Abstract

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Project Title : Polymer electrolyte membranes based on poly(acrylonitrile-*co*-styrene sulfonic acid)

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Proton conducting membranes based on polymers containing sulfonic acid and tetrazole moieties were developed. Successful syntheses of poly(acrylonitrile-*co*-styrene sulfonic acid) (PAN-*co*-PSSA), poly(acrylonitrile-*co*-5-vinyl tetrazole) (PAN-*co*-PVTz), and poly(acrylonitrile-*co*-5-vinyl tetrazole-*co*-styrene sulfonic acid) (PAN-*co*-PVTz-*co*-PSSA) were confirmed by ^{1}H-NMR, elemental analysis, and FTIR. Two approaches were performed to study the effects of molar ratio of sulfonic acid to tetrazole and tetrazole content on membrane properties. In the first approach, PAN-*co*-PSSA was blended with PAN-*co*-PVTz at three molar ratios. The second approach focused on PAN-*co*-PVTz-*co*-PSSA membranes with various tetrazole contents. PAN-*co*-PSSA membrane was also prepared. All solution-cast membranes were hydrolytically stable, except for PAN-*co*-PVTz-*co*-PSSA with 71% tetrazole. Surface morphologies of blend membranes were studied using SEM, and no phase separation was observed. Water uptake was shown to increase with increasing tetrazole. All membranes exhibited high thermal stability (up to 250 °C), and high storage moduli. Proton conductivity was found to depend significantly on relative humidity. The influences of sulfonic acid to tetrazole ratio and tetrazole content on proton conduction were observed and discussed. A maximum proton conductivity of 7.1 x 10^{-3} S/cm at 26 °C was obtained from PAN-*co*-PSSA membrane. In addition, all tested membranes showed relatively good oxidative stability after treatment in Fenton's reagent.

Keywords : conductivity, electrolyte, fuel cell, tetrazole