OPTICS11 life

PIUMA

NANOINDENTER

Explore mechanics of 3D tissue models.


OPTICS11 life

ABOUT OPTICS 11 LIFE

Optics11 was founded in 2011 as a university spin-off. The first product was built in 2012: an extremely sensitive and easy to use measurement device for mechanical characterization of soft materials. The company now has two business units: Optics11 develops integrated fiber-optics based sensors for industrial applications while Optics11 Life focuses on Life Science applications.

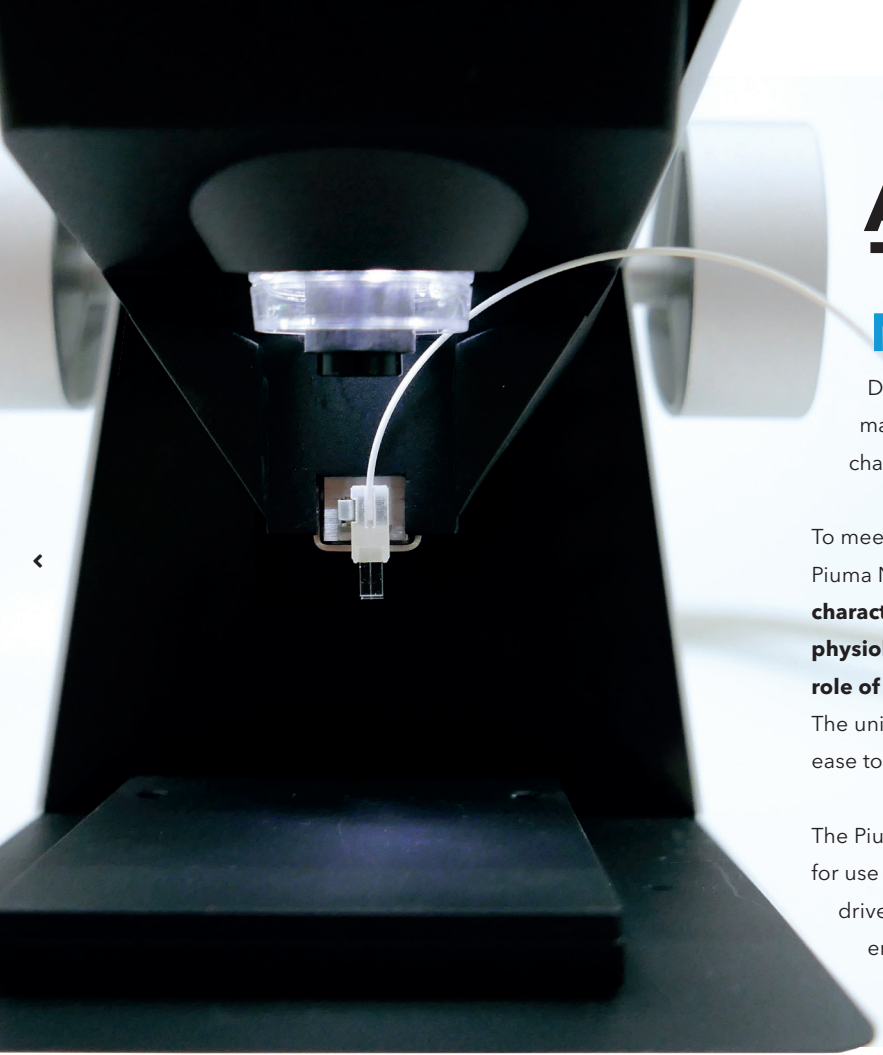
Currently, Optics11 Life offers a range of Nanoindentation instruments used for various applications, from routine hydrogel testing and single-cell mechanobiology experiments to high-throughput mechanical screening of 3D tissue models.

