

**Chemical Vapor Deposition and Characterization of
Poly(*p*-phenylene vinylene) Films**

by

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An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the degree of

DOCTOR OF PHILOSOPHY

Major Subject: Physics

The original of the complete thesis is on file
In the Rensselaer Polytechnic Institute Library

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May, 2008

ABSTRACT

As a conducting, electroluminescent, and photoluminescent polymer, poly(*p*-phenylene vinylene) (PPV) is a material of much interest for electronic and optical applications. Although this polymer has traditionally been deposited using spin-on methods and soluble precursor polymers, the technique has several drawbacks including an increase in contamination and defects from the solvent, the need to convert the precursor into PPV without adding further impurities or damaging the film, and the processing restrictions when dealing with liquid depositions. Chemical vapor deposition (CVD), on the other hand, deposits the precursor polymer in the gas phase and therefore eliminates the need for a solvent and creates the capability for conformal deposition on many types of nanostructured substrates. However, PPV films deposited by CVD remain understudied. This work aims to investigate properties of those films including the removal of bromine left from the CVD precursor, the behavior and structure of PPV after heat treatment at elevated temperatures ($>450\text{ }^{\circ}\text{C}$), the usefulness of encapsulation materials for preventing photodegradation, and characteristics of films deposited on top of nano-size porous materials.

Bromine from the precursor polymer is removed during the first thirty minutes of heating. Films annealed at $300\text{ }^{\circ}\text{C}$ in nitrogen gas consisted of 0.36 % bromine; however, photoluminescence spectra comparing films annealed at 150 and $300\text{ }^{\circ}\text{C}$ showed more defects in the $300\text{ }^{\circ}\text{C}$ film. Heat treatment of PPV beyond the initial anneal showed that the film degrades at $500\text{ }^{\circ}\text{C}$ by emitting monomer fragments without crosslinking.

Photodegradation of PPV films due to incorporation of oxygen during light exposure can be reduced from 80 % to 30 % under UV light and nearly prevented under blue light when encapsulated with 10 nm aluminum oxide. Encapsulation with organic Parylene shows no significant improvement.

Use of the Stern-Volmer equation to examine self-quenching in films shows larger conformational change and increased restriction from change in electron density due to electron transition during excitation in bulk polymer films over 60 nm thick. PPV deposited into porous (~4 nm in diameter) nanostructured substrate shows a larger 0-0 than 0-1 transition peak intensity and decreased disorder in the films due to structure imposed by substrate matrix.