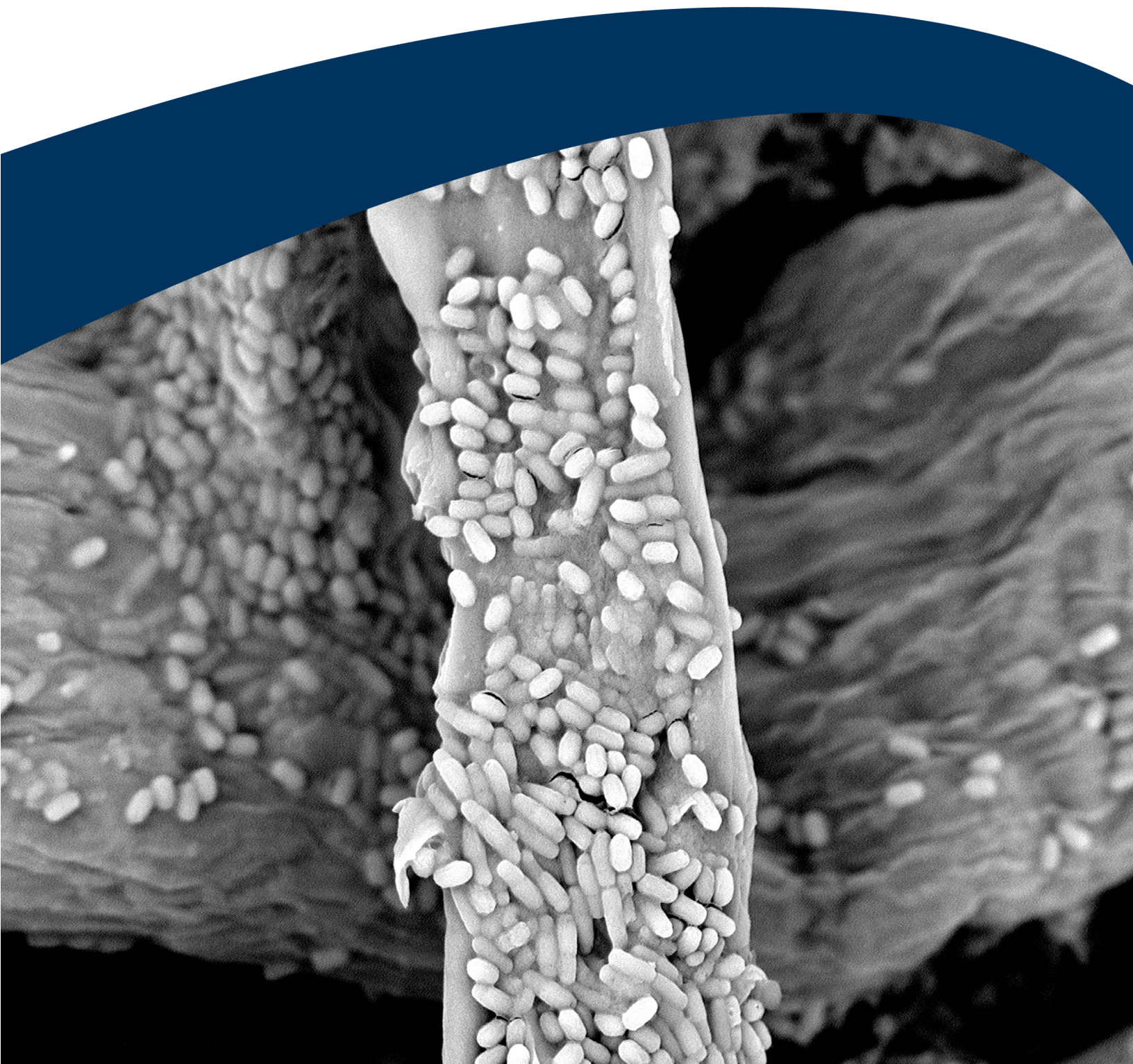


# SOLUTIONS FOR BIOMATERIAL RESEARCH

*from Nanoscience Instruments*



The development of safe and effective biomaterials has become a critical area of study as modern medicine advances towards fully personalized healthcare. Researchers are constantly striving to improve the efficacy and biocompatibility of biomaterials.

