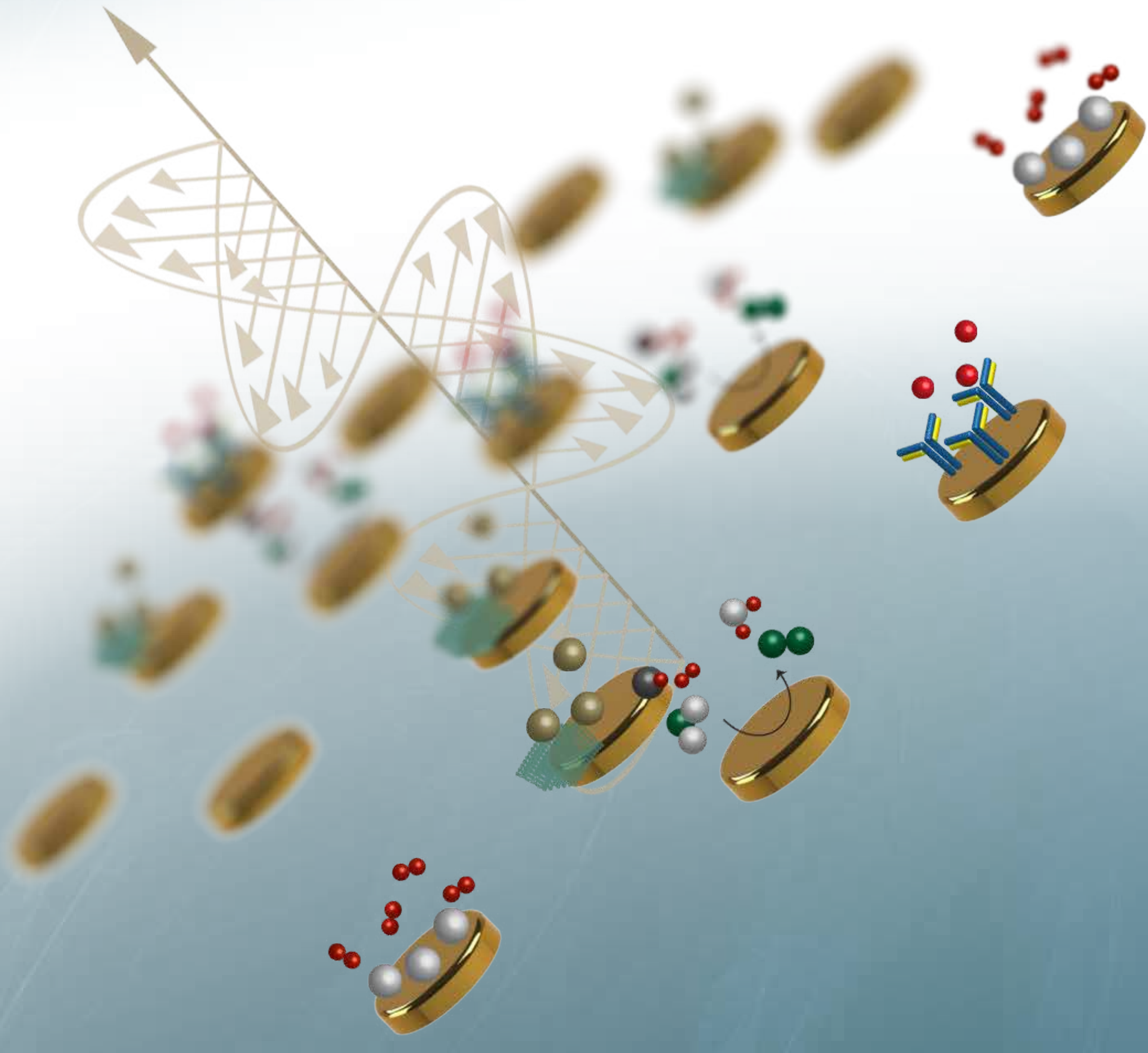
Technology Note

Nanoplasmonic sensing

Fast · Sensitive · Versatile · Robust

Explore nanomaterial surfaces and interfaces with Insplorion's instrument



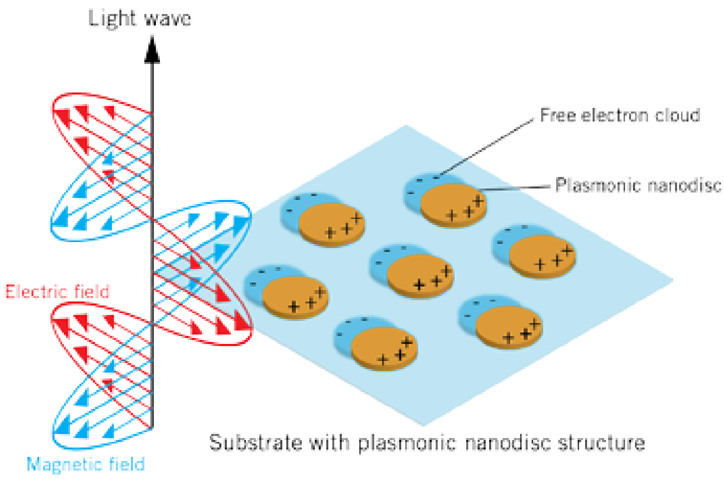
Insplorion's Nanoplasmonic Sensing Technique

Nanoplasmonic sensing (NPS) is an optical technique that exploits gold nanoparticles as local sensing elements. The nanofabricated plasmonic gold discs of the Insplorion sensors are embedded in a custom made dielectric material offering optimal protection and tailored surface chemistry of the sensor. In this arrangement, the gold nanodiscs act as optical antennas, which respond to processes at the sensor/sample interface.

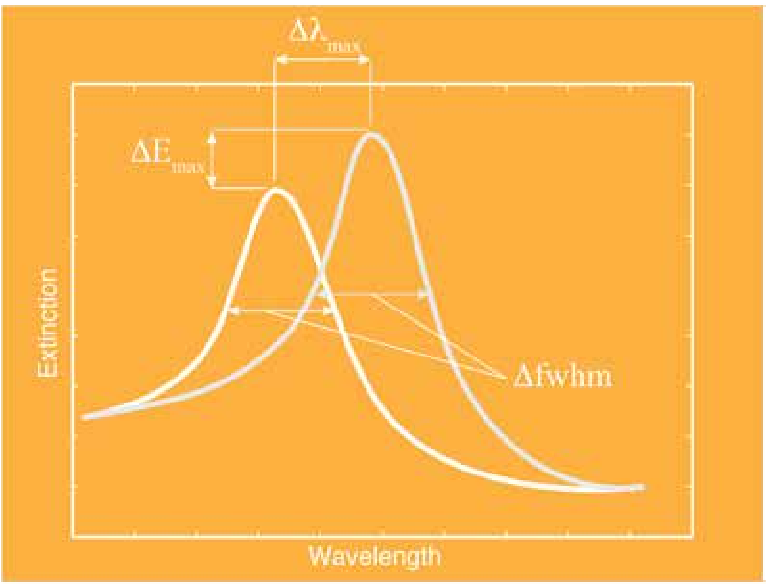
The technique constitutes a very versatile sensing platform that enables detection and monitoring of a large variety of material and interface processes under in situ conditions.

Localized Surface Plasmon Resonance (LSPR)

A localized surface plasmon (LSP) is a coherent, collective spatial oscillation of the free electrons in a metallic nanoparticle. LSPs can be excited by the electromagnetic field of near visible light. When white light passes through a plasmonic sensor, due to absorption and scattering of light by the particles, a peak in the extinction spectrum emerges.
The resonance peak position is determined by the size, shape and material of the nanoparticle, and more importantly, it also depends on the refractive index of the medium in close proximity to the nanoparticle. Thus, by monitoring changes in the resonance peak, it is possible to detect and monitor processes influencing the dielectric environment of the nanoparticles on the sensor surface.



