ELECTROPHYSICAL PROPERTIES OF ION-CONDUCTIVE POLYMER SYSTEMS ON THE BASE OF AN ALIPHATIC EPOXY OLIGOMER AND $LiClO_4$

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ABSTRACT

Nowadays an urgent need in developing and creation of ion-conductive solid electroactive polymers for modern instrument engineering exists [1]. For example, it is known that the use of such compounds as oligooxyethylene offers possible existence of ionic conductivity in dry conditions, which extends the range of operating conditions and, accordingly, the scope of their practical use [2]. The presence of oxygen atoms with significant electro-donor energy in polyethylene oxide chains promotes the formation of bonds with cations [3]. At the same time, an aliphatic epoxy oligomer (DEG) contains ether oxygen, i.e. its chemical structure is similar to the structure of polyethylene oxide (PEO). That enables to take it as a basic product for creation of ion-conductive (Li^+ by using $LiClO_4$) polymer materials [4].

In such materials cation transport from one “oxygen-area” to another under the impact of the external electrical field depends on segmental mobility of polymer chains, which is in turn a function of the glass transition temperature of the polymer matrix [5]. Such features of chemical structure and charge transport mechanisms in the proposed materials allow obtaining the high temperature ion-conductive materials.

Epoxy oligomer DEG and lithium perchlorate salt $LiClO_4$ were used for synthesis of ion-conductive epoxy polymer material. $LiClO_4$ content was varied from 0 to 20 phr, DEG content cases was 90 phr for all. Polyethylene polyamine hardener (PEPA) was used as a curing agent. The content of PEPA was 10 phr for all cases.Thermal characteristics as well as the impact of the $LiClO_4$ content on electrical and dielectric properties of the epoxy polymer systems obtained were studied. The conductivity multiplies more than two orders of magnitude with increasing the content of $LiClO_4$ and reaches maximum value $\sigma' = 1{,}1\ 10^{-3}$ at T = 200 ^oC. The values of permittivity ε' tend to 10^6. It is shown that the increase of lithium perchlorate content, on the one hand, leads to an increase in σ' and ε' since LiClO4 is a source of cations Li^+ and, on the other hand, it affects the hardening process of epoxy matrix (DEG) as evidenced from a significant increase in the glass transition temperature with increasing of $LiClO_4$ concentration in the reaction mixture.

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