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Novel quaternized polyvinyl alcohol/quaternized chitosan nano-composite as an effective hydroxide-conducting electrolyte

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Abstract

A novel polymer composite electrolyte consisting of quaternized polyvinyl alcohol (Q-PVA) and quaternized chitosan nano-particles (Q-chitosan) is synthesized for use in a direct alcohol alkaline fuel cell (DAAFC). The quaternization efficiencies of PVA and chitosan particles are 2.6% and 39%, respectively. Incorporation of 5% Q-chitosan nano-particles into the Q-PVA matrix results not only in an increased ion-exchange capacity but also a decreased polymer crystallinity and higher free volume hole density, which significantly enhance ion conduction. The shrunk polymer free volume size suppresses methanol permeability in the Q-PVA/Q-chitosan composite. In addition, the resulting nano-composite exhibited an inhibited in-plane swelling ratio without sacrificing the alkali uptake level. The KOH-doped Q-PVA/Q-chitosan was resistant to the Fenton reagent. In DAAFCs, a maximum power density of 73 mW cm^{-2} is achieved using the Q-PVA/5%Q-chitosan electrolyte when fed with 2 M methanol at 60°C or 59 mW cm^{-2} with 3 M ethanol at 60°C. The resulting

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