Nanostructured TCO film for molecular spintronic applications

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The research field of Spintronics emerged from experiments on spin-dependent electron transport phenomena in solid-state devices. Since electron spin is intrinsically binary by nature, spintronics devices could be well suited to digital electronics. The basis of molecular electronics is the use of interconnected molecules to perform the basic functions of digital electronics. An ideal device would comprise only one or, at most, a few molecules, unlike conventional electronic devices which depend on the transport of large quantities of charge carriers. In molecular spintronics, the aim is to exploit an advantage organic molecules have over most metals and semiconductors. They allow spin coherence to be preserved far longer and thus raise the real possibility of transporting spin between molecular devices capable of reading the spin and transforming it to perform the familiar operations of digital logic circuits. To supply the necessary voltage and to allow the transmission of the emitted light an electrode with low resistance and high transparency in visible region is required. The most used material for this purpose is Indium Tin Oxide (ITO).

We realize Transparent Conductive Oxide (TCO) films by PLD to be used as electrodes in multilayered structures in molecular spintronic devices, which will be fabricated at the NNL facilities. These layers will be formed of undoped ITO or of ITO doped with ferromagnetic ions as Cr, Ni etc. in our PLD facility, equipped with an excimer laser operating at different wavelengths (248 and 193 nm) which can ablate in a very controlled way the target material. The deposition chamber is equipped with a multitarget holder, which permits the fabrication of multilayered structures and with an X-Y computer assisted motion substrate holder to realize large area films with a good thickness uniformity. Doped films have been already fabricated by exploiting a double-target technology, using a target of undoped ITO and another one of magnetic metal. The relative number of laser pulses directed alternatively to the two targets defines the level of doping into the film. In this way the desired doping concentration can be obtained during the deposition process. The first undoped ITO films present a very smooth surface which is mandatory for this kind of devices.

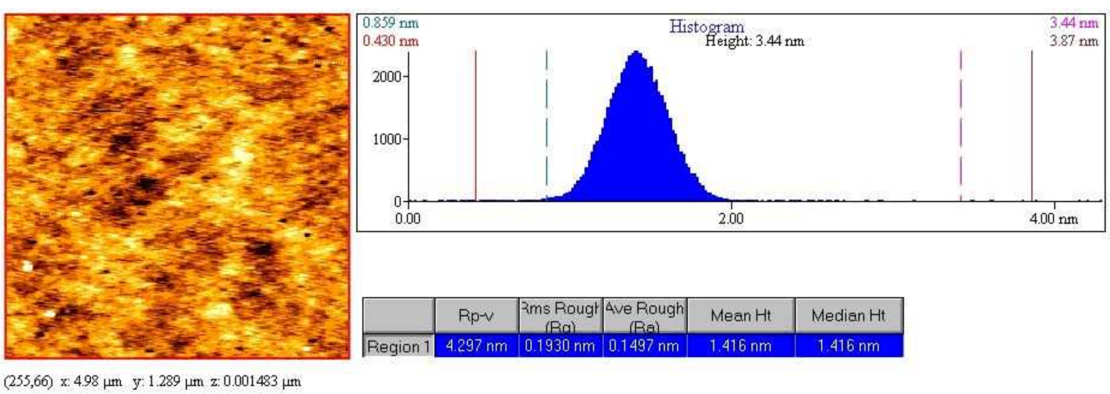

Figure 1. AFM micrograph of ultrasmooth ITO film