Nanoscience Instruments and our sister company, Nanoscience Analytical, offer several solutions to aid in the development and evaluation of electrospun biomaterials:

- Automated SEM analysis and characterization of biomaterials
- Analyze cleanliness and wettability of surfaces to investigate biocompatibility
- Fabricate tissue scaffolds, coat medical implants, and optimize encapsulated drug delivery
- Real-time monitoring of surface interactions and biomolecular processes in situ
- Contract R&D, process development, and analytical services

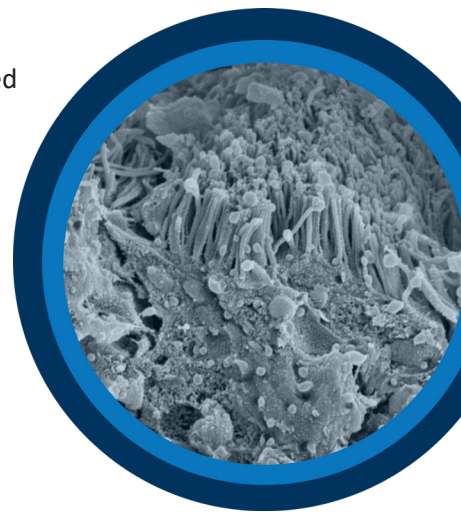
## HIGH RESOLUTION IMAGING OF DELICATE SAMPLES WITH A FIELD-EMISSION DESKTOP SEM

### PHENOM PHAROS G2

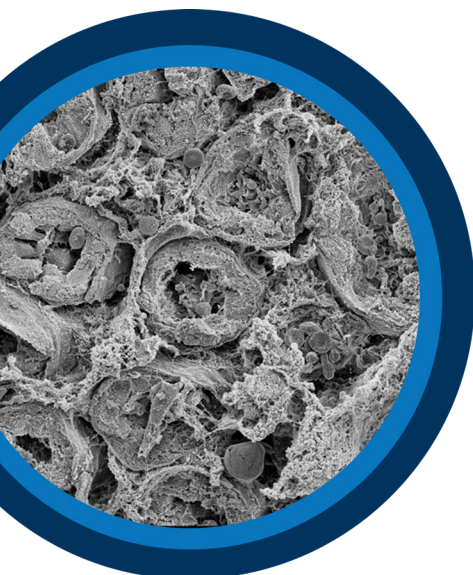
The Phenom Pharos is the only field emission source desktop SEM (scanning electron microscope). Operating on a broad range of acceleration voltages, it eliminates the need for coating and ensures biological and polymer samples remain undamaged.

- Low kV suits imaging of soft biomaterials
- 1 kV to 20kV operating voltage range
- < 2.0 nanometer resolution
- Backscattered electron, secondary electron, and energy dispersive spectroscopy detectors
- Auto-script sample tests to acquire results faster and reduce image variation

SEM image of lung tissue at 30000x magnification

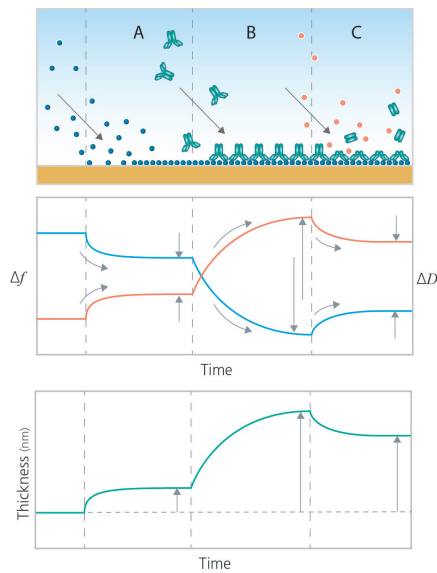


SEM image of lung tissue at 2000x magnification



# EVALUATING BIOCOMPATIBILITY OF IMPLANTS AND SURFACE INTERACTIONS BY QCM-D

At its most fundamental level, quartz crystal microbalance with dissipation (QCM-D) is an acoustic biosensor capable of measuring changes in mass at the nanogram level. Its scope of applicability in biomaterials is extensive, enabling real-time monitoring of biomolecular interactions and characterization of biomembranes. Sensors are customizable with different materials and can be adjusted to fit specific research demands, meaning that scientists can tailor the instrument to emulate real conditions. Scientists employing QCM-D can delve into protein adsorption, cell attachment, and the myriad of coatings applied on implants for evaluating and refining the composition of viable biomaterials.