Nanoplasmonic sensing is an optical technique for detecting and monitoring material and interface processes under in situ conditions.



Multi-parameter Analysis

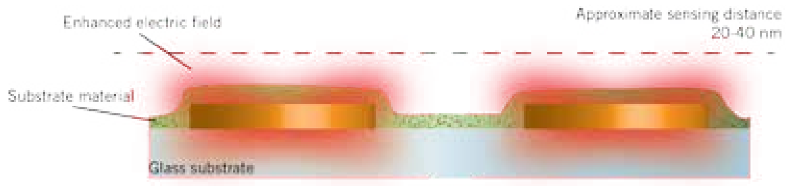
Changes in plasmon extinction peak-position ($\Delta\lambda_{max}$), height (ΔE_{max}), and width (Δfwhm) can be detected and evaluated in real-time.

The shift in peak position provides quantitative information on e.g. surface concentration, density, and mass.

Changes in the shape of the peak are related to changes in absorption, conductivity, and other material properties.

Sensor Architecture

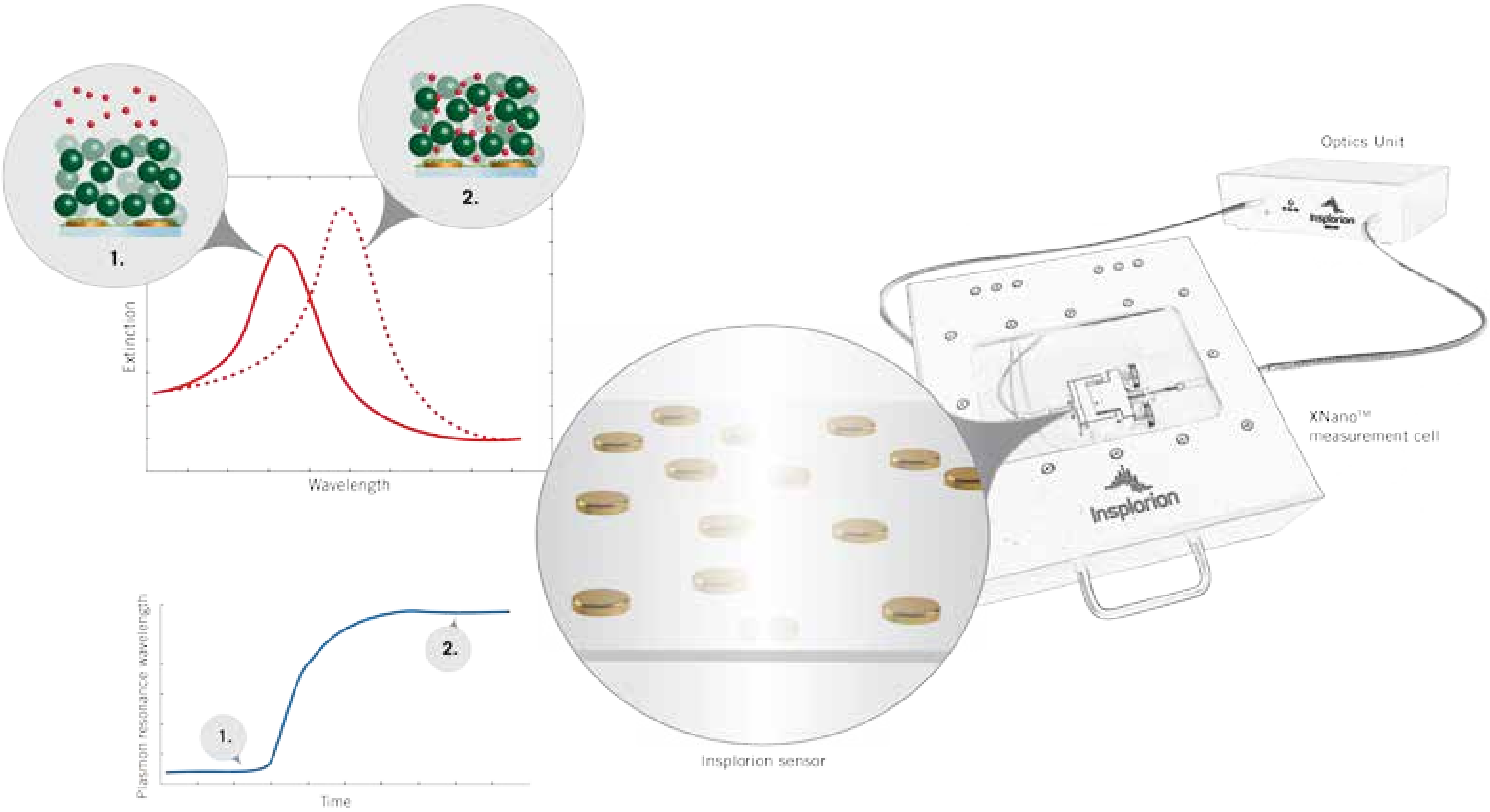
Insplorion's proprietary sensors are precisely manufactured in a state of the art cleanroom environment. The sensors consist of an amorphous gold nanodisc array embedded in a dielectric substrate material. Virtually any material that can be deposited (e.g. by CVD, PVD, ALD, spin-coating) as a thin film can be used as substrate material. Standards include SiO_2, Si_3N_4, Al_2O_3, and TiO_2. It is also possible to use the bare gold nanodiscs as substrate.



