Electric field induced conductance switching of single-molecule junctions with non-volatile memory properties

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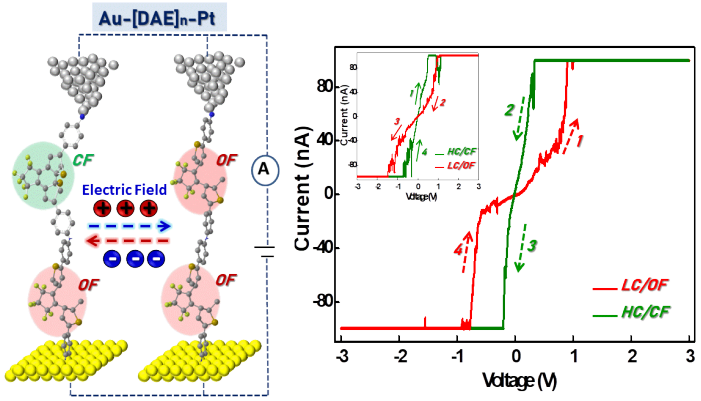
Abstract:

The global demand for data storage and processing has increased exponentially in the past decade. In-memory computing with logic operations has attracted much attention and been largely used to store data and machine code. The use of memoristic single molecule in molecular electronics aims to fabricate single molecule memoristor with lower cost and optimized functionality with efficient charge transport. The formation of highly stable single-molecular junctions (SMJs) with covalent molecule-bottom electrode contact allows not only conductance measurements but also reliable I/V characterization at room temperature. Under this circumstance, investigations of SMJs with central switchable molecules are of great interest to obtain resistive switches with high on/off ratios for non-volatile memories. We have recently investigated diarylethene (DAE) based SMJs using STM-bj technique by connecting single DAE molecule (pre-grafted using diazonium electroreduction) between two metal electrodes.[1-4]

NH_2-DAE-NH_2 is chosen as a central photochromic unit (for building SMJ) which can switch between its closed and open forms upon UV and visible light irradiation in solution as well as on surface, showing different conjugated structures.[1] Au-[NH2-DAE-NH2]n-Pt (n=1, 2, 3) SMJs are built using STM-bj technique where light-induced high conductance (HC) and low conductance (LC) states are recorded corresponding to conductance switching between the molecular CF and OF states, respectively.



Most importantly, electric field is then used as an external stimulus to trigger the SMJ switching. Cycles of reproducible hysteresis I(V) loops are obtained display a field-generated SMJ non-volatile memory function between their OF and CF states. Repeated cycles of "reading,writing and erasing " [4] processes are successfully practice showing a XOR logic-in memory effect. Such switchable SMJs may serve as full-electric room temperature memristors that are the keys to the future of molecular storage devices.

References:

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4. X. Yao, L. H.Guan, F. Lafolet, X, Sun*, J. C. Lacroix*, *to be submitted*