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Preparation and Characterization of Layer-by-Layer Films based on Poly(p-phenilenevinilene) and Single-Walled Carbon Nanotubes

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Abstract –This paper describes the preparation and characterization of layer-by-layer (LbL) thin film based on poly(p-phenilvinilene) (PPV) precursor and modified single walled carbon nanotube. The PPV precursor was converted to PPV upon heating of the films in ambient atmosphere. The UV-Vis and photoluminescence (PL) spectra show an intense vibronic structure that indicated the conversion PPV precursor and the growth of films.

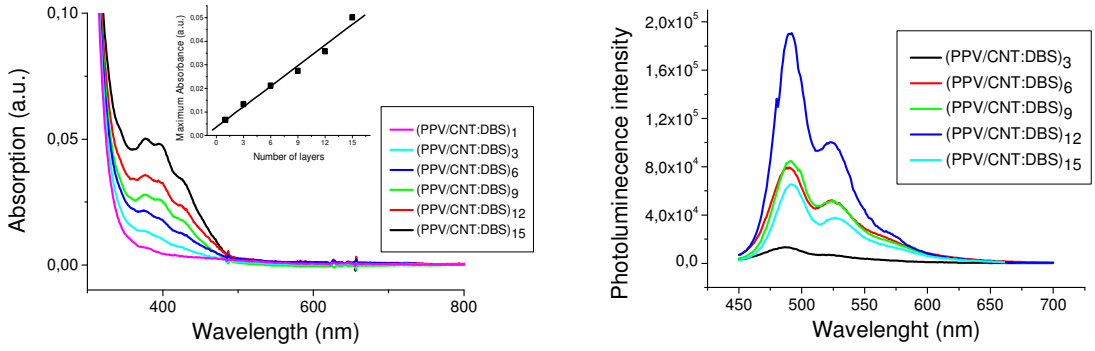
Thin films based on poly(p-phenilenevinilene) (PPV) and single walled carbon nanotubes (SWNT) have been prepared by different deposition techniques for application in some electronics devices, e.g., thin film transistor, light-emitting diodes and organic solar cells. Among these techniques, the layer-by-layer deposition emerges as a simple and versatile tool to obtain improved device's performance.

In this study, we prepared LBL thin films from a cationic precursor of PPV (poly-xylylidene tetrahydrothiophenium chloride - PTHT) and SWNT dispersed into a sodium dodecylbenzenesulfonate (NaDBS) solution. Hydrophilic glass substrates were dipped alternatively into an aqueous solution of PTHT followed by dipping in a SWNT dispersion for 2 minutes, respectively. After each immersion the films were dried with a stream of nitrogen flow. The concentration of PTHT solution was fixed at 0.5 mg mL^{-1} and all experiments were carried out at room temperature. The films were assembled in the following architecture: $(PTHT/SWNT:NaDBS)_n$, where *n* is the number of bilayers. The conversion of precursor PTHT to PPV was carried out by heating at 110 °C at ambient atmosphere as described by Marletta et. al. [1]

The optical absorption spectra (Figure 1) showed a broad band between 350-500 nm attributed to π-π* transition of the PPV polymer. As expected, the PPV absorption increases as the number of layers increases. The insert in Figure 1 shows a linear dependence of maximum absorption on the number of layers (Lambert-Beer Law). It was an indicative that after each deposition, a same amount of the material is deposited on the substrate, suggesting accuracy in the thickness control.

The photoluminescence spectra showed in Figure 2 reveal that the films with 3 bilayers presented the lowest photoluminescence which corroborated with small amount of luminescent material. Increasing the number of bilayers (6, 9 and 12 consecutively), one may observe an increase in photoluminescence intensity. Nevertheless, when the number of bilayers was increased to 15, considerable photoluminescence quenching was observed. This can be attributed to concentration effects, possibly leading to formation of aggregates and also to the onset of inner effect filter [2].

The PTHT/SWNT:NaDBS films were employed, at first time, as active layers in photovoltaic devices. This results will also be presented.



(a) **(b)**

Figure 1. UV-Vis **(a)** and photoluminescence **(b)** spectra for the LBL films of PPV and SWNT. The insert in **(a)** shows the linear relation between maximum absorption and number of layers.

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[2] J. R. Lakowicz, *Principles of Fluorescence Spectroscopy*, 2006, 3rd edition, Plenum Press, New York.