Enhancement of anti-degradation effect of sulfonated poly(arylene ether ketone) fuel cell membrane by grafting of crown ether for enhanced cerium ion fixation

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In operation of polymer electrolyte membrane fuel cell (PEMFC), OH radicals are the major cause for the degradation of polymer electrolyte membrane. In order to enhance its anti-oxidation stability, cerium ion (Ce^{3+}, CE), an OH radical quencher, is introduced to membrane, as it converts the OH radicals into inactive chemicals. In this study, aminoethyl-15-crown-5 (CRE) is grafted on the sulfonated poly(arylene ether ketone) (SPAEK) to prevent the migration of CE ions from the membrane for long term anti-oxidation stability, as CRE forms a coordination complex with CE. The chemical and physical structure of the CRE grafted SPAEK are examined using 1H NMR, EDX, and SAXS spectroscopy. The physical properties of the CRE grafted SPAEK membrane are investigated and compared with those of the CRE blended and CE blended ones. While the grafting of CRE does not significantly affect the thermal and mechanical and water uptake behaviors of membranes, it leads to a significant improvement of anti degradation effect compared with other blend systems according to Fenton's test. The proton conductivity decreases with addition of CE but its effect is lessened by introduction of CRE.