Illustrative diagram of molecular adsorption, binding, and enzymatic processes with frequency and dissipation data yielded by QCM-D.



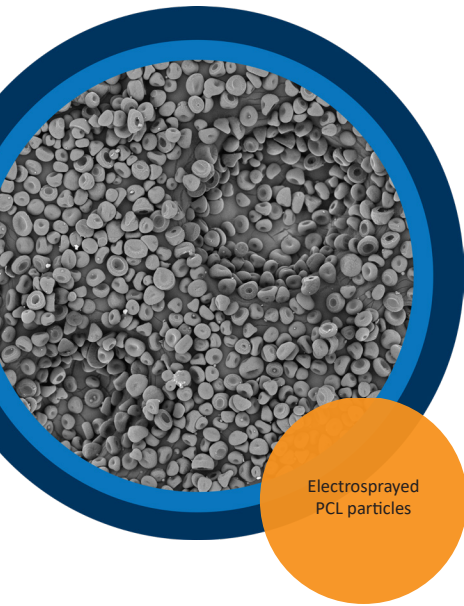
## QSENSE QCM-D

QSense microbalances scrutinize the ways in which biomolecules interact with biomaterial surfaces and open many analytical possibilities for evaluating molecule-surface interactions, biosensors, implants, and drug-delivery vessels.



- Real-time monitoring of mass and viscoelastic properties
- QSoft data-acquisition software captures up to the 13th harmonic for more accurate results
- Modules for light microscopy and ellipsometry applications
- Time-resolved interaction kinetics data with 5 ms resolution

# FABRICATING NANOFIBERS AND NANOPARTICLES FOR BIOMEDICAL APPLICATIONS



Electrospayed  
PCL particles

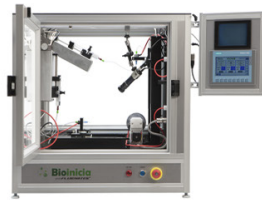
Electrospinning is a voltage-driven process governed by the electrohydrodynamic phenomena to generate fibers (20 nm to 10  $\mu\text{m}$ ). Though applicable in a range of disciplines, electrospinning finds frequent employment in the restoration and substitution of deteriorating tissues.

Mimicking the extracellular matrix environment requires the ability to tune fiber diameter, surface morphology, pore size, porosity, among others. The electrospinning technique allows users to tightly control and tune these parameters while achieving batch-to-batch consistency and reproducibility to mimic targeted tissue scaffolds. Tendons, heart valves, and vascular tissue constitute a set of commonly researched tissues where electrospinners yield successful structures. Typical materials for generating these grafting samples include the use of natural polymers like collagen and gelatin, synthetic polymers like polycaprolactone and polyethylene terephthalate, additives like vascular growth factors and even ceramics or metals based on application needs.

If the concentration of the polymer solution used in electrospinning is below a certain threshold, the instrument produces micro / nanoparticles instead of fibers, and the technique becomes what's called electrospaying. Electrospayed particles are viable in a number of expanding research fields like implant coatings, drug deliveries, biomedical imaging, and microencapsulated cell carriers.

## FLUIDNATEK LE-50

The Fluidnatek LE-50 is the ideal benchtop instrument for advanced R&D for the development of new biomaterials and formulations. This unit boasts impressive features for its size, including optional environmental control unit to allow sample reproducibility, dual sample processing with independent voltages to generate two types of materials simultaneously, and automated needle motion in X & Y directions for ease of solution optimization.



