NANONIS APPLICATION NOTE

FAR-FIELD FIBERED INTERFERENCE SCANNING OPTICAL MICROSCOPY (iSOM) - imaging living cells

In the field of biology, the scanning techniques in air or liquid environments are nowadays intensively used. AFM, STM, SNOM are relatively fast imaging methods allowing sub-µ resolution, in contrast with conventional optics allowing for fast and noncontact imaging, but suffering from lack of resolution according to Rayleigh criterion.

We present a complementary method for imaging of biological cells by a fibered high-resolution optical microscope: interferometric Scanning Optical Microscope (iSOM). The principle is based on the interference of the internally reflected light at an optical fiber tip with the light reflected by the surface facing the tip (Figure 1a). The tip-sample distances of the order of a few microns- optical far field, therefore. Surface µ-ranges with roughness can then imaged without any mechanical contact, essential condition for the observation of living cells. Even more, no closed-loop in the z direction, as in AFM or NSOM, is needed. The whole setup is computer controlled using the Nanonis SPM controller.

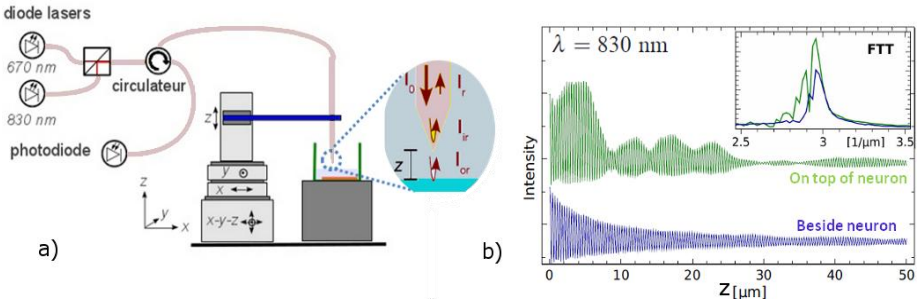

Figure 1. a) iSOM setup. Nanonis electronics is used to control the sensor and the scanning procedure. b) z-spectroscopy above and beside a neuronal soma, FFT inset.

The key part of the iSOM setup is the probe optical fiber tip, essential for the quality of the measurements. We use optimized chemically etched fibers for efficient imaging at relative high distances up to z ~ 50 µm. The achievable resolution is typically ½ wavelength laterally to the fiber and better than 10 nm axially for highly reflective samples. Making use of iSOM topographical information and surface structure of mouse fibroblasts and living hippocampal neurons in liquid environment were obtained (Figure 2).

An important application could be the tracking of living cells for hours, enabling thus information on the mechanics of cells, i.e. mechanical deformation associated with growth or electrical activity of neurons.

J.P. Decombe et al., Living cell imaging by far-field fibered interference scanning optical microscopy, *O*ptics Express **19**, 2702 (2011).

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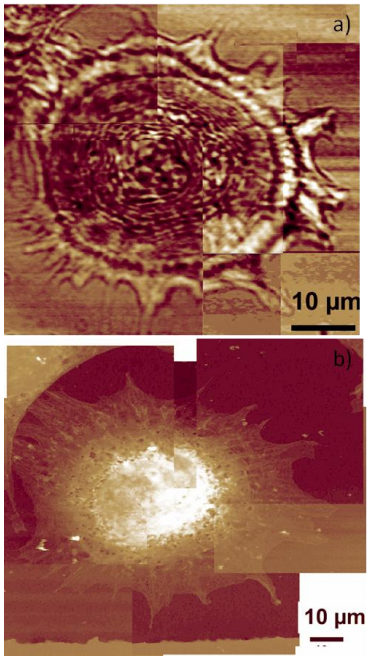

Figure 2. iSOM and AFM images of a fixed fibroblast cell. The iSOM image shows cell topography by contour lines.

System:

- Home-built iSOM - liquid environment

Nanonis Modules in Use:

- Base Package (BP4)
- LabVIEW Programming Interface (PI)
- Integration of the motorized stages
- Photon counter

NANONIS
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