MOLECULES AND NANOELECTRONICS: THE FUNCTIONALIZATION OF NANO-OBJECTS, A KEY FOR HYBRID NANOELECTRONICS

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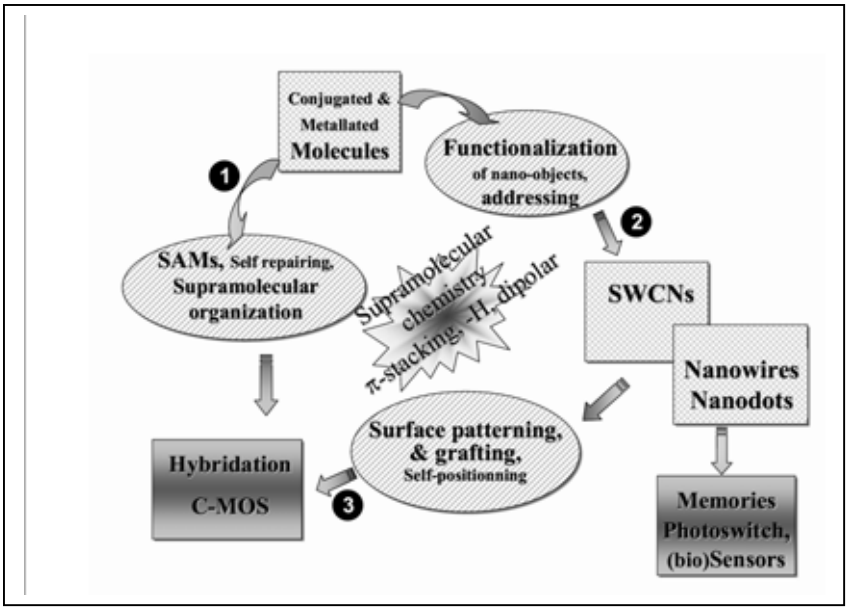
Presently, the **role of molecules** in classical micro/nanoelectronics processes is, simply put, confined to macromolecules (polymers, resins) passive tools for the coating, lithography and packaging. For the molecular electronics of the 2020's horizon, as suggested by its name, molecules will be structural elements and active components able to treat, to transform (photoelectronics) and to store (molecular memory) the information. However, between our silicon age and the Holy Grail of the very molecular electronics, an intermediate period designed by hybrid nanoelectronics is a key step for acquiring new knowledges for interfacing molecular objects and for designing new fault tolerant architectures.

The bottom-up approach of this coming **hybrid nanoelectronics involves the functionalization, assembly or/and the positioning of objects of nanometric size (nano-objects, NObs)** onto C-MOS devices in order to implement architectures talented for "classical" electronic functions such as transistors, diodes, optoelectronic transducers, molecular memories or switches (vide infra).



***Molecules in nanoelectronics**: Nano-objects can be categorized in 3 classes, molecules, carbon nanotubes, nanowires & nanodots. Molecules can be directly integrated in C-MOS devices (route 1) or for the functionalization of NObs (route 2) or/and for the preparation of receiving surface allowing the positioning of naked or functionalized NObs (route 3).*

To do that, the nanoelectronics specialist relies on elemental bricks, **the nanoelectronics Lego®**, such as molecular architectures, carbon nanotubes, semiconducting or conducting nanowires or nanodots. Besides these artificial nanostructures, biological molecules such as DNA, proteins and virus are intensively used as template or scaffolding elements to build up or to assemble nanostructures, via bio-inspired approaches.

The concepts of synthetic and supramolecular chemistry and biochemistry allow **the tailor-made dressing of these NObs** for conferring them new electrical, photo-physical, redox and bio-recognition properties. In addition, considering the “ex situ” synthesis of carbon nanotubes and nanowires, their solubilisation, sorting out and positioning also need **chemical surface functionalization**.

This lecture will be restricted to the **presentation of the route 2**, i.e.: the functionalization of single wall carbon nanotubes, SWCTs, semiconducting nanowires and semiconducting or conducting nanoparticles. After a brief and general presentation of the specificities of each functionalization depending on the nature of the NOb, illustrations will be given based on recent literature developments and focused on molecular memories or nanobiosensors.