

Z51 - STUDY OF THE SURFACE STRUCTURE OF ORGANIC AND INORGANIC MATERIALS BY MEANS OF ATOMIC FORCE SCANNING MICROSCOPY (AFM)

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Atomic force microscopy (AFM) provides a precise topographical information about surfaces of both conductive and non-conductive materials. The AFM operates by scanning the surface with a sharp probe, which is mounted on a flexible cantilever. Deflection of the cantilever during scanning is sensed using a laser beam and a multi-element photodetector and, successively converted into a three-dimensional image of the examined surface.

The aim of the AFM laboratory course is to demonstrate the surface imaging technique using the atomic force scanning microscope (AFM). In particular, students will get familiar with the construction and principle of operation of the AFM microscope. The laboratory experiment will make use of a low resolution AFM from Nanosurf and will be focused on investigation of topographic features of selected surfaces (surfaces of crystals, polymers, biological structures, e.g. cells) at a micron length-scale. An important aspect of the exercise is the training in image analysis techniques.

Preparatory questions

- AFM construction elements [1, 3]
- The principle of operation of the AFM microscope [1, 2]
- AFM microscope modes (contact mode, non-contact mode) [1, 2]
- Piezoelectric effect [1, 4]
- Definition of resolution in AFM microscopy [5, 6]

Computational assignments

1. Make a surface profile based on the AFM image and determine the sizes of the measured surface structures.
2. An image in the AFM contact mode was acquired with a constant force of 2nN. Calculate the AFM lever deflection, knowing that its spring constant is 0.1 N/m.

Apparatus and materials

- Atomic Force Microscopy by Nanosurf [2]
- AFM probes
- AFM sideview camera [2]
- Samples

Experiment

- Mounting of the sample, starting the microscope.

- Initial parameters adjustment (scan speed, force in the contact mode and the so-called "feedback parameters").
- Acquisition of topography images of selected samples in contact and non-contact mode depending on the scanning parameters.
- Image analysis and preparation of the report.

Data analysis

Data analysis will include:

- analysis of surface images in Nanosurf software
- preparation of cross-sections (surface profiles), estimation of dimensions of the imaged surface structures.
- comparison of images recorded with different scan parameters

References

- [1] Atomic force microscopy (AFM) principle
- [2] Atomic Force Microscopy: Biomedical Methods and Applications, Pier Carlo Braga, Davide Ricc; Totowa, New Jersey : Humana Press, ©2004
- [3] <https://www.nanosurf.com/en/products/naioafm-the-leading-compact-afm>
- [4] <http://www.nanoscience.gatech.edu/zlwang/research/afm.html>
- [5] Overview of Atomic Force Microscopy, Greg Haugstad
- [6] Atomic Force Microscopy: Understanding Basic Modes and Advanced Applications; Greg Haugstad; John Wiley & Sons, 4 wrz 2012 – 488

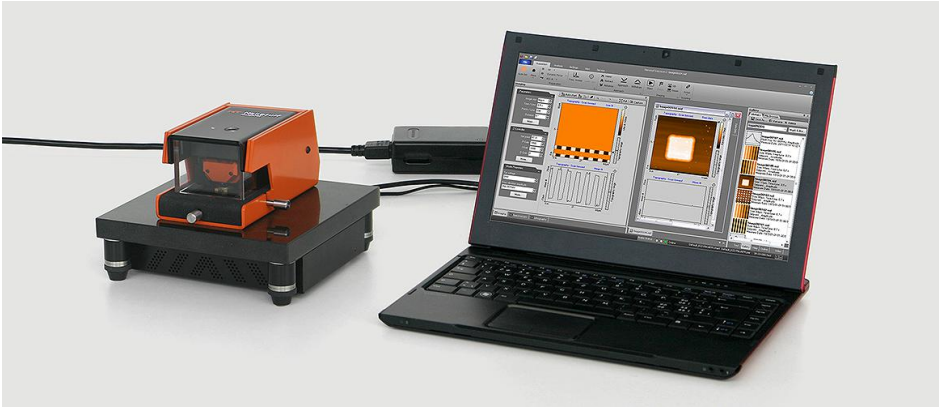


Figure 1: Image downloaded from the website:
<https://www.nanosurf.com/en/products/naioafm>