Go the the website

PATENTED **FIBER OPTICS TECHNOLOGY**

USED IN **22 COUNTRIES** AND **5 CONTINENTS**

- Amsterdam, The Netherlands
- Boston, US



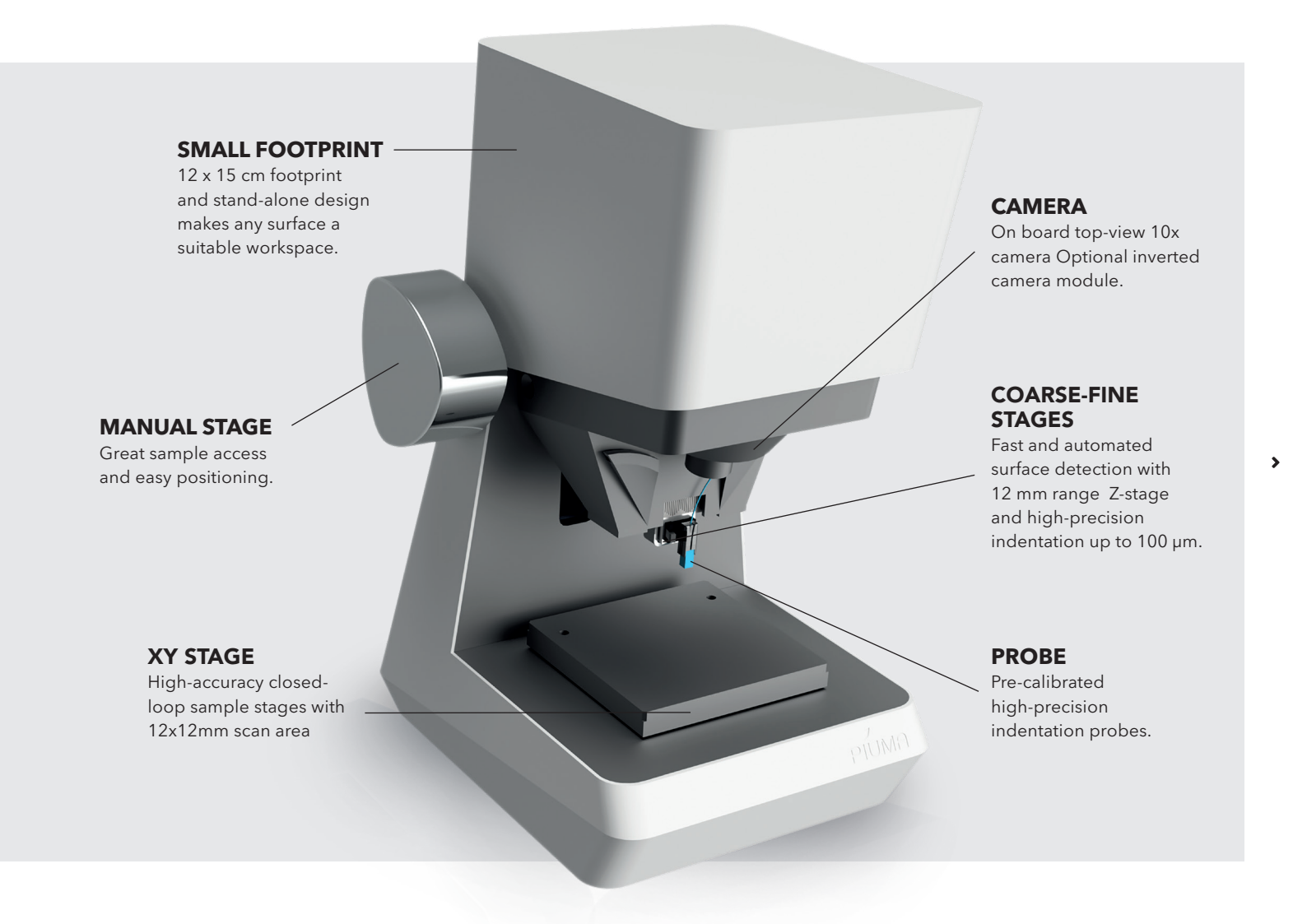
ABOUT THE PIUMA NANOINDENTER

Do you want to investigate the mechanics of soft complex materials? Do you work with biological materials that are challenging to characterize?

To meet this challenge Optics11 Life introduces the Piuma Nanoindenter instrument. The Piuma is designed to **characterize materials from micro to macro scales in physiological conditions**, providing true insights in the **role of mechanics in biology and biomaterial science**. The unique force sensor and user-orientated design enables ease to use, fast and flexible operation.

The Piuma is designed as a small but powerful stand-alone device for use in any lab. You can now start to explore the structure driven mechanical design and function of biological and engineered samples in your own lab!

Small but powerful tool for characterization


SMALL FOOTPRINT
12 x 15 cm footprint and stand-alone design makes any surface a suitable workspace.
CAMERA
On board top-view 10x camera Optional inverted camera module.
MANUAL STAGE
Great sample access and easy positioning.
COARSE-FINE STAGES
Fast and automated surface detection with 12 mm range Z-stage and high-precision indentation up to 100 µm.
XY STAGE
High-accuracy closed-loop sample stages with 12x12mm scan area
PROBE
Pre-calibrated high-precision indentation probes.

