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Building-up supramolecular self-assemblies on surfaces: toward organic nanoelectronics

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Self-assembly of functional organic molecules on atomically flat surfaces opens new perspectives towards “molecular nanoelectronics,” a realistic strategy in the miniaturization of electronic devices. One simple way to investigate 2D supramolecular self-assemblies at the nanoscale is to generate them at a liquid-solid interface and observe them in situ by means of scanning tunneling microscopy (STM). A variety of 2D architectures have been recently obtained with functional molecules (liquid crystals, molecular wires, graphite-like molecules, etc) by controlling the subtle interplay between molecule-molecule and molecule-substrate interactions. In this presentation, we first illustrate this approach with various families of conjugated compounds such as alkoxy-triphenylenes, star-shaped oligothiophenes, triazatrinaphthylenes, etc. One step further, we demonstrate the possibility to work in the vertical dimension and pile-up two or three layers of similar or different molecules on top of each other in homo- or heteroepitaxy. Even further, we use very long n-alkanes physisorbed on a solid substrate (graphite, gold) as tailored templates for the growth of complex self-assembled bi- and trilayers of large conjugated discal molecules possessing electrical and/or optical properties. Finally, we show that STM allows for the first time to image the surface of a bulk single crystal organic semiconductor down to molecular resolution and to record its local I/V curves in the dark and under photoexcitation.