CHARACTERISTICS OF COMPOSITES BASED ON ALIPHATIC AND AROMATIC OLIGOMERS AND LITHIUM SALT

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Polymer blending technique is a quick and economic alternative, which has been widely used for obtaining materials with optimized properties and potentially can offer an easy control of physical properties by compositional change for a wide variety of application prospects. Epoxy resins are important thermoset materials owing to their excellent chemical and electrical properties, thermomechanical, barrier, low shrinkage upon cure and outstanding adhesion to various substrates. Copolymers, which have similar functional epoxy groups, enable formation a cross-linked network because of the similar reaction with an amine curing agent.

In our case, different content of aliphatic diglycidyl ether of polyethylene glycol DEG-1, aromatic diane-epoxy resin DER-331 and salt of lithium perchlorate $LiClO_4$ were used for synthesis of epoxy polymer composites. Polyethylene polyamine was used as a curing agent.

The structural organization of the composites were investigated by wide-angle X-ray scattering (WAXS) using the X-ray diffractometer DRON-4.07. The WAXS showed that the polymer composite with $LiClO_4$ are amorphous in contrast to the pure salt. Amorphous state of the salt in the composite is achieved by interactions between $LiClO_4$ and the polymer matrix.

Thermogravimetrical analysis (TGA) was performed using TA Instruments TGA Q50 in the temperature range from +25 to +700 °C with the linear heating rate of 20 °C/min in nitrogen atmosphere. According to TGA increasing the aromatic component leads to an increased thermal stability of the composites, but adding more lithium perchlorate salt makes them less thermostable.

The thermal characteristics were studied by differential scanning calorimetry (DSC) in the temperature range from −70 °C to +200 °C with the heating rate of 10 °C/min. DSC results show that the introduction of more $LiClO_4$ content into the composites leads to a significant increase of their glass transition temperature. This can be a result of the electrostatic interactions between lithium cations Li^+ and ClO_4^- anions and the polymer matrix with forming of coordinative complexes. At the same time, the increasing amount of the aliphatic component in the system leads to the decrease of glass transition temperature indicating the plasticizing effect of DEG-1.

The dielectric characteristics of the composites were investigated by the broadband dielectric analyzer 'Novocontrol Alpha' with Novocontrol Quatro Cryosystem in the frequency range from 10^{-1} to 10^7 Hz and the temperature range from −60 °C to +200 °C. The increasing values of the real part of the conductivity and the complex permittivity with increasing amount of the aliphatic component, lithium perchlorate salt and temperature of measurements were found.

According to the study, the synthesized composites based on aliphatic diglycidyl ether of polyethylene glycol, aromatic diane-epoxy resin, polyethylene polyamine and lithium perchlorate salt are amorphous. Increasing the aromatic component in the system leads to the increased thermal stability and glass transition temperature of the composite. Introduction of salt leads to decrease of thermal stability and increase of glass transition temperature, conductivity and permittivity.