Novel photo-stable small-molecule based organic thin-film transistors coupled with pentacene devices

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Small molecule-based organic thin-film transistors (OTFTs) have always attracted interests from researchers due to their potentials for flexible or transparent future thin-film devices. Pentacene OTFT is a well-known example. We report on a new small molecule organic thin-film transistor, named Cho3 which is different from previously-developed or –reported ones. The new organic film shows good crystalline quality with HOMO-LUMO gap of 2.9 eV, which thus allows almost all visible lights without much absorption. The film is so transparent and even shows some white emission under ultraviolet energy excitation. When we fabricate an OTFT with several types of dielectrics using the thin-film, the new OTFT displays superior subthreshold swing to that of pentacene-based OTFTs but lower on-current (or mobility). Based on above properties, Cho3-based OTFT operates as a component of a logic inverter[1] and an image pixel[2] when coupled with pentacene OTFTs, since those two OTFTs have different electrical/optical properties: threshold voltages and optical absorption. In the present work, our pentacene and Cho3 OTFTs have the same source/drain/gate electrode and 10 nm-thin CYTOP on 50 nm-thin atomic layer deposited Al_2O_3 as a bottom gate dielectric for 8 V operation. Transfer curves and inverter operations from the new OTFT are demonstrated as shown in Fig. 1, coupled with pentacene OTFT. More details will be discussed in the meeting.

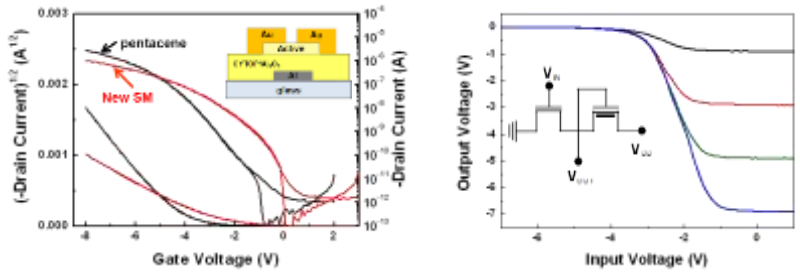

Fig. 1 Transfer curves from pentacene (red) and new OTFTs (black), which respectively play as load and driver in a logic inverter. A maximum voltage gain was ~5 at -7 V operation.

References

1. "High-gain pentacene-based inverter achieved through high and low energy ultraviolet treatments" Jeong-M. Choi, Jae Hoon Kim and Seongil Im, Applied Physics Letters, **91**, 083504 (2007)

2. "Almost transparent image pixel with pentacene/ZnO photo-diode, pentacene thin-film transistor, and 6,13-pentacenequinone phosphor layer" Kwang H. Lee, Hee Sung Lee, Kimoon Lee, Tawoo Ha, Jae Hoon Kim and Seongil Im, Advanced Materials, **23**, 1231 (2011)