Universität Basel

Swiss Nanoscience Institute

SNI SWISS NANOSCIENCE INSTITUTE
EINE INITIATIVE DER UNIVERSITÄT BASEL UND DES KANTONS AARGAU

Project P1501 Nanomechanical mass and viscosity measurement-platform for cell imaging

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The "Center for cellular Imaging and Nanoanalytics (C-CINA)" offers a highly interdisplinary working environment with close collaborations between physicists, chemist and biologists. We are looking for a highly motivated physicist, nano-scientist or engineer to develop as novel imaging platform based on nano-mechanical vibrating of fully clamped planes. A background in experimental physics and programming, data-processing and finite element simulations take center stage in this project. Interest in biology and/or chemistry is from advantage.

The aim of the project is to develop a novel imaging or microscopy-platform for biological cells. The latter will be performed in close collaboration with biologists studying neurodegenerative diseases. During recent years we developed a real-time nanomechanical sensing platform to measure liquid viscosities and fluid densities based on cantilever technology1-5. The platform uses an optical actuation and read-out system, which is mechanically separated from the nanomechanical transducer and the measurement chamber. Therefore the mechanical resonator can be easily exchanged, e.g., with thin, fully clamped membranes. We postulate, that using such membrane-resonators at different modes of vibration allows calculating the mass and viscosity distribution on the membrane surface.

We will develop an incubation chamber for eukaryotic cell growth for our measurement set-up, the temperature control is already implemented (Figure 1A). The Si3N4 membrane surface will be functionalized for the growth of eukaryotic cells. This is routinely performed at the C-CINA and several adherent cell systems are permanently cultivated, e.g., HEK or neuronal LUHMES cells.

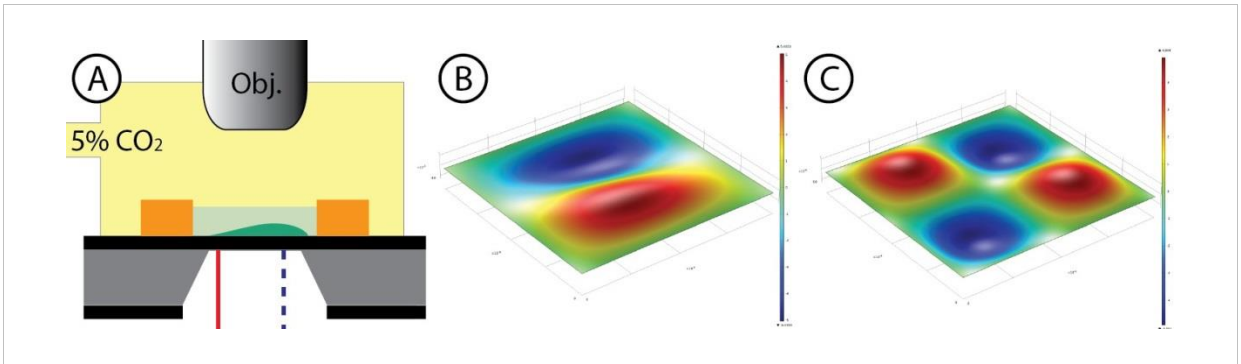

Figure 1 *Mass/viscosity imaging platform for adherent eukaryotic cells.* ***A)*** *Schematic overview of platform: cells (green) are grown on polylysine functionalized silicon nitrite surface in miniaturized polydimethylsiloxane (PDMS) wells (orange) under a controlled atmosphere (5% CO_2,yellow). The cells can be observed from above (Obj.) by fluorescence microscopy (illumination not shown), actuation and response read-out is performed using an optical system.* ***B&C)*** *Finite element simulations of quadratic planes at different vibrational eigenmodes (****B****: mode m,n=1,2;* ***C****: m,n = 2,2).*

References

1. Bircher, B. A., Krenger, R. & Braun, T. Automated high-throughput viscometer using nanomechanical resonators. 1–11 (2015). Submitted.
2. Bircher, B. A. Fluid Characterization by Resonant Nanomechanical Sensing (PhD Thesis). University of Basel 1–194 (2014).
3. Bircher, B. A., Krenger, R. & Braun, T. Influence of squeeze-film damping on higher-mode microcantilever vibrations in liquid. EPJ Techn Instrum 1, 10–13 (2014).
4. Bircher, B. A. et al. Real-time viscosity and mass density sensors requiring microliter sample volume based on nanome-chanical resonators. Anal. Chem. 85, 8676–8683 (2013).
5. Bircher, B. A., Lang, H.-P., Duempelmann, L., Gerber, C. & Braun, T. Photothermal excitation of microcantilevers in liquid: effect of the excitation laser position on temperature and vibrational amplitude. Micro & Nano Letters 8, 770–774 (2013).

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