Imade-imide cross-linked PEEK proton exchange membrane

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The proton exchange membrane is a key component of polymer electrolyte membrane fuel cell (PEMFC). It plays an important role, conducts protons and separates the fuel from oxidant in PEMFC. DuPont's Nafion® is a perfluorinated sulfonic acid polymer based membrane. Because of its high proton conductivity and good chemical stability, it has been widely used as the proton exchange membrane in PEMFC [1]. However, the high cost of fluorinated polymers limits the large-scale commercialization of PEMFC [2].

Sulfonated polymeric membranes (such as PEK, PEEK, PSU, PES etc.) have been studied as potential alternatives to Nafion® due to their many advantages, characterised by good mechanical properties, high thermal stability and proton conductivity. The proton conductivity of the membrane based on the sulfonated polymer increases with increasing degree of sulfonation (DS). However, the sulfonation increase swelling, even soluble in water and therefore mechanical strength is decreased [3]. This drawback limits the sulfonated polymeric membrane with high proton conductivity for practical PEMFC application.

In this work, a novel cross-linked membrane was prepared by cross-linking a highly sulfonated polymer (SAPEEK). SAPEEK has two types of functional groups, SO_3H for proton exchange and NH_2 for further cross-linking. The cross-linked membrane is low cost due to its use of non-expensive chemical. The membrane exhibited high proton conductivity, and extremely reduced water uptake compared with that of non-cross-linked membrane. It suggested that the cross-linked PEEK membrane (CSAPEEK) is a promising candidate of proton exchange membranes for PEMFC applications.

References

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