Electrospray Ion Beam Deposition and Direct Imaging of Single Molecules and Nanoribbons

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Molecular electronics aims to use single molecule as the fundamental building blocks for electronic devices, enabling components with unprecedented miniaturization and functionality. Organic semiconductors, bridged typically by biomolecules such as DNA, proteins and peptides play an important role in the development of the field (1). However, their structural complexity pose challenges for present analytical methods in characterizing their individual molecular structures, hindering the understanding of their structure-property relationships. Ensemble-averaged measurement on molecules with extensive structural variation leads to loss of structural information for individual molecules.

We address this problem by using Electrospray Ion Beam Deposition (ESIBD), a technique that transfers molecules into the gas-phase, mass-selects, and soft-lands them onto a cold single-crystal metal surface. This is followed by their imaging using Scanning Tunneling Microscopy (STM) and Scanning Transmission Electron Microscopy (STEM), correlated with DFT calculations to reveal their individual structures on surface. We successfully applied our approach to conjugated polymers (2), biomolecules (3-5), as well as MoS_2 nanoribbons (6). This method opens a new avenue to access individual structures of increasing complexity that can be electrosprayed and deposited onto a surface.

References:
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