

*Practical work: “Scanning probe microscopy”*

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**Duration: 5 weeks**

**Group size: 3 persons**

**Presentation of results: written report, oral presentation**

**Title: VO<sub>2</sub> films with metal-insulator transition: analysis of surface, structure and electronic transport at the nanometer scale**

VO<sub>2</sub> is one of the most studied phase-changing materials, which is considered for a broad range of applications from smart windows to memristors and functional elements in neuromorphic circuits. This TP explores polycrystalline VO<sub>2</sub> in the thin film form integrated on silicon for electronic applications. Here, we study application-relevant structural properties of VO<sub>2</sub> films and the most important electronic properties relating to the metal-insulator phase transition.

**Objectives :**

- Analysis of the microstructure, roughness, and grain size distribution in polycrystalline VO<sub>2</sub> films deposited on different substrates.
- Measurements of electrical conduction at the nanometer scale vs voltage and temperature. Mapping electrical conduction at different temperatures, detection, and mapping MIT at the nanometer scale. Analysis of the local variations of the phase transition in relation with the micorstructure

**Acquired skills and studied techniques:**

- Basic AFM operation, mounting and alignment of probes, and configuring measurements
- AFM contact mode /non-contact mode – specific approaches for quick time-efficient scans and enhanced resolution imaging
- conductive AFM, local probing of transport properties, conduction mapping, analysis of temperature-dependent transport properties at the nanometer scale
- analysis of SPM scans using different software packages
- use of the SPM tip as a precise probe for electrical characterization

*Support information:* relevant papers and application notes will be available for the group members