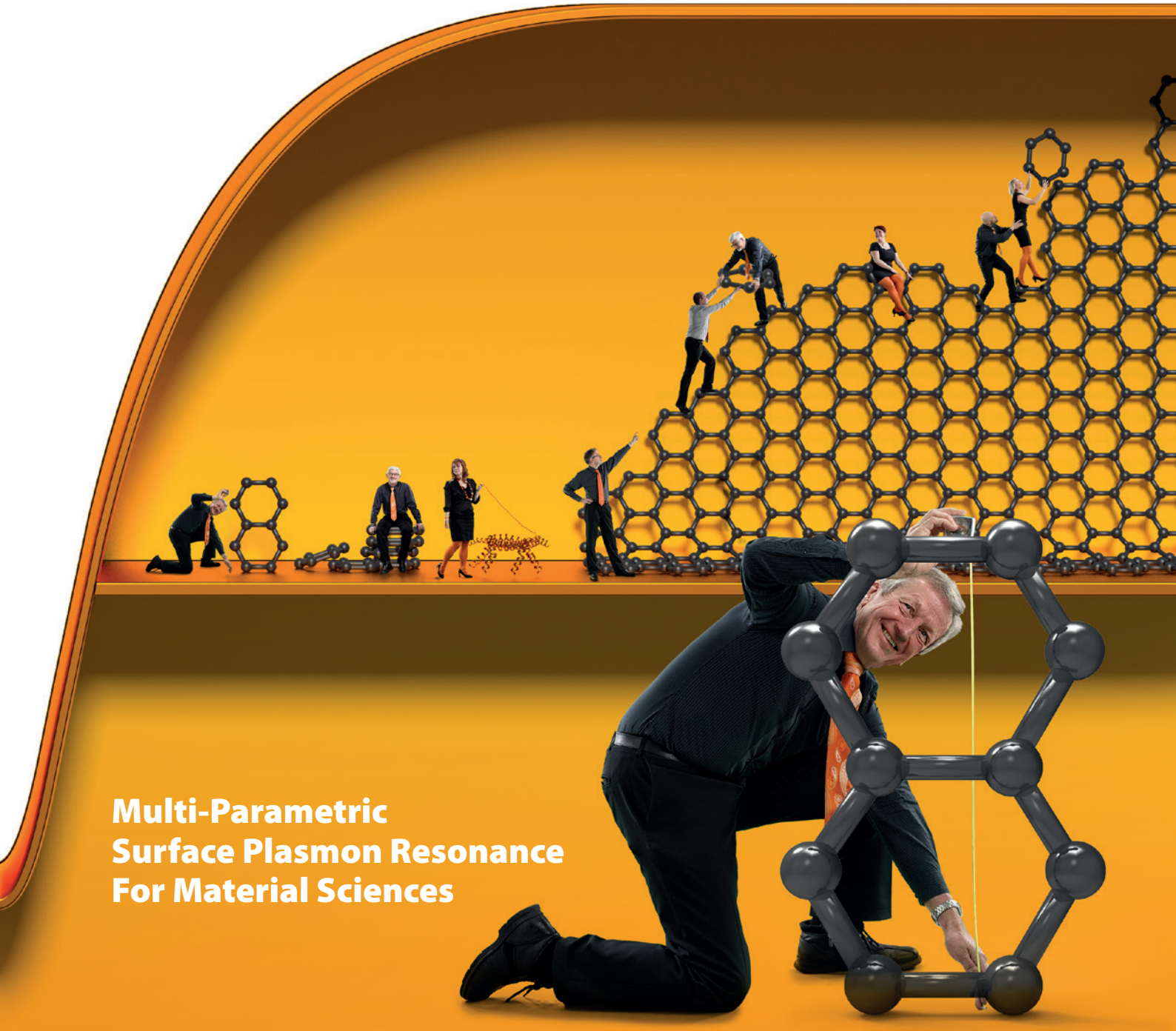
Excellence in Surface Plasmon Resonance

BioNavis

From Ångströms to microns

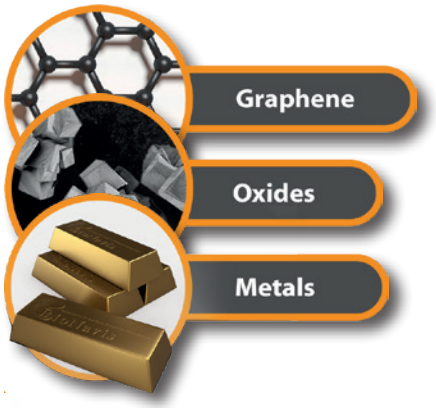


Multi-Parametric
Surface Plasmon Resonance
For Material Sciences

MP-SPR Applications

Thin solid films

Solar cells, displays, food packaging, anticorrosive, antimicrobial, antireflective functional coatings - MP-SPR helps to reduce the coating thickness while maintaining the functionality. MP-SPR allows measurements of interactions as well as plasmonics, thickness and complex refractive index of ultrathin metal coatings from 3Å to 100 nm.

