meetings of this kind are essential if the trend towards the compartmentalisation of science is to be arrested.

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