GROWTH AND CHARACTERIZATION OF A NOVEL ORGANIC TFT USING A CARBON BASED DIELECTRIC

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Abstract

Organic electronics as a technology is expected to grow rapidly over the next two decades. Organic electronic based devices with applications ranging from displays, lighting, RFIDs and flexible electronics systems is expected to be used in diverse areas including consumer, industrial, life science, security and telecommunications. It is predicted that the organic electronics market alone would be of the order of the present semiconductor market (US $ 250 billion) by 2025. The key to the success of these organic electronics is the thin film transistors. Thin film transistors based on Pentacene and Rubrene have recently been reported to exhibit mobilities in the range of 3-10 $cm^2 V^{-1} S^{-1}$. Which is superior to the existing amorphous silicon TFT response. However there are still many issues, especially related to the materials, whether it is the semiconductor, conductor or the dielectrics, which need to be addressed. Further there are the issues of the interfaces. One of the key issue to the efficient performance of the organic TFT is the gate dielectric and its compatible to the organic semiconductors.

In an effort to address this issue, presented in this paper, is a study on the experimental and simulation study of organic TFTs with novel tetrahedral amorphous carbon, grown at near room temperature, using Cathodic arc process as dielectric. Pentacene and Theophene based polymers were considered for simulation studies. Theophene based polymers were used to fabricate TFTs, with inverted staggered structures. Theophene based polymers were grown using injection based deposition and vacuum annealing. The initial experimental and simulation results show switching behaviour. However the voltages are higher than the conventional TFTs. Further the on current and off current difference is lower, of the order of 10^3. We have been studying arc based carbon with structure varying from amorphous to nanoclusters, nanopillars and fibers at near room temperature. With further optimization, we believe using amorphous or nanocarbon as dielectric, could be very useful in applications including flexible displays and organic electronics.