

The Characterization of a Luminescent PPV Derivative by Various Spectroscopic Methods

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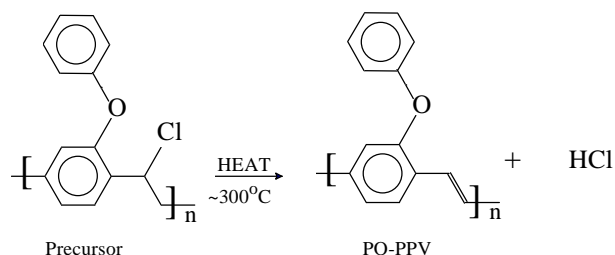
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INTRODUCTION

Poly(*p*-phenylene vinylene) (PPV) and PPV derivatives comprise a group of conjugated conducting polymers with promise for OLED applications.(1) These polyarylenes have the necessary mechanical and optoelectronic properties for such applications. The wavelength of emission can be "tuned" by substitution of the PPV backbone with various electron-donating or withdrawing groups. For this reason researchers have pursued the synthesis of novel PPV derivatives. This study involves the characterization of a newly synthesized PPV derivative, poly (phenoxy phenylene vinylene) (PO-PPV) by several spectroscopic techniques: photoluminescent (PL) spectroscopy, ultraviolet-visible (UV/vis) spectroscopy, infrared spectroscopy and dynamic infrared linear dichroism (DIRLD).

PPV and PPV derivatives are usually prepared using a precursor route(2) because the precursor form of the polymer is soluble in contrast with the highly conjugated insoluble PPV product. Several precursor routes are known. In the synthesis of PO-PPV that includes a solid-state thermal elimination reaction, the chlorine precursor route (CFR) shown below was utilized.(3)



Dynamic infrared linear dichroism (DIRLD) has extensive applications to polymer systems. By applying a periodic strain to a polymer and measuring the phase-specific spectroscopic response, chemical structure information can be correlated to macroscopic physical properties. This study is unique in its application of DIRLD to an electroactive conjugated polyarylene, poly (phenoxy phenylene vinylene) (PO-PPV), and its non-conjugated precursor polymer. In this investigation, the effect of conjugation on the phase and intensity of the spectral response is related to mechanical properties obtained by dynamic mechanical analysis. In addition, the dynamic spectral information is used in the identification of IR normal absorption bands.

EXPERIMENTAL

A Varian Cary 5E UV/vis/NIR spectrophotometer was used. A Perkin-Elmer photoluminescence spectrometer was utilized at a photo excitation wavelength of 434 nm. A infrared spectrophotometer (Bio-Rad FTS 6000) in step-scan mode was used to collect dynamic spectra. The dynamic strain was applied sinusoidally to the polymer film using a polymer modulator (Manning Applied Technology) driven by a waveform generator (Agilent Technologies). A stretching amplitude of 75 microns and a frequency of 16 Hz was applied.

RESULTS AND DISCUSSION

The UV/Vis spectrum of PO-PPV(dashed) is shown in figure 1. The high-wavelength absorption edge of the $\pi - \pi^*$ transition of a conjugated polymer can be used to calculate the bandgap energy. In this case, the absorption edge at 515 nm determines a bandgap of 2.40 eV. The PL spectrum of PO-PPV(solid) is also shown in figure 1. Upon photoexcitation at 434 nm, PO-PPV is seen to emit light at 560 nm.

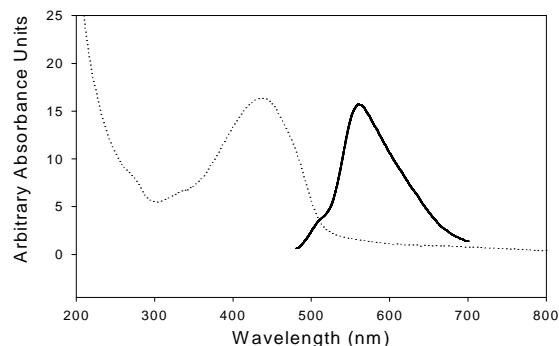


Figure 1: The UV/Vis (dashed) and PL (solid) spectra of PO-PPV

Dynamic infrared spectra (not shown) provide information about the polymer re-orientation. The dynamic spectra is composed of two orthogonal components: in-phase and quadrature.(4) Two-dimensional cross-correlation of the dynamic spectra yield synchronous and asynchronous plots.

CONCLUSIONS

The characterization of PO-PPV includes UV/vis and photoluminescence spectra as well as infrared spectral analysis that was enhanced by the application of DIRLD. The normal IR modes were compared with those in the literature for PPV(5) and with known assignments.(6) Results indicate that vibrational modes of the backbone phenyl can be distinguished from the pendant group.

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