E1-24: Electrical conductivity of protonic conducting poly (ethyleneimine)-phosphate polymeric system

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There is an interest in developing fast ion conductors especially fast ion conducting polymers (polymer electrolytes) for applications such as solid state batteries and sensors. Among the polymer electrolytes, the protonic conducting systems seemed to have the desirable high conductivities at ambient temperatures. The electrical conductivity of such a protonic conducting polymer system with branched poly(ethyleneimine) (BPEI) and phosphoric acid (H_3PO_4) was studied.

Different compositions of BPEI, xH_3PO_4(x being the No. of acid moles per PEI repeat unit, with x ranging from 0.1 to 1.5) were prepared by mixing appropriate amounts of phosphoric acid with 2 g of BPEI (50% solution in water) and the solutions were allowed to evaporate at 50°C under vacuum for 2 days. The resulting solid was ground to powder and pressed into pellets. The electrical conductivities of the samples as a function of temperature up to 85°C were measured using the complex impedance technique.

The conductivity variation with composition showed that the conductivity reached a maximum for x=0.3, then decreased up to 0.35 and after that it increased for

compositions with $x > 0.35$. The conductivity for $x = 0.3$ composition was 1.47×10^{-8} S cm^{-1} at 25°C and 4.17×10^{-3} S cm^{-1} at 85°C. For the $x=1.5$ composition the corresponding values were 8.13×10^{-5} S cm^{-1} and 7.67×10^{-3} S cm^{-1} respectively. The variation of the conductivity with temperature for the low concentration samples showed an Arrhenius type behaviour, whereas for higher concentration samples ($x > 0.7$) it obeyed the Vogel-Tamman-Fulcher (VTF) equation.

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