TECHNOLOGY

MULTI-SCALE MECHANICS

The Optics11 Life Piuma Nanoindenter is purposely-built to explore soft and stiff materials (5Pa-1GPa) from cell-length scales (micro) up to tissue scales (macro), providing true insights into the mechanics of natural and engineered biomaterials.

UNIQUE PATENTED TECHNOLOGY

The unique fiber-optical interferometric MEMS technology developed by Optics11 Life makes it possible to measure even the softest materials with high force resolution in a non-destructive way, also while immersed in liquids or in air. The design of the probes combined with novel sensing technology also enables measurements of heterogeneous and irregularly-shaped samples inside 96 wellplates or custom chambers, giving flexibility to your experimental protocol.

NANOINDENTATION

Piuma Nanoindenter uses the **sensor to gently push a spherical glass tip on the surface of the sample similar to AFM**. By closely monitoring the resulting sample deformation, the Piuma Nanoindenter can rapidly provide mechanical information of the indented spot. Indentation profiles are fully customizable to provide high-precision in terms of maximum load, indentation depth, and deformation rate. Beyond classical static indentations, Piuma can perform dynamic mechanical analysis (DMA) for viscoelastic characterization of biomaterials similar to rheometry.

EASY TO USE

All Optics11 Life probes are **pre-calibrated making them plug-and-play design that** streamlines experiments. This ensures fast measurements which are critical for time-sensitive biology-related experiments.

INSTRUMENT FEATURES

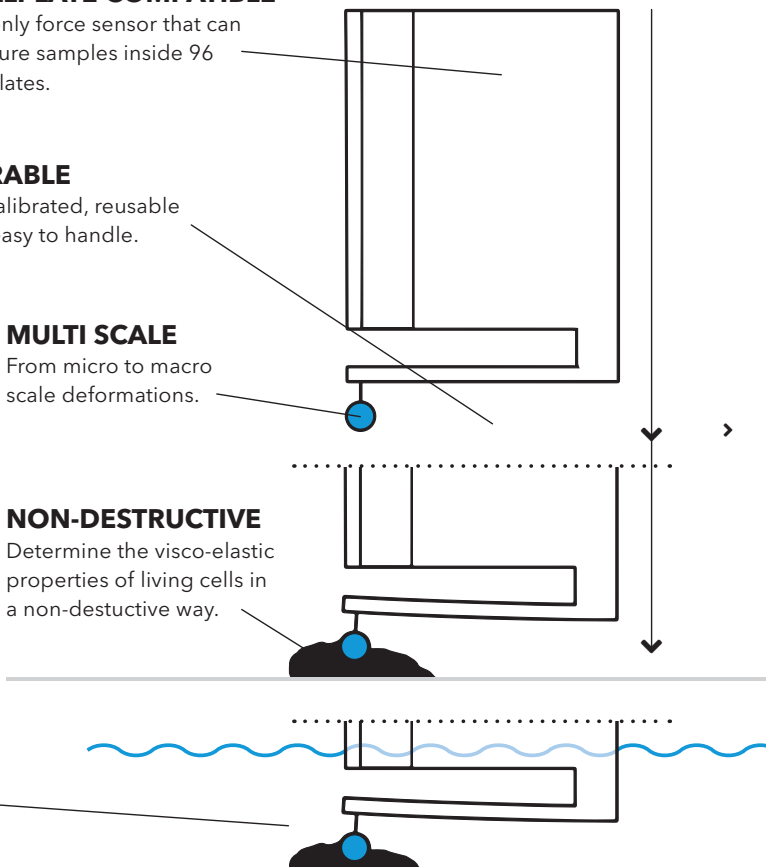
- Easy to learn and master.
- High-precision long-range XYZ stages for both small features and large samples.
- High-precision long-range piezo for both surface and bulk deformations.
- Customizable indentation profiles.
- Micro-DMA for viscoelasticity.
- Adhesion mode for sticky samples.
- Mechanical maps and topography.
- Automatized experimental procedures.

WELLPLATE COMPATIBLE
The only force sensor that can measure samples inside 96 wellplates.

