Integration of Biomolecular Electronic Devices and Sensors

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In recent years incredible strides have been made in the development of molecular electronic systems that possess unique functionality. By combining chemical design with physical modeling and electrical characterization techniques it has become clear that molecules are capable of a wide range of impressive electronic functions that extend far beyond the development of standard devices such as transistors and diodes. An array of electromechanical, electrochemical, thermoelectric, and quantum devices now provide promise for memory devices, sensors, and multi-state logic units which could yield new paradigms for in-memory computing, various post von Neumann architectures, or for chemical and biological sensing systems. But, despite these possibilities, one of the major issues that arose in the nascent days of molecular electronics still lingers and limits its ultimate utility. That issue is integration. Despite a wide range of unique devices, and novel chemical and physical properties, it has remained difficult to integrate these materials into a larger-scale system in a way that is reliable, reproducible, and eventually manufacturable. In this talk we will discuss emerging approaches aimed at integrating and characterizing molecular-scale electronic systems to move them from the lab and into applications. We will discuss approaches for integrating top-down lithographic approaches with bottom-up self-assembly methods to make secure and robust covalent contacts to a single-molecule using carbon nanotubes to allow facile integration with traditional photolithographic processes, as well as the use of combined opto-electronic characterization techniques to examine structure-transport relations at the single-molecule level.