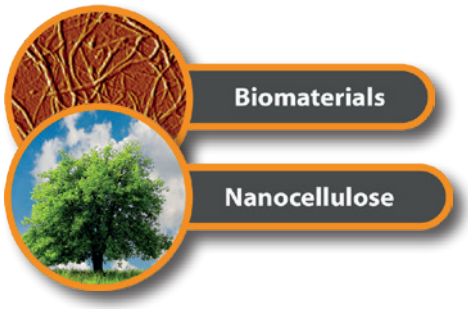


Soft materials

MP-SPR measures interactions to polymers from ultrathin films up to 20 µm thick films. MP-SPR is the most sensitive label-free technique for biomaterial interaction studies and layer characterization. MP-SPR assists optimization of barrier layers, including functional moisture, pH, antireflective, antifouling and antibacterial coatings.

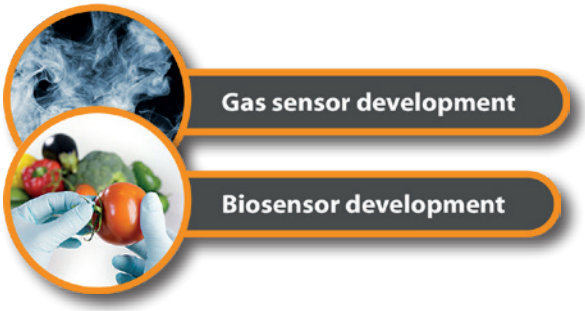
"We coat MP-SPR sensors with different nanocelluloses to monitor the interactions at the solid/gas and solid/liquid interfaces. We work with highly hydrophilic systems that bind large amounts of water and study them under different conditions of pH, temperature and ionic strength. It is essential for us that MP-SPR is able to decouple the contribution of hydration and bound water for quantification of adsorbed mass, layer thickness and other parameters."

–Prof. Orlando Rojas, NCSU, USA and Aalto University, Finland



Sensor development

MP-SPR can be used to fine-tune sensitive coatings for specific gas or liquid components. Amongst others, MP-SPR is able to detect hydrogen (3 Dalton) on Palladium surface, cancer cells on a targeted surface, bacteria in drinking water, α-Lactalbumin in milk, or cocaine in saliva. MP-SPR is used for development of poin-of-care assays as well as for testing of the materials for microfluidic handling of the samples. Quantify your results using our concentration analysis module!



Nanoparticles

Whether you develop metal, silica, polymer or other nanoparticles, MP-SPR is an excellent choice for nanoparticle characterization. Get your "before and after" images with SEM or AFM. See the dynamics of self-assembly, targeting, release or internalization in real-time with MP-SPR!

Electrochemistry

Multiple electrochemical methods such as potentiometric, amperometric or impedance spectroscopy can be coupled to MP-SPR. This enables simultaneous monitoring of (electro)chemical reactions at the surface, label-free and in real-time.

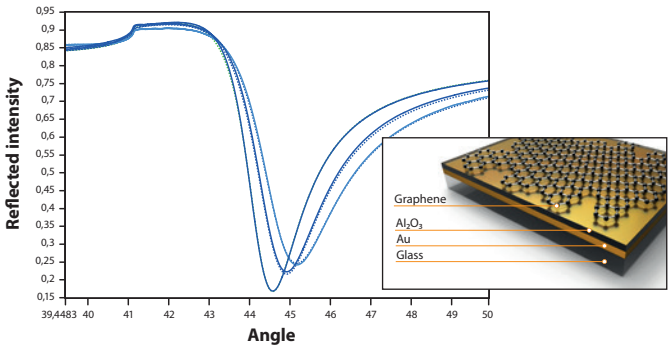
"We use MP-SPR to quantify conformation changes of proteins at the surface under different environmental conditions."

