OPTICS11 LIFE PAVONE

Mechanical properties of biological tissues and cells are important parameters that influence their healthy functioning and play an important role in diseases. In cell cultures, mechanical microenvironment, such as substrate stiffness or external forces, has been shown to influence cell morphology, biochemical signaling, and differentiation. In tissue engineering, the stiffness of tissue constructs will change during maturation and degradation, and essentially, should mimic the biomechanical behavior of native tissues.

Furthermore, mechanics have the potential to be a label-free biomarker for diagnostic, drug development, biofabrication, and quality control applications where automation of mechanical testing is required. Thereby, Optics11 Life developed the first high-throughput mechanical screening platform. The Pavone combines state-of-the-art fiber-optics force-sensing technology with integrated imaging and precision mechatronics to provide one solution for any mechanical analysis challenge.

With a capacity of up to two well plates, automated experimental procedures can be performed including synchronized imaging with indentation, mapping of mechanical properties of heterogeneous samples, and dynamic mechanical analysis for viscoelastic characterization.

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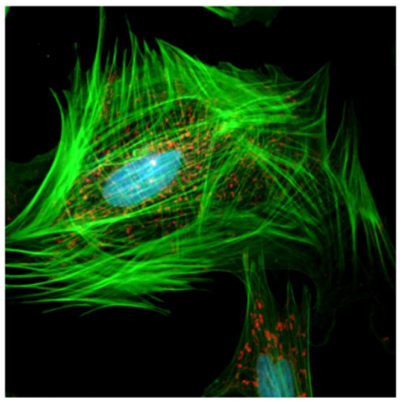
Applications

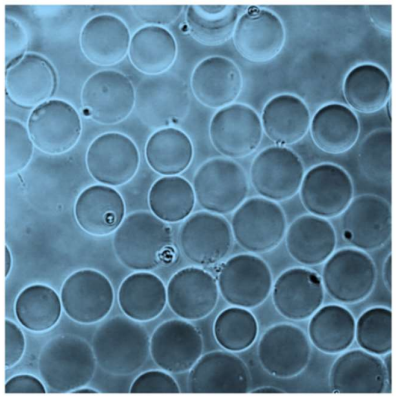
- Biofabrication: development of mechanically relevant biomaterials, their validation and quality assurance of processes e.g. bioprinting.
- Tissue engineering: quantify engineered tissue mechanics over time (degradation, ECM production).
- Single-cell mechanical screening: studying mechanical phenotypes of cells and their responses to drugs.
- Tissue and cell pathology: clarify the role of mechanics in diseases such as cancer or fibrosis.
- Tissue or cell physiology: capture structure-stiffness relationship.
- Biophysics: unravel mechanosensing phenomena at cell and tissue levels.
- Characterization of other types of materials: biofilms, cultured meat, plants.

Key features

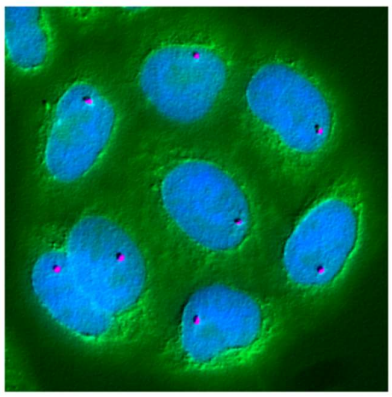
- Small footprint benchtop instrument (68 x 60 CM)
- Compatible with various petri dishes and well plates (up to 384 wells)
- Pre-calibrated re-usable indentation probes
- Fully customizable indentation profile and experimental sequence
- Click-and-go interface for fast positioning
- Interchangeable objective and filter cubes
- Bright-field and phase-contrast microscopy (optional fluorescence*)
- Temperature control (optional CO2 and humidity control*)



Single cells



Hydrogels



Tissues

*On the product roadmap. Get in contact for more information.

Technical specifications

Imaging capabilities	
Objective	Up to 40x, interchangeable (manual)
Focus	Motorized Z-travel 17mm @ 5nm resolution
Compatibility	Bright-field and phase-contrast with digital switch
	LED light source (standard)
	Fluorescence (optional)*
CMOS camera	40 frames/s, monochrome
Indentation capabilities	
Probe force range	200 pN – 2 mN
Elastic modulus range	10 Pa – 1 GPa
Indentation stroke	Up to 100 µm@0.5 nm resolution
Tip size and geometry	3 µm – 250 µm, spherical
Contact size diameter	1 µm – 100 µm
Coarse X-Y stage travel	120 x 190 mm@50nm resolution (2 well plates)
Coarse Z stage travel	25 mm @ 2.5 nm resolution
Compatible formats	All common dishes/plates (up to 384 wells)
Minimum sample volume	>0.4 µL for 96-well plate (thickness 3 µm)
Indentation speed	Automated change between wells
	Automated mapping
	~2.5 hr per 96-well plate (~960 static indentations)
Single indentations	Click-and-go interface
	Coordinate list indentation (semi-automatic)
Modes of interrogation	Quasi-static indentation (E, G)
	Step-response (Creep / Stress-Relaxation)
	Dynamic/oscillatory (DMA: E', E'', G', G'')
	Adhesion mode
Frequency range	0.01 – 20 Hz
Control modes	Load/depth/piezo-displacement
Test environments	Air or liquid (water, culture medium)
Environmental control	
Temperature control	Stage frame heating with 4 sensors (0.1 ^{o}C accuracy)
	Range: ambient from RT to 50 ^{o}C $^{+}/_{-}$ 0.5 ^{o}C
	~15 min recovery time to 37 ^{o}C after opening
	~5 min stabilization time for 1 ^{o}C increments
	0.5 ^{o}C uniformity at 37 ^{o}

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