Electrochemical-Gate Controlled Transport in Redox Molecules

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The ability to measure and control electron transport through single molecules is a basic requirement in molecular electronics. We have studied charge transport through single redox molecules, perylene tetracarboxylic diimide derivatives (PTCDI), covalently bound to two gold electrodes, and observed that the current through the molecules can be controlled reversibly over 3 orders of magnitude with an electrochemical gate. These PTCDI derivatives, terminated with different linker groups, exhibit similar gate potential dependence but have rather different conductance values at a given gate potential. In order to investigate the mechanism of the large gate effect in these molecules, we have studied the electron transport properties of the molecules as a function of temperature, in different solvents and electrolytes, and with and without the electrochemical gate control. The experimental results indicate that the large gate effect is due to a two-step electron transfer process, in which electrons tunnel from one electrode into the empty state of the molecule, and then from the molecule to the second electrode.

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