FLEXIBLE ORGANIC THIN FILM TRANSISTORS FOR HIGH-PERFORMANCE BIOSENSORS

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Solution-gated transistors have shown promising applications in biosensors due to the high sensitivity, low working voltage and the simple design of the devices. Solution-gated transistors normal have no gate dielectric and the gate voltages are applied directly on the solid/electrolyte interfaces or electric double layers near the channel and the gate, which lead to very low working voltages (about 1 V) of the transistors. On the other hand, the devices can be easily prepared by solution process or other convenient methods because of the much simpler device structure compared with that of a conventional field effect transistor with several layers. Many biosensors can be developed based on the detection of potential changes across solid/electrolyte interfaces induced by electrochemical reactions or interactions. The devices normally can show high sensitivity due to the inherent amplification function of the transistors. In this talk, I will introduce several types of biosensors studied by our group recently, including DNA[1], glucose[2], dopamine, uric acid[3], cell[4], protein [5] and bacteria sensors, based on flexible solution-gated organic thin film transistors. The biosensors show high sensitivity and selectivity when the devices are modified with functional nano-materials (e.g. graphene, Pt nanoparticles) and biomaterials (e.g. enzyme, antibody, DNA) on the gate electrodes or the channel. Furthermore, the devices are miniaturized successfully for the applications as sensing arrays [6]. The solution-gated organic devices are also used for voltage-controlled drug release in aqueous solutions [7]. It is expected that the solution-gated organic transistors will find more important applications especially wearable electronics for healthcare in the future [8,9].

Reference

[1] Lin P., Yan F., et al. Adv. Mater. 23, (2011) 4035-4040.
[2] Tang H., Yan, F. et al. Adv. Funct. Mater. 21, (2011) 2264-2272.
[3] Liao C. Z., Yan F., et al. Adv. Mater. 27, (2015) 676-681.
[4] Lin P., Yan F., et al. Adv. Mater, 22, (2010) 3655-3660.
[5] Fu Y., Yan F., et al. Adv. Mater. (2017) DOI: 10.1002/adma. 201703787.
[6] Liao C. Z., Yan F., et al. Adv. Mater. 27, (2015) 7493-7527.
[7] Liu S. H., Yan F. et al Adv. Mater. 29, (2017) 1701733.
[8] Yang A. N., Yan F. et al. dv. Mater. 30, (2018) 1800051.
[9] Wang N. X., Yang A. N., Fu Y., Li Y. Z., and Yan F., Acc. Chem. Res. (2019).