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Self-assembly at the liquid/solid interface: from patterns to function

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Self-assembly - the spontaneous organization of molecules into stable, structurally well-defined aggregates - has been put forward as a possible paradigm for generating nanoscale templates under ambient conditions. A very convenient method for the formation of extended two-dimensional (2D) networks is physisorption at the liquid-solid interface. The preparation is relatively simple and scanning tunneling microscopy (STM) allows a detailed investigation of the structural aspects of the 2D patterns. A deep understanding and control of the spatial orientation and packing of molecules in self-assembled systems is indispensable for the development of future nanodevices. We have developed hydrophobic - hydrophylic nanopatterns at electrified surfaces via the self-assembly of amphiphilic molecules. For this purpose we selected 5-hexadecyloxy isophthalic acid: this neutral amphiphile forms hydrogen-bonded rows that are commensurate with the Au(111) surface. Based on the successful adsorption of these amphiphiles, multicomponent architectures have been realized at these electrified surfaces as the result of the potential directed assembly of charged and non-charged molecular systems. Following a slightly different approach, nanoporous two-dimensional networks were formed at the interface between an organic liquid and highly oriented pyrolytic graphite. Pore sizes of more than 5 nm in diameter can be realized. As an alternative approach to make nanoporous two-dimensional networks, molecular defined shape-persistent two-dimensional oligomers, such as molecular spoked wheels, are used.