

## AEG Carbon Fiber-Elastomer Composite Bipolar Plate for PEM Fuel Cells

Fuel cells constitute one of the most promising sources of environmental friendly energy for the future. These systems produce electrical energy by converting the chemical energy stored in a fuel, such as hydrogen or methanol, through oxidation-reduction reactions. A proton exchange membrane (PEM) fuel cell is a stack of electrochemical cell systems (Figure) placed in series. Since the electrons must transit from the anode of one cell to the cathode of the next cell, electrical conductivity through the plate is a main requirement. Another important requirement is the low permeability to the reacting gases or to ions. The bipolar plates should remain chemically inert for an extended period of time. The bipolar plates also should be lightweight and easily manufactured using mass-production technologies. Cost reduction is the most critical issue for automotive industry to achieve the practical use of proton exchange membrane (PEM) fuel cells. The bipolar plate is the most expensive component in the current fuel cell system assembly.

American Engineering Group (AEG, Akron, OH) has developed a new elastomer-carbon fiber composite bipolar plate for PEM fuel cells with high electrical conductivity, high strength, light weight and very low permeability. This new unique composite bipolar plate is a less-expensive and light-weight alternative to graphite and steel. The use of highly conductive elastomer compound and multi-stage molding technology enables the fabrication of bipolar plates with high carbon fiber content. This composite bipolar plate is a promising solution, as their thermal and chemical stability is matched by good mechanical strength and dimensional stability values.

This plate has the potential for being produced at low cost. The plate is produced using short carbon fiber structure with elastomer impregnation into pre-form uncured structures. This AEG proprietary multi-stage manufacturing process makes this multi-layer elastomer-carbon fiber plate very conductive and low permeable. Current AEG effort is to optimizing the manufacturing process, characterizing prototype components and power generation tests. Preliminary study noted following features for the new carbon fiber bipolar plate:

- Bulk Conductivity : 600 Siemens/cm
- H<sub>2</sub> permeability :  $2 \times 10^{-6}$  cm<sup>3</sup>/cm<sup>2</sup>-sec
- Corrosion rate : 10  $\mu$ A/cm<sup>2</sup>
- Estimated Cost : \$9/kW

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