hydrogel & biomaterial

Exploring mechanical forces with automated AFM-based nanomechanical measurements to reveal powerful insights

Hydrogel & biomaterial applications

Tissue engineering & regenerative medicine.
Pharmaceuticals & drug delivery.
Wound healing.
Microfluidics
Soft robotics & biosensors
Cosmetics & ophthalmology

The challenges of today

Characterization Technique

Absence of standardized nanomechanical testing.

Limited availability of high-throughput mechanical testing.

Material

Intrinsic viscoelasticity and poroelasticity of hydrogels.

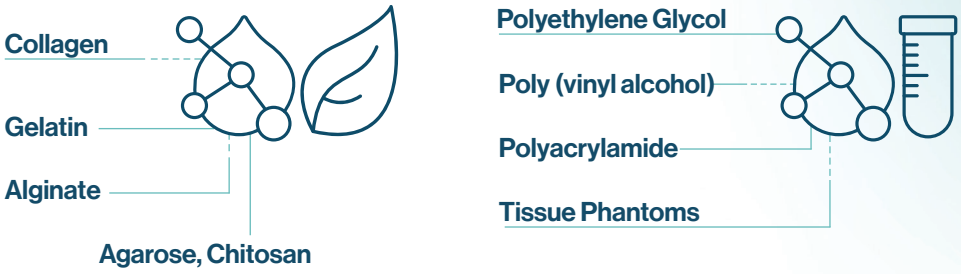
Structural heterogeneity at microscale dimensions.

Insufficient long-term stabilitys.

straightforward **workflow** of Artidis® nanomechanical phenotyping platform

artidis

Hydrogel & Biomaterial assays



Nanoscale Characterization of Tunable-Stiffness Hydrogels for Advanced Biomaterial Design

Background

Polyacrylamide (PAAm) hydrogels areextensively applied in biomedicine,including tissue-mimicking phantoms for ultrasound and surgical training, scaffolds for cartilage repair, and 3D cell culture substrates that replicate physiological stiffness to regulate stem cell differentiation and mechanotransduction. Despite their visco-elastic instrinic properties, they are typically characterized by elastic modulus as a single parameter. The comprehensive characterization of such materials is critical for their biomedical and tissue engineering applications.

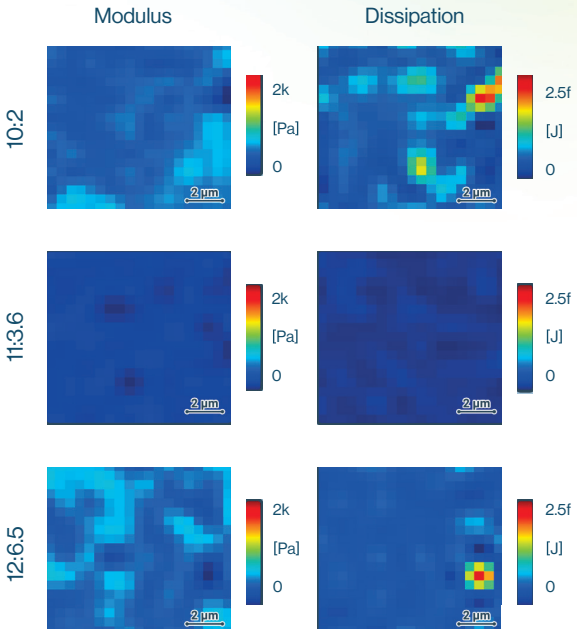
Artidis solution

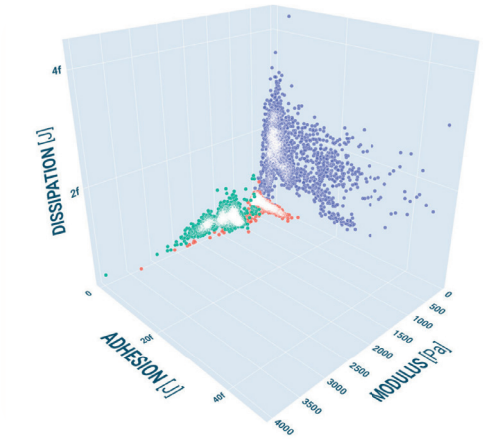
Artidis nanomechanical phenotyping platform is a multi-modal nanomechanical testing instrument designed for the automated and standardized characterization of soft materials in a liquid environment. Different mechanical properties, such as elasticity, viscoelasticity, and adhesion of the sample, are determined from the same data acquisition in a high- throughput manner (> 10000 data points per sample). In this example, the Artidis platform was used to characterize the elasticity (modulus [Pa]), viscoelasticity (dissipation [fJ]) and adhesion [fJ] of PAAm hydrogels with different ratios of monomer (Acrylamide; AA) and crosslinker (N, N'-methylenebisacrylamide; bAA) in PBS buffer.

Results and discussion

With the ARTIDIS platform, very soft Polyacrylamide hydrogels (modulus down to 70 Pa) have been measured in a liquid environment. Additionally, viscoelastic and adhesion properties were calculated from the same dataset, and softer hydrogels (lower modulus) exhibit higher viscoelastic and adhesion properties. With a high number of data acquisitions on different locations of the sample, the homogeneity of the hydrogel surfaces can be examined. This multiparametric characterization empowers researchers to fully understand the hydrogels and accelerates innovation in biomedical and tissue engineering applications.

PAAm Hydrogel Samples
with different ratios of AA:bAA





3D Scatterplot of dissipation versus reduced modulus and adhesion
showing the relationship between viscoelasticity and adhesion with the elasticity