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Abstract:

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, 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. We notably showed recently that they can be used a nanodielectrics in transistors,[1] or as active material in organic memory-based circuits.[2] 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. In this presentation we will first present the formation of molecular thin films of controlled thickness based on two kind of diazonium salts (an insulating and an electroactive one) and then show how they can be combined in controlled double-layers for improved performances. The three different types of molecular layers were notably integrated in leakage-free large-area (>100 µm^2) vertical metal-molecules-metal junctions and their electronic performances were evaluated.

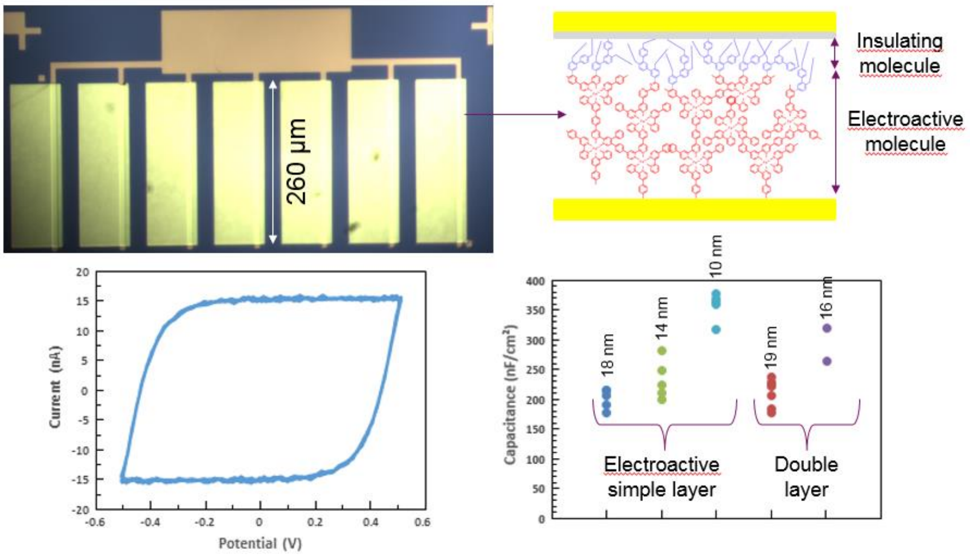

Figure 1. Final sample obtained for electrical measurements (top). Electrical measurement at 1500 Hz for one electrode (bottom left). Capacitance results for various layers (bottom right).

[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.