QI™ mode – Quantitative Imaging
with the NanoWizard® 3a AFM family

Quick and intuitive to operate for experiments under ambient conditions or in liquid

High-resolution images for any sample, particularly for demanding samples that are soft and sticky, loosely attached or have steep edges

Works for most delicate samples due to precise force control at every pixel position

Get quantitative mechanical, chemical and electrical information such as stiffness, adhesion, dissipation, conductivity while scanning

Real force curves while imaging with maximum number of data points

168 bp DNA nanorings on Poly-L-Ornithine protein layer in buffer solution. 3D topography and force curve at the marked point. Scan size: 80×80 nm. Z-range: 2.5 nm. Imaged in closed-loop
Sample courtesy: Dr. Damian Ackermann, LIMES, University of Bonn, Germany

Vertical deflection (pN)
Height (measured) (nm)

0.8
1.0
0.4
0.6
0.2
-0.2
0.0

-100 -50 0 50 100 150 200 250 300 350 400 450

Living Chinese Hamster Ovary (CHO) Cells measured in a JPK PetriDishHeater™ at 37°C in buffer solution
Left: optical phase contrast image overlaid with AFM height image
Right: 3D topography. Scan size: 25×25 µm. Z-range: 3.6 µm. Imaged in closed-loop

Striped gold layer surface measured under ambient conditions
Left: adhesion image. Right: height image
Scan size: 5×5 µm. Adhesion range: 22.4 nN. Z-range: 90 nm. Imaged in closed-loop

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QI™ makes challenging samples easier to image

QI™ makes challenging samples easier to image. QI™, the new quantitative imaging mode from JPK, is developed to make AFM imaging easier than ever before.

With QI™ – a force curve based imaging mode – the user has full control over the tip-sample interaction force at every pixel of the image. There is no longer a need for setpoint or gain adjustment while scanning anymore.

Applying JPK’s ForceWatch™ technology, QI™ delivers outstanding results on challenging samples. Problems with soft samples (hydrogels or biomolecules), sticky samples (polymers or bacteria), loosely attached samples (nanotubes or virus particles in fluid) or samples with steep edges (powders, MEMS structures) are removed.

**QI™ ease-of-use benefits**
- Any kind of sample can be imaged: samples with steep edges, loosely attached samples, soft, sticky and brittle samples
- Works under ambient conditions and in fluid
- Quick to learn and easy to operate
- No cantilever tuning needed like in cantilever oscillating modes
- No force setpoint adjustment while scanning due to JPK’s ForceWatch™ technology
- Unattended imaging with user programmable patterns for multiple scans at different locations
- Available with the new NanoWizard® 3a AFM family

1. Twisted amyloid fibrils measured in buffer solution. Left: height image. Middle: Young’s Modulus. Right: force distance curve at the marked point. Scan size: 500×500 nm. Z-range: 10 nm. Elasticity range: 125 MPa. Imaged in closed-loop. Sample courtesy Dr Claudio Canale, Italian Institute of Technology, Genoa, Italy

2. Dendronized polymer (polystyrol backbone, dendritic side chains of third generation) were adsorbed onto freshly cleaved mica and measured under ambient conditions. Left: height image. Right: elasticity image. Scan size: 500×500 nm. Z-range: 6 nm. Elasticity range: 250 MPa. Imaged in closed-loop. Sample courtesy Prof. A. Dieter Schlüter, ETH Zürich, Switzerland

3. Hexacontane C60H122 preparation on HOPG. Height image. Inlay: elasticity. Stripes are monomolecular layers of Hexacontane. They correspond to the length of the molecule (7.5 nm). Scan size: 5×5 μm (inlay 300×300 nm). Z-range: 12 nm. Elasticity range: 2.2 GPa. Imaged in closed-loop
The newly developed QI™ and QI™-Advanced modes make the NanoWizard® AFM the most versatile instrument for both high-end research and routine use. Compared to other imaging modes, QI™ delivers real quantitative data. AFM moves from purely imaging to deliver real quantitative measurements.

Measuring a real and complete force distance curve at every pixel of the image gives all information about the local tip-sample interaction with high spatial resolution.

**QI™ technology benefits**

- Minimal yet precisely controlled vertical force while imaging
- No lateral forces applied to the sample – no pushing away or moving around of sample features
- No piezo travel limit
- Constant pulling velocity for accurate adhesion data
- Real force curve data, ideal for post processing

1. 3D topography of living Cyanobacterium measured in buffer solution and cross section of the marked region · Scan size: 10 × 10 µm · Z-range: 4.8 µm · Imaged in closed-loop

2. PTFE (Teflon™) layer measured under ambient conditions · Top: height image · Middle: elasticity · Bottom: 3D topography overlaid with elasticity · Scan size: 10 × 10 µm · Z-range: 1.4 µm · Elasticity range: 350 MPa · Imaged in closed-loop · Sample courtesy of Adam Mickiewicz University, Poznan, Poland

3. Polystyrene-block-polybutadiene film showing contrast between soft polybutadiene-matrix and glassy Polystyrene-cylinders measured on silicon under ambient conditions · Top: height image · Middle: adhesion · Bottom: elasticity · Scan size: 1 × 1 µm · Z-range: 20 nm · Adhesion range: 2 nN · Elasticity range: 400 MPa · Imaged in closed-loop

Herpes Simplex Virus adsorbed onto silanized glass slide measured in buffer solution; virus substructure can be easily resolved · 3D topography · Scan size: 300 × 300 nm · Z-range: 150 nm · Imaged in closed-loop · Sample courtesy Dr Wouter Roos, Vrije Universiteit Amsterdam, The Netherlands
The QI™-Advanced option delivers parameters such as adhesion, stiffness, dissipation and more

The QI™-Advanced software package is an extension of the standard QI™ version enabling quantitative measurement of nanoscale material properties such as stiffness, adhesion, dissipation and more. The imaging data are quantitative with high spatial resolution.

**QI™-Advanced mode option**

- Is an optional add-on to the standard QI™ software with more data channels and additional features for data extraction and processing
- Provides additionally adhesion, stiffness and dissipation data while scanning
- Depending on application, it can also deliver electrical conductivity or molecular recognition in a single scan
- Full datasets of force curves can be stored for post processing by the user
- Data analysis can be done either with JPK’s DP software or, for example, with user-written software for more flexibility, to use advanced fitting models for adhesion and Young’s modulus

**QI™ and QI™-Advanced mode configuration**

- QI™ mode comes with the NanoWizard® 3a as a standard feature
- QI™-Advanced mode is an optional add-on software module for nanoscale material properties and can be easily upgraded
- QI™ and QI™-Advanced mode require NanoWizard® 3a
- QI™ and QI™-Advanced work with standard cantilevers

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**Selected publications:**


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