Biolin Scientific
[Progress Together]

Attension | 3D Topography Module

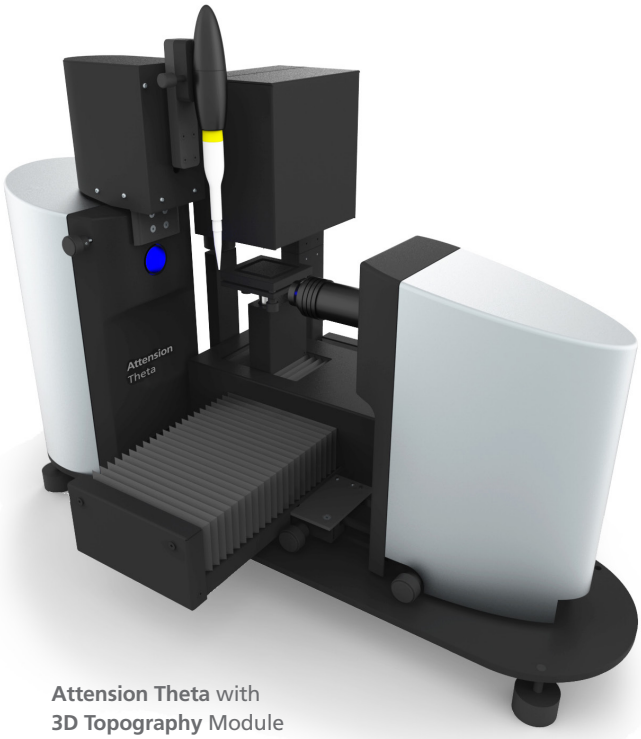
Evaluate the influence of roughness on wetting

The Attension 3D Topography Module combined with Attension Theta optical tensiometer is the first product which makes it possible to combine 3D surface roughness measurements in conjunction with contact angle measurements and to perform those measurements on the same exact sample location.

- OneAttension software automatically calculates roughness corrected contact angle and surface free energy
- The fully automatic measurement takes only a few seconds and can be run and analyzed without a specialist
- Separates the impact of surface chemistry and roughness of various coating formulations and surface modifications

Optimize wetting and adhesion

Many surface modification and coating technologies that are used for optimizing wetting and adhesion properties influence both surface chemistry and roughness. Understanding the mechanisms that impact wetting by separating these two factors can be a useful tool in product development processes and in quality control. Roughness correction on contact angles also enables the calculation of fundamental surface free energy on rough surfaces.



Attension Theta with
3D Topography Module

Application examples

Biocompatibility of implants

Various materials such as metals, ceramics, and polymers, are being utilized as implants in the medical field. The surface of the implant is typically modified through mechanical roughening and chemical treatment to enhance biocompatibility with the surrounding host tissue. Separating the impact of chemical and mechanical treatment on water contact value can be very useful in implant development and quality control. See more details in application note 17 at biolinscientific.com/attension/applications.

Paper and board coatings

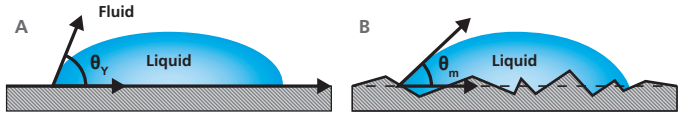
Optimized wetting and adhesion of paper surfaces play a crucial role in ensuring quality and runnability in various converting and finishing operations such as printing and packaging. Base paper can be coated for example with pigment coatings to provide a smooth surface for printing purposes or by wax coating to ensure a barrier against odor and gas transmission in packaging applications. Paper surfaces typically obtain microscale roughness that has an influence on wetting and adhesion in addition to applied coating chemistry. Thus, understanding the impact of roughness on wetting may ease the coating formulation and the optimization of surface treatment processes as well as give a better understanding of the root cause of quality issues.

Construction and building materials

Coating and surface finishing of construction and building materials are important for enhanced appearance and durability of the materials. Adhesion of different types of coatings, such as paint or veneer sheeting depends on the surface. Both surface topography and surface chemistry are known to have an effect on adhesion and wettability. The Theta optical tensiometer can be used for evaluating surface processing quality and its influence on wetting ability. See more details in application note 16 focusing on wood plastic composites at biolinscientific.com/attension/applications.

Technology

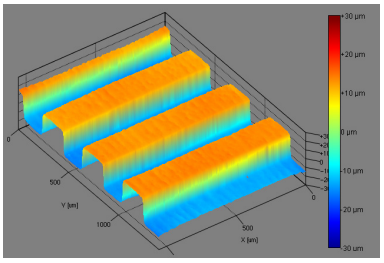
Wettability is typically studied by a contact angle measurement that can be defined with the Young equation on ideal surfaces. Surface free energy theories are also based on assumptions that Young contact angles are used for calculations. Thus, the surface is assumed to be chemically homogenous and topographically smooth. This is, however, not true in the case of real surfaces. It is well established that surface roughness enhances the existing wetting behavior and influence on adhesion. The 3D Topography Module combined with Attension Theta optical tensiometer makes it possible to define Young contact angle and surface free energy measurements as well as measurements for rough surfaces according to the Wenzel theory. See more details in thechnology note 7 at biolinscientific.com/attension/applications.



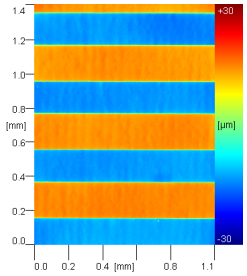
(A) Contact angle on an ideal surface, called Young contact angle.
(B) Apparent or measured contact angle on a real surface.

The 3D Topography Module is a high-resolution 3D shape acquisition system using structured lighting technique called fringe projection phase-shifting. The phase-shifted fringe illumination patterns are sequentially projected onto the studied surface. A digital camera captures the fringe patterns from which the 3D shape of the object is reconstructed by phase-shift coding. The 2D and 3D roughness parameters are calculated from the 3D shape of the object.

3D visualization



2D visualization



Specifications

Hardware

Dimensions: 17 cm x 16.5 cm x 11.5 cm

Weight: 2.6 kg

Power supply: 100 - 240 V AC

Frequency: 50 - 60 Hz

System requirements

Computer requirements: 2 GHz processor, 2 GB RAM, 40 GB hard disk drive (20 GB free), 1024 x 768 resolution, 2 USB port, 1 Firewire port or 1 PCI slot

Antivibration or stone table recommended

Motorized XYZ sample stage required

Other specifications

Method name: Fringe projection phase-shifting

XY pixel size: 1.1 µm x 1.1 µm

Measured range in Z direction: 1 µm – 60 µm

Lateral sampling: 1.41 mm x 1.06 mm (XY).
(Stitching option up to 4.2 mm x 4.2 mm)

Working distance: 18 mm

Maximum sample size on sample stage:
Unlimited x 180 mm x 22 mm (L x W x H)

Imaging options:
Optical image, 2D roughness map, 3D roughness map

Measurement duration per one measurement:
5-30 s (1280 x 960 measurement points)

Analysis parameters (ISO 4287, ISO 4288):
- r (for Wenzel equation)
- θc, roughness corrected contact angle/Wenzel contact angle
- Sdr (%), Sa (um), Sq (um)
- Horizontal, vertical and from chosen 2D line segment Ra, Rq, Rp, Rv, Rz, R10z

Waviness filtering: Gaussian high pass filter (ISO 11562)

Sample requirements/limitations:
Diffuse reflecting surface required

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