–Prof. Barbara Jachimska, Polish Academy of Sciences, Poland

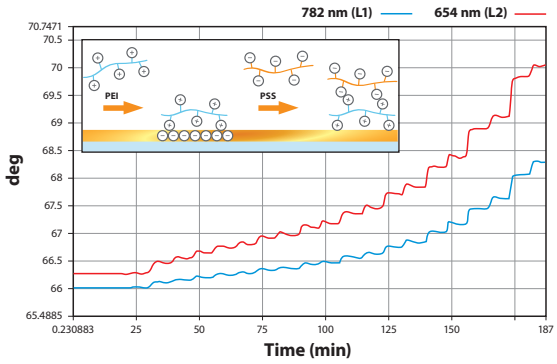
Note: See also our brochure on life science applications!

Why choose MP-SPR?

True thickness from Å to µm: The unique wide-angle scanning range ensures compatibility not only with thin layers (from Ångströms) but also thicker layers (up to a few micrometers). Thickness and refractive index (RI) can be determined by fitting of curves using Fresnel equations. With additional wavelengths, a single solution can be found without prior knowledge of RI or thickness.

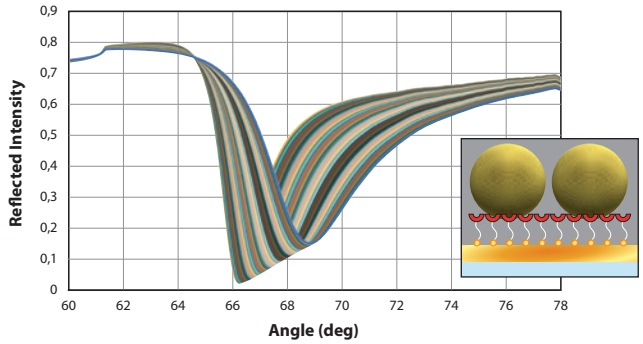


Single monolayer of graphene was measured as 3.7Å thick at 670 nm wavelength. Thin layers form a single peak in a MP-SPR scan.

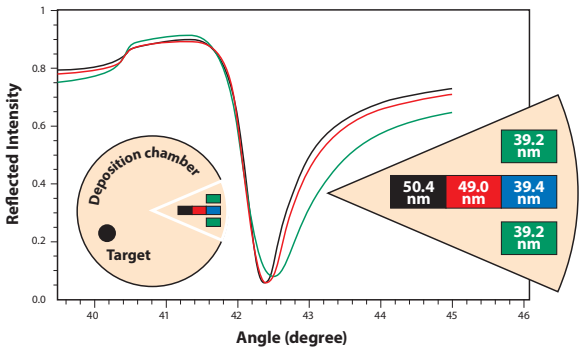


Self-assembly of polyelectrolyte multilayers is measured in real-time at two wavelengths (670 nm and 785 nm). Twenty layers are formed *in-situ*. Thickness for each layer can be determined. The true layer thickness is 2.5 nm per bilayer.

From nanoparticles to layers and multilayers: MP-SPR can serve as an at-line validation tool for thin film deposition processes such as CVD and ALD may it be for a single layer or for a stack. As there is no vacuum required, measurements can be done in minutes.

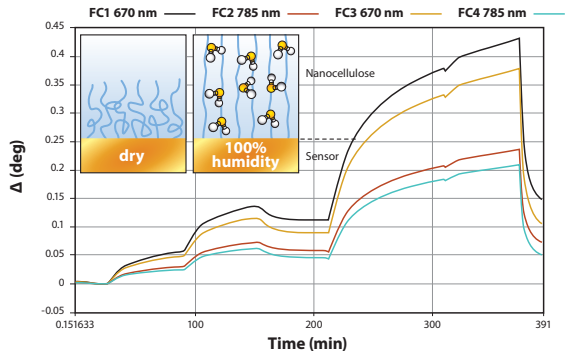


Binding of functionalized gold nanoparticles (50 nm in diameter) onto a self-assembled polymer surface measured with MP-SPR at 785 nm.

