Abstract

Over the past few decades, proton exchange membranes (PEMs) are of great interest because of their application as solid electrolyte in proton exchange membrane fuel cells (PEMFCs). At present, Dupont's Nafion® is the most commonly used materials in PEMFCs because of its excellent oxidative and chemical stability along with high proton conductivity. However, there are several shortcomings of Nafion® for example: high cost, high fuel permeability, loss of proton conductivity and mechanical stability at high temperature (> 80 ºC) etc. which restricts its uses for practical applications. In general, most of the hydrocarbon based PEMs, exhibit poor phase separated morphology and electrochemical stability and allow a compromise between proton conductivity, and mechanical and dimensional stability. In this regard, semifluorinated polymers are considered as a middle approach to balance the advantages and disadvantages of hydrocarbon-based polymers and perfluoro-polymers.

In this research, five different series of new fluorinated sulfonated polytriazole copolymers were prepared by click polymerization of four different dialkyne monomers (TA, TF, TH, and TS) with molar equivalent of a mixture of two diazide monomers (either QAZ, or OAZ) and a sulfonated diazide monomer (SAZ). Initially, the structure of -CF_3 substituted comonomer (QAZ) is optimized for high thermal stability and high mechanical strength through preparation of several new fluorinated polymers. Four different bisphenol dialkynes e.g. TA, TF, TH, and TS with two different non sulfonated diazides e.g. QAZ, OAZ were used systematically to vary the fluorine content and IEC_W of the copolymers. Incorporation of fluorine in the form of -CF_3 or [>$C(CF_3)_2$] groups are effective in improving the oxidation stability and the mechanicalproperties of the copolymer membranes. The polymers showed good solubility due to the presenceof the -CF_3 or [>$C(CF_3)_2$] groups in the backbones, which disrupted the regularity of the molecular chains and hindered the dense chain stacking. Also, -CF_3 or [>$C(CF_3)_2$] groups increased the hydrophobicity, and helped in lowering water uptake and swelling polymers and generate phase separated morphology. Increasing fluorine content and IEC_W values resulted in improvement in proton conductivity. An attempt is made to correlate the various PEM properties with

chemical structure of the copolytriazoles,degree of sulfonation, fluorine content, and IEC_W values.

Keywords: *Fluorinated Sulfonated Polytriazole, Click polymerization, Thermal properties, Mechanical properties, Oxidative stability, and Proton conductivity.*