

Electroluminescence from vacuum deposited poly(p-phenylene)

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1. Introduction

π -conjugated poly(arylene)s exhibit interesting electrochemical, optical, and electric properties, and various studies have been made on the chemical and physical properties of the poly(arylene)s¹

Poly(p-phenylene)(PPP) is a well-known highly conductive and highly stable organic material and is the subject of great interest in electronic device applications. Preparation of a thin film of PPP is not easy because of its insolubility.

The elcetroluminescent layer of PPP film can be prepared via a soluble precursor polymer or by electrochemical polymerization.² Only, one paper was found, entitled vacuum deposition of PPP for preparing light-emitting diode.

In this paper, we report degree of polymerization and EL, PL and UV/Vis spectrum of the vacuum deposited poly(p-phenylene) light-emitting diode.

2. Experimental

Polymer synthesis

PPP was synthesized by Yamamoto method.³ The 51mg of NiCl₂(bpy) was added to a mixture of the products obtained by the reaction of 11.8g(50mmol) of p-dibromobenzene with 1.22g of magnesium in dry tetrahydrofuran(50ml). After refluxing for 10h, the reaction mixture was poured into 500ml of ethyl acohol. The polymer precipitated was collected over a glass filter, washed with dilute hydrochloric acid and ethyl alcohol, and dried in a vacuum.

Device Preparation

Substrate used was ITO-coated glass with a sheet resistance of less than 20Ω /square. The ITO-coated glass substrates were etched and patterned to serve as the anodes, Al was used as the cathode. The ITO surface was carefully cleaned before use. A thin film was prepared on an ITO-coated glass substrate from its powder by a vacuum deposition method. The vacuum deposition was executed on pressure under 1×10^{-5} Torr.

3. Results and Discussion

Fig.1 showed optical absorption and emission spectra of a vacuum-deposited PPP(vd-PPP) device. A strong absorption peak at 325nm and 350nm assigned as interband absorption.³ The photoluminescence of vd-PPP showed the maximum peak at 450nm and two shoulders at 435nm, 485nm. This was similar to spectra of p-sexiphenyl film made by vacuum deposition method.⁴

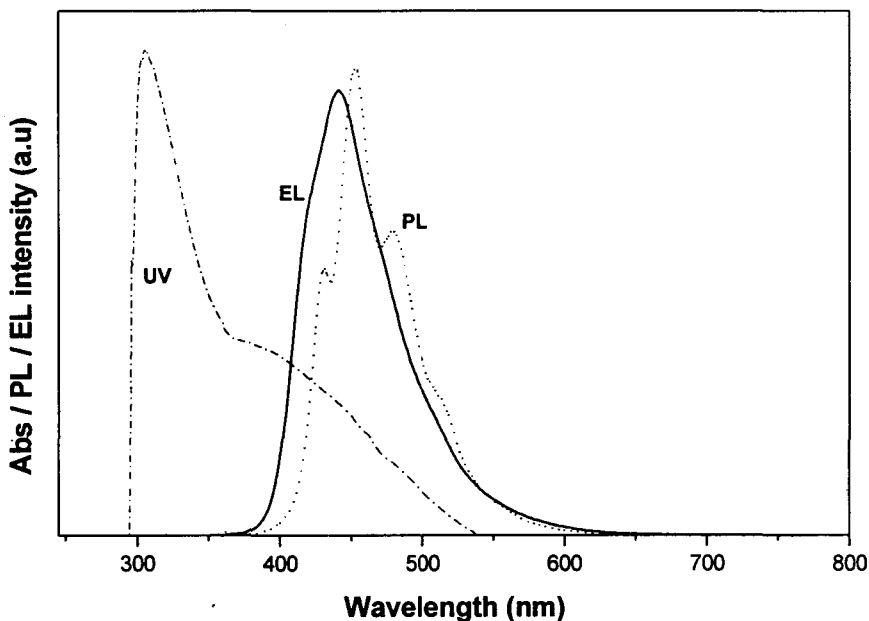


Fig1. UV-Vis absorption and Luminance spectrum of ITO/vd-PPP/Al device

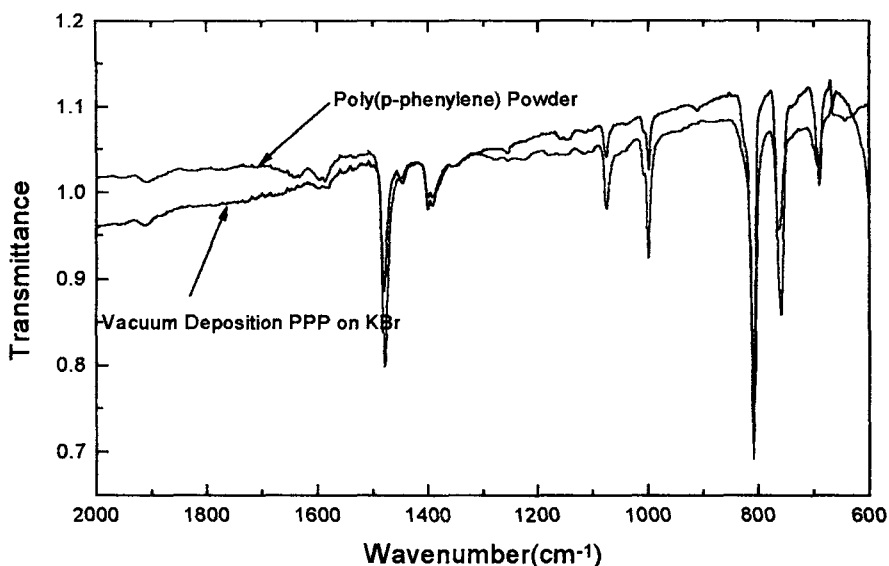


Fig2. IR-spectrum of vd-PPP and PPP powder.

The electroluminescence of ITO/vd-PPP/Al exhibited the sharp peak at 445nm. This appeared blue-emitting region. Compared to the other blue emitting phenylene derivatives, vd-PPP had relatively narrow band width.

The vacuum-deposited thin film formed from PPP powder was characterized by IR spectroscopy. Fig.2 shows a typical IR spectrum of vd-PPP. The absorption peaks at 1481($\text{C}=\text{C}$ skeletal vibration of phenylene ring), 1001 ($\text{C}-\text{H}$ in-plane deformation of phenylene rings), 806 ($\text{C}-\text{H}$ out-of-plane deformation of 1,4-substituted phenylene rings), and 765cm^{-1} ($\text{C}-\text{H}$ out-of-plane deformation of mono-substituted phenylene rings) are characteristic of a 1,4-phenylene structure. The phenylene chain length can be calculated from the peak intensity ratio of the *para* band ($800\text{--}830\text{cm}^{-1}$) and the mono-substituted phenylene ring band($690\text{--}710\text{cm}^{-1}$).⁵ The phenylene chain length of the vacuum-deposited PPP thin film is given as $n=8.2$ (average).

We have investigated the some properties of poly(p-phenylene) layer formed by the vacuum deposition method, such as degree of polymerization and EL, PL, UV/Vis and I-V characteristics.

4. Reference

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