Poster

ORGANIC TRANSISTORS BASED ON SELF ASSEMBLED MONOLAYERS

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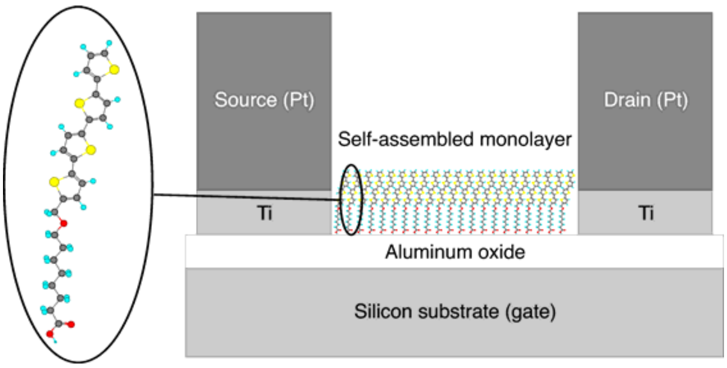
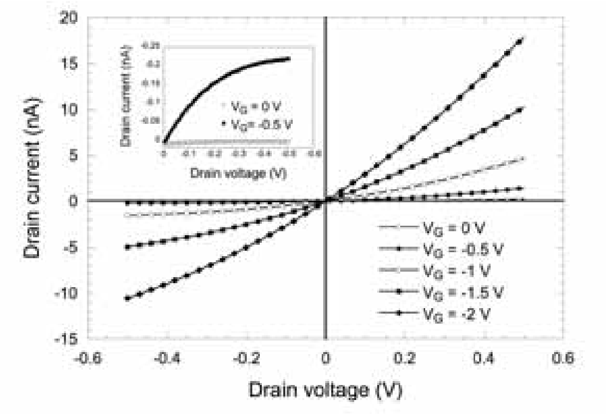
The tendencies in organic thin film transistor (OTFT) are the reduction of size of the device, for the lateral dimension (source- drain distance) but also for the thicknesses of the semiconductor and the insulator. This reduction opens the way to devices operating at low bias [1].

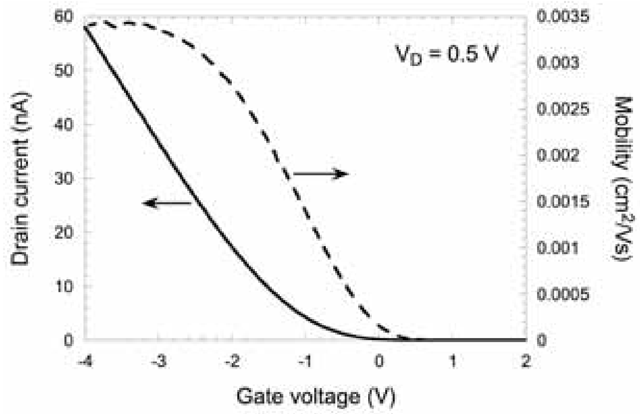
To reduce the thickness of the organic semiconductor, we use organic self assembled monolayer (SAM) grafted on the gate insulator (100nm alumina or 10nm silicon dioxide). The molecules used for the SAM formation are formed by an alkyl part (8 or 10 carbon atoms) linked to a moiety rich in π electrons (terthiophene or quarterthiophene). The molecules react with gate insulator by a -$SiCl_3$ moiety for the silicon dioxide, or a -COOH moiety for the alumina. Source drain electrodes (either top or bottom contact configuration) were patterned by e-beam lithography, with channel length ranging comprise between 16 and 1000nm, and a width to length ratio of 100. The scheme of the device (bottom configuration) is presented below.



The structure of the SAMs was characterized by atomic force microscopy (AFM), infrared spectroscopy, ellipsometry, contact angle to validate the synthesis. Some electrostatic force microscopy (EFM) measurements were done to analyze the distribution and concentration of injected charges in the SAM.

For the electrical characterization in most cases, ill-defined I-V curves were recorded, which we attribute to a poor electrical contact between platinum and the oligothiophene moiety. Most of the devices did not give any signal (*i.e.* current less than 8pA corresponding to a very low leakage current through the insulator).
However, a few devices offered well-defined curves (see figures below) with a clear saturation, thus allowing us to estimate a mobility of 0.0035 cm2/Vs for quaterthiophene and $8x10^{-4}$ cm^2/Vs for terthiophene. In the first case, the on-off ratio reaches 1800 at a gate voltage of -2 V.





The field effect behavior was only obtained with negative bias, thus indicating that only injection of holes could be achieved. The non-linearity of the current voltage curves and absence of saturation are attributed to the poor quality of the contacts.
Interestingly, the device operates at room temperature and very low bias, which may open the way to applications where low consumption is required.

References:

[1] G. S. Tulevski, Q. Miao, M. Fukuto, R. Abram, B. Ocko, R. Pindak, M. L. Steigerwald, C. R. Kagan, C. Nuckolls, J. Am. Chem. Soc. **126** (2004), 5048.
[2] Mohammad Mottaghi, Philippe Lang, Fernand Rodriguez, Anna Rumyantseva, Abderrahim Yassar, Gilles Horowitz, Stéphane Lenfant, Denis Tondelier, Dominique Vuillaume, Adv. Funct. Mater. (2006) *Accepted.*