

HELIUM ION MICROSCOPE – A NEW TOOL FOR NANOSCALE IMAGING AND FABRICATION

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A Helium Ion Microscope (HIM) system has recently been installed in the cleanroom of the Nanoscience center (NSC) of the University of Jyväskylä. The acquisition of this state-of-the-art microscopy tool has been carried out in collaboration of the Departments of Physics and Biology with infrastructure funding from the Academy of Finland.

The helium ion microscope is a novel development within the family of scanning beam microscopes. Instead of using electrons for beam particles, as in conventional scanning electron microscopes (SEM), helium ions are used. He ions have a focal depth that is 5-10 times larger than electrons in SEM, a beam spot size below 0.5 nm, and very small interaction volume producing secondary electrons, resulting in images with striking clarity. Another important advantage of HIM is its capability to image insulating materials without charging effects (no metal coating needed) as the positive surface charging from He ions can be neutralized with an electron flood gun. HIM therefore provides an unprecedented resolution in the microscopy of biological samples.

The helium ion beam of a HIM can also be used for high resolution ion beam milling in a similar way than gallium is used in conventional focused ion beam (FIB) systems, but with higher resolution and without contamination by metallic ions. For higher milling rates neon beam can be utilized. Very high resolution ion beam lithography can be performed with an advanced pattern generator of the HIM system.

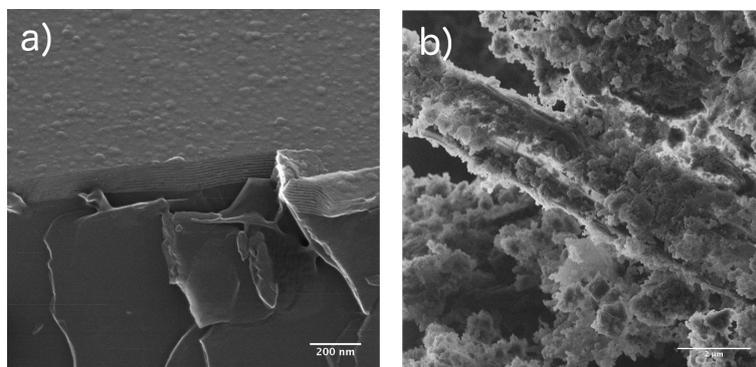


Figure 1: Images recorded with the helium ion microscope of University of Jyväskylä. a) $\text{Al}_2\text{O}_3/\text{TiO}_2$ nanolaminate film deposited with ALD. Each of 10 layers is 5 nm thick. b) Fibrillated cellulose imaged directly without conductive coating (sample by VTT).