Karakteristik sifat mekanik dan elektrik pelat bipolar sel bahan bakar berkarbon grafit dalam matrik polimer ABS

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Abstrak

Komposit yang dikenal dengan PMC (Polymer Matrix Composite) telah lama dikembangkan. Komposit jenis ini dapat memenuhi kriteria untuk sel bahan bakar baik dari sifat mekanikal ataupun elektrikal. Material polimer thermoplastik seperti halnya ABS (Acrylonitril Butadiene Styrene) sifatnya yang cukup ringan dan ulet bila diperkuat dengan karbon grafit yang keras dan ulet serta kompensasi berat melalui pengkayaan grafit dengan carbon black dapat menghasilkan sistem komposit berupa graphite bipolar plate untuk aplikasi sebagai sel bahan bakar. Bipolar plate merupakan komponen yang sangat penting dalam sistem Proton Exchange Membran Fuel Cell berperan untuk menghindari bercampurnya oksigen dan bahan bakar hidrogen.

Pada penelitian ini telah berhasil dibuat pelat bipolar sebagai bagian suatu sistem sel bahan bakar berbasis PEMFC (Proton Exchange Membrane Fuel Cell). Material campuran grafit/carbon black dan ABS dicampur dengan pelarut pelarut MEK (Metyl Etyl Keton) dalam suatu reaktor batch dan dibantu peralatan Ultrasonic stirrer pada temperatur operasional sekitar 60°C. Komposit pelat dengan komposisi 75:25%, 60:40% dan 50:50% (fraksi volume) diperoleh melalui hot pressing compression pada tekanan 100, 150, 200 bar dengan temperatur 175, 200 dan 225°C.

Pada penelitian ini juga dipelajari pengaruh temperatur heating dan kompaksi terhadap karakterisasi dari komposit graphite bipolar plate yang meliputi pengujian kuat tarik, kuat tekan, flexural strength, kekerasan, densitas, porositas, konduktivitas listrik dan struktur internal bipolar plate. Dari hasil penelitian ini diperoleh bahwa dengan pemanasan temperatur mendekati (225°C) sifat mekanik kuat lentur meningkat rata - rata 22 %. Konduktivitas listrik tertinggi diperoleh dari komposit dengan komposisi 75 : 25. Komposit bipolar plate dengan komposisi 40 : 60 , yang diperoleh melalui pemanasan pada temperatur 225°C dan penekanan 200 bar merupakan komposit yang paling memenuhi spesifikasi bipolar plate yang digunakan secara luas.

.....The so called Polymer Matrix Composite, PMC is a well developed composite materials. The PMC is considered able to fulfil requirement mechanically and electrically for fuel cell bipolar plate applications. Although, thermoplastic polymer like ABS (Acrylonitril Butadiene Styrene) is light and soft materials, however, when reinforced by hard and tough graphites, enriched further by carbon black this should resulted in a composite system which suitable for graphite bipolar plates fuel cell applications. Bipolar paltes is one of most importnat component in Proton Exchange Membran Fuel Cell system acting to prevent oxygen and hydrogen gasses mixing.

This research is aiming at observing the influence of heating temperature and pressure especially on mechanical and physical properties of bipolar plates. The electrical conductivity of the plates is another objectives of current research work. The research works have succeded to prepare a bipolar plate for PEMFC (Proton Exchange Membrane Fuel Cell). Graphite and carbon black powder as well as ABS matrix were mixed together with MEK (Methyl Ethyl Ketone) solvent in an ultrasonic stirrer at temperature ~ 60°C. The volume rasio of carbon : matrix were fixed as 75:25% , 60:40% and 50:50% . the mixture

materials were the dried in a oven at 60OC and successively pressed using a hot press compression apparatus at a pressure of 100, 150 and 200 bar and operating temperature heating of 175, 200 and 225°C respectively.

The mechanical properties like tensile strength, flexural strength, compressive strength,hardness as well as the physical propertis like density, porosity, electric conductivity and internal structure were sistematicaly evaluated. Experimental results showed that heating at 225°C increased flexural strength at about 22 %. The highest electical conductivity was obtained in a bipolar plate with 75 : 25 volume ratio composition. However, the bipolar plate with 60 : 40 volume ratio which compressed under a pressure of 200 bar at 225°C was found to be the best result so far, having the closest properties with that utilized as bipolar plates in fuel cell applications.