Electrically Stable Transparent Complementary Inverter with Organic-inorganic Nano-hybrid Dielectrics

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Keywords : transparent, complementary TFT inverter, ZnO TFT, pentacene TFT

"Transparent" electronics has been one of the key terminologies forecasting the ubiquitous technology era. Several researchers have thus extensively developed transparent oxide-based thin-film transistors (TFTs) on glass and plastic substrates although in general high voltage operating devices have been mainly studied considering transparent display drivers. However, low voltage operating oxide TFTs with transparent electrodes are very necessary if we are aiming at logic circuit applications, for which transparent complementary or one-type channel inverters are required. The most effective and low power consuming inverter should be a form of complementary p-channel and n-channel transistors but real application of those complementary TFT inverters also requires electrical- and even photo-stabilities. Since p-type oxide TFTs have not been developed yet, we previously adopted organic pentacene TFTs for the p-channel while ZnO TFTs were chosen for n-channel on sputter-deposited AlO_x film. As a result, decent inverting behavior was achieved but some electrical gate instability was unavoidable at the ZnO/AlO_x channel interface. Here, considering such gate instability issues we have designed a unique transparent complementary TFT (CTFTs) inverter structure with top n-ZnO channel and bottom p-pentacene channel based on 12 nm-thin nano-oxide/self assembled monolayer laminated dielectric, which has a large dielectric strength comparable to that of thin film amorphous Al_2O_3. Our transparent CTFT inverter well operate under 3 V, demonstrating a maximum voltage gain of ~20, good electrical and even photoelectric stabilities. The device transmittance was over 60 % and this type of transparent inverter has never been reported, to the best of our limited knowledge.

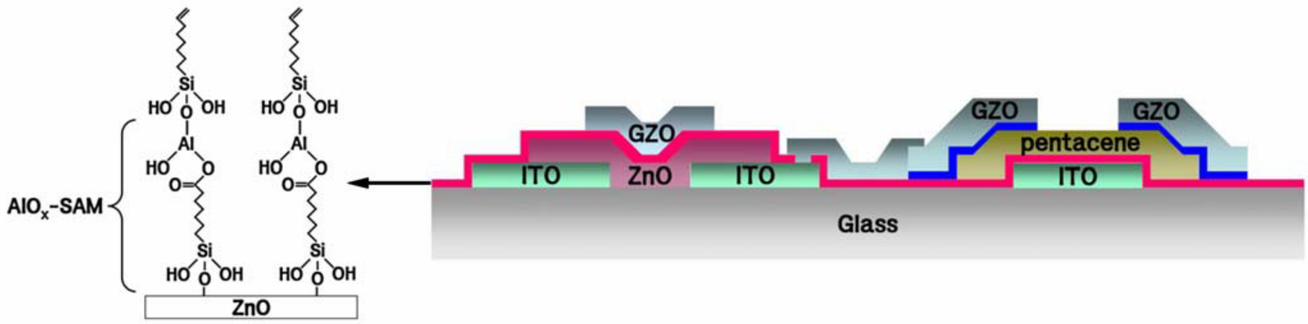

Figure 1. Schematic cross section of transparent CTFT inverter with ZnO and pentacene hybrid channels respectively using top and bottom gate structure

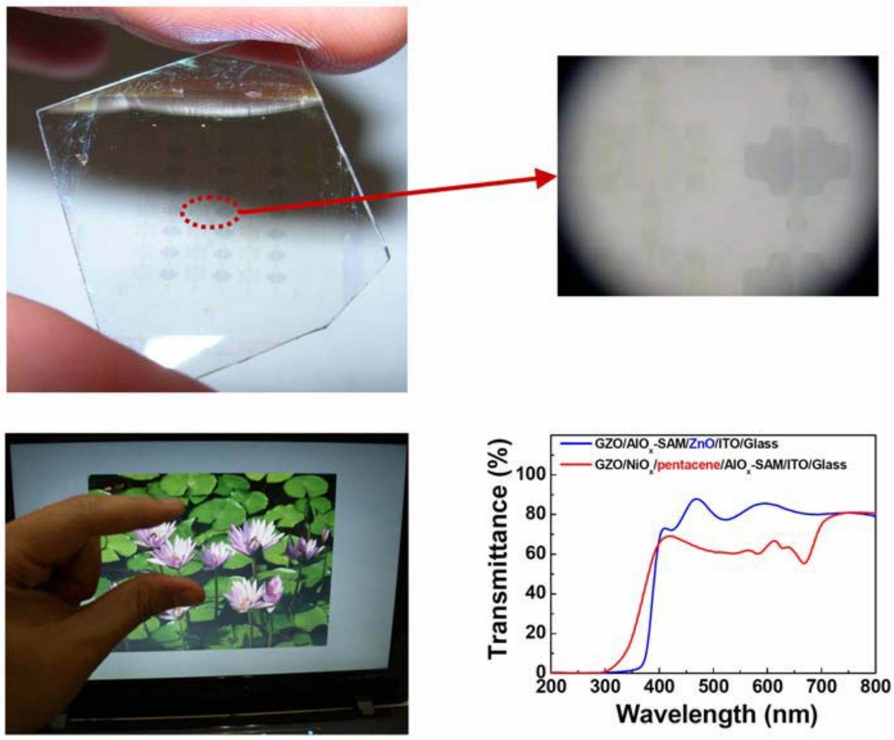

Figure 2. Photographs of our transparent complementary TFT inverter sets and transmittance of our device sets.