

Role of organometallic interface on dynamic photoresponse of organic field-effect-transistor under illumination

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Organic field-effect-transistors (OFETs) have attracted enormous attention due to low cost, light weight, flexibility, and large area applications [1]. As one of the important parameters for the device performance, the photoresponse of the OFET under light illumination has been widely investigated [2]. Under light illumination, the interfaces formed with an organic semiconductor (OSC) in the OFET, being in contact with a dielectric layer in addition to the source (S) and the drain (D) electrodes play critical roles on the dynamic behavior of the charge carriers contributing to the output signals. Many of the previous studies have been focused on the effect of the OSC/dielectric interface on the charge accumulating characteristics of hydroxyl groups [2]. However, the relationship between the physicochemical properties of the OSC/S and OSC/D interfaces and the resultant photoresponse of the OFET has not been fully investigated yet.

In this study, we demonstrate how the organometallic interfaces affect the dynamic photoresponse of the OFET under light illumination. Three pentacene-based OFETs with three different SD electrodes of gold (Au), silver (Ag), and aluminum (Al), respectively, were fabricated using the same gate insulator of poly(4-vinylphenol) (PVP). It was found that upon the periodic illumination of light, for the Au case, the photo-generated current barely decayed and accumulated whereas for the Al case, it exhibited well-defined recovery processes as shown in Fig. 1. This phenomenon is mainly attributed to the interplay between the hydroxyl group at the OSC/dielectric interface and the energy barrier at the OSC/SD electrode in the OFET.

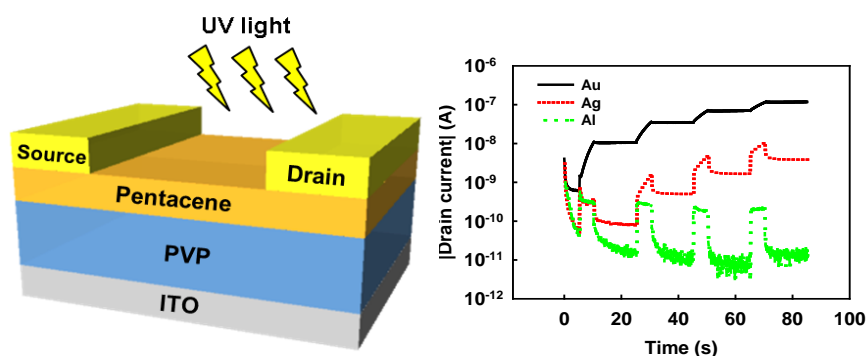


Fig. 1. (a) Schematic diagram of the OFET configuration being fabricated and (b) the photodynamic responses of three OFETs with Au, Ag, and Al at the gate voltage of 20 V

Our photo-dynamic approach to the characterization of the organometallic interface in the OFET will provide a useful guideline not only to deeply understand the charge transport-associated phenomena at the interfaces but also to select suitable SD electrodes for the optical applications of the OFET.

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References

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