Dielectric behavior in erbium-doped tellurite glass for potential high-energy capacitor

ABSTRACT

The use of erbium ions, Er^{3+} to enhance the dielectric properties is investigated in tellurite glass system for the first time, to the best of our knowledge. A glass series of tellurite glass with chemical composition, $\{[(TeO_2)_{70}(B_2O_3)_{30}]_{70}(ZnO)_{30}\}_{100-y}(Er_2O_3)_y$ (y = 0, 0.005, 0.01, 0.02, 0.03, 0.04 and 0.05) was fabricated via melt-quenched technique. The X-ray diffraction and Fourier transform infrared spectroscopy analysis proved the amorphous structure and the formation of nonbridging oxygen in the glass system. The Er^{3+} ions affect greatly to the dielectric constant, ε' in which the dielectric constant, ε' show high value at a lower frequency and higher temperature (above 110 °C). The reduction of dielectric constant, ε' is found with the increment value of frequency, which corresponds to the formation of the hindrance effect on heavy dipoles caused by the mixed transition-ion effect. Meanwhile, the dielectric constant, ε' is enhanced with the increase of temperature. The activation energy of the glass system is found to decrease, which is due to the high polarizability of Er^{3+} ions in the glass system. Based on these results, the erbium-doped tellurite glass is a potential kind of high-energy capacitor.

Keyword: Dielectric; Tellurite glass system; High-energy capacitor