High Thermal Stability of Top-Gate Organic Field-Effect Transistors Based on Novel Thienoacene Derivatives

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As organic field-effect transistors (OFETs) reached performances competing with other technologies such as amorphous silicon thin-film field-effect transistors, their stability and easiness of fabrication become critical issues. In our previous study, we have shown that solution processed OFETs based on a novel thienoacene derivative "OSK-040" [1] with top gate configuration exhibit high field effect mobility and good electrical stability [2]. Here we demonstrate the high thermal stability of solution processed top-gate OSK-040 FETs with Teflon AF 1600 insulator.

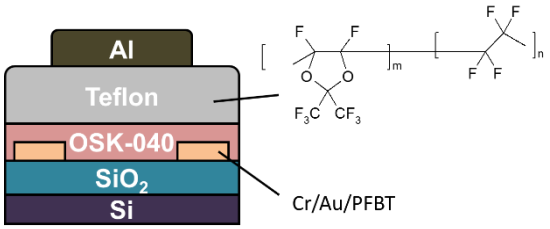

Fig. 1 Device structure.

The OFETs structure is shown in **Fig. 1**. A pentafluorobenzenethiol (PFBT) self-assembled hole injection monolayer was formed on Cr/Au source-drain electrodes by spin-coating. Then, the OSK-040 (Nippon Kayaku) semiconductor layer was spin coated using a 0.4 wt% *o*-xylene solution and immediately annealed at 140 °C for 10 min. The OFET structure was completed by the spin coating of a fluoropolymer insulator Teflon AF 1600, followed by curing for 10 min at 120 °C. This preparation and the measurements were done in a N_2 filled glove box.

The transfer characteristics of an OSK-040 OFET with Teflon AF 1600 insulator showed slight degradation after it was heated at 130 °C for 1 h. They are shown in **Fig. 2.** Thus the thermal durability of OSK-040 OFETs is remarkably improved by using a Teflon AF 1600 insulator (T_g = 160 °C) instead of a CYTOP insulator (T_g = 108 °C). The mobility maintained a value higher than 2 cm^2/Vs. Such high mobility after 130 °C thermal stress is comparable or superior to that of OFETs based on vacuum deposited DNTT films [3].

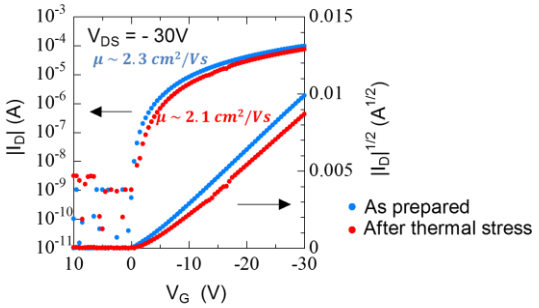

Fig. 2 OSK-040 OFET transfer characteristics before and after the thermal stress.

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[2] C. Guichaoua *et al*, JSAP Spring Meeting 2017, Yokohama, Japan, No. 17a-P5-16.
[3] K. Kurubara et al, Nat. Commun. 3, 723 (2012).
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