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Synthesis of novel copolymer based butylimidazolium ionic liquid and polybenzimidazole as anion exchange membrane for fuel cell application

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Electrolyte membranes are very important component in fuel cells and influence significantly their performance. Polymers such as poly(olefin)s, poly(styrene)s, poly(phenyleneoxide)s, poly(phenylene)s and poly(aryleneether)s have been studied for their use as electrolyte membranes for fuel cells. In this work, a series of electrolyte membranes have been synthesized by copolymerization of polybenzimidazole, polystyrene and polyvinylimidazolium. Various ratios were studied in order to realize a good compromise between high conductivity, swelling ratio and water uptake. The conductivity test reveals that the percentage of each component in the copolymer influences directly the ion conductivity of the final membranes. The copolymerization of polystyrene and polyvinylimidazolium was confirmed by H NMR and FTIR. Compared to the commercial reference fuel cell membrane, A201 Tokuyuama; 6 of the synthesized membranes exhibit better conductivity at high temperatures and 3 at all temperatures. The best conductivity is observed for membrane $PBI_{0.5}$ S_1VIB_5 which reaches chloride conductivity of 26.3 $mScm^{-1}$ at 25°C and 73.7 $mScm^{-1}$ at 100°C; the membrane has an ion exchange capacity of 2.6 mmol/g and a low activation energy of 6.62 kJ/mol; membrane $PBI_{0.5}$ S_2VIB_5 is one of the 3 membranes with a 10.77% swelling ratio with a 6.66 kJ/mol as activation energy. All synthesized membranes show a linear Arrhenius behavior and exhibit low activation energy and mostly in plane swelling ratio. From TGA and DSC analyses, the membranes are thermostable up to 250°C. Morphology studies explored via TEM and AFM show a well-developed bicontinuous phase distribution of hydrophilic and hydrophobic regions that confirms facile ion transport channels.

Biography

Amina Ouadah is a PhD scholar, working on developing new materials for use as electrolyte membrane in order to improve the electrical, mechanical and alkaline behavior. The concept is based on the generation of totally new polymers or copolymers offering a good compromise for industrial utilization. The final products are normally less expensive than the actual commercial ones and present pretty good compromises proving by different analysis and measurements.

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