

## Formidlingsaktivitet

Art: STEM/STEAM science communication.

Sted: SDU

Skole: Ryslinge Efterskole, 10. klasse elever

Dato: 01. februar 2024.

Tid: 10:00 – 13:45.

Antal elever: 4

GDPR / pictures for public? Yes. Permission obtained.

Lærerkontakt: n/a (but they obtained permission to visit SDU)

Formidler: Tobias C. Hinse (Syddansk Universitet, FKF / SDU-Galaxy).







# NanoWizard® AFM Unlimited Possibilities

### What is an Atomic Force Microscope (AFM)?

An AFM uses a miniaturized cantilever with a very sharp tip at its end to mechanically scan the surface of a sample. The tip is brought into close contact with the surface and is moved the surface by line across it. The cantilever deflects as it travels across the nano landscape. This deflection is usually measured by a laser beam, which is reflected off the backside of the cantilever. The movements of this reflected light are "seen" by a segmented photodiode. This information about the tip movement is then reconstructed into three-dimensional images of the sample.

Depending on the operation mode AFM detects and quantifies electrical, magnetic, mechanical or optical properties of the sample. Furthermore, forces can be measured on the nm length-scale with piconewton accuracy.



Labels: Detection laser, Cantilever, Attraction or repulsion, Sample, Cantilever deflection, Quartz photodiode.

### High resolution imaging



**Camilla girge DNA**, showing both the major and minor grooves in the DNA double-helix, imaging in closed-loop xy in liquid.

**True atomic resolution image** of mica in liquid, 5nm scan region, imaging in closed-loop mode. The hexagonal unit cell is clearly resolved.

### Fast scanning



**Image of Colgate® (Colgate, USA)** with scan region 1µm, z scale 100nm, 23Kz line rate, closed-loop xy.

**DNA origami** imaged in 1AE-1Mg buffer using closed-loop xy. Scan region 130 nm.

**4 Time series polymer crystallization** showing crystallization of the biodegradable copolymer poly(lactide-co-valerate), (PLVA). Scan region 1.5 microns, imaging in closed-loop xy, 3 frames shown out 58 in the experiment.

### Kelvin probe microscopy



**Kelvin Probe Microscopy (KPM)** on an interdigitated electrode.

Scan size: 21µm x 21µm

The height image is shown as 3D topography, with the color indicating the measured surface potential. The spaced electrodes (100nm (10:4) µm) are imaged in pairs, the separation between topography and potential is clear.

### Conductive AFM



**Conductive AFM topography (left)** and current (right) images of optically active conducting polymer film on ITO using the JPK Environmental Conductive AFM module.

Scan size: 8µm x 8µm

The conductivity is reasonably constant over the film, but highly dependent on incident light. The 200 pA and 400 pA current levels are applied simultaneously and off on in darkness giving an increase of the current to around 200A.

### Optical integration with DirectOverlay™



Living cells imaged in the JPK PetriDishHeater™ at 37°C. DirectOverlay™ combination of optical phase contrast and AFM images. Series of 10 µm AFM images using closed-loop xy, 40 Hz line rate, 3 frames between images, showing structures that remain fixed (square) and others that move (circle).

Sample courtesy of Prof. B. Herrmann, Humboldt University Berlin.



AFM and fluorescence images of Alexa555-labeled Rad51 proteins bound to DNA. Rad51 assembles into filaments along double-stranded DNA, which can be seen in the 3D plot of the 700nm topography image (right). In the fluorescence overview image (left), the Rad51 filaments are red fluorescent, with the AFM scan regions superimposed in blue using the JPK DirectOverlay™ software. Each AFM scan encloses a single DNA molecule, partially coated with Rad51. The fluorescence image was captured with an Andor™ Xion+ 897 EMCCD camera, fully integrated with the AFM software.

Sample courtesy of Dr. Muelhalp, CNRS-MaxPlanck, France.

### Quantitative Imaging with Q1™ Mode



Polystyrene-block-polybutadiene film showing contrast between soft poly-butadiene-matrix and glassy Polystyrene-cylinders measured on silicon under ambient conditions.

