Nanocomposites and nanomaterials

Hybrid polymer composites based on thermoset and thermoplastic oligomers and lithium perchlorate salt

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Broad efforts have been devoted to multifunctional and lightweight materials for a stationary energy storage systems and an electric vehicles. For such applications, lithium batteries are considered to be the most promising device because of their high energy density, excellent rate capability, no requirement for priming and low maintenance. Polyethylene oxide (PEO) is one of the mostly studied oligomers, which are used for solid polymer electrolytes elaboration. Such composites based on lithium salt are the best studied systems because the cations Li^+ are the smallest in size with the highest electropositive charge and can easily move in a polymer matrix, and, therefore, they are widely used in energy storage devices. The presence of ether oxygen atoms in polymer chains of the epoxy oligomer of diglycide aliphatic ester of polyethylene glycol (DEG-1) makes its structure similar to PEO structure and provides the possibility for lithium cations transfer throughout the ether oxygen atoms. In the present work polyethylene oxide and salt of lithium perchlorate were added in DEG-1 used as plasticizer with the idea to decrease the crystallinity of PEO-10000. Polyethylene polyamine hardener was used as a curing agent. The dielectric and electrical characteristics of the synthesized composites were investigated by the Broadband Dielectric Analyzer "Novocontrol Alpha" with Novocontrol Quatro Cryosystem in the frequency range 10^{-1} - 10^7 Hz. A significant increase of the permittivity and the conductivity is observed above the melting point because the system becomes amorphous that facilitates charge transfer along the polymer chain. The obtained hybrid polymers have values of permittivity (~10^4) and ionic conductivity ($9.5 \cdot 10^{-5}$ S/cm) at elevated temperatures (100°C). The degree of crystallinity PEO decreases and T_g is shifted to positive temperature when it is added to the composites. It suggests a chemical interaction between polyethylene and DEG-1. These composites has a great significance in designing next-generation solid polymer electrolytes.

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