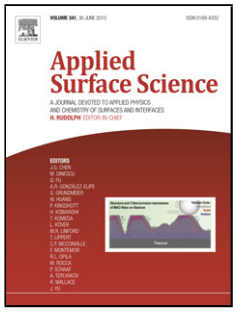

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Author: S. Neelakandan P. Kanagaraj R.M. Sabarathinam A. Nagendran

PII: S0169-4332(15)02541-6
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2015.10.122
Reference: APSUSC 31603

To appear in: *APSUSC*

Received date: 26-8-2015
Revised date: 11-10-2015
Accepted date: 18-10-2015

Please cite this article as: S. Neelakandan, P. Kanagaraj, R.M. Sabarathinam, A. Nagendran, Polypyrrole layered SPEES/TPA proton exchange membrane for direct methanol fuel cells, *Applied Surface Science* (2015), http://dx.doi.org/10.1016/j.apsusc.2015.10.122

Polypyrrole layered SPEES/TPA proton exchange membrane for direct methanol fuel cells

S. Neelakandan[a], P. Kanagaraj[a], RM. Sabarathinam[b], A. Nagendran[a*] nagimmm@yahoo.com

[a] PG & Research Department of Chemistry, Polymeric Materials Research Lab, Alagappa Government Arts College, Karaikudi - 630 003, India
[b] Functional Material Division, Central Electrochemical Research Institute, Karaikudi – 630 006, India

Tel.: 91 4565 224283; fax: 91 4565 227497

Highlights

- A series of Ppy layered SPEES/TPA composite membranes were prepared.
- SPEES/TPA-Ppy hybrid membranes displayed efficient methanol resistance than Nafion 117.
- SPEES/TPA-Ppy4 membrane exhibits highest relative selectivity of 2.86×10^4 S cm^3 s.
- Increasing Ppy layer on membrane surface reduces the leaching out of tungstophosphoric acid.

Abstract
Hybrid membranes based on sulfonated poly(1,4-phenylene ether ether sulfone) (SPEES)/tungstophosphoric acid (TPA) were prepared. SPEES/TPA membrane surfaces were modified with polypyrrole (Ppy) by in-situ polymerization method to reduce the TPA leaching. The morphology and electrochemical property of the surface coated membranes were studied by SEM, AFM, water uptake, ion exchange capacity, proton conductivity, methanol permeability and tensile strength. The water uptake and the swelling ratio of the surface coated membranes decreased with increasing the Ppy layer. The surface roughness of the hybrid membrane was decreased with an increase in Ppy layer on the membrane surface. The methanol permeability of SPEES/TPA-Ppy4 hybrid membrane was significantly suppressed and found to be 2.1×10^{-7} cm^2 s^{-1}, which is 2.35 times lower than pristine SPEES membrane. The SPEES/TPA-Ppy4 membrane exhibits highest relative selectivity (2.86×10^4 S cm^{-3} s) than the other membrane with low TPA leaching. The tensile strength of hybrid membranes was improved with the introduction of Ppy layer. Combining their lower swelling ratio, high thermal stability and selectivity, SPEES/TPA-Ppy4 membranes could be a promising material as PEM for DMFC applications.

Keywords
SPEES, PEM, TPA, Polypyrrole, AFM, DMFC