Polymer based nanocomposites with nonlinear electrical properties. Prospects for molecular electronics and printed electronics

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Nonlinear current-voltage *(I-V)* characteristics are important for creation of organic semiconducting devices. Three classes of nanocomposites are considered in this presentation: polyurethane (PU)/single wall carbon nanotubes (SWNT) self-organized thin films; 2D percolative network of polyaniline (PANI) in surface-modified poly(vinylidene fluoride) (PVDF); and polymer core-shell latex systems (PANI/PVDF). All systems under consideration are also suitable for printed electronics applications. Structure-properties relationships for semiconducting nanocomposites are studied with several modes of atomic force microscopy, namely, traditional topography imaging and ultrasonic force microscopy (UFM), Raman spectroscopy, and surface conductivity characterization. Nonlinear electrical characteristics are found in all systems with surface-modified ferroelectric polymers (PVDF or PU) and are related to a local electrical field produced by polarization of ferroelectric domains of PU or PVDF matrices under application of the external field. These findings are important for development of all-plastic field effect transistors (FET), electrically switchable memory devices and sensors.

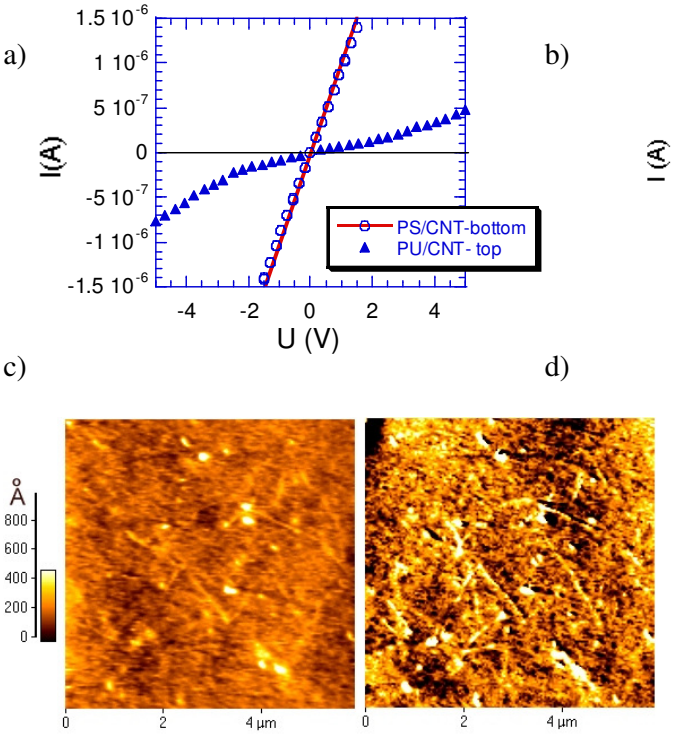

Figure 1. Examples of nonlinear I-V curves in PU-SWNT (a) and PVDF-PANI (b) nanocomposites, and percolation network formed on the surface of 150 nm thick PU-SWNT film imaged in AFM topography (c) and UFM (d) modes.