Effects of functionalization by carboxylic groups of carbon nanotubes on the formation of composites with MEHPPV

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Abstract – In this work a poly (2-methoxi-5-(2-etylhexyloxi)-p-phenylenevinylene))- MEH-PPV, conjugated polymer and single-walled carbon nanotubes (SWNT) CoMoCAT®[1] were chosen to perform composites systems. The carbon nanotubes commercial were functionalized with carboxylic group to improve the dispersion in the polymeric matrix. The use of functionalized carbon nanotubes into polymeric matrix allows obtaining composite materials with enhanced mechanical, thermal and conducting properties for application in optical devices.

Pristine carbon nanotubes are unfortunately insoluble in organic media. Therefore they are difficult to disperse in a polymeric matrix. This complicates efforts to utilize the nanotubes outstanding physical properties in the manufacture of composite materials, as well as in other practical applications which require preparation of uniform mixtures of carbon nanotubes with polymeric materials. In order to make nanotubes more easily dispersible in organics media, it is necessary to graft physically or chemically certain molecules, or functional groups on their walls without significantly changing nanotubes desirable properties. This process is called functionalization. The chemical functionalization of single-wall carbon nanotubes is necessary to solubilize the materials and to assist in the dispersion of the bundles for a variety of its applications.

In this work we perform studies on optical and structural properties of conjugated copolymer/ functionalized single walled carbon nanotubes (SWNT-COOH) composites [2]. The carbon nanotubes was modified with nitric acid and then were dispersed in organic solvents (NMP, *N-Methyl-2-pyrrolidone* and THF, *tetrahydrofuran*) by sonication and after they mixed together to obtain composite systems in the proportion 1:1 v/v. The composite films were prepared by casting technique and deposited onto quartz substrate. The materials were characterized by Raman spectroscopy and to SWNT pristine and to composite systems were used as probe the G and D band spectral position and theirs intensity ratio as shown in the figure 2. These studies were carried out to optimize the attachment of the carboxylic groups on carbon nanotubes. The good dispersion quality of the SWNT was obtained through the resonance ratio (R_{ratio}=0.117) as showed in the figure 1. A Stokes shift of 57 nm was observed of the optical absorption and photoluminescence spectra for the MEHPPV/SWNT-COOH composite as shown in the figure 3. Our results evidence the formation of polymer-SWNT composite, and it does not significantly change the optical properties of the luminescent polymer. The functionalization with -COOH could not only increased carbon nanotubes solubility and its dispersibility but also improved the interfacial interaction with polymeric matrices in this composite.

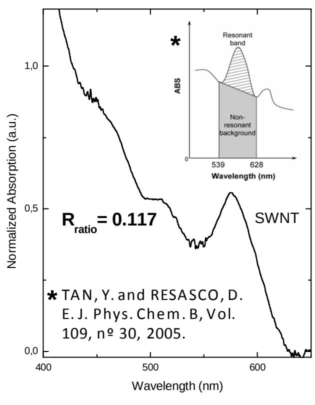

Figure 1: Absorption spectrum in the range of 400-700 nm for the functionalized SWNT. Inset resonant band used in R_{ratio} calculus.

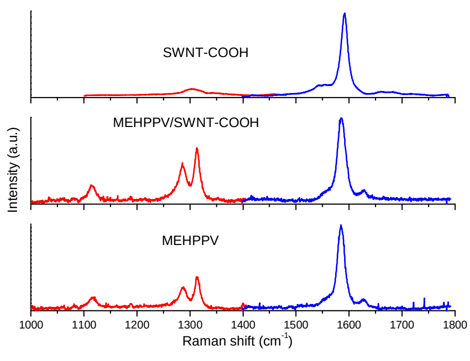

Figure 2 Micro-Raman spectra of MEHPPV, SWNT-COOH and MEHPPV/SWNT-COOH composite in the range 1000 to 1800 cm^{-1}

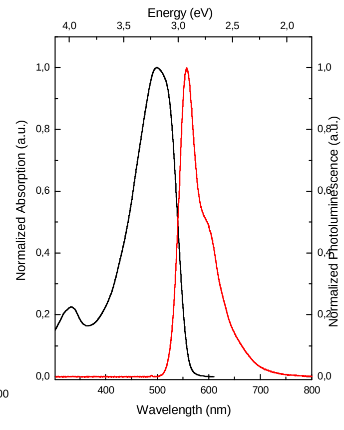

Figure 3: AO and PL spectra in the range of 400-700 nm for the MEHPPV/SWNT-COOH composite

References
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