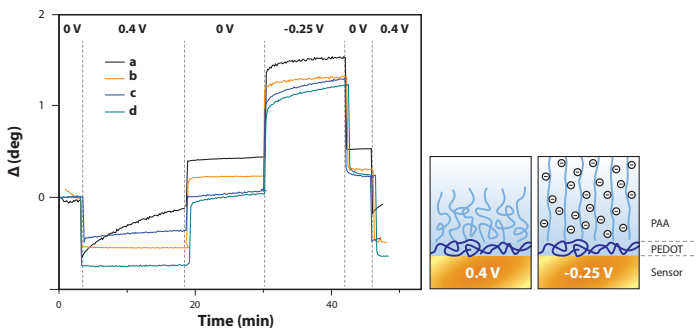


Even subnanometer differences in the inner and outer circles within a CVD chamber can be measured using MP-SPR. Here, MP-SPR discovered a 10 nm difference in metal deposition thickness towards center and 0.2 nm difference along the outer circle.

Real-time interactions: MP-SPR is a real-time method and therefore allows for measurements of swelling of materials when moving from dry to wet environment, material-solvent interactions, nanoparticle adsorption kinetics, protein resistance and more.



Real-time swelling of nanocellulose under different water vapour concentrations.



PAA polymer brushes swelling and collapse caused by pH and electric potential change.

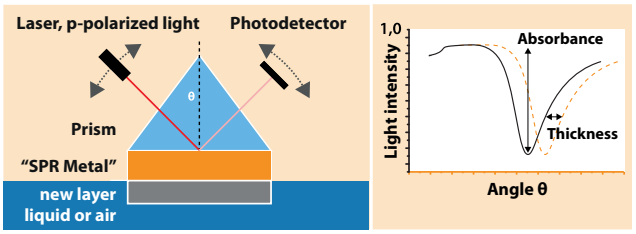
MP-SPR Technology

From drug discovery to Ångström precision in coatings and material development

While Surface Plasmon Resonance (SPR) has been established for more than 20 years in drug discovery, BioNavis has further developed and optimized the technology for materials research. Whereas traditional SPR has been developed for label-free protein-protein interaction kinetics measurements, Multi-Parametric Surface Plasmon Resonance (MP-SPR) measures surface interactions on metals and dielectrics, including cellulose, SiO_2, Ag, Pt, ceramics as well as graphene. Apart from kinetics, MP-SPR can determine thickness and refractive index of thin films from a few Ångströms up to microns.

The key to the Multi-Parametric Surface Plasmon Resonance is the scanning measurement of full SPR curves at multiple wavelengths. When measured as a function of time, the results can be calculated to many different physical parameters describing sample properties or interactions.

Working principle



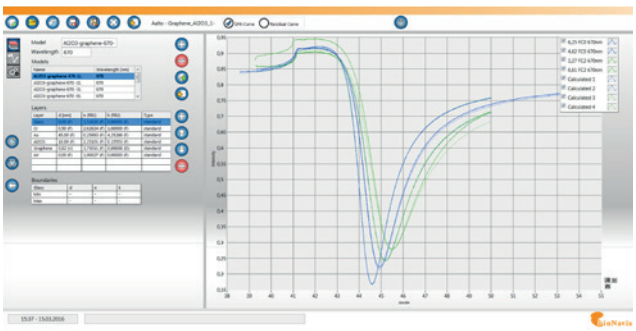
Surface plasmons are waves of free electron plasma on a metal surface, which can be excited by p-polarized light under resonance conditions. The amount of light reflected from the sensor slide is monitored. The method is able to detect even subnanometer changes at the surface as changes in the resonance angle. These measurements can then be converted into thickness, refactive index, absorption, and surface coverage. The technique measures the values over time and can thus provide also dynamic measurements such as adsorption kinetics, swelling, release of material and other.

What can you measure with MP-SPR?

Surface interactions	Layer properties
Kinetics (k_a, k_d)	Refractive index (n)
Affinity (K_D)	Thickness (d)
Concentration (c)	Extinction coefficient (k)
Adsorption/Absorption	Density (ρ)
Desorption	Surface coverage (Γ)
Adhesion	Swelling (Δd)
Electrochemistry (E, I, Z (ω))	Optical dispersion (n(λ))

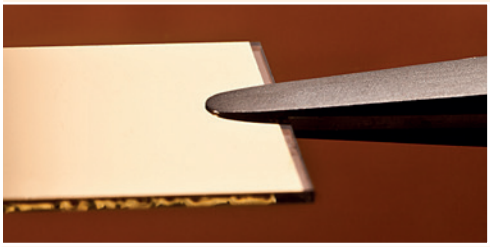
LayerSolver™ : True thickness of nanolayers

Refractive index, thickness and wavelength at which they are measured, form a set of *n* vs *d* solutions. Typically, refractive index has to be assumed from literature, based on value for bulk of the material and a given wavelength. For nanolayers, such refractive index (RI) is unfortunately not sufficiently close to the real value. RI varies for different deposition methods, material composition, moisture, electric field, etc. Hence, for precise thickness (or true thickness) determination, RI has to be determined as well. MP-SPR measures at multiple wavelengths which enables resolving both thickness and refractive index at the same time.

