Modifikasi permukaan boron-doped-diamond dengan Ni-Mn, Ni-Co, dan Ni-Cu serta aplikasinya pada fuel cell berbahan bakar urin = Modification on boron-doped-diamond surface using Ni-Mn, Ni-Co, and Ni-Cu to urine-fuel cell application

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Abstrak

Modifikasi permukaan boron-doped-diamond (BDD) dengan Ni-Mn, Ni-Co dan Ni-Cu telah dilakukan untuk digunakan sebagai elektroda kerja pada sistem sel bahan bakar berbasis membran polimer elektrolit (Polymer Electrolyte Membrane Fuel Cell, PEMFC). Modifikasi dilakukan dengan rangkaian teknik wet chemical seeding (pembibitan kimia), electrochemical overgrowth of the seeds (penumbuhan kimia), annealing (pemanasan), serta refreshed and activation. Karakterisasi siklikvoltametri dan XPS menunjukkan spesi elekrokatalis Ni(OH)2 pada sampel Ni-Mn/BDD, Ni-Cu/BDD, dan Ni-Co/BDD dapat dideposisi pada potensial +0,32 V, +0,31 V dan +0.33 V berturut-turut, dengan energi ikat sebesar 855,6 eV. Agar dapat mengelektrooksidasi urea, dilakukan perubahan spesi -NiOOH menjadi -NiOOH yang lebih stabil dari Ni(OH)2 dengan siklikvoltametri dalam KOH 1 M selama 300 siklus. Poks tertinggi terdapat pada sampel Ni-Cu/BDD yakni 2.75 A pada +0,59 V. Namun, pada pengaplikasian urea-PEMFC, Ni-Mn/BDD menunjukkan hasil terbaik menggunakan anolit 0,33 M dan KOH 0,1 M di ruang anoda serta katolit H2O2 2 M dan H2SO4 2 M di ruang katoda dengan densitas daya rata-rata 0,061733 mW/cm2, densitas arus rata-rata 0,185242 mA/cm2, potensial rata-rata sebesar 0,34 V vs SHE, dan efisiensi tegangan maksimal sebesar 15.83%. Sedangkan pada PEMFC berbahan bakar urin, densitas daya rata-rata yang dihasilkan 0.0889 mW/cm2, densitas arus rata-rata 0.189 mA/cm2, potensial rata-rata sebesar 0.66 V vs SHE dengan waktu pengoperasian selama 3600 detik

.....Surface modification on boron-doped diamond (BDD) using Ni-Mn, Ni-Co dan Ni-Cu have been performed for application as working electrodes in a Polymer Electrolyte Membrane Fuel Cell (PEMFC) system. The series of wet chemical seeding, electrochemical overgrowth of the seeds, annealing, refreshed and activation techniques has been applied to modify the surface area. Characterization using cyclicvoltammetry and XPS indicate that Ni(OH)2 able to be well deposited on Ni-Co/BDD, Ni-Mn/BDD, and Ni-Cu/BDD samples at potential +0,32 V, +0,31 V dan +0.33 V respectively with binding energy as 855,6 eV. To electrooxidize urea, the change of -NiOOHto -NiOOH from deposited Ni(OH)2 electrochemicaly can be conducted by giving constant potential for 300 cycles in 1 M KOH. Highest oxidation peak of Ni3+ is belong to Ni-Cu/BDD as high as 2.75 A at +0,59 V. In contrary, application Ni-Mn/BDD to urea-PEMFC shows best result by using mixture of 0.33 M urea and 0.1 M KOH as anolyte in anodic chamber, while a mixture of 2 M H2O2 and 2 M H2SO4 as chatolyte in cathodic chamber with average power density 0,061733 mW/cm2, current density 0,185242 mA/cm2, and potential of 0,34 V vs SHE with 15,83% of maximum voltage effiency yield. Urine as fuel in PEMFC has been also applied into the system with producing average power density as 0.0889 mW/cm2, 0.189 mA/cm2 for average current density, and 0.66 V vs SHE for open circuit votage for 3600 second of operation time.