Centre for NanoHealth

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Bio Atomic Force Microscope

The JPK NanoWizard® Atomic Force Microscope (AFM) lined the way for a multitude of applications in Soft Matter and Life Science research. In life science applications, all these techniques require perfectly controlled conditions, in solvents or buffered solutions, while handling the softest and most fragile samples that can be imagined.

Specifications

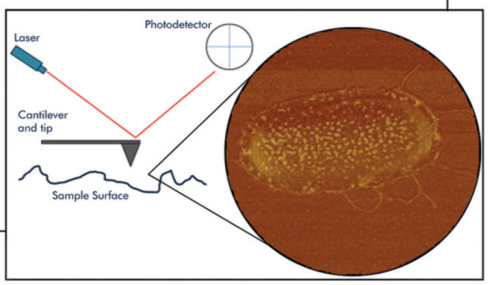
- Temperature control, gas flow and liquid cells.
- 100x100x15μm^3 scan range for the head in closed-loop Mode.
- Motorized precision stage with 20x20mm^2 travel range with joystick or software control.
- Special holders and liquid cells (Ø140x20 mm^3 free sample volume).
- Pixel resolution: >131,000 pixels for force curves.

Features

- AFM combined with Zeiss 510 Confocal Laser Scanning Microscopy for improved biocharacterisation.
- High Resolution Imaging (nanometre range for sample).
- Imaging in biological/chemical fluids or in air.
- Force Measurements achievable on single molecule. Possibility to reach easily the single bond forces.
- Accessibility of mechanical information of a surface following range of forces applied (stiffness, adhesion and / or elasticity data).
- Measurements at variable temperatures with perfusion possibilities.
- Nanoscopic manipulation or lithography by using the tip as a nanoscopic operator.
- Inverted research Microscope, Carl Zeiss

Benefits

- Extended variety of experiment profiles thanks to the modulated inverted microscope (optical phase contrast, DIC, epi-fluorescence, confocal microscopy, FRET).
- Combination of different types of experiments, perfect overlay of optical and AFM data with sub-diffraction limit precision to compare results.
- High Sensitivity increased by anti-vibration unit.
- High repeatability in measurement.
- Large scan field area allowing work with large area samples.
- Simultaneous capture of morphological and biological information.



Swansea University
Prifysgol Abertawe

Centre for NanoHealth, Swansea University, Singleton Park, Swansea, SA2 8PP, Wales, UK
T: +44 (0)1792606471 Web: www.swansea.ac.uk/nanohealth E: nanohealth@swansea.ac.uk

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Case Study

Goal: Identify a suite of biomarkers that can be used to successfully isolate stem cells from articular cartilage and perform force-curve measurements for use within regenerative procedures for osteoarthritis treatments.

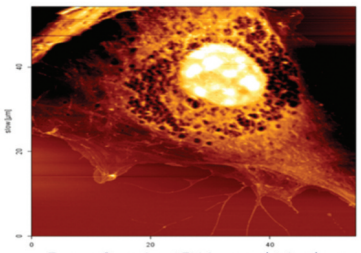

Figure: Scanning AFM image obtained on a single cell

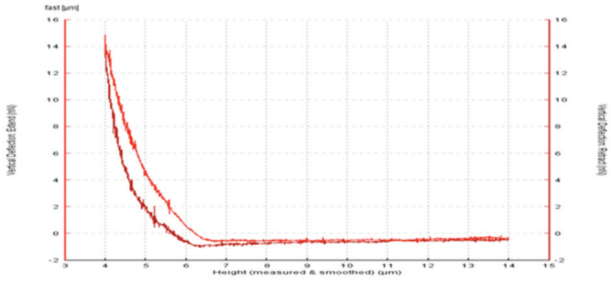

Figure: An example force curve obtained for a single cell as seen above.

AFM was used to measure morphological changes in endometrial cancer cell lines Ishikawa and Hec 50 following treatment with an epigenetic modifying drug 5-aza-2′-deoxycytidine.

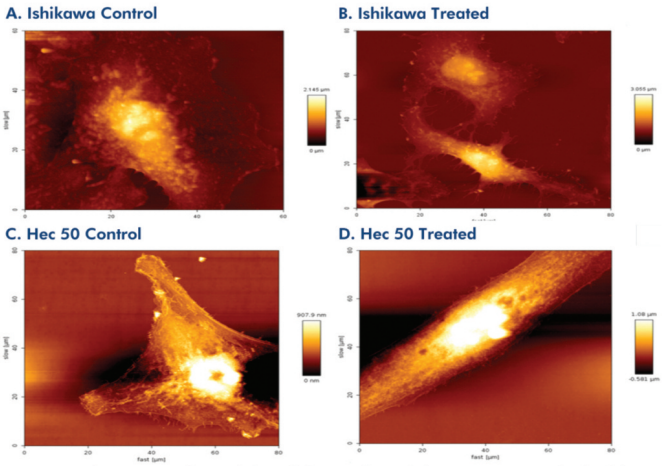

Figure: Changes in cell morphology following de-methylation treatment in both Ishikawa and Heraklio cell lines. (A) Control Ishikawa have a rounded flat appearance, similar to the Heraklio high resolution images (C). Following treatment the cells were observed to change morphology, becoming longer and thinner (B+D).

Applications

Area of Interest	Applications
Life Science	• Live cell imaging. • Cell membrane investigations. • Elastic properties of the skeleton and cell adhesion. • Pharmaceutical studies such as drug delivery mechanisms.
Nanoscience, Polymers and Thin Films	• Biomaterial studies and biosensor capsules. • Implants coatings and biochips. • Testing functionalized surface. • Soft materials studies such as degration, mechanical or electrical properties. • Polymers and thin film imaging and mapping in air and liquid with different. temperatures of liquids such as non aqueous solvents. • Nanoparticles, nanotubes, nanocomposites, vesicles and colloids investigation.
Instrumentation / Nanomanipulation	• Combination of AFM with others imaging systems (STORM, STED, fluorescence...). • Binding studies such as Receptor/ligands or antigens/antibodies. • Single molecules studies in DNA, RNA, proteins, Dendrimers, lipids.

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