Enhanced Hole Injection in DNTT-based Thin Film Transistors by using MoO_x interfacial layer

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Organic thin film transistors (OTFTs) have many advantages such as low processing temperature, low cost application, flexibility, and large-area capability. However, a few drawbacks, such as the stability issue, hinder the commercial application. One of the commonly utilized organic semiconducting materials, which is pentacene, is easily oxidized so that suffers from this stability issue in OTFTs [1].

In order to avoid air induced oxidation, newly synthesized semiconductors with large ionization-potential, such as dinaphtho[2,3-b:2′,3′-f]thieno[3,2-b]thiophene (DNTT), have been introduced[2] and implemented into a variety of applications such as organic memory and sensor[3,4]. Nonetheless, the large ionization potential induces deeper highest occupied molecular orbital (HOMO) in the semiconductors so that typical contact metals such as gold (Au) and silver (Ag) may not form ohmic contact due to the energy level misalignment between metal and semiconductor.

In this study, we investigated the contact property of the DNTT-based TFTs with various contact metals such as gold (Au) and aluminum (Al) with molybdenum oxide (MoO_x) as an interlayer. Hydrophobic polymer (Cyclic olefin copolymer, COC) was adopted for the modification of SiO_2 surface rather than self-assembled monolayer (SAM) to acquire homogeneous performance among various devices[5]. Field-effect mobility, surface trap density, contact resistance, bias stability of the DNTT-based TFTs with various contacts were characterized and compared to investigate the contact effect. The DNTT-based TFTs with MoO_x/Au contact exhibited the 5-fold increase in field-effect mobility and 10-fold decrease in contact resistance in comparison with the TFTs with bare Au contact..

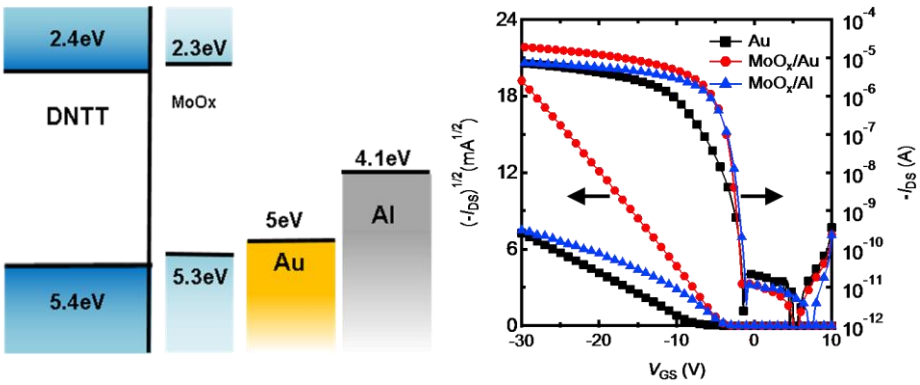

Fig. 1. Energy band diagrams and transfer characteristics of the DNTT-based TFTs with various contact metals in a linear regime where V_{DS}= -3V.

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References

1. F. De Angelis, M. Gaspari, A. Procopio, G. Cuda, E. Di Fabrizio, *Chem. Phys. Lett.*, 468 **(**4-6), 193 (2009).
2. T. Yamamoto, K. Takimiya, *J. AM. CHEM. SOC.*, 129, 2224 (2007)
3. Zschieschang, *J. Mater. Chem.*, 22, 4273 (2012)
4. Ante, *Small*, 8, 73 (2012)
5. Lay-Lay Chua , Jana Zaumseil, Jui-Fen Chang, Eric C.-W. Ou, Peter K.-H. Ho, Henning Sirringhaus & Richard H. Friend, *Nature*, 434, 194 (2005)