for mobile power systems. There is an estimated market for 1 million electric vehicles per annum in the U.S.A., provided limitations on vehicle performance and range can be overcome.

Ross A. Lemons of Los Alamos National Laboratories pointed out that transportation accounts for 60 per cent of U.S. petroleum consumption, which could potentially be replaced by methanol. Studies have been carried out to compare various fuel cell systems for transportation, and solid polymer electrolyte fuel cell technology has been developed for this application. Work has focused on reducing catalyst loading and cost, increasing the power density, and operating the cells on hydrogen from reformed methanol. As part of the studies improved reformers have been developed, and fuel cell performance enhanced by making them tolerant of carbon monoxide in the fuel stream. The platinum loading for the proton exchange membrane has been reduced to 0.55 mg/cm^2 compared to the 8 mg/cm^2 typically required for aerospace applications, while increasing the performance to 0.9 W/cm^2 on hydrogen/air.

Improvements in methanol reformer design were given in a separate talk by N. E. Vanderborgh of the Los Alamos National Laboratories, in conjunction with workers at the Delco Remy Division of General Motors. Advances in polymer membrane electrode design were detailed by S. Gottesfeld also of Los Alamos, who pointed out that despite the significant advances currently being reported for proton exchange membrane cells, especially using modified electrodes to concentrate the noble metal at the electrode/electrolyte interface, only a small proportion of the platinum is currently being utilised, leaving considerable room for improvement. By adding small amounts of oxygen (2 to 5 per cent) to the reformate fuel fed to the fuel cell, poisoning by carbon monoxide can be substantially reduced, giving improved performance.

Proton exchange membrane cells are also being developed by Ballard Technologies Corporation, Canada, and performances of over 5 A/cm^2 have been demonstrated using an advanced membrane material produced by Dow. Several 2 kW stacks have been constructed by Ballard and are being evaluated for Autonomous Underwater Vehicles. J. K. Hoadley described the efforts by the Treadwell Corporation to construct proton exchange membrane cells for various aerospace and military applications.

Conclusions

Although the development of fuel cells has proven to be more difficult and slower than anticipated, the potential benefits of higher efficiency and freedom from pollution are becoming more apparent in an increasingly environmentally-conscious world. Commercialisation of the 200 kW combined heat and power unit offered by International Fuel Cells may trigger a much wider demand for fuel cells, and so help to speed up their implementation. The Japanese commitments to fuel cell technology, and the current success of their programmes, can be expected to result in further worldwide interest D.S.C.

Surface Area of Catalyst Gauzes

The surface restructuring and metal removal that results from catalytic etching of platinum alloy gauzes used for ammonia oxidation, or hydrogen cyanide production by the Andrussow process has been investigated on many occasions. However, no quantitative data has been published about the surface area changes that result.

This has now been remedied with the publication of a paper describing a cyclic voltammetric technique which enables many of the features associated with catalytic etching to be studied, and the surface area of platinum alloy gauzes to be measured accurately ("Catalytic Etching of Platinum Alloy Gauzes", D. R. Anderson, *J. Catal.*, 1988, **113**, (2), 475–489). Results presented show that the top gauze in a catalyst pack has the highest surface area, and the gauze surface areas decrease progressively through the pack. Values of 250 cm^2/g and 35 cm^2/g are quoted for the top and bottom gauzes, respectively, based upon the weight of a new gauze having a geometric area of 25 cm^2/g.