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# Electro-induced peeling of nanostructured organic material

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Soft materials comprised of low molecular weight organic molecules are attracting increasing interest because their importance in a number of emerging areas in nanoscience and technology, including molecular electronics, nanosystems for energy conversion, and devices in the widest sense. Their interaction with electrodes and their behaviour under electric fields is a topic of vital significance for these areas, and one about very little is known.

The material under investigation is a monoalkylated tetrathiafulvalene derivative xerogel. The employed sample preparation produces a material, with muscular appearance, in which relatively straight bundles of supramolecular fibres extend over several tens of microns in length. We provide unprecedented evidence for the peeling of organic molecular material when a voltage is applied between the conducting system and the conducting probe of a scanning force microscope (C-SFM). The conducting response of the sample surface was obtained by following different strategies, such as simultaneously acquiring topographic z(x,y) and current maps I(x,y) movies, either at constant voltage intervals or at constant time intervals for a fixed voltage. We also make use of the so called 3D modes as part of a combined methodology which permits separating, controlling and probing the relation between mechanical deformation and transport properties and correlating the electro-induced changes with the surface relief.

A layer by layer peeling phenomenon has been uncovered. The removal of molecular material starts at voltage excursions beyond some hundreds of mV and results in an increase in current and irreversible morphological changes (mechanical disruption) without applying any mechanical compression. The process starts at the fibres ends or close to the bundles borders. It never starts in the middle of the fibre. Once the process starts (breakdown), it triggers the peeling of the fibre similarly to a staircase burning reaction (figure 1). The results indicate the importance of electric fields on the stability and performance of conducting organic systems at the nanoscale.

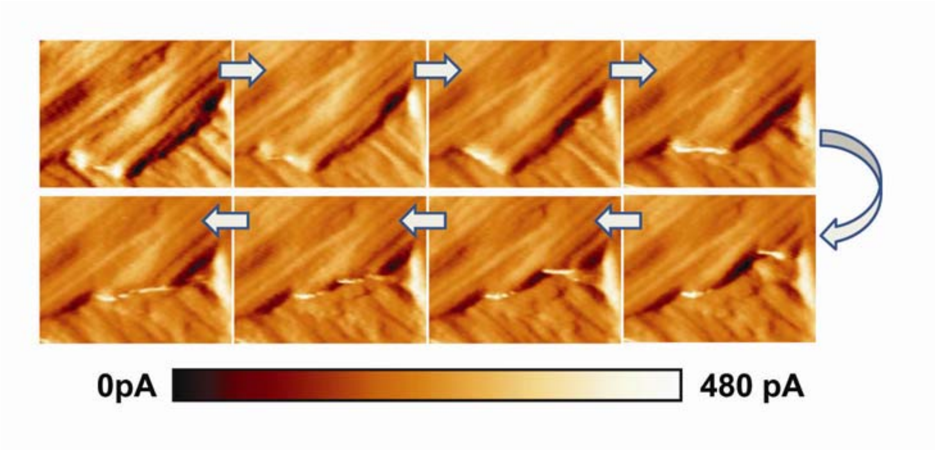


**Figure 1.** Sequence of frames extracted from a SFM movie taken at constant voltage. The time evolution is indicated by the solid arrows. The total duration of the movie of about 11h.