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Greatly Improved Dielectric Properties of Poly'vinylidene fluoride' Nanocomposites Using Ag-$BaTiO_3$ Hybrid Nanoparticles as Filler

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Abstract : There is an increasing need for high–permittivity polymer–matrix composites (PMC) owing to the rapid development of the electronics industry. Unfortunately, the dielectric permittivity of PMC is still too low (□□ < 80). Moreover, the dielectric loss tangent is usually high (tan□ > 0.1) when the dielectric permittivity of PMC increased. In this research work, the dielectric properties of poly(vinylidene fluoride) (PVDF)–based nanocomposites can be significantly improved by incorporating by silver–BaTiO3 (Ag–BT) ceramic hybrid nanoparticles. The Ag–BT/PVDF nanocomposites were fabricated using various volume fractions of Ag–BT hybrid nanoparticles (fAg–BT = 0–0.5). The Ag–BT/PVDF nanocomposites were characterized using several techniques. The main phase of Ag and BT can be detected by the XRD technique. The microstructure of the Ag–BT/PVDF nanocomposites was investigated to reveal the dispersion of Ag–BT hybrid nanoparticles because the dispersion state of a filler can have an effect on the dielectric properties of the nanocomposites. It was found that the filler hybrid nanoparticles were well dispersed in the PVDF matrix. The phase formation of PVDF phases was identified using the XRD and FTIR techniques. We found that the fillers can increase the polar phase of a PVDF polymer. The fabricated Ag–BT/PVDF nanocomposites are systematically characterized to explain the dielectric behavior in Ag–BT/PVDF nanocomposites. Interestingly, largely enhanced dielectric permittivity (□□>240) and suppressed loss tangent (tan□<0.08) over a wide frequency range (102 – 105 Hz) are obtained. Notably, the dielectric permittivity is slightly dependent on temperature. The greatly enhanced dielectric permittivity was explained by the interfacial polarization between the Ag and PVDF interface, and due to a high permittivity of BT particles.

Keywords : BaTiO3, PVDF, polymer composite, dielectric properties
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