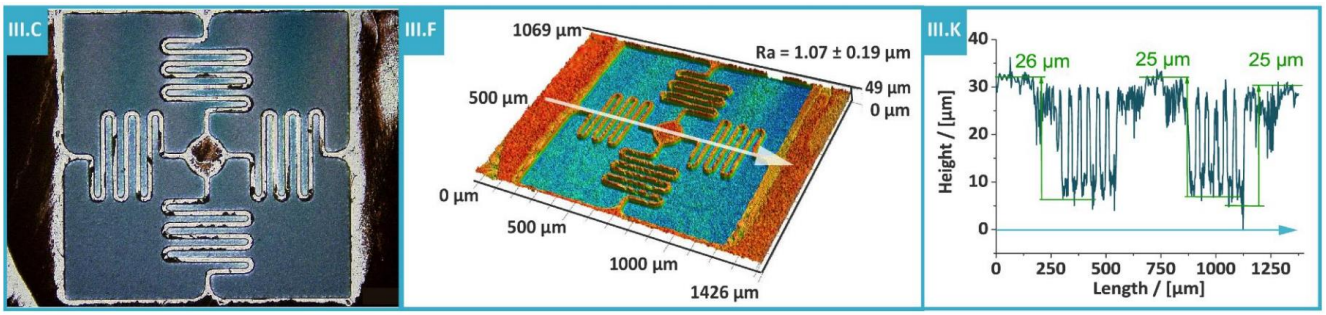
UNIVERSITÄT HEIDELBERG
ZUKUNFT SEIT 1386

# Recording of Pico- to Micro-Newton Traction Forces

## Technology Offer

Ref. No.: 1015-21




## Category

## Keywords

- Bioengineering
- Piconewton Measurement
- Microsensor
- Measurement Device

## Development stage

Prototype

## Seeking

Licensee

## IP status

Patented

## Background

Advances in life sciences, biomedical engineering, and next-generation technologies such as personalized medicine increasingly rely on a deeper understanding of cellular structure–function relationships. This is a central focus of Biomechanics and Mechanobiology, where the mechanical behavior of cells plays a key role in fundamental biological processes.

A major challenge remains the quantitative measurement of cell-generated forces in three dimensions, for example during migration and adhesion. Existing techniques are limited by reduced dimensionality, restricted force range or resolution, qualitative outputs, and high system complexity.

As a result, a comprehensive and reliable method for 3D cell force measurement is still lacking. The technology presented herein addresses this gap by enabling precise, quantitative, and real-time measurement of cellular forces in three dimensions.

## Contact

ScienceValue Heidelberg GmbH
Berliner Straße 47 | 69120 Heidelberg | Germany
+49 (0)6221 - 567435 | www.sciencevalue-heidelberg.de/en
ScienceValue-Heidelberg@med.uni-heidelberg.de

SVH ScienceValue Heidelberg

## Technology

The technology enables a surface-integrated mechano-optical microsensor system which allows for the simultaneous record of pico- to micro-newton traction forces in 3D including a continuous screening of the sensor element condition during the measurement.

The displacement of a sensor element with a well-defined structure is directly correlated to a distinct force by determining the element spring constant for each spatial direction. The microsensor allows the measurement of 3D forces for adhesive specimens and living systems, such as cells and bacteria, providing a powerful tool to understand the structure-function on relationship in processes connected to cell migration, adhesion and signalling.

The microsensor finds applications in the field of biomechanics of natural materials, artificial skin, wound healing, humanoid robotics, high-tech prosthetics, personalized medicine and generally in any fields where mechanobiology is the basis for pursuing biophysical and bioengineering understanding.

## Benefits

- Measurement of 3D forces for adhesive and living systems
- Measurement in the scale of pico- to micronewton traction forces
- Recording of quantitative measurement results

## Applications

- Atomic, and nano scale surface analysis
- Nanomaterials and thin-film characterization
- Precision positioning and metrology

## Publications

- Prototyping of a Surface-integrated Mechani-optical Microsensor System for 3D Traction Force Measurements by DHM/DIC; Hendrikje M. Neumann; 2019

- Patent WO2021043366 / US11835405B2 / EP4025918B1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