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S E M I N A R
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Halbleiterphysik und Nanotechnologie

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"Atomic force microscopy methods for nanoscale characterization of resistive switching in iridates and manganites"

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Further improvement of nanoelectronic devices such as switches and memories, requires development of novel materials and advanced mechanisms for the dynamic control of their electrical properties. In this context, one of the most studied mechanisms is the resistive switching (RS) - an electrically induced change of the resistance of various thin metal- oxide films. This research is mainly motivated by possible applications in new data storage devices such as resistive random access memories. Beside the RS induced by applying bias voltage, strain engineering can be used for this purpose as well. The mechanical control gives a new freedom in the design of resistive switching devices since it does not depend on the film thickness while biasing is not needed. In order to explain complex processes during RS, nanoscale characterization methods are essential. Therefore, in this talk the main focus will be on atomic force microscopy (AFM) based methods for RS studies.

In the first part, the results for the electrically induced RS in semimetallic $SrIrO_3$ thin films will be presented as a function of metal-insulator transition (MIT) triggered by film thickness reduction. It is shown that thin films are insulating and characterized by hysteretic I-V curves. The threshold voltage indicating the transition from high- (HRS) to low-resistance state (LRS) is well defined implying a band gap opening due to MIT. On the other hand, thicker films are semimetallic, so the transition from HRS to LRS is characterized with a smooth increase of the current without a threshold voltage. In the second part, mechanically induced switching of surface electrical properties of $La_{0.67}Sr_{0.33}MnO_3$ (LSMO) thin films covered by magnetic nanoparticles will be discussed. The local pressure applied by AFM tip leads to a drop of the electrical conductivity, finally inducing an electrically insulating state for high enough normal load. Subsequent electrical characterization by AFM methods suggests that the switching process is mainly governed by the flexoelectric field induced at the sample surface.