Low hysteresis n-type printed organic thin-film-transistor with TiO_2/PMMA bi-layer gate dielectrics.

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Polymeric dielectric materials are the promising candidates for a flexible gate insulator with durable, low-cost, and easy processing. However, most of polymeric dielectric materials have relatively low dielectric permittivity than that of inorganic dielectrics. Thus, a variety of studies on a development of composite with high-k dielectric material have been accomplished. In this study, we were fabricated the n-type organic thin-film-transistor(OTFT) with TiO_2/PMMA bi-layer gate dielectric with dielectric permittivity up to 20nF/cm^2. Also, we investigated the effect of dielectric layer on the performance of OTFT, in order to achieve reduced off-current and hysteresis.

In consideration of the channel stability, the device fabricated with top gate bottom contact structure was used. Au source/drain electrodes were thermally deposited on si-wafer substrate and poly{[N,N9-bis(2-octyldodecyl)-naphtha-lene-1,4,5,8-bis(dicarboximide)-2,6-diyl]-alt-5,59-(2,29-bithiophene)};[(P(NDI2OD-T2))] n-type polymer semiconductor was spun coated as a semiconductor layer. Both TiO_2-PMMA bi-layer and TiO_2-PMMA blended film were compared with PMMA single layer, all were deposted by spin-coating. Au gate electrode was thermally deposited and compared with the inkjet-printed Ag electrodes. Using the TiO_2/PMMA bilayer and composite, the capacitance of the dielectric was increased and the hysteresis of the device was significantly reduced. The mobility of the bi-layer device was shown to 0.002 cm^2/Vs, which increased by 2.5 times compared to single-layer device(0.0007 cm^2/Vs).

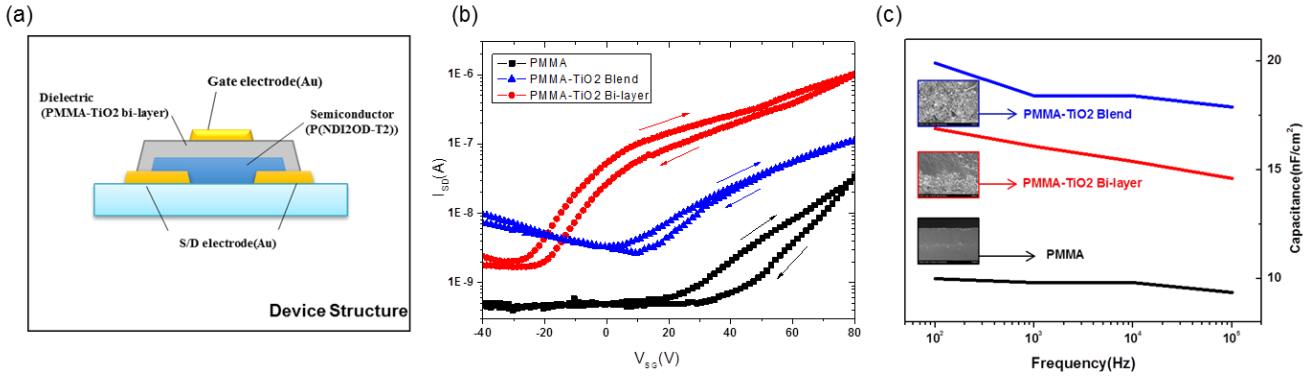

Fig. 1. (a) The structure of OTFT, (b) the transfer characteristics and hysteresis of n-type OTFT with PMMA, TiO_2-PMMA blended and PMMA-TiO_2 bilayer, (c) the C-F plot of the three different dielectrics.

Acknowledgment

This research was supported by Leading Foreign Research Institute Recruitment Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Science, ICT & Future Planning(MSIP) (2010-00525)

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