

Spectroscopic studies in PVDF-based nanocomposite films: A comparative of co- and ter-polymers

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Lead-free ceramic powder $0.8\text{BaTiO}_3\text{-}0.2\text{Bi}(\text{Mg}_{0.5}\text{Ti}_{0.5})\text{O}_3$ [BT-BMT] was synthesized by sol-gel method. The estimated average size of the nanoparticles was 200-250 nm. Two separate sets of free-standing polymer composite films were prepared by the simple and affordable solution casting method. The BT-BMT particles were dispersed into the individual polymer matrix: P(VDF-TrFE-CFE) terpolymer and P(VDF-TrFE) copolymer. The filler content in both cases was maintained as 7wt. %. The ceramic powder, as-obtained polymer powder and the prepared polymer composite films were characterized by X-ray diffraction (XRD), attenuated total reflection Fourier transform infrared (ATR-FTIR) and Raman spectroscopy techniques at room temperature.

XRD results confirmed the perovskite-type tetragonal phase formation of the BT-BMT powder (corresponding to the standard card JPCDS: 05-0626) [1]. The polymer composite films clearly exhibited the peaks from the two phases: perovskite phase (from the filler particles) with a strong (110) preferential orientation and the peaks associated with the respective polymer.

The fingerprints of polar β -phase and nonpolar- α -phase of the PVDF co/ter-polymers were well obvious through the formation of well-defined peaks in FTIR and Raman spectrums. These peaks in pure polymer powder and composite films were almost in the same wave numbers [2,3].

This research suggests a successful method to include ceramic nanoparticles in the polymer matrix, which while maintaining the properties of the relaxor polymer and the ceramic fillers can lead to high-quality flexible free-standing polymer composite films that have the potential to be used in various applications such as energy storage, electrocaloric applications.

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