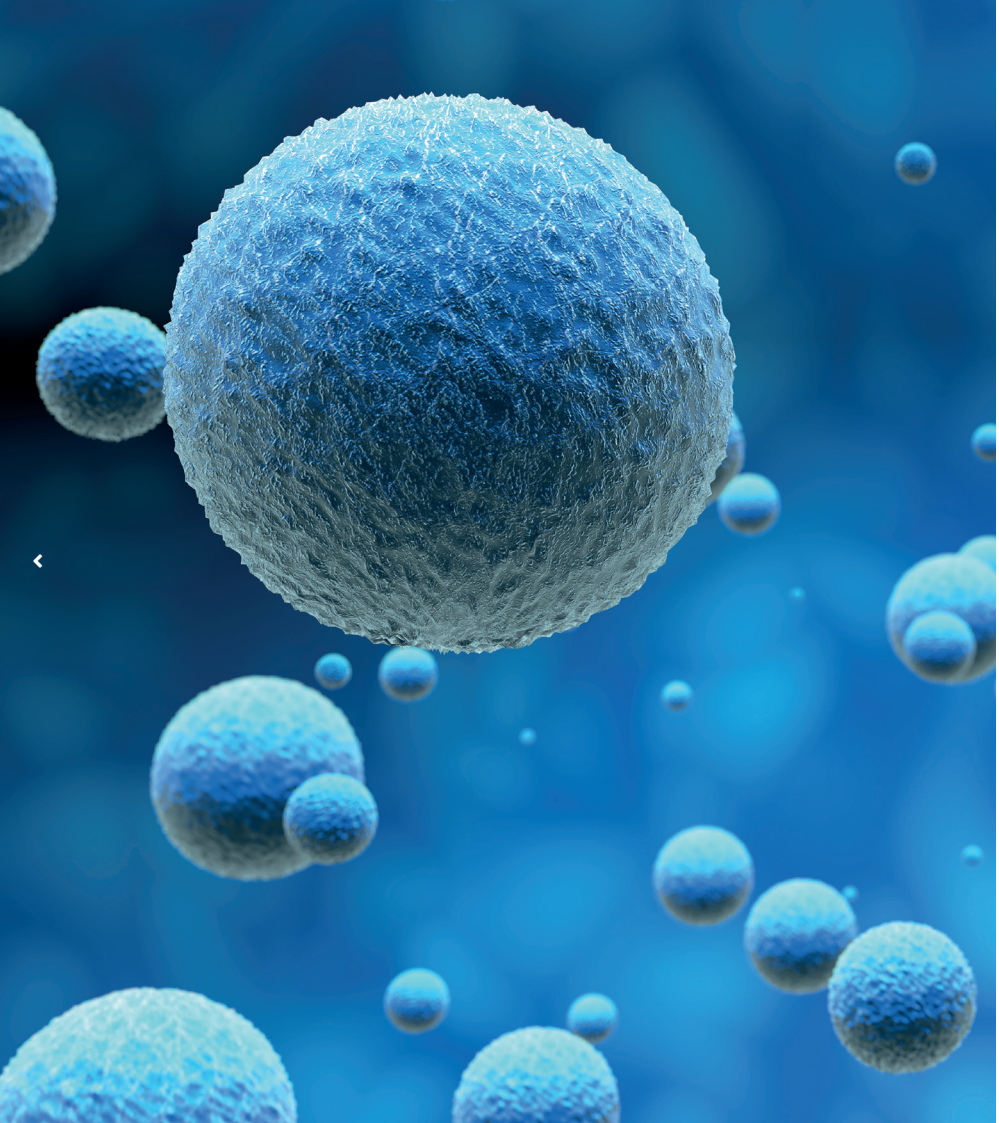
DURABLE
Pre-calibrated, reusable and easy to handle.

MULTI SCALE
From micro to macro scale deformations.

NON-DESTRUCTIVE
Determine the visco-elastic properties of living cells in a non-destuctive way.



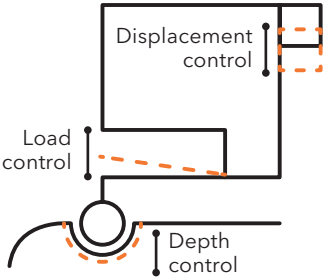
IMMERSED IN LIQUIDS
Measurements can be performed while the sample is immersed in liquids and in other complex environements.



