INVESTIGATING THE EFFECT OF NANOPARTICLE DOPING ON THE OPTICAL PROPERTIES OF POLYMER THIN FILMS

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We report on the influence of nanoparticle doping on the optical properties of polymer thin films prepared by solution casting. A series of nanocomposite films based on poly(vinyl alcohol) (PVA) was fabricated with different concentrations of metal-oxide nanoparticles (0–5 wt.%). The optical response of the films was investigated using UV–Vis spectroscopy in the wavelength range of 200–900 nm. The absorption spectra revealed a systematic increase in absorbance with increasing nanoparticle concentration, indicating enhanced light–matter interaction due to the embedded nanostructures.

The optical band gap was estimated using Tauc plots for indirect allowed transitions. A gradual decrease in the band gap from 5.20 eV to 4.65 eV was observed as the doping level increased, which can be attributed to the formation of localized states and changes in the polymer matrix ordering. In addition, the refractive index and extinction coefficient were extracted from transmission data, showing a concentration-dependent modification consistent with improved optical density.

These findings suggest that nanoparticle-doped polymer films can be tuned for potential applications in opto-electronic devices, UV shielding, and flexible photonic components.

[1] R. A. Smith, Optical Properties of Materials, Wiley, 2019