Preface

Plastic or organic electronics offer several advantages over conventional inorganic technologies. Firstly, the molecular structure of organic semiconductors and conductors can be tuned for various applications using synthetic chemistry. In addition organic thin films are flexible, and can be processed and patterned inexpensively. However, improving the thin film conductivity of organic semiconductors and conductors is necessary for widespread application and adoption. *The overall goal of this thesis is to investigate and control organic small molecule growth at surfaces in order to improve the performance of organic electronic devices.*

In Part I of the thesis, improving the charge carrier mobility of organic thin film transistors (OTFTs), the building block for plastic electronics, is discussed. The nucleation, stability and thin film growth of model organic semiconductors such as pentacene and C_{60} are described with focus on correlating thin film structure to charge carrier mobility. More specifically, pentacene nucleation and growth on the most common substrate for OTFTs, an octadecylsilane (OTS) monolayer modified silicon oxide surface, is investigated. The role of the density of the OTS was determined to be a critical device parameter that impacts organic semiconductor nucleation and growth, and the charge carrier mobility, as the OTS transitions from an amorphous monolayer into a crystalline one. Dense OTS monolayers were fabricated using the well known ultrathin film Langmuir Blodgett (LB) technique, as well as a new spin-coating technique developed in our lab. The crystalline OTS monolayer serves as an excellent template for promoting desirable organic semiconductor thin film growth leading to high performance transistors. Therefore a crystalline OTS dielectric surface modification layer, which greatly improves organic semiconductor performance, may be important for the future success of OTFTs and organic circuits.

In the Part II of the thesis, lessons learned from studying organic semiconductor nucleation and growth are applied to improving the conductivity of carbon nanotube (CNT) networks for transparent electrode applications. Selective growth of organic small molecules with low molecular orbital energies was used to greatly reduce the sheet resistance of CNT films by both decreasing junction resistances and stable doping of the semiconducting CNTs. The result is a material which has the highest value (in terms of transparency and sheet conductivity) of any carbon based transparent electrode.

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