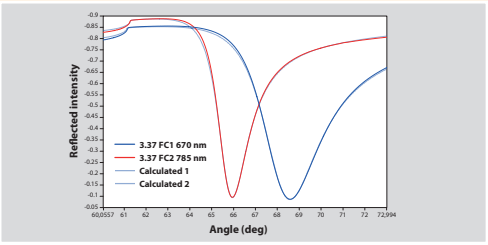


LayerSolver™ is a dedicated software module that allows fitting of multiple nanolayers simultaneously from multiwavelength measurements.

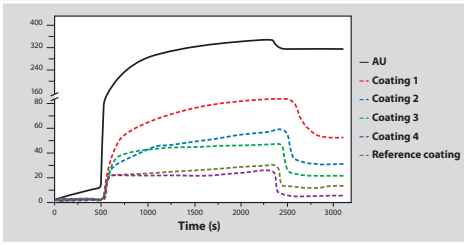
Measurement step-by-step



Choose a substrate. Use ready substrates including Au, Ag, Pt, Al, SiO_2, TiO_2, Al_2O_3, PS, PDMS, nanocellulose etc., or make your own using CVD, ALD, LB, sol-gel, spin coating, electrodeposition, self-assembly, or others.



Verify your deposition using LayerSolver™: thickness and refractive index.



Measure interactions in real-time: adsorbed protein mass, release kinetics, swelling, etc.
Here, a protein-resistant coating is evaluated.

MP-SPR Navi™ Comparison

	MP-SPR Navi™ 220A NAALI	MP-SPR Navi™ 210A VASA	MP-SPR Navi™ 200 OTSO
Number of fluidic channels	2	2	2
Autosampler for liquids	96 well plate and 6-vials	6-vials	-
Buffer degasser	★★★	★★★	(★★)
Compatibility with organic solvents	(★★)	★★★	(★★)
Kinetics and affinity characterization	★★★	★★	★
PureKinetics™	★★★	★★★	★★★
Temperature range	★★	★★	★★
Living cell measurements	★★	★★★	★★
Sensitivity	★★★	★★★	★★★
Additional lasers (-L): 2-3 wavelengths	(★★★)	(★★★)	(★★★)
Measurements in dry state	★★★	★★★	★★★
Gas or vapor measurements	(★)	(★★★)	(★★★)
Electrochemistry measurements	(★★)	(★★★)	(★★★)
Fluorescense measurements	(★)	(★★)	(★★)
Sensor slide range	★★★ Au, Al, Pt, SiO_2, TiO_2, PMMA, PS, nanocellulose, etc.		
MP-SPR Software			
TraceDrawer™: Affinity, concentration and kinetics	★★★	(★★★)	(★★★)
LayerSolver™: Thickness and complex RI[a]	(★★★)	★★★	(★★★)
Control and Data Viewer	★★★	★★★	★★★

★★★ Optimal ★★ Excellent ★ Good

★ in standard configuration (★) optional feature

a) To get the full benefit, combine MP-SPR Navi™ Layer Solver™ with additional wavelength (-L) feature.

All of our instruments are designed and manufactured in Finland.
To honor the Finnish roots of our products, we named our instruments after Finnish wild animals: OTSO (a bear), VASA (a reindeer) and NAALI (an arctic fox).

More detailed specifications are available in product sheets.
Specifications are subject to change without prior notice.
Information in this catalogue is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions.

"We re-designed SPR technology routinely used in drug discovery to MP-SPR to provide Ångström precision to coatings and materials."

Team of BioNavis

Your samples – analyzed!

Besides instrumentation, BioNavis provides also measurement and testing services on contract basis. We have an experienced team with wide variety of expertise ranging from biomolecular interactions to coating and characterization of thin solid metal films. Our clients include companies from semiconductor, precision mechanics, specialty chemicals, biosensors and pharmaceutical industries.

Contact information

BioNavis Ltd
Hermiankatu 6-8 H
33720 Tampere
Finland

+358 10 271 5030
+1-858-999-4233 (USA)
info@bionavis.com

www.bionavis.com/material

B_502.705.b