**The Development of Electroless Coated Bipolar Plates with Injection Molding for PEM Fuel Cell System**

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Bipolar plate requires several properties to achieve the desired fuel cell stack performance that are electrical conductivity, gas tightness, chemical stability, lightweight and mechanical strength to withstand clamping forces. Therefore, bipolar plate needs to be optimized with respect to material, design, and manufacturing process. The optimal bipolar plate should be low-cost and easily manufactured. Bipolar plates in PEMFC have been typically made of polymer resin impregnated graphite. However, the material is very expensive and difficult to be machined into the gas flow field channels providing gas distribution for the streams. It is considered that the alternative materials to graphite are carbon-carbon composites, and carbon-polymer composites. Therefore, several kinds of composite plates for PEMFC are currently under development to be simple produced easily and to reduce cost, stack volume and weight. In this work, we present the preparation method and characterization of alternative bipolar plate material, which can be researched for the application of PEMFC vehicle.

The bipolar separator plate molds were made with flow fields for an anode and a cathode with water-cooling channels on the opposite side, as shown in Fig. 1. Measurements of the electrical, chemical, and physical properties of the injection molded plates have met or exceeded the DOE specified targets The conductivity measured by four point probe. The corrosion rate were performed in 0.1mM $H_2SO_4$ solution of 2 ppm fluoride at 80°C, pH~4. Hydrogen permeability was measured as a function of Table 1. From the results of flexibility of various bipolar materials, we obtained those of flexibility test interfacial resistance molding pressure, for either dense, non-porous molded plates. Additionally, the plate measured the strength, flexibility, surface roughness and interfacial resistance characteristics of the plates anticipating a magnitude of 200 psi fuel cell holding forces, non-uniformity of sealing and stack assembly, plus handling and packaging actions from the production line.

The performance of alternative material bipolar plate for PEMFC with 25 and 50$cm^2$ was evaluated at various conditions. From the Fig.2, we could get almost 75% of power density values at Pd-Ni electroless coated on PC polymer plate compare the non flexible graphite plate. It means that electroless plated polymer plates can be substituted as effective power source supporting material with its high flexibility than graphite or other inorganic materials, which has been caused a factor of leakage of flemable hydrogen and oxygen gas at graphite bipolar plates. Furthermore, becauseof its typical weightless and flexibility of polmer characteristics, this material shows 25% higher power density of per weight than graphite plate and commercial Al50520. But the The single cell performance was more than 0.37 W/$cm^2$ (0.77 W/g) for polymer composite bipolar plate at 50°C under atmospheric pressure in external humidified hydrogen and oxygen condition. The electrical interfacial resistance measurements (Fig.1) were conducted by measuring the potential between the plates and the gas diffusion media of carbon cloth in a single cell structure, which was roughly modified with a typical unit arrangement in PEM fuel cell with 140, 200 and 300 N/$cm^2$ pressure at 5A. The performance characteristics of the single cells with an active area of 25 and 50 $cm^2$, and the stack with 7 cells were evaluated at various conditions. As the results, we could show the results that the alternative material bipolar plates were favorable in the aspect of electrical and physical properties compared with those of the commercialized conventional resin impregnated graphite plates. These values are expected to be within a good safety factor. The plates also have retained their properties after being subjected to immersion in boiling water and freeze-thaw cycles.

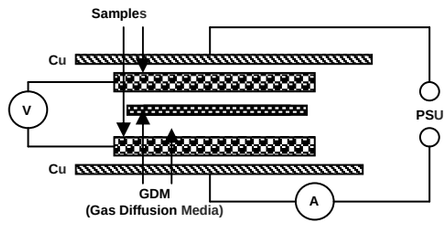


Fig. 1. The test method of electrical conductivity of bipolar materials with gas diffusion media(GDM) in unit PEMFC cell.

Table 1. Comparision of corrosion test for various bipolar plates

| Sample | $I_{corr}$ (mA/$cm^2$) |
|---|---|
| Aluminum | 122 |
| Pd-Ni / Aluminum | 9.8 |
| Au / Aluminum | 1.38 |
| Pd-Ni / PC | 7.9 |

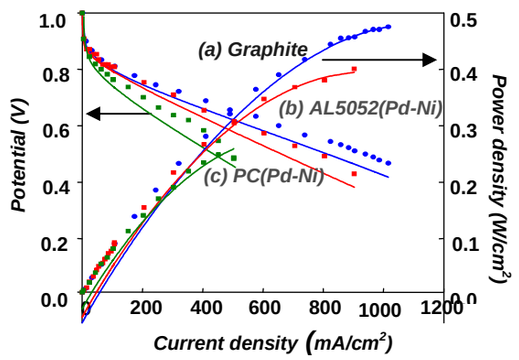


Fig. 2. The comparision of power density with alternative bipolar plates. (a) graphite ,(b) AL5052(Pd-Ni), (c) PC(Pd-Ni),

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