ABSTRACT:

Structure-property relationships for poly(vinylidene fluoride)-graft-polystyrene sulfonic acid (PVDF-g-PSSA) fuel cell membranes prepared by a single step method involving radiation-induced grafting of sodium styrene sulfonate (SSS) onto electron beam (EB) irradiated poly(vinylidene fluoride) (PVDF) films were established. The physico-chemical properties of the membranes such as ion exchange capacity, water swelling and proton conductivity were correlated with the degree of grafting (G, %) and the structural changes taking place in the membrane matrix during the preparation procedure. The variation in the crystallinity and the thermal stability of membranes was studied by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA), respectively. The membranes were found to undergo substantial structural changes in forms of ionic sites increase, hydrophilicity enhancement, hydrophobicity reduction and crystallinity decrease with the variation in G (%) and the preparation method. The structural and thermal properties of the obtained membranes were also compared with their counterparts prepared by a conventional two-steps method i.e. radiation induced grafting of styrene onto EB irradiated PVDF films followed by sulfonation. The PVDF-g-PSSA membranes obtained by a single-step method were found to have superior properties compared to those obtained by the conventional two-steps method.