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Optical characteristics of polymer and nanocomposite films

Abstract: Nowadays, polymeric materials are successfully applied in optical instruments, communication systems, fiber optics, data recording devices, displays, LEDs, etc., because of their low cost, reduced weight, flexibility and excellent transmittance in the visible and near-infrared spectra. Unique priority of polymers over glass is safety which determines their only choice in medical clinical applications. Main disadvantages of polymers are their low temperature stability and hygroscopicity but restricted range of refractive index values is the most important challenge to the designers. Some drawbacks are surmounted when hybrid plastic-glass optical elements are applied. Bulk polymers as well as polymeric films are used, though our previous investigations show differences of their optical properties. The diapason of available optical polymeric materials can be broadened using inorganic nanoparticles with high refractive index value. Such materials are preferred in optical design giving a variety of aberration compensations, technological applications in waveguides, optical switches, antireflective coatings, etc. In this study investigation of neat optical plastic and composite films is reported. Casting and spin coating methods of blended solutions on glass substrates have been applied to obtain polymer layers with different thicknesses. Prediction of final refractive properties is established by means of some of the known theoretical models. Comparison among the computed and experimental results is accomplished. Transmittance curves in visible and near-infrared region up to 2600 nm are presented and discussed. Our results show that incorporation of polymeric materials with metal oxide nanoparticles increase the refractive index value though possible optical application is determined by the final transmission of the composite in the operating spectral range.

Keywords: polymer films, nanocomposites, transmission in visible and near-infrared spectrum, refractive index

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