The new JPK Contact Point Imaging (CPI) option based on QI™ mode

JPK Instruments recently launched its new QI™ mode (Quantitative Imaging) which is based on force spectroscopy and a unique pixel to pixel movement algorithm. This combination provides real quantitative image data of all parameters that can be derived from a force curve. One such parameter is the contact point that defines the height at which the cantilever just starts to touch the surface. More than any other imaging mode, contact point images give a true impression of extremely soft and inhomogeneous surfaces like those of living cells. These are uninfluenced by peak forces. Due to the vertical cantilever movements during the imaging process, no lateral forces are applied to the sample, which could modify the surface topography, as is the case for contact mode imaging.

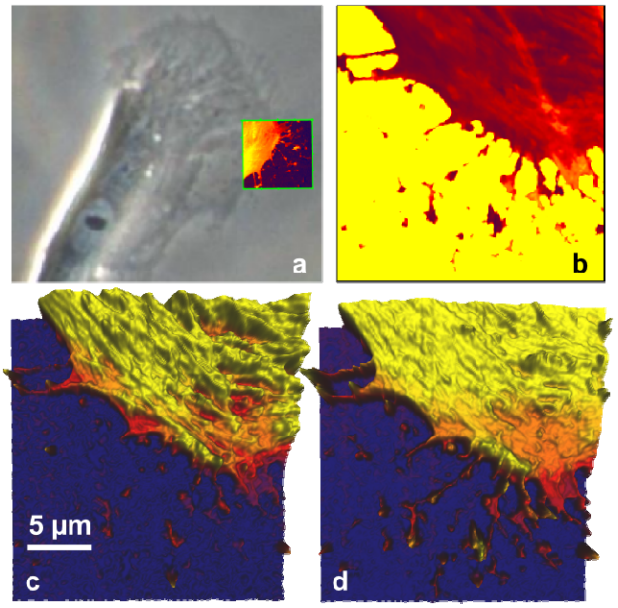
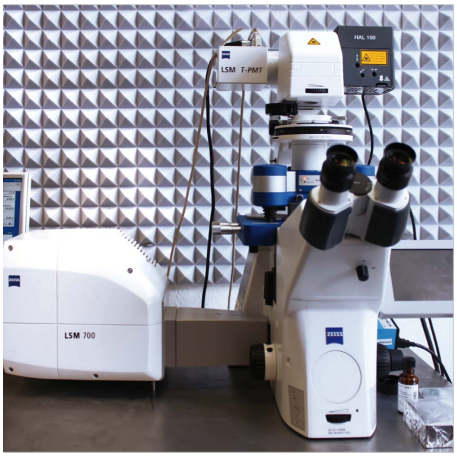


Figure 1: Living fibroblast imaged in QI™ mode. (a) Overlay of optical image (Zeiss Axio Observer, Phase contrast, 40x) with QI™ image. (b) Calculated Young's modulus image (Young's modulus range = 200 kPa) (c) height at 1 nN setpoint force (height range = 200 nm) and (d) calculated contact point image (height range = 450 nm).

The outstanding feature of QI™ is the recording and accessibility of real force curves, measuring a linear movement of the cantilever under constant velocity, which is different from other oscillation based imaging techniques.

True surface imaging of biological samples

Contact point images provide a new, outstanding quality of image that differs considerably from standard contact or dynamic mode images. Especially for extremely soft and inhomogeneous materials, such as living cells, the contact point is the only true height information that doesn't suffer from peak forces or height differences due to variations in the mechanical properties of the sample. Consequently, the contact point reveals the real surface topography, rather than an image of the cytoskeleton as is typical for images measured in contact or dynamic modes. Figure 1 shows the impact of mechanical properties on interaction force based height images. The setpoint height image (c) shows the stress fibers of the cytoskeleton which are obviously stiffer than the surrounding cell material, as it is clearly visible in the Young's modulus image (b). The contact point image (d) shows a different topography, which is not influenced by the stiffness of the different cell components.



NanoWizard® 3 on Zeiss Axio Observer equipped with the Zeiss LSM 700.

Applications

- Live cell imaging
- Drug or gene delivery systems
- Fragile surfaces like capsules or coatings
- Bacteria and viruses
- Polymer brushes, Langmuir-Blodgett films
- Thin films

Conclusion

JPK contact point imaging displays the height at zero force and is completely unaffected by interaction forces and mechanical variations of the sample. This enormous benefit is clearly visible if contact point images of living cells are compared with height images measured in standard AFM modes. The ability to measure real surface topography, independent of mechanical variations, opens completely new possibilities, such as the detection of particles, like quantum dots, on living cells. Contact point images can be calculated from QI™ data, which provide a complete set of force distance curves, pixel by pixel. JPK's QI™ mode facilitates not only the acquisition of zero force images, but also the comparison with various parameters, such as mechanical properties or adhesion forces.

Specifications

- QI™ mode requires NanoWizard® 3
- Available with the JPK QI™-Advanced software
- QI™-Advanced mode is an optional add-on software module for nanoscale material properties and can be easily upgraded
- QI™ works with standard cantilevers
- QI™ is completely compatible with all NanoWizard® 3 options (e.g. BioMAT™) and accessories (e.g. PetriDishHeater™)

Acknowledgement

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