ABSTRACT

For the thesis entitled "Study of Optical Properties of Transition/RE Oxide - Polymer Nanocomposites"

Dhaval Hirani
Department of Applied Physics
Faculty of Technology and Engineering
The Maharaja Sayajirao University of Baroda
Vadodara

Synthesis of rare earth RE (Ce, Dy, Er, Eu, Pr, Tb, Tm) doped TiO_2 / ZrO_2 nanoparticles has been successfully done by hydrothermal technique with 0.1 mol% & 0.2 mol% doping concentration of rare earth elements. Synthesized material blended with polyacrylicacid with 1 mol% & 2 mol% respectively to develop thin films of RE doped TiO_2 / ZrO_2 – polyacrylicacid (PAA) nanocomposites.

The structural and elemental properties of the powder samples were studied by X-Ray Diffraction (XRD), Energy Dispersive X-ray Spectroscopy (EDS) and Particle Size Analyzer (DLS). Fourier Transformation Infra-Red Spectroscopy (FTIR) studies the functional groups in the samples. Study of fluorescence emission of TiO_2:RE-polyacrylicacid nanocomposites was carried out by Photo-Luminescence (PL) Spectroscopy. UV-Visible Spectroscopy was used to determine the optical properties of the prepared nanocomposites.

The XRD results revealed the formation of material as nano crystallite and confirms the material structure formation and it matches with the standard JCPDS results. DLS results give particle size distribution in nano meters. The EDS spectra of samples indicate the presence of Titanium/Zirconium, Oxygen and rare earth elements. The FTIR spectra confirms the presence of different functional groups with respective wavenumber for PAA. The Photoluminescence study exhibits wide peaks in UV region and violet-blue region.

The optical properties of RE:TiO_2 – PAA nanocomposites were analysed by UV- Visible Spectroscopy. The bandgap values of the composites are between that of pure TiO_2 and pure PAA. The refractive index is higher than pure PAA. The variation of absorption coefficient with wavelength shows higher absorption in UV range. The value of extinction

coefficient is high for all the samples below 315 nm. PTRE1 (1 mol%) set of samples show higher absorption of UV in comparison with PTRE2 (2 mol%) samples.

The optical properties of RE:ZrO_2 – PAA nanocomposites were analysed by UV- Visible Spectroscopy. The bandgap values of the composites are between that of pure ZrO_2 and pure PAA. The refractive index is higher than pure PAA. The variation of absorption coefficient with wavelength shows higher absorption in UV range. The value of extinction coefficient is high for all the samples below 310 nm. PZRE1 (1 mol%) set of samples show higher absorption of UV in comparison with PZRE2 (2 mol%) samples.

The results of the optical studies are correlated and can be used for its possible applications. We selected composites of PTRE1 and PZRE1 for UV-shielding films. We measure a current at a constant temperature of 25 $^{\theta}$C with compare to pure PAA and a blank glass, to ensure we put a probe of a digital thermometer inside the small sample box. The current value of all the nanocomposites (thin film) show comparatively large decrease with compare to blank glass as well as pure PAA and reinforced by the results of UV-Vis Spectroscopy where the samples show higher absorption than pure PAA.

The best results are obtained for the PTDy1, PTEu1 and PTPr1 nanocomposite thin films. Hence, We successfully synthesis Rare Earth doped Transition metal oxide-Polyacrylic acid nanocomposites as an important material for UV-Shielding films.