

X-TIP



STRP 505634-1 X-TIP

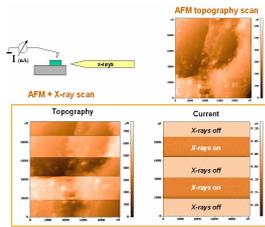
Development of Laboratory Setup for X-Ray/AFM Experiments

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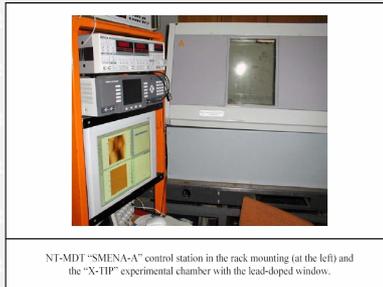
First AFM/X-ray experiment at ISSP in 2002-2003



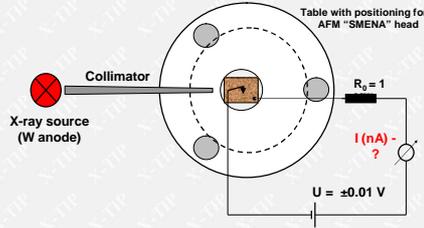
Sample: CdWO₄ single-crystal

Preliminary in-lab tests, performed at ISSP in 2002-2003 years, suggested possibility to perform AFM measurements under x-ray irradiation from conventional x-ray tube, mounted on diffractometer. In the first experiments, the CdWO₄ single-crystal was used as a sample since it allows visualization and positioning of incoming x-ray beam through the visible green photoluminescence. Sample topography and current between grounded sample and the AFM conductive tip were simultaneously detected.

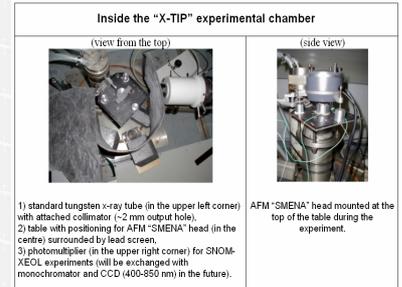
In-lab "X-TIP" setup at ISSP



NT-MDT "SMENA-A" control station in the rack mounting (at the left) and the "X-TIP" experimental chamber with the lead-doped window.



AFM head mounting

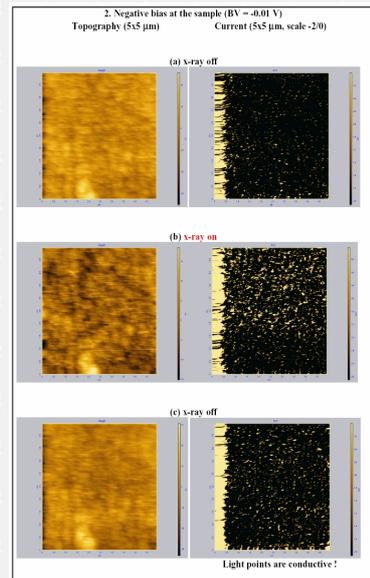
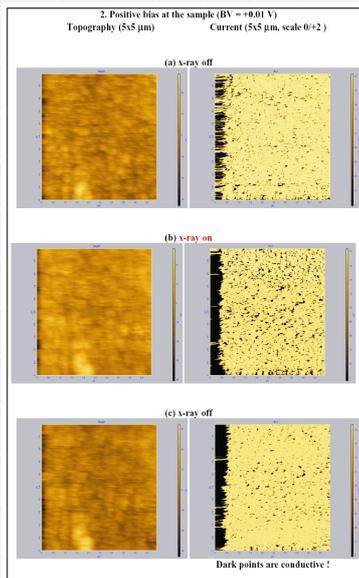
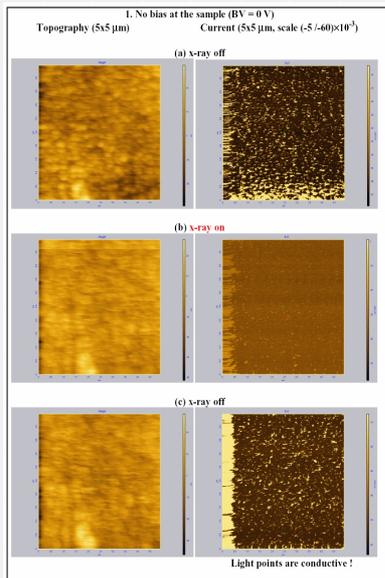


1) standard tungsten x-ray tube (in the upper left corner) with attached collimator (~2 mm output hole), 2) table with positioning for AFM "SMENA" head (in the centre) surrounded by lead screen, 3) photomultiplier (in the upper right corner) for SNOM-XEOL experiments (will be exchanged with monochromator and CCD (400-850 nm) in the future).



Version 1 with rough X-Y movements, Version 2 with precise X-Y movements. New setup for head mounting, having better stability and better sample positioning.

AFM measurements of x-ray induced changes in oxide thin films



Sample Preparation

Mixed (Mo-Ru)O_x thin films were prepared by dc reactive magnetron sputtering. Metallic Mo and Ru targets were used as a source. The sputtering was performed in a variable Ar-O₂ atmosphere, leading to the growing of metallic/oxidized thin films. The electrical conductivity and optical properties were controlled. It was found that films obtained in pure argon atmosphere have metallic luster and are highly conductive (resistivity about 2-20 Ω/cm²), whereas the films prepared in mixed Ar-O₂ atmosphere with oxygen content more than 10% have brown/translucent colour with resistivity of the order of MΩ/cm².

CONCLUSIONS:

1. X-ray induced changes in the conductivity can be detected by AFM in the STM mode.
2. Currently only samples with mixed metallic-insulating properties as Mo-Ru and Re oxide thin films were studied. The metallic part changes clearly its conductivity under x-ray irradiation.