

module for this application. Performance targets are 540 mA/cm<sup>2</sup> and 684 mV per cell, with a cell active area of 1180 cm<sup>2</sup>. Small single cells operating under 2 bar pressure of hydrogen and oxygen have exceeded this target and shown excellent stability up to 18,000 hours, with only 2  $\mu$ V per hour decay. The cells comprised DuPont Nafion membranes and 4 mg of platinum/cm<sup>2</sup> electrode loading. Recent improvements in cell construction and water management have increased the current density to 700 mA/cm<sup>2</sup> at the rated cell voltage.

Emphasis on fuel cells for manned space missions is presently focused on the development of regenerative fuel cell systems, as evidenced by presentations from NASA, Los Alamos and the Hamilton Standard Division of United Technologies Corporation. The use of electrolyzers powered from solar arrays in conjunction with either alkaline or PEM fuel cells, to provide power during dark orbiting periods, offers the best opportunity as energy storage systems for the long duration space missions being planned for Mars and beyond. PEMFCs appear to be attracting favour due to their

potential for longer term catalyst stability compared to the alkaline systems.

## Conclusions

“Fuel cells are five years from commercialisation” has been a frequently used phrase for many years! We now, however, appear to have reached the time when this phrase can be stated more in truth than in false hope. Led by the Japanese companies, Fuji and Toshiba, the phosphoric acid fuel cell will soon become a practical reality for 50–200 kW combined heat and power applications. Worldwide concerns about pollution and global warming continue to increase, and in the coming years this will serve to broaden further the scope for commercialisation of these fuel cells. Similarly, a major new opportunity for the Proton Exchange Membrane Fuel Cell has opened up, with the start of programmes to build fuel cell/battery hybrid power systems for transportation, which could lead to the development of pollution free motor vehicles. As noted by several speakers, “the future for fuel cells is brighter now than ever before.”

G.A.H.

## Quasicrystals in Rapidly Solidified Alloys

Five-fold electron diffraction patterns were found in a rapidly solidified aluminium-palladium alloy in 1978. Although a number of quasicrystals have since been identified in particular alloys of aluminium with a platinum metal, no systematic study has been made.

Now a series of papers on the topic, reporting work carried out in the P. R. China, has been published in the *J. Less-Common Met.*, 1990, **163**, (1). An overview of quasicrystals in aluminium-transition metal alloys in general, and aluminium-platinum group metals in particular, is presented by K. H. Kuo (Pages 9–17). Aluminium-ruthenium and aluminium-osmium alloys have been studied by Zhong-Min Wang, Yi-Qun Gao and K. H. Kuo, mainly by transmission electron microscopy. They observed icosahedral quasicrystals in melt-spun ribbons of Al,Ru, but not in Al,Os. Decagonal quasicrystals form readily in the latter, but only rarely in the former (Pages 19–26).

Rong Wang, Lina Ma and K. H. Kuo have discovered decagonal quasicrystals in both rapidly solidified Al,Rh and Al,Ir, and in addi-

tion have found two new hexagonal aluminium-iridium phases (Pages 27–35). L. Ma, R. Wang and K. H. Kuo confirm the presence of decagonal quasicrystals in rapidly solidified Al,Pd, but not in Al,Pt (Pages 37–49).

## Grove Fuel Cell Symposium

The successful First Grove Cell Symposium, held in London, England during September, 1989, was reviewed here immediately after the conference (D. G. Lovering, *Platinum Metals Rev.*, 1989, **33**, (4), 169–177). A second meeting is now planned, and this will again be held at the Royal Institution, London, from 24th to 27th September, 1991.

In addition to those already engaged in fuel cell technology, the Symposium is expected to be of particular importance to people involved with advanced energy systems, and those responsible for energy and environmental policy making.

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