OPTICAL CHARACTERIZATION OF LOW MOLECULAR WEIGHT ORGANIC FILMS.

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1. Abstract

Optical properties of conjugated compounds: 1-(*m*-cyanophenyl)-2-(*p*-pyridyl)ethene, 1-cyano-1-(*m*-pyridyl)-2-(*p*-chlorophenyl)ethene, 1-cyano-1-phenyl-2-(*p*-chlorophenyl) ethene and 1-cyano-1[(*o*-pyridyl)-2-(*p*-fluorophenyl)]ethene, were characterized by absorption and fluorescent due to their potential applications in optoelectronic devices. A single layer film of each compound was deposited by spin coating technique using poly-(N-vynilcabazole) as matrix and toluene or chloroform as solvent. ITO coated glass serve as anode and substrate and In-Ga eutectic as cathode. The films characterization were carried out by IR, absorption UV-Vis and AFM measurements.

2. Introduction

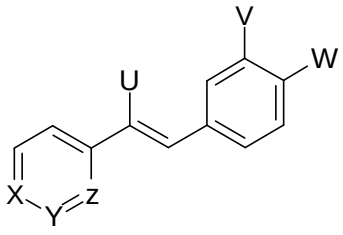
Organic light emitting devices based on thin films of organic molecules and polymers have had a great development since the first demonstration of a green organic electroluminescence in 1987 by Tang and VanSlyke, [1]. Organic EL devices represent a low-cost route for large-area light-emitting display technology [2]. In the single approach, organic EL devices are formed by an organic film placed between two metallic electrodes. Films of low molecular weight compounds can be obtained using a polymeric matrix and then the film can be deposited by easy techniques like spin-coating [3]. In the present work the optical properties of low molecular weight pirydinevinylene compounds were studied. Optical absorption and photoluminescence properties in solution and in thin films were determinate in order to apply in organic light emitting devices using Polyvinilcarbazole as matrix.

3. Experimental

The compounds were synthesized according to the reported method [4]. An UV-Vis absorption spectra were recorded at room temperature with a Ocean Optics Spectrometer SD2000 and a Light Source UV/Vis DT 1000 CE of Analytical Instrument System. Fluorescence emission spectra were recorded with the same Spectrometer and a Mineralight UVGL-58 UV lamp as excitation source. IR spectra were carried out with a Bruker Vertex 70 FT-IR spectrometer. Morphology and films thickness were measured using an atomic force microscope (AFM) EasyScan of Nanosurf. PVK from Aldrich was purified before used as a host polymer. PVK-dye toluene solutions with concentration 100:25 %wt were used to obtain thin films by Spin Coating. Quartz and indium-tin oxide (ITO) coated glass (30-60 Ω) are used as substrate and anode respectively to measure optical properties and electroluminescence (EL) spectra. IN-GA eutectic alloy is used as cathode.

4. Results y discussion

The structure of the compounds F1: 1-(*m*-cyanophenyl)-2-(*p*-pyridyl)ethene, F2: 1-cyano-1-(*m*-pyridyl)-2-(*p*-chlorophenyl)ethene, F3: 1-cyano-1-phenyl-2-(*p*-chlorophenyl) ethene and F4: 1-cyano-1-(*o*-pyridyl)-2-(*p*-fluorophenyl)]ethene is shown in the scheme I.



F1 X=N, Y=C, Z= C, U=H, V= CN, W=H
F2 X=C, Y=N, Z= C, U=CN, V= H, W=Cl
F3 X=C, Y=C, Z= C, U=CN, V= H, W=Cl
F4 X=C, Y=C, Z= N, U=CN, V= H, W=F

Scheme I. Structures of the molecules studied.

The figure I shows the UV-Vis absorption and the fluorescence spectra of the F1-F4 compounds. The absorption of the compounds showed a principal band due to $\pi \rightarrow \pi^*$ transition at 293 and around 320 nm, the PVK showed a typical spectrum. The effect of the electron withdrawing atom on the structure was observed as a red shift being bigger for the fluor atom. In the fluorescence spectra for F1-F4 compounds, also it can observed a red shift like absorbance behavior. The figure II, shows the absorption of the blend PVK-Compound deposited over quartz , it did not showed any shift which indicated that PVK acts only as a matrix, i.e. there are not intermolecular interactions between the compounds and the PVK. The intermolecular interaction was not observed by IR spectroscopy.

