PREPARATION AND CHARACTERIZATION OF POLYMER NANOCOMPOSITES WITH PIEZOELECTRIC PROPERTIES

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ABSTRACT

The β-crystallization of PVDF was investigated in this study. Nanocomposites were prepared by melt mixing PVDF, and 80/20 w/w PVDF/PMMA blends, with non-activated and mechanical activated (5 min and 10 min) $BaTiO_3$ in a Brabender Plastograph internal mixer. The samples were then quenched in ice water followed by annealing at 80 °C for 24 hours. The sizes of the $BaTiO_3$ particles were reduced through mechanical activation prior to mixing, and the activated $BaTiO_3$ particles interacted better with the polymer matrix. Scanning electron microscopy (SEM) showed good dispersion of $BaTiO_3$ particles in the polymer matrix, with some agglomerates. Fourier-transform infrared (FTIR), X-ray diffractometry (XRD), and Raman spectroscopy showed the presence of the β-phase in the blend and blend composites. The addition of non-activated and activated $BaTiO_3$ in PVDF did not nucleate β-phase crystallization. Non-activated $BaTiO_3$ particles induced α-phase crystallization of PVDF/PMMA, while the activated particles induced the β-phase. Thermogravimetric analysis (TGA) showed a decrease in the thermal stabilities of PVDF and the PVDF/PMMA blend with the addition of $BaTiO_3$. Dynamic mechanical analysis (DMA) and dielectric spectroscopy revealed that at a fixed content of the filler, the storage modulus and dielectric constants increase with an increase in activation time of the filler. The crystallization and melting temperatures of the matrix were slightly affected by the addition of activated $BaTiO_3$ particles.