FABRICATION AND CHARACTERIZATION OF POLYMER BASED METAL-OXIDE-SEMICONDUCTOR AND NON-VOLATILE MEMORY DEVICES

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ABSTRACT

Organic field-effect transistors (FETs) have been widely investigated due to their potential applications in low cost, large area, and flexible electronics. Despite the rapid progress in organic FETs there are still obstacles such as high density of defect in organic semiconductor and poor interface between dielectric and organic semiconductor.

In this dissertation, charge transport characteristics of ethyl-hexyl substituted polyfluorene (PF2/6) using hybrid metal-oxide-semiconductor (MOS) structures are presented. Capacitance and conductance-voltage measurements give insight into the presence of distribution of trap charges at the interface. In addition, by thermal annealing of PF2/6 film to a semicrystalline phase, the bulk and interface properties of PF2/6 are significantly improved.

Charge storage characteristics of MOS structure containing size tunable sub-2 nm Pt nanoparticles between Al_2O_3 double layers were studied. Significantly different amounts of memory window were obtained due to the different size of Pt nanoparticles and reached a maximum of 4.3 V using 1.14 nm Pt nanoparticles. Satisfactory long term non-volatility was attained in a low electric field due to the Coulomb blockade and quantum confinement effects in ~1 nm Pt nanoparticle. Further, our metal nanoparticle formation at room temperature can be integrated to polymer dielectric and semiconductor to produce polymer-based non-volatile memory.