Insplorion's sensors can be used to monitor substrate-sample and sample-sample interactions and/or chemical and physical processes in the substrate and sample materials.

Measurement Principle

In the Insplorion XNano measurement cell, white light is transmitted through the sensor substrate and the transmitted intensity is measured as a function of wavelength by the Insplorer® software and the Insplorion Optics Unit. The optical response of an LSPR measurement is characterized by a distinct extinction peak at the plasmon resonance wavelength. During an experiment the spectral position of the peak is monitored as a function of time. Typically, shifts as small as 10^{-2} nm can be resolved with a temporal resolution of more than 1 Hz.



Testimonials

"I find Insplorion's technology extremely interesting for studies of dye impregnation of Dye Sensitized Solar Cells. It is likely to become a valuable tool to improve the dye impregnation process and thus the performance of DSCs."

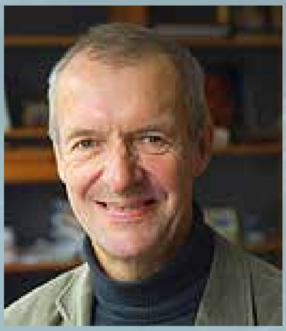
Prof. Michael Graetzel,
Ecole Polytechnique Fédérale de Lausanne

"The Insplorion instrument is a great tool for us. I wish we had this instrument ten years earlier!"

Prof. Hans Niemantsverdriet,
Eindhoven University of Technology

"I am amazed by the enormous sensitivity, robustness and versatility of the Insplorion LSPR technology."

Prof. Bengt Kasemo,
Chalmers University of Technology



Selected publications

Controlling Lipid Membrane Architecture for Tunable Nanoplasmonic Biosensing. **Small** Vol 10(23), p4828-32. 2014

Nanoplasmonic Sensing for Nanomaterials Science. **Nanophotonics** Vol 1(3-4), p249-266. 2012

Time-Resolved Indirect Nanoplasmonic Sensing Spectroscopy of Dye Molecule Interactions with Dense and Mesoporous TiO_2 Films. **Nano Letters** 12(5), p2397-2403. 2012

Indirect Nanoplasmonic Sensing: Ultrasensitive Experimental Platform for Nanomaterials Science and Optical Nanocalorimetry. **Nano Letters** 10(9), p3529-3538. 2010

Nanoplasmonic Probes of Catalytic Reactions. **Science** Vol 326, No 5956, p1091-1094. 2009

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