Enhanced charge injection into an organic semiconductor in top-contact field-effect transistors with a metal oxide buffer layer

Byung-Eun Park[1], Eul-Yong Shin[1], Jaehyun Lee[2], Yoon-Seok Choi[1], and Min-Hoi Kim[2]
[1]Dept. of Electronic Engineering, Hanbat National University, Daejeon, 305-719, Korea
[2]Dept. of Creative Convergence Engineering, Hanbat National University, Daejeon, 305-719, Korea
Tel.:82-42-821-1973, E-mail: mhkim8@hanbat.ac.kr

Recently, organic field-effect transistors (OFETs) have been widely studied to creat flexible electronic devices such as backplanes of displays and transponders of radio frequency identification tags. Particularly, solution-processed organic semiconductor-based OFETs is considered as a good electronic elecment due to their low cost fabrication compatibility. Among the solution-processible organic semiconductors, 6, 13-bis(triisopropylsilylethynyl)-pentacene (TIPS-pentacene) exhibits relatively high performance [1]. However, for the high performance of the OFETs, the charge injection from a source electrode to organic semiconductor is required to be enhanced.

In this work, we introduce metal oxide buffer layer between the organic semiconductor and the source/drain electrodes for enhancing charge injection. In our OFETs, 1wt% TIPS-pentacene solution in dichlorobenzene was spin-coated on the gate insulator as an active layer. For a buffer layer, the metal oxide such as rhenium oxide (ReO3) or molybdenum oxide (MoO3) was theramally deposited on the active layer through shadow mask under the pressure of 10^{-6} Torr. A 60 nm-thick silver was formed through shadow maske used for the source/drain electrodes. It is found that the electrical characteristics of the OFETs with the metal oxide buffer layer are greatly enhanced. The deep electron affinity of the metal oxide layers leads to the large vacuum level shift at the interface of active layer and silver electrodes, which increases the charge injection from the source electroe to the organic semiconductor. This provides an valid method to realize the high performance OFET-based circuits.

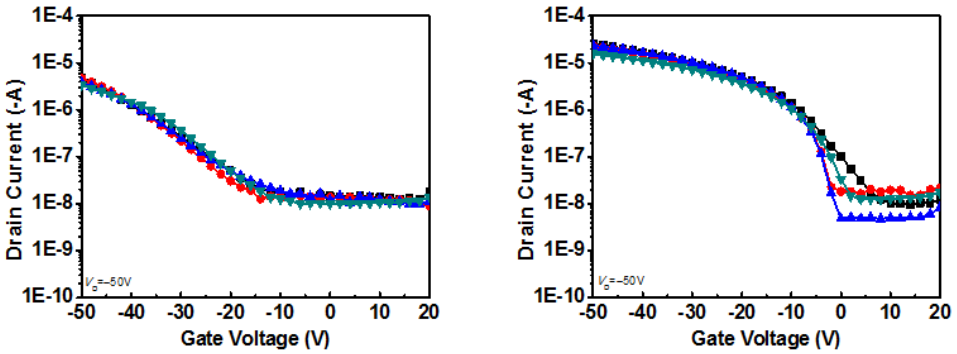

Fig. 1. Transfer characteristic curves of (a) the conventional reference OFETs and (b) the buffer layer OFETs

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References

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