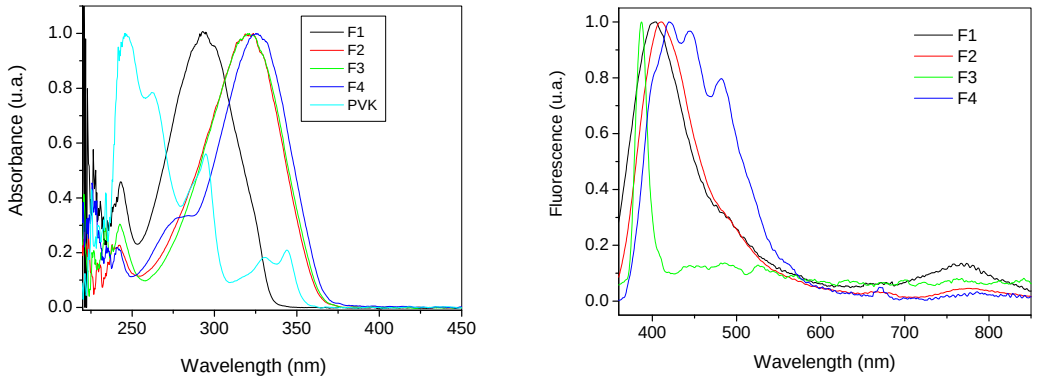


Figure I. UV-Vis Absorption of the compounds in CHCl3 and fluorescence spectra of the F1-F4 compounds respectively.

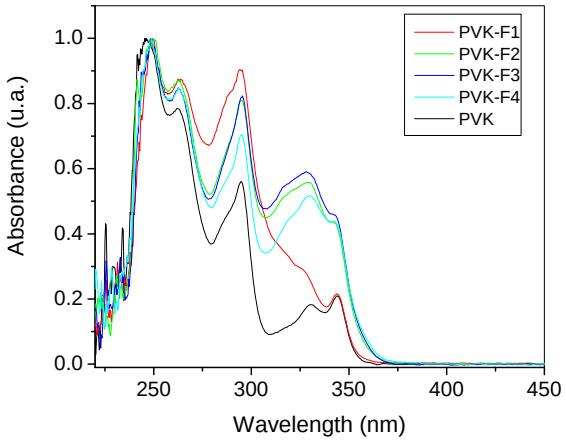


Figure II. UV-Vis absorption of the F1-F4 films.

The thickness of the all PVK-Compound films was about 150 nm as well as homogeneous and smooth surface pinhole free was obtained. Single layer EL device consisting of ITO/PVK-compund/In-Ga was fabricated. The devices showed a electroluminescence of low intensity and ohmic behavior, which might owe to the low intensity of the emission [5,6].

5. Conclusions

The optical properties of the novel synthesized compounds could have interesting applications as EL devices, however, when their electroluminescent properties was measured only a moderate emission can be obtained. Their effectiveness can be improved modifying the compound structure by introducing groups as electron-donating (D) or –accepting (A) in the structure in order to increase the carriers injection.

6. References

[1] Tang, C. W.; VanSlyke, S. A. *Appl. Phys. Lett*. 1987, **51**, 913.

[2] Saito, S.; Tsutsui , T.; Era, M.; Takada, N.; Adachi, C. *Proc. SPIE* 1993, **1910**, 212.

[3] E. Gondek, A. Danel and I.V. Kityk, *Journal of Luminescence*, 2008, **128,**348-354.

[4] Ruíz F.R. Tesis de licenciatura Síntesis y caracterización de compuestos conjugados de bajo peso molecular, facultad de ciencias químicas, BUAP, en proceso 2008.

[5] Amitava Patra, Michael Pan, Christopher S. Friend, Tzu-Chau Lin, Alexander N. Cartwright, and Paras. N. Prasad *Chem. Mater.* 2002**, 14**, 4044-4048

[6] Daniel A. Bernards, Tomasz Biegala, Zachary A. Samuels, Jason D. Slinker, and George G. Malliaras *Applied Physics Letters* 2004, 84, 3675.