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Conductance switching and electronic states in polymer nanodevices NIKOLAI ZHITENEV, Bell Labs., Lucent Technologies, ALEXANDER SIDORENKO, DONALD TENNANT, RAYMOND CIRELLI — Organic materials offer new electronic functionality not available in the inorganic devices. However, the integration of organics within nanoscale electronic circuitry poses new challenges for material physics and chemistry. To rationally control the conducting properties of small devices, the electronic states in organics have to be optimized relative to the Fermi level of metal contacts. We demonstrate a novel approach to create and chemically modify such electronic states in thin polyelectrolyte films. Nanoscale devices fabricated using integrated shadow masks and the polyelectolyte film grafted to electrodes display reversible switching between conducting and non-conducting states. The conductance is related to the creation and annihilation of the chain of the electronic levels in the polymer. The electronic properties and the switching dynamics are broadly tunable by the chemical composition of the polymers. The open design of our nanodevices allows us to perform the chemical conversion targeting primarily carboxyl groups inside the completed junctions. The conduction memory effect is observed in devices with lateral size down to 30 nm.

Nikolai Zhitenev
Bell Labs., Lucent Technologies

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