Influence of SiO₂ nanofillers on polymer-based ZnO nanocomposite flexible sheets as high dielectric and thermally stable materials

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Abstract

Polymer-based nanocomposite (NCs) with high dielectric constant and low-loss factor have remarkable applications in light emitting and energy storage devices. Flexible sheets of polymer-based zinc oxide silica (PB-ZnO-SiO₂) NCs are synthesized by co-precipitation method. The development of ZnO and SiO₂ planes confirms the synthesis of polycrystalline PB-ZnO-SiO₂ NCs. Peak intensity of ZnO planes is decreased with increasing wt.% of SiO₂ nanofillers. Surface morphology of synthesized PB-ZnO-SiO₂ NCs is associated with increasing wt.% of nanofillers. EDX spectrum confirms the presence of C, O, Zn and Si in the synthesized sheets. FTIR analysis confirms the presence of chemical bonding between the involved elements. Above 450 °C, the weight loss of S-1 is found to be 90.42% which is decreased to 49.32% for sample S-6. Dielectric properties like dielectric permittivity (13.71) with low loss factor (0.025), impedance ($Z' = 0.16 \text{ M}\Omega$) and large AC conductivity (19.92 mS/m) are observed for sample S-6. The values of dielectric constant, low loss factor, low impedance and high AC conductivity of S-6 are 5.11, 0.53, 0.029 and 2.98 times higher than the value of S-1 respectively. These findings confirm that the synthesized flexible sheets are promising candidates for better light emitting and energy storage devices at high temperature.

Full Text

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