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F-V/SMS: A New Technique for Studying the Structure and Dynamics of Single Molecules and Nanoparticles

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We recently introduced a new technique for semiconductor nanoparticle research that involves simultaneous single molecule spectroscopy (SMS) *and* controllable oxidation/reduction in an electronic device. The new technique (denoted by fluorescence voltage F-V/SMS) is analogous to current vs. voltage ($I - V$) measurements for devices and electrochemical cells. F-V/SMS data are reported for single molecules (nanoparticles) of the conjugated polymer MEH-PPV as a function of bias voltage on the device and bias sweep rate to obtain information on both the energetics and kinetics of the charge transfer (oxidation/reduction) process in situ on the nanoscale. The extensive F-V/SMS data presented in the talk reveal that the dynamics for oxidation/reduction of MEH-PPV nanoparticles are controlled by various factors including filling of deep hole traps in the charge transporting layer of the device, the oxidation/reduction chemical "state" of the MEH-PPV molecule, and the molecular scale heterogeneity of the device.

1."Charge Injection and Photooxidation of Single Conjugated Polymer Molecules," J. Am. Chem. Soc., So-Jung Park, Andre J. Gesquiere, Ji Yu, and Paul F. Barbara, J. Am. Chem. Soc., 127, 4116 (2004).