CONTROL MODES

1 Operate

Combine any mode of operation



RHEOLOGY (DMA)

2 Indent

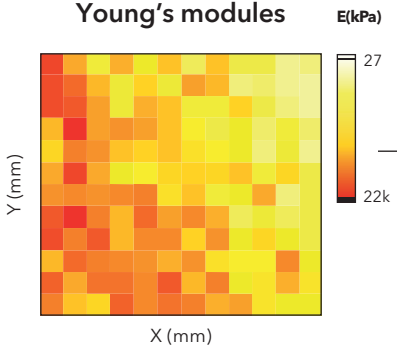
With any identation profile

Quasi-static profile

Dynamic oscillatory profile

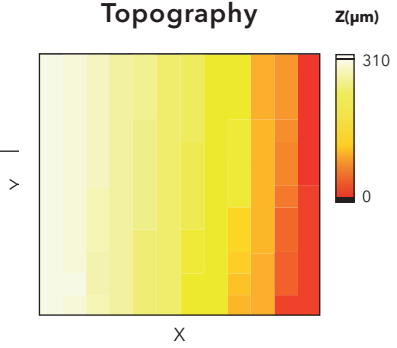
MAPPING

Young's modules



TOPOGRAPHY

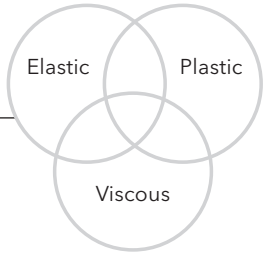
Topography

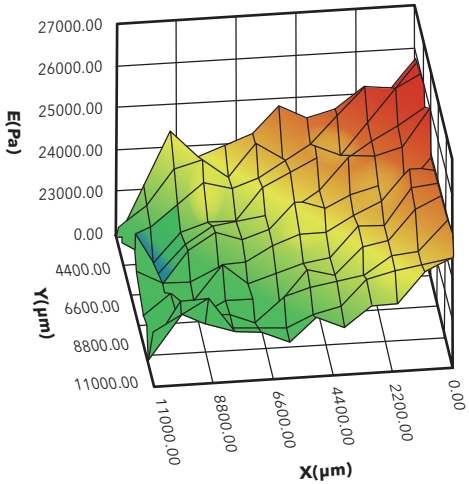


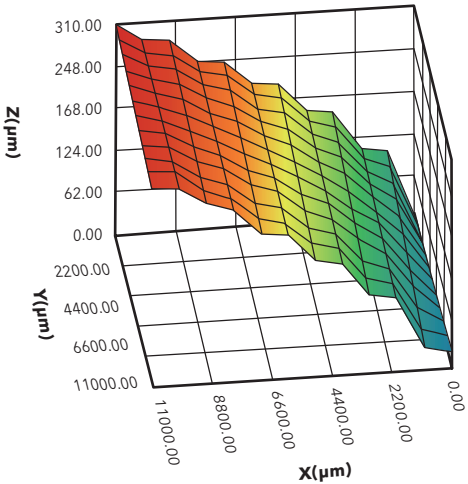
MECHANICAL BEHAVIOR

3 Data analysis

Measure the mechanical properties



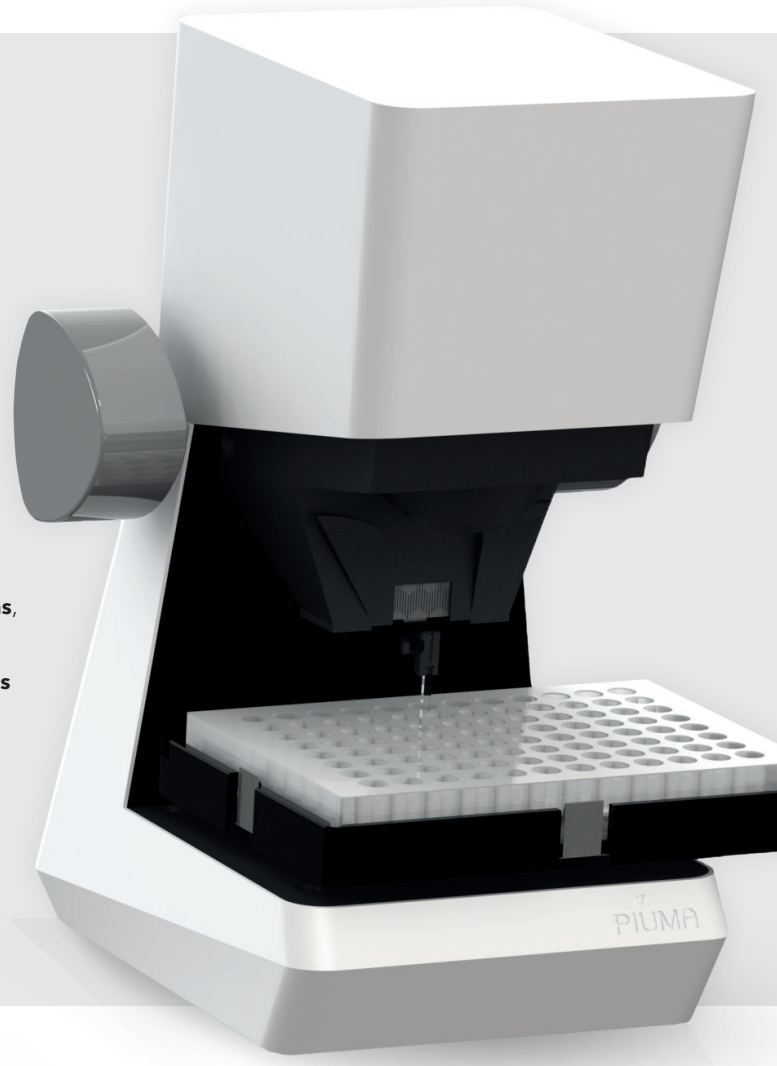




APPLICATIONS

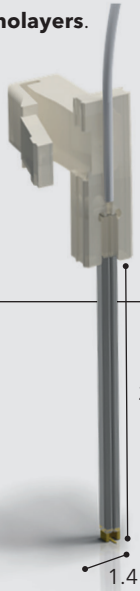
3D tissue models are revolutionizing diagnostics, drug development, and regenerative medicine. Mechanics have the potential to serve as a label-free biomarker for the assessment of the structure and function of 3D cell cultures. Piuma has been proven to be a powerful tool for mechanical characterization of various biomaterials from cell monolayers and spheroids to large tissues and scaffolds. Some key applications are:

- **Monitoring of hydrogel and other scaffold formulations**, **preparation protocols**, and **degradation**.
- **Mechanical screening of cell monolayers and spheroids** for phenotyping, diagnostics, or drug screening.
- **Development of disease microenvironments** for cell cultures.
- **Healthy and pathological tissue characterization and correlation** with tissue architecture and disease state.



MEASURE MECHANICAL PROPERTIES OF BIOMATERIALS

- Force-sensing in **cells, tissues and monolayers**.
- Force-sensing **during swelling, migration and growth**.
- Adhesion **force spectroscopy**.
- **Cell-material** interactions.
