Aplikasi katalis bimetal berbasis karbon untuk pengembangan elektroda proton exchange membrane fuel cell (PEMFC)

Anis Nahdi, author

Abstrak

Proton exchange membrane fuel cell (PEMFC) merupakan tipe fuel cell yang paling banyak digunakan dalam aplikasi. Efisiensi dan performa merupakan hal yang sangat penting dalam pengembangan PEMFC. Elektrokatalis memiliki peranan penting dalam menentukan performa fuel cell. Penelitian katalis baru untuk peningkatan aktifitas, stabilitas, daya tahan, dan mengurangi biaya (40% biaya satu unit fuel cell) merupakan tantangan teknologi dan komersialisasi fuel cell. Makalah ini, efisiensi dan performa PEMFC telah dipelajari menggunakan katalis Pt/C (kontrol) dan beberapa katalis bimetal (Pt-Co/C, Pt-Ni/C, and Pt-Ru/C), menggunakan single stack PEMFC standar, luasan aktif 25 cm2 dan bipolar plate paralel. Sistem operasi diatur dengan kecepatan alir H2 dan O2 100 mL/menit, tekanan 0.1 bar dan temperatur 50°C. Performa PEMFC diukur dengan electronic discharge meter, 3300 C Electronic Load Mainframe ®Prodigit 3311D 60V/ 60A, 300V. Pt-Co/C pada katoda menghasilkan performa PEMFC tertinggi (0,445 V, 0,131 A, 0,058 W) dimana Pt-Co/C > Pt-Ni/C > Pt-Ru/C, dan pada anoda, Pt-Ru/C menghasilkan performa PEMFC tertinggi (0,403 V, 0,101 A, 0,041 W) dimana Pt-Ru/C > Pt-Co/C > Pt-Ni/C. Transfer massa dan efisiensi konsumsi H2 telah dihitung berdasarkan energi bebas Gibbs dan potensial selnya. Dari transfer massa, diperoleh efisiensi 57,51 % untuk Pt-Co/C di katoda dan 53,54 % untuk Pt-Ru/C di anoda.
.....Proton exchange membrane fuel cell (PEMFC) is the most available fuel cell type in various applications. Efficiency and performance are important focus on developing proton exchange membrane (PEM) fuel cell. Electrocatalysts and their corresponding catalyst layers thus play critical roles in fuel cell performance. Therefore, exploring new catalysts, improving catalyst activity, stability, durability, and reducing catalyst cost (40% for 1 unit fuel cell) are currently the major tasks in fuel cell technology and commercialization. In this paper, efficiency and performance of PEM fuel cell were studied with Pt/C catalyst as control and some bimetal catalyst (Pt-Co/C, Pt-Ni/C, and Pt-Ru/C) as electrode materials The membrane electrode assembly (MEA) was made using those catalyst then used with standard PEM fuel cell single stack 25 cm2 active areas with parallel bipolar plate. System operation was running in flow rate of 100 ml/min for hydrogen and oxygen at pressure 0.1 Bar and temperature was set constantly at 50°C. Performance of PEM fuel cell has measured by electronic discharge meter, 3300 C Electronic Load Mainframe ®Prodigit 3311D 60V/ 60A, 300V. Using Pt-Co/C on cathode was obtained the highest performance of PEMFC (0,445 V, 0,131 A, 0,058 W) whereas Pt-Co/C > Pt-Ni/C > Pt-Ru/C. Using Pt-Ru/C on cathode was obtained the highest performance of PEMFC (0,403 V, 0,101 A, 0,041 W) whereas Pt-Ru/C > Pt-Co/C > Pt-Ni/C. Mass transfer reaction and efficiency of H2 consumption in cell has been calculated by Gibbs free energy and open circuit voltage. Efisiensi was calculated based on mass transfer reaction and obtained 57,51% for Pt-Co/C as cathode material and 53,54% for Pt-Ru/C as anode material in PEMFC.