Nanocomposites and nanomaterials area

Nanostructurization of the hybrid polymers based on amorphous epoxy resins and semi-crystalline polyethylene oxide

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It is known that the use of organic compounds such as oligoethylene oxide makes possible an existence of ionic conductivity at anhydrous conditions that widens the range of operating conditions and, accordingly, the sphere of their practical application. As charge transport in polymer electrolytes passes mainly through the amorphous regions, a high level of crystallinity greatly reduces the ionic conductivity at room temperature, but provides opportunities of sufficiently high conductivity at elevated temperatures. In the present work polyethylene oxide (PEO-10000) was injected in epoxy oligomer of diglycide aliphatic ester of polyethylene glycol (DEG) used as plasticizer with the idea decreasing the crystallinity of PEO-10000. PEO content from 0 to 20 phr on 90 phr of the DEG were used for synthesis of solid polymer material. Polyethylene polyamine was used as a curing agent. Composites were post-cured at 50 °C during 3 hours. The structural organization and features of macromolecular ordering of the synthesized polymer systems were investigated by wide-angle X-ray scattering (WAXS) using the X-ray diffractometer DRON-4.07. WAXS showed that the synthesized composites are semi-crystalline. That is confirmed by presence of two diffraction peak of two crystallite types at $2\theta_m$~19,2^{o} and $2\theta_m$~23,2^{o} on the background of imaginary amorphous halo, which the angular position ($2\theta_m$) is about ~20,8^{o}. The average value of the period (d) of a short-range molecular ordering of DEG internodal molecular segments in a polymer volume equals to 4.3 Å. The intensity of diffraction peaks, which identify the crystalline structure of PEO in the composites, are significantly less than their intensity in the pure polyethylene oxide. This suggests chemical interaction of DEG and PEO. As a result of thermogravimetric analysis mass loss of the composites is 1% at 100°C. The thermal characteristics were studied by differential scanning calorimetry (DSC). The increase of PEO amount in reactive mixture from 0 to 20 phr leads to a linear increase of the glass transition temperature from −22°C to -14°C. The melting temperature of pure PEO is 66.1 °C and 58.7 °C for composite with 10 phr of PEO. According to the DSC results the decrease of crystallinity up to 40 % and 30% for composites with 5 and 10 phr of PEO, respectively, in polymer system was found.