Growth control of electrografted diazonium thin layers on patterned gold electrodes for nano-devices

F. Lebon, Y.-P Lin, H Casademont, R. Cornut, V. Derycke, B. Jousselme

Growth control of electrografted diazonium thin layers on patterned gold electrodes for nano-devices.

F. Lebon[1], Y.-P. Lin[1], H. Casademont[1], R. Cornut[1], V. Derycke[1], B. Jousselme[1].

LICSEN, NIMBE, CEA, CNRS, Université Paris-Saclay, CEA Saclay 91191 Gif-sur-Yvette Cedex

Despite the recognized potential of organic molecules for electronics, only very few types of devices (like OLEDs) incorporating thin molecular layers as active elements, have reached the level of industrial applications. Two major issues slowdown such integration: *(i)* the way of incorporating molecules in electronic systems is usually incompatible with device miniaturization, and *(ii)* thin molecular layers suffer from a limited robustness notably toward back-end process steps.

The properties of molecular layers are commonly studied using either self-assembled monolayers (SAMs) or thick non-patterned layers prepared by spin or dip coating. Electrografting by reduction of diazonium salts, as illustrated in scheme 1, provides an efficient alternative to these methods. It leads to robust covalent organic thin films of adjustable thickness (typically in the 5 to 50 nm range) and rich functionality. These films can be assembled on all conducting or semi-conducting electrodes, are compatible with lithography and allows the selective grafting of different electrodes of the same chip with different molecules.

However, the integration of such versatile organic thin films in functional devices requires a deep understanding and thorough control of their growth mode. This presentation aims at elucidating the influence of different parameters on the formation of molecular thin films based on two kind of diazonium salts: one leading to an ultrathin insulating layer that can be used as a nanodielectric in transistors[1], and one that can be used to form resistive memory devices[2].

[1] H. Casademont, L. Fillaud, X. Lefèvre, B. Jousselme, V. Derycke, *J. Phys. Chem. C*, 2016, **120**, 9506−9510

[2] Y.-P. Lin, C.H. Bennett, T. Cabaret, D. Vodenicarevic, D. Chabi, D. Querlior, B. Jousselme, V. Derycke, J.-O. Klein, *Scientific Reports*, 2016, **6**, 31932.

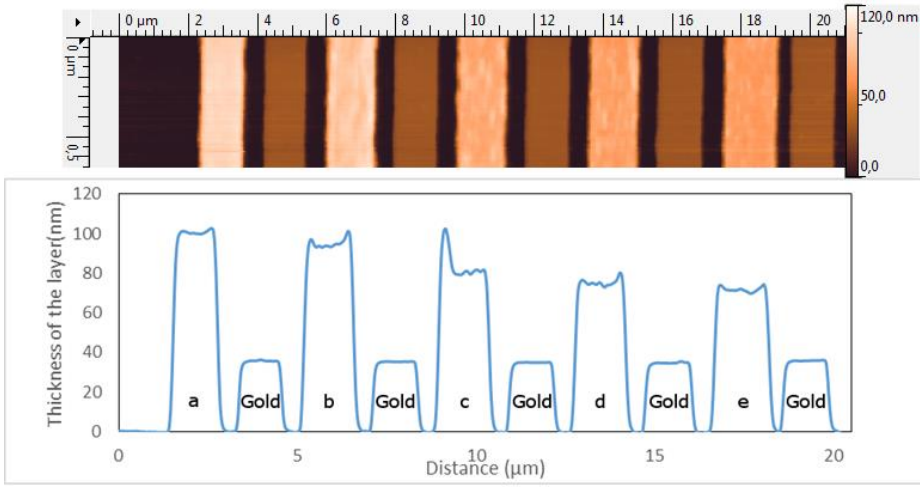
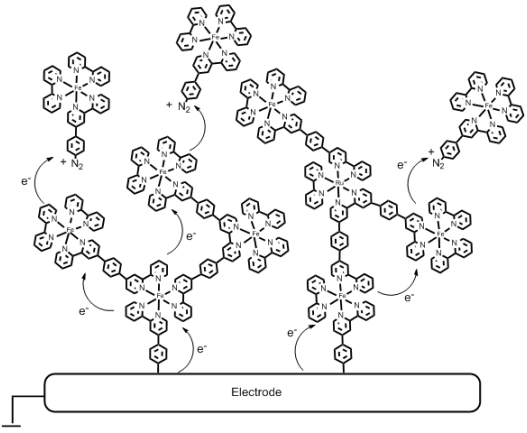


Figure 1. AFM image of gold electrodes grafted in different conditions with a TBPFe diazonium salt (up) and its corresponding profile (down). The electrodes a, b, c, d and e are grafted while the gold electrodes are used as a height reference.



Scheme 1. Scheme of an electrografting of a diazonium salt of TBPFe on a gold electrode.