International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.9, No.07 pp 596-610, 2016

Synthesis and characterization of nanostructured carbon-supported Pt electrocatalysts for membraneless methanol fuel cells (MLMFC)

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Abstract : Carbon-supported Pt−Ru−Fe/C (70:20:10), Pt−Ru−Fe/C (70:15:15), Pt−Ru−Fe/C (70:10:20), Pt−Ru/C (50:50), Pt−Fe/C (50:50) and Pt/C (100) electrocatalysts were synthesized by co-impregnation reduction method. The physicochemical characterizations demonstrated that all the compositions have the Pt face-centered cubic (fcc) structure with variations in the lattice parameter, indicating the incorporation of Ru and Fe. Transmission electron microscopy measurements revealed a decrease in the mean particle size of the catalysts for the ternary compositions. The electrochemical characterization showed that binary and ternary electrocatalysts have higher catalytic activity than Pt/C toward methanol electrooxidation. Voltammetric data showed the addition of Fe to Pt–Ru/C significantly diminished the potential of methanol and CO oxidation, due to the electronic effect exerted by this metal along with the bifunctional mechanism. Single cell tests on a membraneless methanol fuel cell at room temperature with Pt−Ru−Fe/C (70:20:10) showed superior performance compared to Pt−Ru−Fe/C (70:15:15), Pt−Ru−Fe/C (70:10:20), Pt−Ru/C (50:50), Pt−Fe/C (50:50) and Pt/C (100) electrocatalysts. The i-V characteristic curve indicated an enhancement in fuel cell performance with the addition of Fe and Ru to Pt-catalyst.
Keywords: Co-impregnation reduction, Membraneless fuel cells, Methanol, Platinum, Ruthenium, Iron, Sodium perborate.

S. Begila David *et al* /International Journal of ChemTech Research, 2016,9(7),pp 596-610.

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