Fabrication and electrical characteristics of graphite composite materials with resin binder for bipolar plate of redox flow battery

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INTRODUCTION

Recent year, the development of redox flow battery with a high energy density has been performed for renewable energy such as solar and wind, etc. [1]. Redox flow battery produces electric power by the electrochemical reaction of redox couple between electrolyte and electrode. Furthermore, internal resistance of redox flow battery should be controlled by the improvement of bipolar plate as electric collector [2]. Bipolar plate is also one of core components in stack module of redox flow battery cell. Therefore, the bipolar plate is required to have some characteristics with high conductivity, liquid barrier and mechanical properties with low cost. Especially, bipolar plate has a large volume among the stack components of redox flow battery system.

In this work, we introduce the fabrication and electrical characteristics of graphite composite materials with resin binder for bipolar plate of redox flow battery.

EXPERIMENTAL

The graphite composite materials for compress molding were prepared via mixing at room temperature or heat mixing in labo-milling device and then the composite bipolar plates were fabricated according to the composition of composite materials by compress molding device. As the starting materials, the stoichiometric amount of some kinds of graphite and resign, CNT and additives were mixed in labo-milling device with heating at 150~200°C. The graphite content was kept to 50~80wt% by controlling the amount of resin binder and additives such as CNT, stirring for homogeneous composite. The composite bipolar plate was formed with compress molding at 120℃ and 60Mpa.

Meanwhile, composite bipolr plate could also be fabricated by tape-casting process with thin thickness and high quality. Slurry was prepared by mixing the graphite filler and binder polymer with some solvents for 2 days. In here, carbon fillers such as graphite were added at the range of 40wt% to 80wt% for electronic conductivity and its viscosity was also controlled for tape casting process. Casting film sheet of 10~100 ㎛ is fabricated using tape-casting device at dry temperature of 80°C and then the film sheets are also stacked and laminated at 80°C and 60MPa.

To investigate the dispersibility and morphology, the characteristics of composite materials were investigated using the SEM and EPMA analysis. The physical characteristics such as electrical conductivity and strength, etc. were evaluated on the above samples of composite bipolar plate.

RESULTS AND DISCUSSION

The composite bipolar plates were fabricated by compress molding and tape-casting process, respectively. Figure 1 and 2 showed the surface morphology of composite bipolar plate prepared by each process.

It is found that there are some different morphology of sample surface between two process. As shown in the figure 1, even though the graphite is sphere-like shape, the graphite showed the status of uniform dispersion with resign binder after fabricated by the compress molding process. Therefore, the composite bipolar plate showed an excellent electrical value of under 10mΩ.cm with a high strength. However, the samples which was prepared by tape-casting process showed a different dispersion behavaior as shown in the figure 1. they showed the SEM morphology of top and bottom film in according to the graphite shape. In here, needle shape graphite of sample 3 showed a good dispersion status due to the fluidity of composite materials as compared with sample 1. Moreover, we will introduce the detailed informations of some physical and electrochemical evaluation on the composte bipolar plate samples.

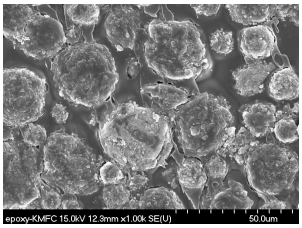

Figure 1. SEM analysis of composite bipolar plate by compress molding process

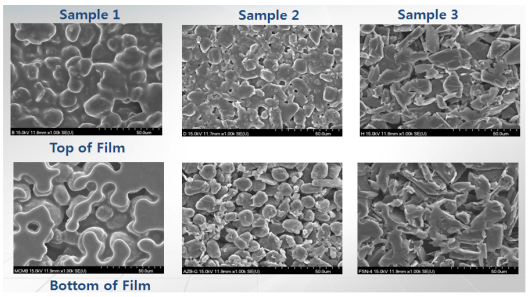

Figure 2. SEM analysis of composite bipolar plate by tape-casting process

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