

Supplementary information

Assembly of functional carboxymethyl cellulose /polyethylene oxide / anatase TiO₂ nanocomposites and tuning the dielectric relaxation, optical, and photoluminescence performances

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2.3. Measurement techniques

The X-ray diffraction (XRD) was measured over a 2θ range of (10° - 70°) using a PANalytical X'Pert Pro target *Cu-K* with secondary monochromator Holland radiation (the tube running at 45 kV with 0.1540 nm wavelength). High-resolution transmission electron microscopy (HRTEM) at 200 kV accelerating voltage was carried out using the JEM-2100F electron microscope to evaluate the shape and size of the prepared TiO₂ nanoparticles. The spectrometer VERTEX 80 (Bruker Corporation, Germany), using platinum diamond disc as the internal reflection element) was used to measure ATR-FTIR spectra in the range 4000-400 cm⁻¹. Field emission scanning electron microscope (FESEM) performed using a Quanta 250 FEG SEM. DSC 131evo (SETARAM Inc., France) was used to perform the differential scanning calorimeter analysis. The instrument was calibrated using the standards (Mercury, Indium, Tin, Lead, Zinc and Aluminum). Nitrogen and Helium were used as purging gases. The test was programmed, including the heating zone from -50°C to 150°C at a heating rate $10^\circ\text{C}/\text{min}$. The samples were weighted in Aluminum crucible 30ul and introduced to the DSC. The thermogram results were processed using (CALISTO Data processing software v.149). The UV-Vis absorption spectra in the range of 190-1000 nm were measured using a UV-Vis spectrophotometer (Jasco V-630, Japan). Photoluminescence (PL) spectra by spectrofluorometer equipped with TCSPC module (UK). The permittivity ϵ' , dielectric loss ϵ'' and alternating

resistance R_{ac} were obtained at room temperature $\sim 30\text{ }^{\circ}\text{C}$ over a broad frequency ranging from 0.1 Hz - to 1 MHz). The measurement was computerized by interfacing the impedance analyzer with a personal PC through a GPIB cable IEE488. A commercial interfacing and automation software program “Lab VIEW” was used for data acquisition. The error in ϵ' and $\tan \delta$ amounts to $\pm 1\%$ and $\pm 3\%$, respectively. The temperature of the samples was controlled by a temperature regulator with (Pt 100) sensor. The error in temperature measurements amounts $\pm 0.5\text{ }^{\circ}\text{C}$.

