



Enhancement on the poly(*p*-phenylene vinylene) emission efficiency in the indium-tin oxide interface

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Abstract - This work addresses the emission efficiency of ultra-thin films of poly(*p*-phenylene vinylene) (PPV) spin coated on indium-tin oxide (ITO) electrode. In order to reduce the PPV degradation in the interface polymer/ITO, we introduce the dodecylbenzenesulfonate (DBS) ion as a counter-ion and carry out the thermal conversion procedure at low temperature for the PPV precursor polymer. The emission efficiency increases ca. 4.5 times in comparison with PPV films obtained conventionally.

Poly(*p*-phenylene vinylene) (PPV) conjugated polymer and light emitter is a promising candidate for optoelectronic applications as an active layer in electroluminescent devices, such as polymer light-emitting diodes (PLEDs) [1] and photocell [2,3]. This is possible due to significant progress in the synthesis route of PPV via a soluble non-conjugated precursor polymer, the poly(xylylidenetetrahydrothiophenium) - PTHT [4]. After processing, the PTHT films are converted into PPV films by using a thermal step to eliminate the lateral group tetrahydrothiophenium, generally at elevated temperatures (> 200 °C). During the PTHT thermal treatment, chemical sub-products (hydrochloric acid, HCl) react with the hole-injector and transparent electrode (indium-tin oxide, ITO) forming indium chloride (InCl₃) [5-7]. This sub product degrades the ITO film and diffuses into the ITO/PPV interface forming an oxidized layer [8]. Alternatively, the PPV can be obtained at lower temperature by using the dodecylbenzenesulfonate (DBS) ion as a counter-ion of the PTHT polymer, with the advantage of acting as a possible less aggressive leaving group [9], reducing the degradation on the electrode during the PPV conversion process. The low conversion temperature opens the possibility of using the PPV as an active layer in multi-layer organic semiconductor devices. In this letter, we use this new chemical route to investigate the effect on the emission properties of PPV layer deposited on ITO substrate, when a less aggressive leaving group, the DBS ion, is used as a counter-ion for the PTHT.

In this work we have studied the influence of the thermal conversion process on the PPV emission efficiency at the interface ITO/PPV ultra-thin films. We have adopted an alternative strategy, or new PPV synthesis route, in which was employed a less aggressive chemical leaving group (DBS) in the precursor polymer. When the DBS and the low temperature conversion process are introduced, the absorption and PL characteristics presents an increase in the relative emission efficiency for the sample PPV+DBS100 (ca. 4.5) (Table 1), due to the significant reduction in the oxidative process into the interface ITO/PPV. In other words, this procedure reduces the thermal and/or chemical degradation effect on the ITO electrode due to the PPV thermal conversion process, as for example, the HCl diffusion during the PPV thermal conversion. For PLEDs, it is expected a considerable decrease in the Schottky barrier formation in the electrode/polymer interface and in the device operating voltage.

Table 1. Relative emission efficiency from PPV and PPV+DBS films processed at different temperature conditions.

Sample	$\eta = \text{PL}/\text{Pot}^*$
PPV200	0.75 x10 ⁵
PPV+DBS100	3.22 x10 ⁵
PPV+DBS200	1.03 x10 ⁵

* Pot = 1-10^{-A(λ)}

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