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Scanning Tunneling Microscopy and Spectroscopy of Conjugated Oligomers at the Liquid-Solid Interface

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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 pi-conjugated oligomers in self-assembled systems is indispensable for the development of future nanodevices. By means of STM, we have investigated the self-assembly of achiral and chiral pi-conjugated small organic molecules at the organic liquid-solid interface with submolecular resolution. In addition, by means of scanning tunneling spectroscopy (STS) we have investigated with molecular and submolecular resolution the electronic properties of isolated and stacked conjugated molecules at the liquid-solid interface. In the first part, we focus on the control of 2D molecular self-assembly of pi-conjugated systems driven by the molecular shape and/or by directional non-convalent interactions such as hydrogen bonding. Examples include alkylated molecules with a rhombus or triangle shaped pi-conjugated core, hydrogen bond forming p-phenylene vinylenes, and oligothiophenes. In the second part, we report on bias dependent imaging and STS experiments revealing information on the electronic properties of electron donor-acceptor-donor triads, and isolated and stacked oligothiophenes.