POLYMERIC COMPOSITE BIPOLAR PLATES FOR PROTON EXCHANGE MEMBRANE FUEL CELLS

Bipolar plate is a multifunctional component within the PEM fuel cell stack. It connects and separates the individual fuel cells in series to form a fuel cell stack with required voltage, aids uniform distribution of fuel gas and oxygen over the whole active surface area of the membrane-electrode assemblies (MEA), conducts electrical current from the anode of one cell to the cathode of the next, facilitates water management within the cell, supports thin membrane and electrodes and clamping forces for the stack assembly, among other things.

The polymer composite materials can alleviate some of the concerns related to weight and volume, and hence the cost of fuel cell stacks. Conventional pure graphite bipolar plates (Figure 1) contribute significantly to the cost and weight of PEM fuel cell stacks. Metals such as stainless steel and metal alloys − plrs such asss9tai6( )]T(Fi tnill soFnllbonte m64(e)]TJ (Fig

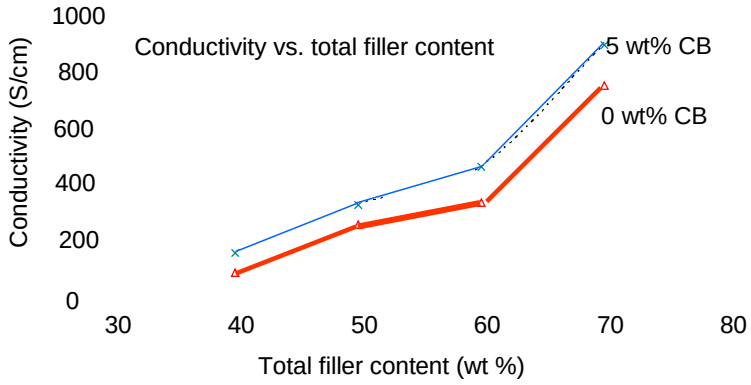

Figure 3. Electrical conductivity of epoxy-expanded graphite-carbon black composites as function of total filler loading.

Results to date:

- The study showed that highly conductive epoxy composites can be developed using synergistic combinations of EG and CB as conductive fillers.
- The data on electrical conductivity, thermal and mechanical properties, and stability against long exposure to acid solution indicate that these composites will be very suitable for bipolar plates in PEM hydrogen fuel cells. Specifically, the composites developed in this study exceeded many specifications set by the industry, e.g., these provide in-plane conductivity ~200-500 S/cm, high through-plane conductivity of 77 S/cm, low area specific resistance, high glass transition temperatures (T_g ~ 180°C) and high thermal degradation temperatures (T_2 ~ 415°C).
- It was seen that water diffusion in both unfilled epoxy resin and composites followed linear Fickian diffusion behavior. It was also seen that incorporation of EG rendered composites more hydrophobic and significantly decreased the maximum water uptake and water diffusivity. Accordingly the composites studied in this work would yield favorable performance for wa 0.28 Tw T* [((i)-o0eaw 8.04 0 0 8.

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