Study of Film Formation From PS Latex/AgNPs Composites Via Fluorescence Technique

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In this study, we investigated the characteristic change in film formation, optical, morphological and electrical properties of pyrene (P) labeled polystyrene (PS) latex/silver nanoparticles (AgNPs) (PS/AgNPs) composites using steady state (SSF) and fast transient (FTRF) fluorescence techniques in conjunction with UV–vis (UVV) technique. Nine different mixtures were prepared by mixing of PS latex dispersion with different amount of AgNPs in the range of (0- 50 wt%). PS/AgNPs films were then prepared on glass substrates using drop casting method and drying at room temperature. After drying, film samples were separately annealed above glass transition temperature (T_g) of PS ranging from 100 to 280 ^{0}C for 10 min. In order to monitor film formation process, fluorescence emission spectra, fluorescence decay curves and transmittances of these composites were measured after each annealing step as a function of AgNPs content. The emission spectrum became narrower [1] depending on the AgNPs content in the range of (3-30) wt%. Fluorescence enhancement and reduced lifetime were also observed with increasing AgNPs content in this range [2]. However, the fluorescence emission spectrum remained almost unchanged and the intensity decreased substantialy with annealing temperature with increasing AgNPs content above 30 wt%. For (3-30) wt% AgNPs content, fluorescence intensities (I_P) from P and transmitted light intensity (I_{tr}) through the films were measured after each annealing step. Below 30 wt% AgNPs, two distinct film formation stages, which are named as void closure and interdiffusion processes, were seen in fluorescence data [3]. However, above 30 wt%, no change was observed in I_P and I_{tr} upon annealing, whereas transparency decreased overall with increasing AgNPs content. The electrical conductivity of these composites was measured as a function of AgNPs content. In the studied concentration range (0-50 wt%) of AgNPs very little increase in electrical conductivity was observed.

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