is then adsorbed in a bed of zinc oxide.

Epyx and Hydrogen Burner Technology are developing fuel-flexible 50 kW fuel processors and S. Ahmed (Argonne National Laboratory) showed that a 3 kW POX reformer is capable of reforming both hydrocarbon and alcohol fuels at below 800°C. W. Mitchell (Epyx Corporation) explained the integration of a 10 kW POX reformer operating on ethanol and California Phase II reformulated gasoline, which has high temperature shift (HTS) and low temperature shift (LTS) convertors, with a 10 kW preferential oxidation (PROX) CO clean-up reactor and a fuel cell stack. The reformer produced H_2 with < 1% CO for over 300 hours. The PROX reduced the CO to < 10 ppm, with a loss of 0.1 to 2% H_2 as water.

The development of higher surface area versions of commercially available shift catalysts for the fuel-flexible POX reformer (F^3P) was described by J. Cuzens (Hydrogen Burner Technology). Testing the HTS and LTS catalysts reduced CO levels from 16% to < 50 ppm under steady state operation and to 500 ppm under transient operation.

LANL have developed a 4-stage PROX reactor. Using inlet CO levels of 8000 ppm it was possible to achieve outlet concentrations of 35 to 50 ppm CO. The PROX will be integrated with the POX reformers being developed by Epyx and Hydrogen Burner Technology.

R. Dams (WCJB) showed progress in the JOULE project to produce a compact methanol steam reformer and a gas clean-up unit. Compact aluminium heat exchangers are used, where one face is coated with a commercial reformer catalyst (Cu/Zn) and a platinum group metal selective oxidation catalyst; the other face is coated with a Pt/AlO_2 combustion catalyst to promote burning of the fuel off-gas to raise the overall system efficiency.

Work at Loughborough University identified platinum/ruthenium catalysts as the most effective for the selective oxidation of CO with almost complete CO conversion at close to 100°C. In the JOULE project the reformer and CO units are typically operated at 275 and 160°C, respectively. Start-up times of 150 s have been achieved with CO contents of < 10 ppm and H_2 concentrations approaching 75%.

Asahi Chemical Industry Co. announced recently that a ruthenium-based selective oxidation catalyst produces < 1 ppm CO from reformate mixes, with no H_2 loss, at temperatures from –20 to 110°C. This approach could further improve selective oxidation reactors. In addition B. Vogel and colleagues (Fraunhofer Institute for Solar Energy Systems) had compared steam and autothermal reforming and found that the latter could decrease start-up times, at the expense of lower H_2 yields.

Future Costs

To conclude, there is much activity in developing PEMFCs; the technology is clearly capable of delivering clean electrical power. In addition, progress is being shown in reducing costs and in resolving fuelling issues. T. R. RALPH

Sixth Grove Fuel Cell Symposium

Ten years after the First Grove Fuel Cell Symposium, the sixth meeting in the series, entitled "The Competitive Option for Sustainable Energy Supply", will be held in London on 13th to 16th September 1999 at the Queen Elizabeth II Conference Centre. Attention will be focused on the achievements throughout this period with papers on technical progress and advances towards commercialisation. The contribution of the fuel cell to sustainable energy supplies will be of particular interest.

Further topics will include marketing developments and the science and technology of fuel cells. It is hoped that there will be demonstrations of various small-scale fuel cell applications.

Invited authorities from all sectors of the fuel cell industry, academia and government will speak. There will also be a poster display for which contributions are requested.

For further information contact Phillipa Orme, Sixth Grove Fuel Cell Secretariat, 12 Church Street, West Hanney, Wantage, Oxon OX12 0LN; tel: +44(0) 1235 868811; fax: +44 (0) 1235 868811; E-mail: p.orme@dial.pipex.com. The Grove Fuel cell website is at http://www.elsevier.nl/locate/fuelcell99.