Composite sPEEK-TPyP Membranes Development for Portable Applications

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ABSTRACT

Composite membranes based on sulphonated Polyetheretherketone (sPEEK) and 5,10,15,20-tetra(4-pyridyl)porphyrin (TPyP) were developed for portable applications. A sulphonation degree of 65% and different weight percentages (0-5%) of TPyP porphyrin were used. The membranes were realized with a standardized doctor-blade method, thermally and chemically treated. Physical-chemical characterizations were carried out in terms of ionic exchange capacity, water uptake, dimensional variations and swelling, structural and morphological analyses. Moreover, proton conductivity measurements at a temperature useful for portable applications, were performed. SEM analyses of composite membranes highlight a similar morphology to the pristine sPEEK membrane. XRD profiles of composite membranes correspond to the amorphous pattern of sulphonated polymer, while the fundamental peaks of TPyP were completely suppressed. This effect indicates that a good interaction occurs between the filler and the polymer matrix. This interaction, in particular between nitrogenous groups of porphyrin and sulphonic groups of polymer, leads to unaltered physico-chemical properties and a proton conductivity respect to the sPEEK membrane, used as a reference. In particular, the membrane with the lowest loading (1 wt%) of TPyP, shows higher water uptake and λ values than the reference membrane, resulting in an increased proton conductivity. This behavior could be attributed to an additive protonation and, consequently, hydration of porphyrin groups able to contribute to the proton conduction mechanism. In addition, the developed membranes were characterized in a PEFC 25cm^2 single cell to verify their applicability in portable devices.

Keywords :Sulphonated PEEK; TPyP; PEFC.