- **Force-induced** mechanotransduction processes.



TECHNICAL SPECIFICATIONS

Probes

Young's modulus*	5 Pa – 1 GPa
Stiffness range	0.02 – 200 N/m
Tip radius (spherical)	3 – 250 µm
Force range*	200 pN – 4 mN
Cantilever bending range	up to 30 µm
Noise level	5nm RMS
Probe material	Glass and silicon nitride
Cleaning	Isopropanol, Helizyme, Trypsin
Calibration	Pre-calibrated

System capabilities

Indenter dimensions (WxLxH)	120x150x280 mm
Indentation stroke	90 +/- 5 µm @0.5 nm resolution
X-Y stage range	12x12 mm @ 80 nm resolution
Z stage range	12 mm @ 80 nm resolution
Minimum lateral pitch	0.2 µm
Output signal bandwidth	20 kHz

Software

Operation	Programmable for automation
Data analysis	DataViewer software Young's modulus E (Hertz, Oliver-Pharr, JKR) Storage and Loss moduli (E', E''), tan(δ)
Raw data format	.txt
Data acquisition rate	1 Hz – 16 kHz

Indentation capabilities

Modes of operation	Displacement, load, indentation
Types of indentation	Quasi-static, step-response (creep/stress-relaxation), dynamic/oscillatory (DMA)
Indentation profiles	Customizable
DMA frequency range*	0.01 – 20 Hz
Maximum displacement speed	100 µm/s
Indentation depth*	0.01 – 100 µm
Contact size diameter*	1 – 500 µm

Options

Dynamic module	Add load/indentation control and DMA modes
Mounting	Tabletop

Maintenance

Software	Regular updates
Training	New user onsite/remote training, online course, advanced training
System	Maintenance visits and upgrade options

* These specifications depends on combination of parameters: probe and sample stiffness, set indentation depth or load, tip radius and environmental noise.

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