The Effect of Passivation on the Positive Bias Stress-Induced Instability of Polymer Thin-Film Transistors

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Organic electronic technology has been extensively developed to be used in the various applications [1]. However, issues on the enviromental effect and long term reliability of polymer thin-film transistors (PTFTs) remained not fully elucidated yet. In particular, the proper use of the passivation process is indispensible in the solution-based process of PTFTs because PTFTs are known to be vulnerable to water molecules and ions.

In this work, we report the effect of passivation on the positive bias stress (PBS)-induced instability of PTFTs by comparing electrical characteristics of two cases with and without passivation. The instability mechanisms of PTFTs are also investigated under the PBS. Consistent with the investigation for the passivation layer on the effective reduction of the ion migration from the back channel [2], it was observed that the passivated devices showed more stable characteristics than the non-passivated devices as shown in Fig. (b). It was attributed to the reduced trapping of polar molecules and ions into the gate insulator. In particular, the non-passivated device shows more stable characteristic with applying the bias stress in a vacuum rather than in atmosphere. This means that the most probable origin of the PBS instability is an ion migration followed by the charge trapping into the gate dielectric as shown Fig. (c). Theses results imply that the passivation against the exposure to air is very important for the stability-booster in the development of PTFTs as main building blocks of the printed electronics.

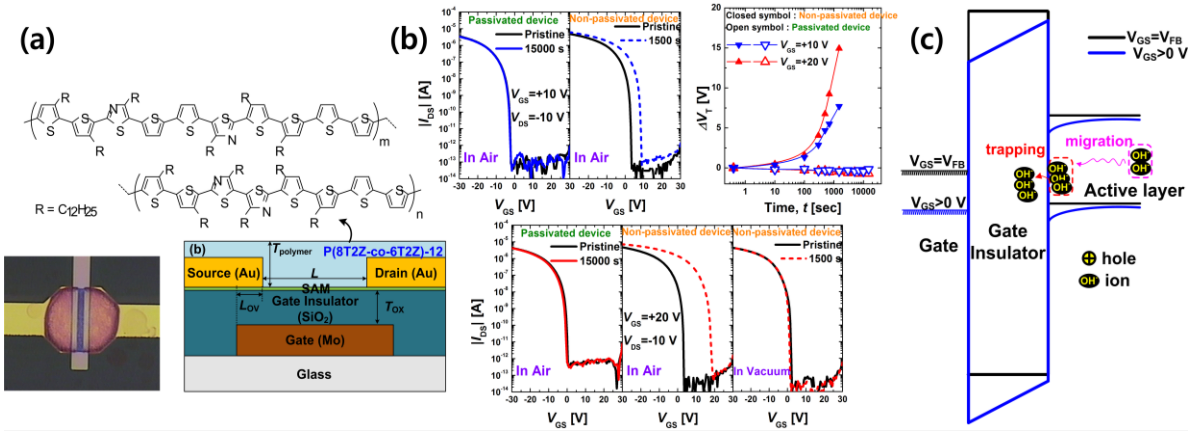

Fig. (a) Cross-sectional schematic of the fabricated PTFT and its chemical structure. (b) Measured t_{PBS} evolutions of I_{DS}-V_{GS} curve in log scale and PBS-induced ΔV_T. (c) Energy band diagram at PBS (non-passivated device).

[1] H. Yan, *nature*. 457, 679 (2009).

[2] A. Sharma, S. G. J. Mathijssen, E. C. P. Smits et al., *Phys. Rev. B* 82, 075322 (2010).