LOW DIELECTRIC CONSTANT-BASED ORGANIC FIELD-EFFECT TRANSISTORS AND METAL-INSULATOR-SEMICONDUCTOR CAPACITORS

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ABSTRACT

This thesis describes a study of PFB and pentacene-based organic field-effect transistors (OFET) and metal-insulator-semiconductor (MIS) capacitors with low dielectric constant poly(methyl methacrylate) (PMMA), poly(4-vinyl phenol) (PVP) and cross-linked PVP (c-PVP) gate dielectrics. A physical method – matrix assisted pulsed laser evaporation (MAPLE) – of fabricating all-polymer field-effect transistors and MIS capacitors that circumvents inherent polymer dissolution and solvent-selectivity problems, is demonstrated. Pentacene-based OFETs incorporating PMMA and PVP gate dielectrics usually have high operating voltages related to the thickness of the dielectric layer. Reduced PMMA layer thickness was obtained by dissolving the PMMA in propylene carbonate (PC). The resulting pentacene-based transistors exhibited very low operating voltages (below -3 V), minimal hysteresis in their transfer characteristics, and decent electrical performance. Low-voltage (within -2 V) operation using thin (≤ 80 nm) low-k and hydrophilic PVP and c-PVP dielectric layers obtained via dissolution in PC, is demonstrated to be a robust means of achieving improved electrical characteristics and high operational stability in OFETs incorporating PVP and c-PVP dielectrics.