Complex Impedance Spectra of Amorphous and Glass-Ceramic Li_2O-7GeO_2 Compounds

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Ionic conductance in glass and glass-ceramics oxide-based materials depends on various factors, such as structure, relative volume of grains and interfacial regions, mean size of ordered nuclei, type of the phases spatial distribution [1]. Among dielectrics with high ionic conductivity, the crystalline and glass-ceramic compounds of lithium germanate family Li_2O-$x$$GeO_2$ are actively investigated. Quenching Li_2O-$x$$GeO_2$ glasses and their stage-by-stage crystallization on heating were published earlier in [2]. In [3] the glass samples with x=7, 11.5 were heat treated into the intermediate state with increased electric conductivity σ. In this abstract we studied complex impedance spectra for the phase states, obtained during crystallization of Li_2O-7GeO_2 glass.

The mechanism of charge transfer in amorphous, glass-ceramics and polycrystalline phases of Li_2O-7GeO_2 compound were studied by measuring the spectra of the complex impedance ρ*(ω). The experimental spectra ρ*(ω) were presented in (ρ'-ρ") complex plane and analyzed by using equivalent circuit approach. The obtained diagrams (ρ'-ρ") were typical for hopping conduction. Impedance relaxation rate τ^{-1} and activation energy E_a, determined for glass, intermediate nanocrystalline and polycrystalline states are in agreement with the results of independent AC conductivity measurements. Assuming that the rate τ^{-1} characterizes hopping of charge carriers, it is shown, that increased conductivity σ of the intermediate nanocrystalline state reflects higher mobility of Li ions as compared with glass and polycrystalline phase.

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