Polymer Gate Insulators for Stable Operation of Organic Field Effect Transistors

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Organic field-effect transistors (OFETs) have attracted considerable attention due to their application as driving devices in organic light emitting diode displays. In this paper, we report the effect of the polymer gate insulators on the stability of OFETs. We fabricated top contact pentacene-OFETs with a various types of polymer gate insulating layer. In order to investigate stability of OFETs, the time variation of drain current under the application of gate and drain voltage is measured.

When the polymer insulator is used for a gate-dielectric layer of OFET, 3 components of time variation of drain current were observed (Fig. 1). First component is increase in drain current with the time scale of several millisecond. This component can be attributed by increase in capacitance of the polymer gate-insulators caused by structural relaxation of the polymer insulator.[1] Second component is decay of drain current with the time scale of several-hundred millisecond. This may be attributed by carrier traps originated from surface dipole of the polymer-insulators. [2] The third component with the time scale of greater than several-tens minute is well known threshold voltage shift caused by bias-stress effect. We found that the bias stress effect is facilitated by roughness and long length chemical species of insulator surface.[3, 4] Based on these results, we concluded that insulating-polymers should possess following characteristics in order to obtain stable operation. Namely, insulating-polymers do not have dipoles in the bulk and surface, and have flat surface. We found that OFETs with such gate dielectric layers show fast response to gate voltage and stable drain current with respect to operation time.[1]

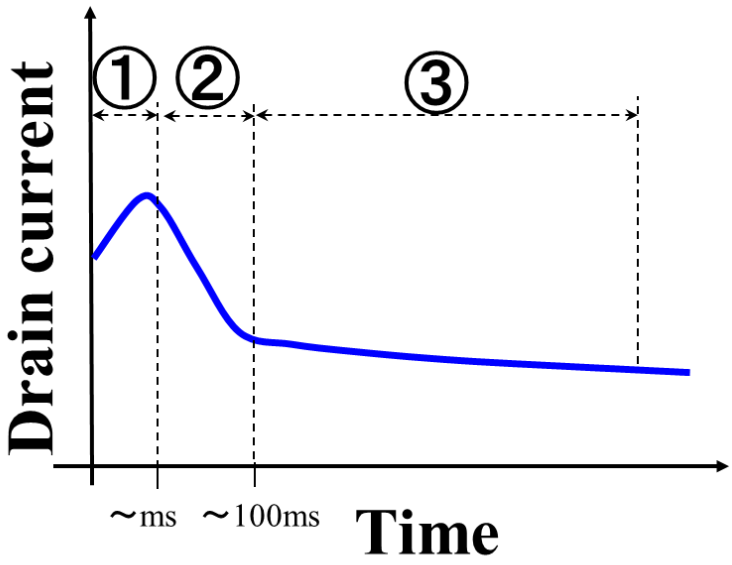

Fig. 1. Time variation of drain current for OFETs with a polymer gate insulator.

References

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