POLYMERIC PROTON COMPOSITE OF MICROCRYSTALLINE CELLULOSE FUNCTIONALIZED BY IMIDAZOLE MOLECULES: FEATURES OF ELECTRICAL CONDUCTION

SMOLARKIEWICZ Iga, RACHOCKI Adam, POGORZELEC-GLASSER Katarzyna, ŁAWNICZAK Paweł, PANKIEWICZ Radosław, TRITT-GOC Jadwiga

Institute of Molecular Physics of the PAS, Poznan, Poland, EU
Adam Mickiewicz University in Poznan, NanoBioMedical Centre, Poznan, Poland, EU;
Adam Mickiewicz University in Poznan, Faculty of Chemistry, Poznan, Poland, EU

Abstract

Nowadays, the rapid development of civilization entails an increase in energy consumption. The content of the work is in the main stream of the research for new proton conducting materials exhibiting high electrical conductivity and temperature operating range above 100 OC (anhydrous condition), which can be used as solid electrolyte membranes in fuel cells or batteries.

The origin of the electrical conductivity and its percolation nature has been studied in new materials consist of microcrystalline cellulose (Cell) as the polymer matrix functionalized with different concentration of imidazole (Im) as a dopant. Under anhydrous conditions the composite with the highest content of Im (5Cell-Im) exhibits electrical conductivity of about 2 × 10-4 S/m at 160 OC. The Nyquist plots of 5Cell-Im are asymmetric in the temperature range from 60 OC to 150 OC and can be fitted with two semicircles. Because imidazole molecules are only present at the surface of the microcrystalline cellulose grains, the origin of the two semi-circles can be explained by the existence of conduction derived from the imidazole layers at the grain surface and the contacts between the grains, respectively.

The percolation model of conductivity was used to simulate the behavior of conductivity as a function of the imidazole concentration. This model allows to show the percolation nature of the electrical conductivity and the phase transition from an ionic non-conducting to the conducting one has been identified for the first time in the Cell-Im composite. Also, the manner in which the clusters of heterocycles are dispersed in the system was recognized as not being randomly, probably they are flocculated into some separated regions.

Author did not supply full text of the paper.