RAMAN SCATTERING STUDIES AND CHARGE TRANSPORT IN POLYFLUORENES

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ABSTRACT

Blue-emitting polyfluorenes (PFs) have emerged as especially attractive π conjugated polymers (CP) due to their strong blue emission and excellent electronic properties and thus great prospects for device applications. This project entails detailed Raman scattering studies and charge transport properties of two side chain substituted PFs: Poly(2,7-[9,9'-bis(2-ethylhexyl)] fluorene) (PF2/6) and Poly(9,9-(di-n,n-octyl) fluorene) (PF8). Raman scattering techniques as a function of thermal cycling are used to monitor the changes in the backbone and side chain morphology of PF8. Theoretical modeling of the vibrational spectra of single chain oligomers in conjunction with the experimental results demonstrate the incompatibility of the β phase, a low energy emitting chromophore, with the overall crystalline phase in PF8. Further, electroluminescence and photoluminescence measurements from PF-based light-emitting diodes (LEDs) are presented and discussed in terms of the crystalline phases and chain morphologies in the PFs.

Charge carrier injection and transport properties of PF-based LEDs are presented using current-voltage $(I-V)$ characteristic which is modeled by a space-charge-limited conduction (SCLC) for discrete and continuous traps. PF2/6 with a high level of molecular disorder is an exemplary system for the SCLC model with discrete single level shallow traps. Charge transport as a function of sample thickness uncovers the origin of these traps. Temperature dependence of $I-V$ and dc conductivity measurements suggest thermal assisted variable-range hopping transport instead of band transport in these materials. Raman scattering studies of PF2/6-based LEDs with doping and in the presence of injected and photo-generated charge carriers show increasing backgrounds with asymmetric Briet-Wigner Fano (BWF) line shapes, indicating strong electron-phonon interactions.