Aspects of structural, optical properties, and relaxation in ($BiFeO_3$ or $NaTiO_3$)–PMMA: hybrid films for dielectric applications

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Abstract

Perovskite–polymer hybrids are fascinating materials combining improved physical properties with a flexibility that make them very suitable for electric and optoelectronic devices and applications. In the present work, nano-sized $BiFeO_3$ and $NaTiO_3$ were mixed with polymethyl methacrylate (PMMA) by solution casting to obtain transparent nanocomposite films. The structural properties, interactions between the film constituents as well as film thickness were evaluated by using X-ray diffraction, Fourier transform infrared spectroscopy, and scanning electron microscopy combined with energy–dispersive spectroscopy. The composite films were nonporous of semicrystalline nature. The $NaTiO_3$ interacted strongly with PMMA molecules than $BiFeO_3$. Nano-filler incorporation narrowed the optical bandgap significantly while maintaining a reasonably high transmittance. The dielectric constant of composite films was higher than that of pure polymer maintaining a low dielectric loss. The effect of these perovskites on the dielectric modulus, relaxation, and ac conductivity were discussed. The prepared composites are suitable for integral thin film capacitors, electric stress control devices, and bio-engineering systems.

***Keywords*:** Perovskite–Polymer; $NaTiO_3$; Bandgap; Dielectric relaxation; Bio-engineering devices.