COMPACT CONDENSER FOR DIRECT METHANOL FUEL CELLS

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As more progress is being made in development of direct methanol fuel cell systems, the interest in their potential application is shifting from small (~ 150 W) portable systems, primarily intended for military applications, to larger (~ 50 kW) systems required by automotive industry. In order to address the kinds of issues associated with such systems, the Jet Propulsion Laboratory in Pasadena is currently building a 1kW prototype demonstration system for the SCAQMD and the CARB, two environmental agencies of the State of California. The fuel cell stack will contain 74 cells, each of which will incorporate membrane electrode assemblies of 400 cm^2 that will operate at 60^0C and deliver 140 mA/cm^2.
The system will enable delivery of 1 kW of power at any humidity and over a temperature range of 25 to 40^0C.

Critical to satisfying the design requirements is a new concept of a compact heat exchanger – condenser developed by MER Corporation of Tucson to provide adequate thermal and water balance at minimized weight and size characteristics. The heat exchanger is assembled using unique corrosion-resistant aluminum elements with highly extended inner surface, formed by a system of longitudinally oriented small diameter channels, and a spiny external surface formed using the same wall material to eliminate contact resistance (Fig. 1).

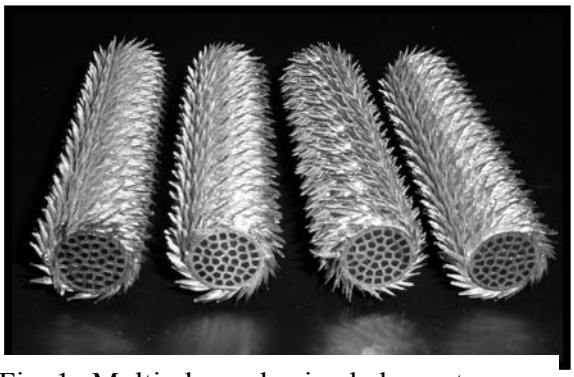

Fig. 1 Multi-channel spined elements

The design features:

- Enhanced convection and drop-wise condensation heat transfer due to unique combination of small diameter internal channels and sharp external spines;
- Low overall hydraulic resistance;
- Light weight and high surface density;
- Variety of allowable working fluids;
- Variety of constructional materials and layouts;
- Ease of manufacturing
- Low cost

As a result of preliminary evaluation, it was shown that the proposed heat exchanger is capable of achieving 2000 W capacity at the values of specific power being 266 *W/kg* (~ 4.1 times more than conventional units) or 182 *W/lit* (~ 9.5 times more than conventional units).