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Electrical Properties Of Pentacene - Based Field - Effect Transistor With A Dielectric Layer Formed By Obliquely Evaporated Silicon Dioxide.

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Recently, organic thin film transistors (OTFTs) have drawn much attention for flexible electronic devices such as smart cards, flexible displays, and several types of low cost and low-end electronics. Since the electrical performances of OTFTs are highly affected by the molecular ordering or crystalline orientation of the organic semiconductors, there are several efforts to modify an insulator surface which is in contact with the evaporated pentacene molecules. In general, highly oriented polymeric layers by mechanical rubbing or irradiation of polarized UV light are used for the purpose. But, the electrical performances of OTFTs on the organic insulators are not satisfactory yet, comparing with those of on the inorganic insulators.

In this work, we investigated anisotropic conduction effects of pentacene-based OTFTs on the inorganic insulators using obliquely evaporated silicon dioxide substrate. For comparison, isotropic silicon dioxide surface was prepared by thermally grown oxidization with about 1400 Å thick on the heavily doped silicon wafer. The effects of the anisotropic inorganic interface were investigated by obliquely evaporating silicon dioxide with e-beam method on the thermally oxidized surface. The thickness of the additional dielectric layer was about 1000 Å. On the inorganic gate dielectric layer, a pentacene layer was deposited by 300 Å thick with a deposition rate of 0.4 Å/s under the base pressure of $1*10^{-6}$ Torr. As source and drain contacts, gold was deposited on top of the pentacene film, where the channel length and width were 100 μm and 1 mm, respectively. Two types of samples were prepared, where the channel direction was parallel or perpendicular to the oblique incidence of the e-beam evaporation. The mobility of the pentacene film in parallel one was higher than that in perpendicular one. The induced mobility anisotropy was about 8 when the inclination angle of the e-beam evaporation was 40°. As the inclination angle was increased, the mobility became even smaller than that on the thermally grown isotropic interface. It was probably due to the increased surface roughness, which resulted in decreased grain sizes.

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