LE-50



LE-100



LE-500

**ADVANCED RESEARCH**

**PRODUCT DEVELOPMENT**

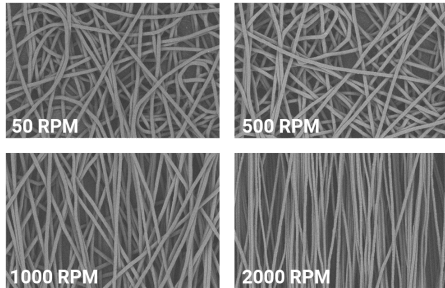
**PILOT**

## FLUIDNATEK LE-100

The Fluidnatek LE-100 is the equipment of choice for cGMP production of high-value particles, stent coating, artificial blood vessels and 3D-shaped electrospun fiber samples relevant to the biomedical and pharmaceutical industries. The design of this system and its size makes it suitable for a vast range of applications where experimental flexibility, tighter process control, and larger sample size are important. With over 21 accessories able to be implemented at any time, including measuring sample thickness in real time, this unit is ideal for advanced development projects, beta-release, and other pre-market introduction activities.

## Temperature and Relative Humidity Control

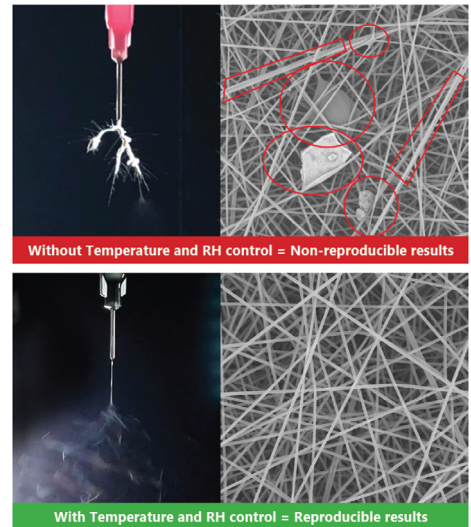
Fluidnatek's exclusive environmental control unit enables full temperature (T, 18-45°C), relative humidity (RH, 10-80%) and air flow control (50-180 m<sup>3</sup>/h) during fiber/particle deposition, which ensures a defect-free and uniform microstructure for the final product. This air is filtered through a HEPA filter to maintain clean conditions during manufacturing. By tightly controlling T and RH, the rate of solvent evaporation is properly managed and optimized to have a stable product development and allow to spin easily clogging solutions all year round.



## Electrospun Fiber Orientation for Tissue Engineering

Electrospun fibers exhibit a proportional relationship between their degree of alignment and the collector's angular speed, allowing room for flexibility in choosing how fibers are aligned

Environmental control units are options on all Fluidnatek models.



## FLUIDNATEK LE-500

The Fluidnatek LE-500 is a powerful tool for commercializing electrospun and/or electrospayed biomaterials and biomedical products. These units allow for ease of scalability to generate samples 50 cm wide on a roll form by implementing up to 370 simultaneous needles and 10 liters of solution for a semi-continuous sample processing. Similar to all other units, the LE-500 can be upgraded to meet cleanroom and sterile production processing for personalized medicine product development.



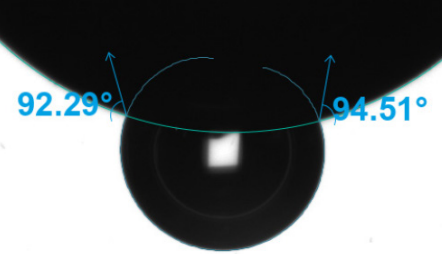
LAB SCALE

INDUSTRIAL SCALE

## FLUIDNATEK HIGH-THROUGHPUT (HT)

The Fluidnatek HT is equipped to operate 24/7 with over 5,000 simultaneous needles, 60-liters tank of refillable solution for uninterrupted industrial-scale production, and electrospun biomaterial sample development in roll form with a width of 1.6 meters. Safety is key for industrial electrospinning production. The HT has been engineered to offer several state-of-the-art features, including low oxygen content using nitrogen when flammable solvents are needed and active exhaust to always maintain a negative pressure to properly remove evaporated solvents (all Fluidnatek models offer this). This unit also monitors all electrospinning parameters and internal signals in the unit to properly monitor and scale sample production on all developed batches.

