supported rhodium aggregates but here carbonylation led to a break-up of the aggregate and the formation of mobile mono-nuclear carbonyl species.

Conclusions

Here it has only been possible to cover a small part of the work reported which, as remarked on earlier, is very concentrated. Many of the other papers are interesting inasmuch as they suggest new techniques, and by analogy, new possibilities for following new directions in research. All papers are of a very high standard, and the comprehensiveness makes this a valuable source of up-to-date reference material.

After five conferences in this series on homogeneous and heterogeneous catalysis it is clear that the discussions engendered are very fruitful. This area of study is still expanding and developing, but there is clearly a long way to go before man can even start to approach nature's enzymes in their efficiency and selectivity.

J.W.J.

Corrosion in Nitric Acid Plants

The use of stainless steels for the heat exchangers in nitric acid plants is widespread, although nickel based alloys are finding application in the newer plants. These steels are subject to corrosion by the reaction products, mainly nitric acid, which are produced during the oxidation of ammonia over platinum-rhodium catalyst gauzes. Such corrosion can lead to premature failure of components, resulting in unscheduled plant shut down and reduced production of nitric acid.

In practice, this corrosion is particularly prevalent on parts subjected to tensional stresses and, in an attempt to understand the factors that contribute to this enhanced corrosion, S. Ž. Kostić of Hemijska Industrija Pančevo, Yugoslavia, has examined the behaviour of two typical stainless steels in boiling nitric acid; in particular the influence of cold work and of galvanic coupling on the corrosion rate (*Br. Corros. J.*, 1987, **22**, (1), 53–55).

Kostić believes that galvanic coupling can result from the deposition of platinum-rhodium particles from the catalyst gauzes onto the stainless steel tubes. The loss of platinum from such catalysts during service is well known, of course, and has a significant impact on the process economics.

Samples of two steels, AISI 304L (18Cr–8Ni) and 2RE10 (25Cr–20Ni), in strained and unstrained conditions, some in contact with platinum-rhodium, were exposed to boiling nitric acid (42–65% vol.), and corrosion rates and electrochemical corrosion potentials measured. The results for the 2RE10 steel indicate that the corrosion rate after 240 hours exposure is substantially increased when the steels are in the strained condition, and that galvanic coupling with platinum-rhodium leads to a dramatic increase in the rate of corrosion. However, these latter results are calculated on the basis of only 24 hours exposure and thus may give a distorted picture.

Anodic polarisation curves in 42 vol. per cent nitric acid measured on AISI 304L steel samples taken from damaged tube elbows, which have a surface deposit containing about 1wt. per cent platinum, show corrosion potentials in the range 1200–1700mV, approximately 300–800mV higher than the same steel before service exposure. The corrosion potential of the latter, typically 900mV, lies within the passive region of the anodic polarisation curve, while that of the "damaged" steel lies in the transpassive region of the curve. Kostić attributes the nobler electrode potential to the establishment of a mixed potential between the steel and platinum-rhodium in the surface deposit. Metallographic examination of "damaged" components and laboratory samples shows corrosion to be intercrystalline, attack being concentrated at chromium carbides in the grain boundaries.

The implication of these results for commercial practice is that the deposition of platinum-rhodium particles onto such stainless steel surfaces should be avoided, if possible, in order to inhibit enhanced corrosion and premature failure. Clearly the use of catchment systems would be beneficial here, since their prime purpose is to trap much of the platinum emitted from the catalyst during service, primarily to improve process economics. Such catchment systems have been shown to be very effective (see, for example, A. E. Heywood, *Platinum Metals Rev.*, 1982, **26**, (1), 28–32) and are being increasingly specified by major nitric acid producers.

C.W.C.