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Basic ionic liquid grafted SBA-15/quaternized polysulfone composite membrane for alkaline fuel cell

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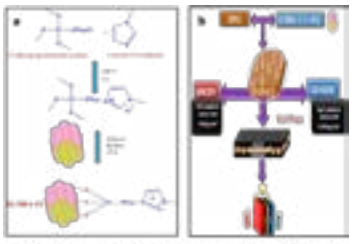
Recently, increased attention is being paid to alkaline fuel cells employing anion exchange membrane (AEM) electrolyte as an alternative to proton exchange membrane fuel cell (PEMFC). AEM is the heart of the Anion Exchange Membrane Fuel Cell (AEMFC), the vital functions of which include; preventing the mixing of fuel and oxidant, increasing the reaction rates at both the electrodes and permitting ions (OH-) to migrate from the cathode to anode (the hydroxyl ion flow direction is opposite to the flow of protons in PEMFC). As a result, AEMFC has many advantages over PEMFC, such as remarkable electrode reaction kinetics, the use of non-Pt catalysts like Ag, Fe, Co and Ni, reduced fuel cross over and easier water management. In recent times, organic-inorganic hybrid membranes have been developed by combining the beneficial properties of organic and inorganic materials by incorporating inorganic filler components into polymer base matrix. Such hybrid membranes possess improved physicochemical and thermo-mechanical properties. In the present study, a novel hybrid membrane was synthesized based on ionic liquid grafted mesoporous silica. In brief 1-Methyl-3-(3-trimethoxysilylpropyl) imidazolium chloride, an imidazolium based ionic liquid was synthesized and chemically grafted onto the synthesized mesoporous silica (SBA-15), resulting in a mesoporous solid (IL-SBA-15) with ion-exchange properties. The prepared IL- SBA-15 was characterized by FT-IR, solid state CP/MAS ^{13}C NMR, solid state CP/MAS ^{29}Si NMR, BET, XRD and TEM. Composite membranes with high ion exchange capacity (IEC) were then prepared by incorporating IL-SBA-15 into the quaternary polysulfone (QPSU) in different weight percentages (1, 2, 3 and 4%). The morphology and crystalline nature of the membranes were analyzed by SEM and XRD respectively. The membrane properties such as water uptake, IEC and hydroxyl conductivity were studied for its suitability in AEMFC. The prepared membranes were tested in an in-house built AEMFC of 25 cm^2 electrode area with platinum anode (0.25 mg/cm^2) and silver cathode (0.375 mg/cm^2). Among the various membranes tested, 3wt% IL-SBA-15 containing composite membrane showed a maximum power density of 278 mW/cm^2 at 60°C. The results suggest that these composite membranes have a promising potential to be used as an electrolyte in future AEMFCs.



Biography

Dharmalingam Sangeetha has been working as an Assistant Professor at Anna University since 2004. She has published more than 131 papers in reputed journals and has contributed more than 196 papers in national and international conferences. She has filed seven patents in the fields of fuel cell activities. She was selected as one of the top 50 innovators of India by the DST Lockheed Innovation Growth Program 2012. She was also chosen as one of the top 10 finalists as the best Chemistry Teacher by the Tata Chemicals 2012.

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