Electrical Characteristics of Organic Thin-Film Transistors with Polyvinylpyrrolidone as a Gate Insulator

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Abstract

Organic thin-film transistors (TFTs) have been the focus of intense research efforts at least since 1980s [1]. The motive of attentions in organic electronics is mainly originated from that organic semiconductors can offer a unique combination of properties: the conductivity of these materials can be tuned by chemical or electrochemical manipulation; they are low density, bendable and easily processed. Additionally, they are compatible with flexible substrates and suitable for large area coverage, where low cost of manufacturing is required. Consequently, it is envisaged that the processing advantages of organic semiconductors will lead to applications that are either very cheap, or complement all-organic display field [2, 3]. Early on, SiO_2 was the most widely used gate insulator but the deposition of SiO_2 in the previous works was done either by high-temperature thermal oxidation, or through LPCVD, PECVD, or sputtering requiring complex equipments. In this case, the processing temperature is generally not compatible with plastic substrates. Therefore, low-temperature processable gate dielectric materials are required to fully enjoy the advantages of organic TFTs, namely, mechanical flexibility and low-cost feature for large-area electronics. Viewed in this light, it is necessary to adopt polymeric gate dielectric materials for organic TFT application.

Polyvinylpyrrolidone (PVPy) is a unique polymer as it provides a remarkable combination of properties that no other molecule is yet able to match. PVPy offers a unique variety of properties, such as good initial tack, transparency, chemical and biological inertness, very low toxicity as well as high media compatibility and cross-linkable flexibility. However, there are few reports which have investigated the characteristics of PVPy and its application. In this work, polyvinylpyrrolidone (PVPy) was used as a gate insulator. We have investigated the electrical characteristics of organic TFTs with PVPy as well as the quality of pentacene thin film on PVPy by atomic force microscopy (AFM) and x-ray diffraction (XRD). To our knowledge, this is the first report studying the characteristics of organic TFTs with PVPy. We believe that this study can be helpful for researchers in the field of organic electronics. These results will be presented.

References

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