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Abstract

TITLE: Nanostructure-Assisted Hole Injection in Schottky Diodes and Application in Organic TFTs

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ABSTRACT BODY: Organic thin-film transistors (OTFTs) have shown great promise for a variety of electronic applications, including flexible displays, chemical sensors, and low-cost microelectronics. The characteristics of OTFTs have been remarkably advanced and even surpass those of TFTs with amorphous Si. Most of efforts for OTFTs have been mainly focused on the improvements of electrical performance. But the basic study in the interfacial characteristics related with device performance is not so much progressed, which is also necessary for understanding device physics and further improvements in device characteristics.
The interface between an organic material and a metal is one of critical factors for the device performance. Recently, some groups have investigated the importance of the interfacial characteristics and attempted to enhance the interfacial characteristics. Therefore, the interfacial properties should be investigated and must be improved in order to make OTFTs competitive with more conventional amorphous Si and poly-Si TFTs.
In this work, we have fabricated the conic-nanostructures on the Al-bottom electrode and investigated the growth of pentacene molecules on the rough conic-nanostructures, combing with the barrier heights for hole injection in Schottky diodes. For the fabrication of conic-nanostructures, the H1 solution, in which polyurethane was dissolved into acetone solvent, was spin-coated onto the Al-bottom electrode. X-ray diffraction results show that the conic-nanostructures can contribute to the ordered growth pentacene molecules. And the barrier height for hole injection from the top-Au electrode was calculated by Fowler-Nordheim theory and found to be lowered for the Schottky diode with conic-nanostructures. This injection barrier lowering can be explained by the ordered growth of pentacene molecules under the influence of conic-nanostructures. We also introduced these structures into the interface bewteen the pentacene layer and gate insulator of OTFTs. It is observed that the electrical characteristics of the OTFT with conic-nanostructures were higher for the device without nanostructures. In particular, the field-effect mobility was significantly improved by using conic-nanostructures, calculated to be about 2.94 cm2/Vs. Consequently, we conclude that the nanostructure-assisted hole injection facilitated the barrier lowering, thereby contributing to achieving high performances in OTFTs. These results will be discussed.

(No Table Selected)