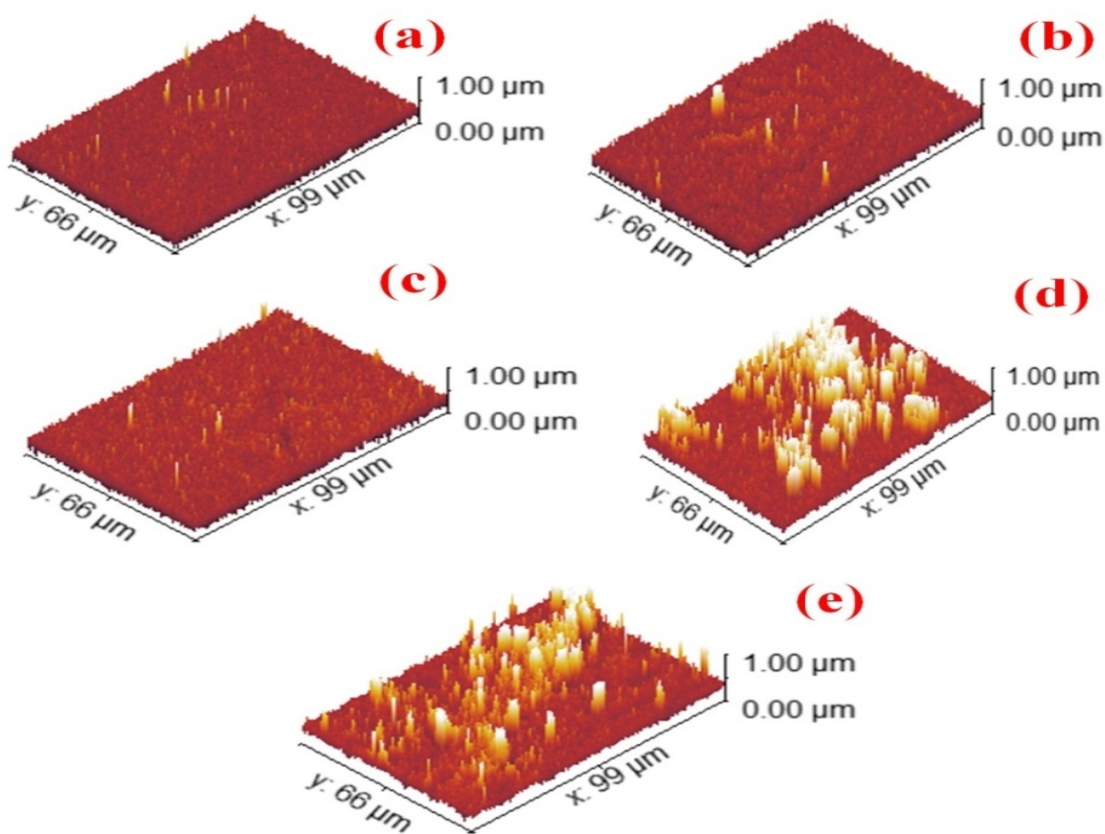


Fig.S1. (Color online) 3D images of (a) CMC/PEO and CMC/PEO inclusion with (b) 2, (c) 6, (d) 10, and (e) 15 "wt%", % TO NCs.

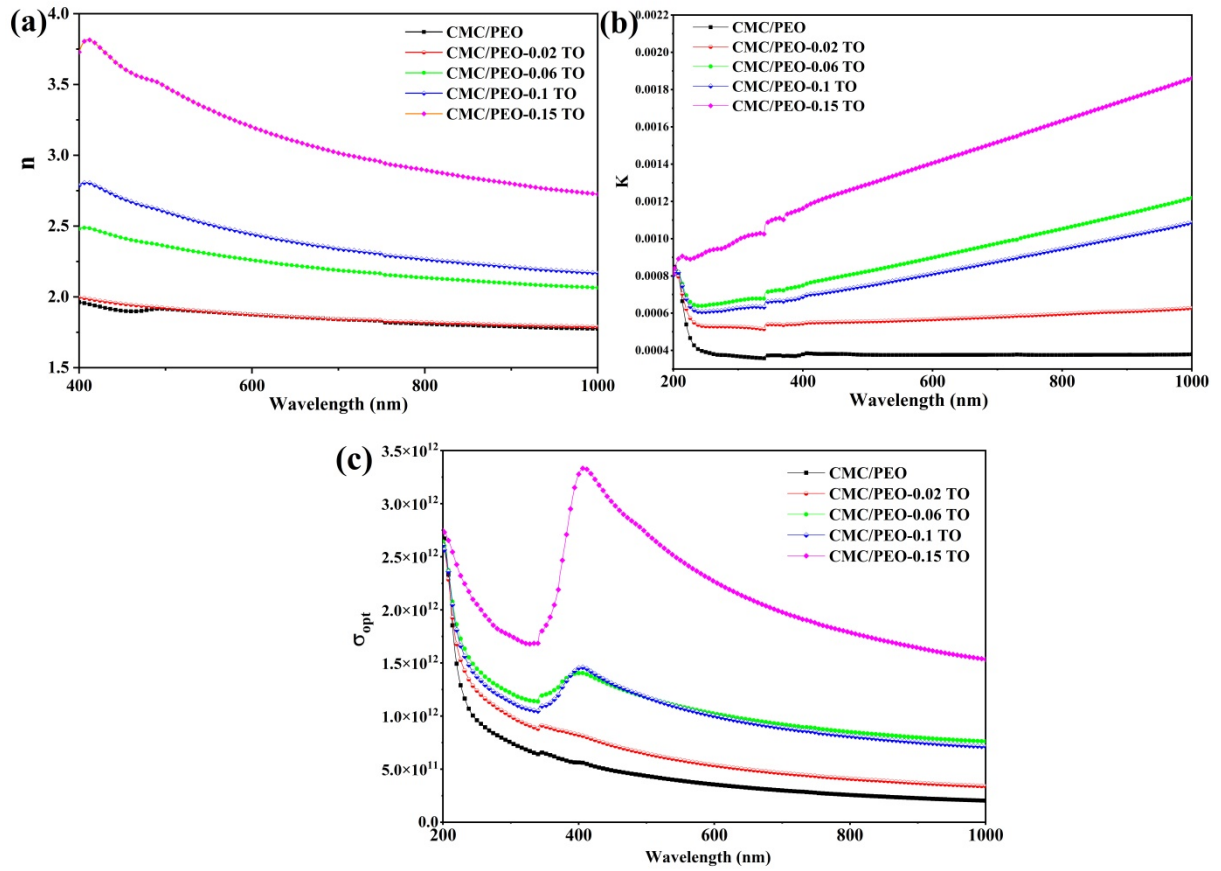


Fig .S2. (Color online) (a) Relations between (a) n , (b) K , and (c) optical conductivity versus wavelength of CMC/PEO and CMC/PEO inclusion with different weight percentage of TO NCs.