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Molecular Architecture, Photoluminescence, dc Electrical Characterization and Sensor Applications of Perylene Derivative Thin Films Thermally Evaporated

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Abstract – Thin films of bis benzimidazo perylene (AzoPTCD) were fabricated using the physical vapor deposition (PVD) technique through thermal evaporation. The molecular organization in the PVD films was determined using the selection rules of infrared absorption spectroscopy (transmission and reflection modes). The fluorescence of the material was studied as a function of the temperature using a micro-Raman system. The AzoPTCD was characterized by current as function of tension (I x V curves) in *dc* measurements. Impedance spectroscopy was used to study the performance of PVD films of the AzoPTCD as transducers in sensing units applied to discriminate Cu^{2+} and methylene blue (MB) in aqueous solutions.

The organic thin film technology applied to electronic devices has attracted the attention of researchers due to its different possibilities of application combined to low cost and easy processability. Within the large number of organic dyes, perylene derivatives have been used as main components in sensors and other electronic devices since they present good thermal and chemical stability and suitable optical and electrical properties. In this work, thin films of a perylene derivative, AzoPTCD, were produced using the physical vapor deposition (PVD) technique through thermal evaporation focusing on the molecular organization of the AzoPTCD [1]. The molecular organization of the AzoPTCD in the PVD film was determined through FTIR and it was found that the molecules are mainly placed on the solid substrates in an edge-on fashion with the chromophore groups perpendicular to the substrate. The PVD films deposited onto Ag islands were applied to exploit the called surface-enhanced phenomena through fluorescence (surface-enhanced fluorescence - SEF) with laser line at 785 nm. For instance, it was found an enhanced factor of 40 for the SEF using the 10 nm PVD films. Besides, fluorescence spectra were recorded for several temperatures as shown in Figure 1. Electrical measurements (I x V curves) indicated a low rectification of the PVD films of AzoPTCD deposited onto both Au interdigitated electrodes (Figure 2) and in a sandwich structure between Al and ITO, respectively. Ongoing measurements of electroemission measurements are being taken. Impedance spectroscopy measurements were used to study the performance of PVD films of the AzoPTCD as transducers in sensing units applied to discriminate Cu^{2+} and methylene blue (MB) in aqueous solutions. The data taken from impedance measurements were analyzed using the Principal Component Analysis (PCA) to extract information on the role played by the interface film/solution in the detection process.

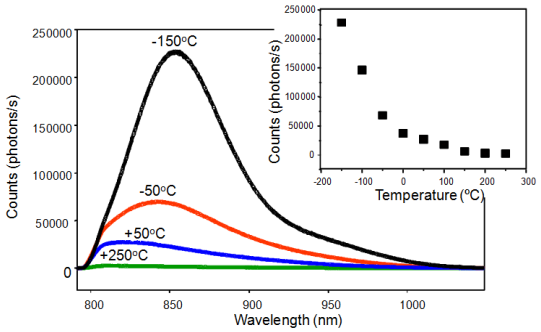

Figure 1: Fluorescence spectra as a function of the temperature. The inset shows the relation between fluorescence maximum intensity and temperature.

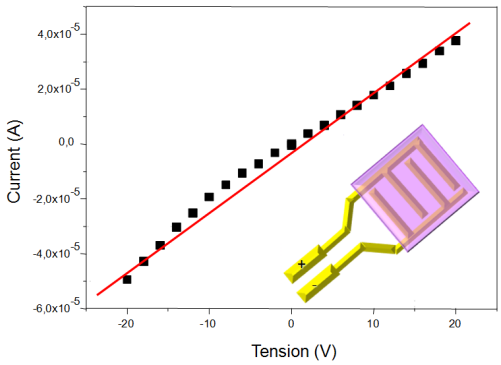

Figure 2: I vs V curve of the AzoPTCD deposited onto Au interdigitated electrodes.

References

[1] D.Volpati, A.E. Job, R.F. Aroca, C.J.L. Constantino. J. Phys. Chem. B 2008, 112, 3894-3902.