Structural Issues in Molecule Based Electronics

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New classes of electronic devices based on molecules as an active component are being created at an accelerating pace by research laboratories around the world. In many cases the molecules initially are configured as a monolayer in the device structure by self- or directed-assembly onto a base electrode surface. This step typically would be followed by metallization to form a second contact. Such devices can act as diodes, resonant tunneling diodes and memory and show great promise for commercial applications because of potential attributes such as low operating power requirements and reduced processing costs, for example. In spite of the efforts to date in making these devices little is actually known about the detailed structures of the molecular assemblies in the devices and how structural variations could affect the device operation. Recent work has pointed to a strong relationship between the details of molecular organization and the operating parameters of the device. Important structural aspects could include the translational, tilt and conformational order parameters of the monolayer as well as specific types of defects. These aspects in turn could be strongly directed by the nature of the bottom contact crystal morphology, as well as by processing conditions such as solvent and temperature. In addition to monolayer structure effects, recent work has also shown that the morphology of the top metal contact may play critical roles in the device operation. This talk will briefly review these structural aspects of the monolayer films and contacts and discuss the role that scattering and spectroscopic studies might play in their characterization.