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Study of electret and dielectric properties of epoxiamine polymer materials

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Abstract

Electret and dielectric properties of polymer materials based on epoxide oligomer DER-311 and toughener of diethylene triamine obtained with different ratio of components and under different conditions of curing are studied. Its advantage is a possibility of comparatively easy change (upgrade) of epoxy polymer materials physical and mechanical properties via structural changes in epoxy resin polymer third-dimensional. Epoxy polymer curing process were proceeded in a special cell to unite with polarization in a constant electrical field. It is shown that maximal values of thermoelectret electret characteristic goes with stoichiometric toughener content in the volume of epoxide polymer and increasing of curing temperature. During the first days after charging polymer electrets surface potential, effective surface charge density and intensity of electrostatic field decrease rapidly, then they stabilize on a certain level. For thermoelectrets based on epoxy resin with 10% toughener at 60^{th} day after charging surface potential V_e = 0.661 kV, effective surface charge density σ_{eff} = 0.362 μC/m^2 and electrostatic field intensity of the electret E = 45.7 kV/m. Dielectric measurements were made in frequency range from 1 Hz to 1 MHz via dielectric spectrometer Novocontrol BDS Concept-80 with automatic temperature control using cryosystem QUATRO. Dielectric experimental data handling were made using WinFit program package. For quantity analysis of dielectric spectra Havriliak-Negami distribution were used. Via dielectric spectroscopy method is proved that dipole groups orientation of epoxide polymer macromolecules fixed by third-dimensional grid and are carriers of thermoelectret charge occurs under polymer transfer into electret state. Electret state of polymer matrix is characterized by a free state of epoxiamine macromolecules.

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