- Left: height image
- Middle: adhesion elasticity
- Right: 1x1 µm
- Scan size: 20nm
- Adhesion range: 2 nN
- Elasticity range: 400 MPa
- Imaged in closed-loop

### Force spectroscopy



Force spectroscopy curve of titin unfolding. The titin protein consists of repeating modular units, which unfold sequentially as the protein is extended. The sawtooth pattern shows the jumps as each 127 (91) domain unfolds. The domain repeats have a contour length of 28.5 nm.



And more...



Labels: 1 NanoWizard® head, 2 Cantilever holder, 3 Piezo disk, 4 Motorized stage, 5 Transmission light beam path, 6 Condenser lens, 7 Objective, 8 Fluorescence excitation path (backport), 9 Side port with fluorescence camera, 10 Eye piece beam path.

[www.jpk.com](http://www.jpk.com)

February 1, 2024 10:31



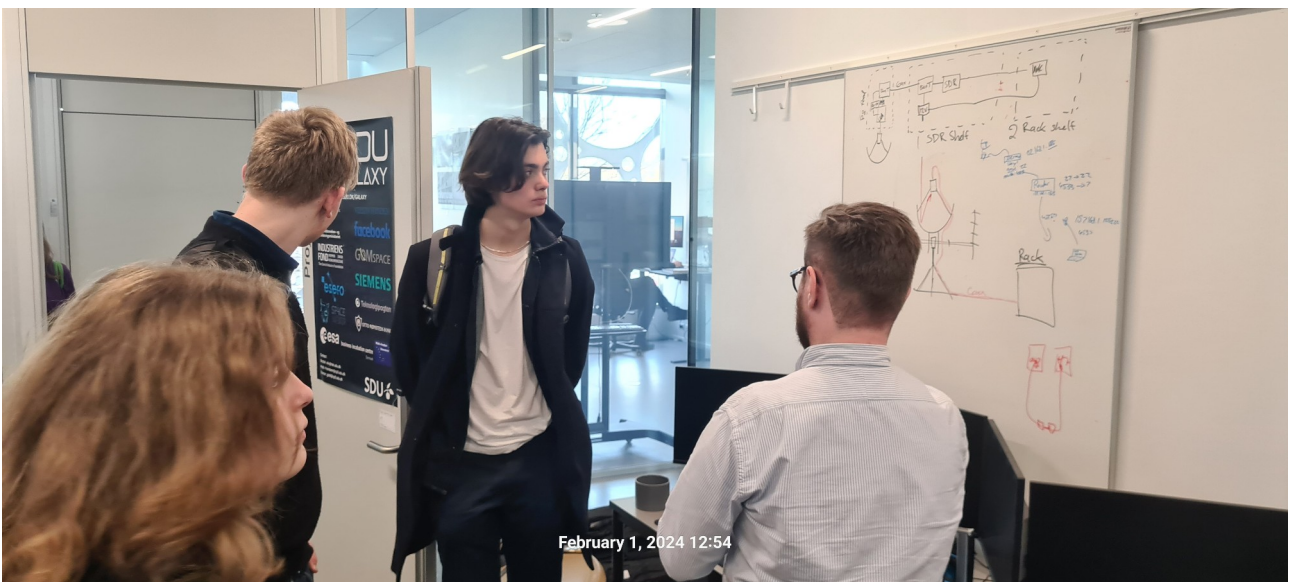






February 1, 2024 12:16





10:00: Ankomst foran SDUB hovedindgang

10:15 - 11:00: Besøg på PhyLife (Frederik W. Lund & Tobias)

11:15 - 11:45: Optisk laboratorium på NAT/TEK (Jakob Emil Olsen & Tobias)

12:00 - 12:30: Studentlabs på NAT/TEK (Lasse og Lau & Tobias)

12:30 - 13:15: Medbragt frokost, rundvisning og snak på CP3 (Tobias)

13:15: Adjourn, farvel & tak