Nanocomposites and nanomaterials area

Solid polymer electrolytes based on epoxy oligomer of diglycide aliphatic ester of polyethylene glycol and lithium perchlorate salt

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The use of such compounds as epoxy oligomer of diglycide aliphatic ester of polyethylene glycol DEG offers possible existence of ionic conductivity in dry conditions, which extends the range of operating conditions and, accordingly, the scope of their practical use. Thereby, the epoxy oligomer DEG (90 phr) and lithium perchlorate salt $LiClO_4$ (from 0 to 20 phr) were used for synthesis of ion-conductive solid epoxy polymer material. Polyethylene polyamine hardener (10 phr) as a curing agent of DEG was used. The effect of $LiClO_4$ content on electrophysical properties of epoxy polymers has been studied by means of methods of the Differential Scanning Calorimetry (DSC), the Broadband Dielectric Spectroscopy (BDS) and Thermogravimetric Analysis (TGA). Dimensions of Li^+ nanoinclusions have been studied by means of method of the Wide-Angle X-ray Spectroscopy (WAXS). It is found that the increase of lithium perchlorate content leads to an increase of conductivity σ' and dielectric constant ε' values as perchlorate lithium is a source of cations Li^+. Ion-conductive polymer materials reaches maximum value of conductivity $\sigma' = 1{,}1 \cdot 10^{-3}$ at T = 200 ^oC. The values of permittivity ε' tend to 10^6. At the same time Li^+ affects on structure of the epoxy DEG as evidenced from a significant increase in the glass transition temperature with increasing concentrations of $LiClO_4$ in the reactive mixture. It is suggested that perchlorate lithium interacts with macromolecular chains of DEG, namely cations Li^+ and ether oxygen (that exists in the chemical structure of DEG) form coordination complexes {ether oxygen - lithium cations - ether oxygen}. As a result, segmental mobility of the epoxy polymer chains is reduced within the complexes formed. Ion-conductive polymer nanosystem based on DEG-$LiClO_4$ are of interest as perspective solid polymer electrolytes, which are able to work at high temperature of 200 ^oC. As a result of TGA mass loss at this temperature is negligible, indicating its operational suitability to high temperatures.