# INVESTIGATING WETTABILITY OF BIOMATERIAL SURFACES

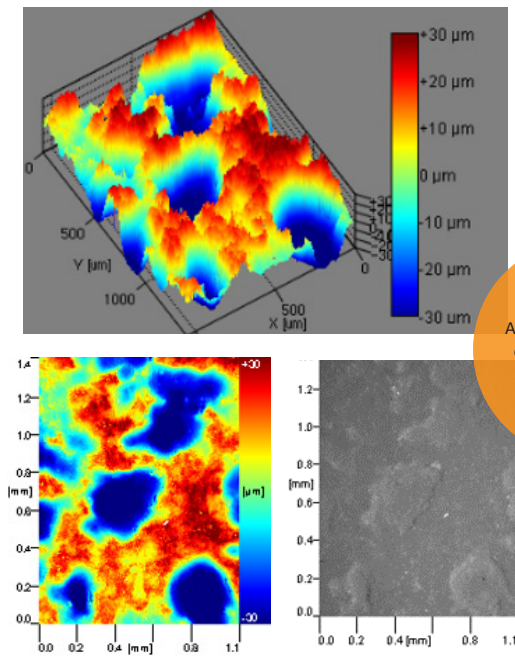


A bubble on a contact lens to demonstrate a contact angle measurement on this surface.

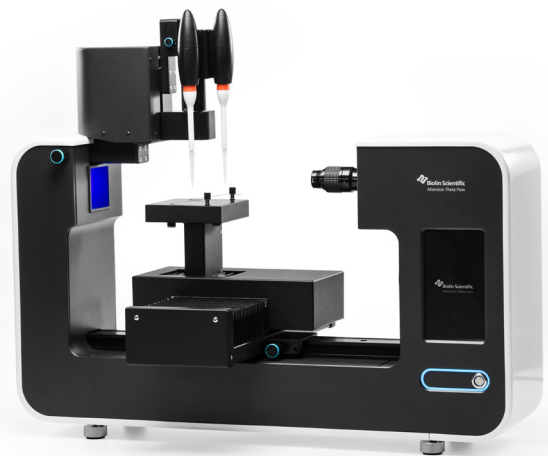
## ATTENTION THETA FLOW











The Attention Theta Flow optical tensiometer delivers accurate, traceable, and repeatable contact angle measurements data across experiments with minimal user intervention. A host of features that automate or sense key instrument settings such as ambient temperature, relative humidity, and camera tilt, among others, ensure a faster workflow and consistently reproducible results.

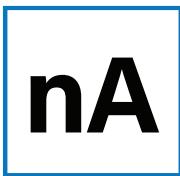
- Automated protocols for contact angle, surface tension, surface free energy, and 3D surface roughness
- Theta Topography module enables wettability testing on biomaterial surfaces with roughness-corrected contact angle
- Best-in-class camera with software controlled autofocus provides superior droplet image definition and sharp contrast for the most accurate baseline measurements
- The comprehensive OneAttention software provides real-time visualization of results and seamless data acquisition and analysis



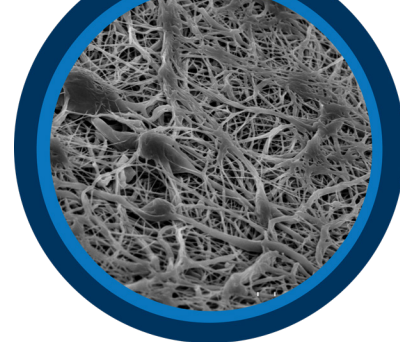
Artificial skin sample, optical, 2D, and 3D images.



	<b>Sessile drop</b> for static contact angle measurement of a liquid droplet		<b>Batch sessile drop</b> for static contact angle measurements in quality control		<b>Automatic DCA</b> for dynamic contact angle measurement		<b>Tilted drop</b> for dynamic contact angle measurements		<b>Meniscus</b> for static contact angle measurement with a fiber/rod
	<b>Captive bubble</b> for static contact angle measurement of a gas bubble		<b>Pendant drop</b> for surface and interfacial tension		<b>Reverse pendant drop</b> for surface and interfacial tension		<b>Pulsating drop*</b> for dilational interfacial rheology measurement		<b>3D Topography*</b> for roughness corrected contact angle



**nanoscience  
Analytical**



## WHO WE ARE

Nanoscience Analytical capitalizes on over 18 years of expertise in advanced instruments for microscopy and surface analysis from our sister company, Nanoscience instruments. Our staff have varied backgrounds in chemistry, biochemistry, materials science, physics, and engineering, with over half of them having earned Ph.D.'s in their respective fields. Our mission is to deliver laboratory solutions to accelerate scientific innovation while being committed to quality, transparency, and sustained partnership with our clients. We represent an efficient, competitively priced source of sophisticated analytical services targeted at our client's needs.

