Fabrication of Sulfonated GO-SiO_2-Nafion Electrolyte Membranes for Polymer Electrolyte Fuel Cell

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Polymer electrolyte fuel cells (PEFCs) emerge as one of the key promising clean technologies. The successful operation of PEFCs relies critically on the performance of proton exchange membranes (PEMs). Nafion is one of the most intensively investigated PEMs. The unique structure endows Nafion membranes with not only good chemical stability but also desirable proton conductivity under high relative humidity (RH). Nevertheless, the proton conductivity of Nafion membranes depends on the water content. At elevated temperature and/or low RH, a sharp decline of proton conductivity is observed for Nafion membranes due to the dehydration.

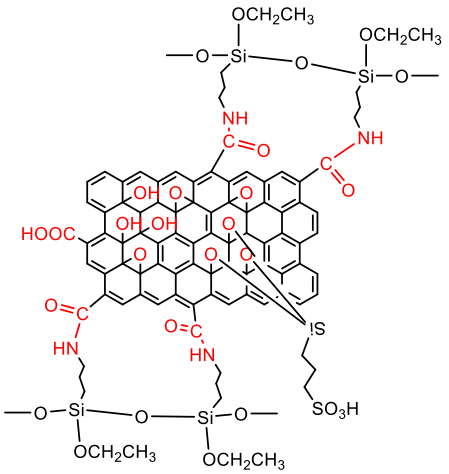

Figure 1. Schematic structure of S-GO-SiO_2.

Sulfonated graphene oxide-silica (S-GO-SiO_2, Figure 1) was synthesized from graphene oxide. It was mixed with Nafion solution to prepare composite PEMs. The proton conductivity, water absorption, and mechanical strength of these composite PEMs were tested for PEFC applications. Three composite PEMs with different mass ratios of S-GO-SiO_2 were prepared. Proton conductivity of these composite PEMs were measured, and the results are shown in Figure 2. A several-fold increase in proton conductivity was observed for 0.5 wt% S-GO–SiO_2/Nafion composite PEMs. The proton conductivity of 0.2 wt% and 0.8 wt% S-GO–SiO_2/Nafion composite PEMs is slightly lower than those of recast Nafion membrane under relatively low humidity conditions, attributing to the "non-proton-conductor" nature of SiO_2.

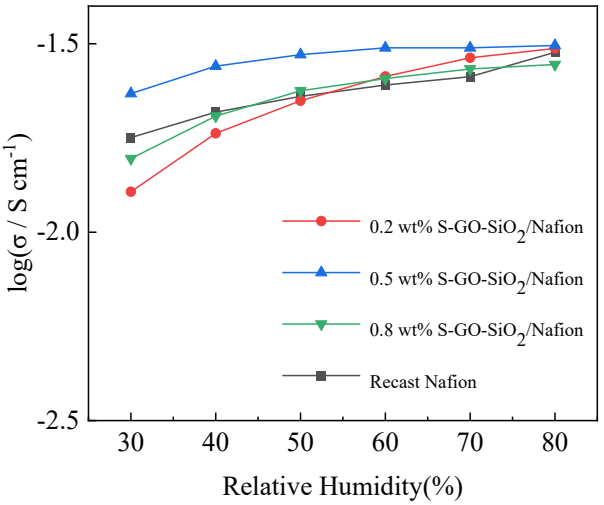

Figure 2. Proton conductivity of composite PEMs and recast Nafion membrane.