

ruthenium catalysts for asymmetric hydrogen transfer reactions, such as the conversion of acetophenone to 1-phenylethanol by IR spectroscopy. A silica-immobilised catalyst was shown to exhibit good selectivity.

Earlier in the programme Professor D. Vogt (Eindhoven University of Technology), in a related talk, illustrated how the immobilisation of catalysts via carbosilane dendrimer supports, in conjunction with ceramic membranes, can remove the problem of separating products from a catalyst. In one example a palladium catalyst had been used to achieve the asymmetric hydrovinylation of styrene. The dendrimer-supported system was shown to achieve high local catalyst concentrations with site isolation overcoming deactivation.

Developments in Novel Media

Continuing with this theme, B.-J. Deelman (University of Utrecht-ATOFINA Vlissingen B.V.) talked about fluororous biphasic catalysis and A. J. Carmichael (University of Warwick) detailed opportunities offered by ionic liquids. Both presentations suggested methods for separating the catalyst from the products.

In the final presentation, Professor D. J. Cole-Hamilton (University of St Andrews) described work performed in supercritical fluids. Notable achievements included the illustration that tri-alkylphosphine complexes readily dissolve in the

supercritical fluid, have good activity for hydroformylation of alkenes and yield better selectivity for the desired straight-chain aldehyde than normal organic solvents. Furthermore, the construction of a flow reactor for supercritical fluid catalysis allowed the use of a biphasic approach involving ionic liquids in conjunction with supercritical CO₂. While the catalyst remained firmly dissolved in the ionic liquid, the aldehydes generated during catalysis were readily soluble in supercritical CO₂ and easily separated.

In summary, the symposium clearly illustrated the strengths and depth of organometallic chemistry and catalysis in the United Kingdom and The Netherlands. It will be interesting to see what new developments will be reported at the fifth meeting in this series, which is scheduled to take place in the U.K. in Sheffield in early 2002. Details of the next Symposium can be found by contacting Dr Michael Turner or Dr Anthony Haynes at the University of Sheffield.

References

- 1 B.-J. Deelman, *Platinum Metals Rev.*, 1999, 43, (3), 105; A. F. Chiffey, *ibid.*, 1998, 42, (1), 25; P. R. Ellis, *ibid.*, 1997, 41, (1), 8

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Chemical Fluid Deposition of Conformal Palladium Films

Thin films of palladium (Pd) and Pd alloys have many industrial applications, such as in catalysis, gas sensors and microelectronics, where Pd film is used as contacts in integrated circuits and as seed layers for electroless plating. Pd film is presently prepared by vacuum sputtering and electroplating, but for complex topographies consistent coverage is problematic.

High-purity, contour-following conformal Pd film may be prepared by chemical vapour deposition (CVD), but at temperatures > 200°C. A drawback to this is that low deposition temperatures are needed by microelectronics to suppress mechanical stress during device fabrication and to minimise interdiffusion and reactions between adjacent layers. The thickness of CVD-produced film also varies, giving inconsistent coverage for high-aspect ratio features.

Researchers at The University of Massachusetts, U.S.A., have now succeeded in depositing highly pure, conformal Pd films onto silicon wafers and polyimide at low temperature using chemical fluid deposition (J. M. Blackburn, D. P. Long and J. J. Watkins, *Chem. Mater.*, 2000, 12, (9), 2625–2631). This involves the chemical reduction of soluble organopalladium compounds in supercritical carbon dioxide (CO₂) at 40–80°C and 100–140 bar pressure.

Deposition by hydrogenolysis of π -2-methylallyl-(cyclopentadienyl)palladium(II) in CO₂ was completed in less than 2 minutes at 60°C, yielding pure, continuous, 100–200 nm thick, reflective Pd films free from ligand-derived contamination. Conformal coverage was observed on a patterned silicon wafer with features as small as 0.1 μ m wide \times 1 μ m deep.