## WHAT WE DO

Nanoscience Analytical provides Process Development for fabricating Nanomaterials and Analytical Services supported by expert scientists in a lab with the latest technologies. We provide our clients with focused, expert guidance and access to multiple, complementary analytical techniques and solutions.

Our expertise in synthesizing nanofibers & nanoparticles provides an efficient path to explore novel materials and their usefulness for many diverse applications. Our analytical capabilities include electron microscopy, tensiometry, optical profilometry, quartz crystal microbalance with dissipation monitoring and Langmuir Blodgett troughs.

### SCANNING ELECTRON MICROSCOPY

*Automated particle,  
fiber, & pore analysis*

## ANALYTICAL SERVICES

### ELECTROSPINNING & ELECTROSPRAYING PROCESS DEVELOPMENT

*Tissue scaffolds,  
implant coatings, &  
drug delivery vessels*

### QCM-D

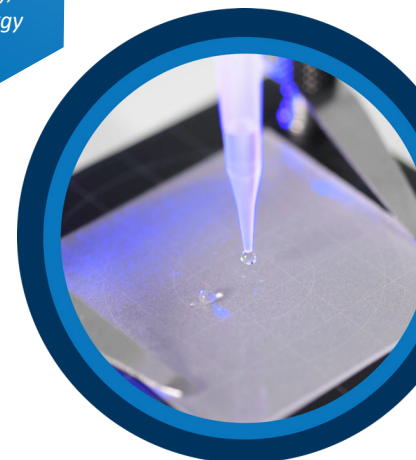
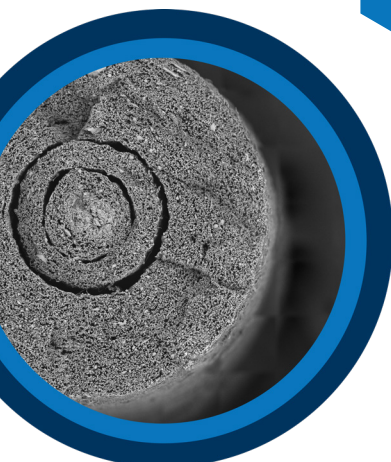
*Biomolecule-surface  
interactions*

### NANOMATERIAL FABRICATION

*Electrospraying, spark  
ablation, & Langmuir  
Blodgett films*

### OPTICAL TENSOMETRY

*Contact angle, surface  
tension, wettability,  
& surface free energy  
measurements*



## CONTACT US

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Nanoscience Instruments combines expertise in microscopy and surface science instrumentation with real-world solutions. We partner with innovative instrument manufacturers around the world to help scientists and engineers solve complex problems, leading to breakthroughs and innovations. Our team of scientists and engineers are passionate about solutions and connecting our customers with the right products, maintenance, and analytical services to accomplish their goals.

## **ThermoFisher** SCIENTIFIC

Phenom World, a ThermoFisher company, develops and manufactures the best-in-class Phenom desktop scanning electron microscopy solutions (SEM) for high-quality imaging and analysis. They aim to make imaging and analysis at the nanoscale accessible to every scientist in every lab in the world. Towards this end, they focus on developing high-quality electron microscopy solutions that are functionally rich, yet simple to use.



## **Biolin Scientific**

Biolin Scientific develops state of the art instruments and smart solutions for experts engaged in surface science investigations. In collaboration with leading universities and industries, they develop tools to solve challenges and simplify workflows. The Biolin Scientific portfolio consists of the QSense, Attension and KSV NIMA brands.



Bioinicia is a company dedicated to developing and manufacturing nano and microstructured materials by electrospinning & electrospraying and providing premium quality electrospinning equipment for lab to industrial-scale processing. Bioinicia aims to partner with their customers for product development, electrospinning-electrospraying technology, and industrial manufacturing. Fluidnatek® is the brand name for electrospinning & electrospraying equipment designed by Bioinicia.