Short Communication

Highly Proton-conducting Hybrid Materials containing Keggin-type Tungstovanadophosphoric Acids and Organic Polymers

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Four new proton-conducting hybrid materials were prepared by Keggin-type tungstovanadophosphoric heteropoly acids $\text{H}_4\text{PW}_{11}\text{VO}_{40}\cdot n\text{H}_2\text{O}$ (PW_{11}V) and $\text{H}_6\text{PW}_9\text{V}_3\text{O}_{40}\cdot n\text{H}_2\text{O}$ (PW_9V_3), organic polymers (polyvinylpyrrolidone, PVP or polyethylene glycol, PEG) and silica gel (SiO_2) at weight ratio of 80:10:10. Structural analysis reveals that the Keggin anions maintained in the hybrid materials, and these products exhibit high proton conductivity with 1.36×10^{-3} (PVP/ $\text{PW}_{11}\text{V}/\text{SiO}_2$), 3.44×10^{-3} (PEG/ $\text{PW}_{11}\text{V}/\text{SiO}_2$), 8.90×10^{-3} (PVP/ $\text{PW}_9\text{V}_3/\text{SiO}_2$) and 1.63×10^{-2} $\text{S}\cdot\text{cm}^{-1}$ (PEG/ $\text{PW}_9\text{V}_3/\text{SiO}_2$) at 26 °C and 75% relative humidity, increasing with higher temperature. Their activation energy of proton conduction is 17.96, 15.34, 17.54, 14.23 $\text{kJ}\cdot\text{mol}^{-1}$, respectively, which is lower than the corresponding pure acid. The proton conduction mechanisms of these materials are also proposed.

Keywords: Keggin structure; heteropoly acids; proton conductivity; hybrid materials; polyoxometalates.

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