Public Abstract

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Title:Fabrication and Characterization of Polymer Based Metal-Oxide-Semiconductor and Non-volatile Memory Devices.

The first highly conducting polymer, chemically and electrochemically doped polyacetylene, was discovered by Heeger, Shirakawa, and MacDiarmid, which won them a Nobel Prize in Chemistry in 2000. This remarkable observation opened up an entire new field called organic electronics, and a new range of applications for conducting and semiconducting organic materials. Organic devices have been widely investigated due to their potential applications in low cost, large area, and flexible electronics. Despite the rapid progress in organic electronics there are still obstacles- high density of defect in organic semiconductor and poor interface between dielectric and organic semiconductor.

In this dissertation, detailed charge transport characteristics of polyfluorene semiconductor using hybrid metal-oxide-semiconductor (MOS) structures are presented. Electrical characterizations give insight into the presence of distribution of trap charges at the dielectric/polymer semiconductor interface. By thermal annealing of the polymer film to a semicrystalline phase, the interface properties are significantly improved. This work underlines the importance of a trapped mechanism that has a great impact on the operation of organic devices, the understanding of which could be exploited to improve device performance.

Non-volatile memory containing size tunable sub-2 nm Pt nanoparticles between double high-k layers were studied. Significantly different amounts of memory window were obtained with the different size of Pt nanoparticles. Our major motivation for sub-2 nm size tunable metal nanoparticle is for better controllability of different memory capability of scaled non-volatile memory devices These properties are very promising in view of device application. Further, our metal nanoparticle formation at room temperature can be integrated to polymer semiconductor to produce polymer-based non-volatile memory.