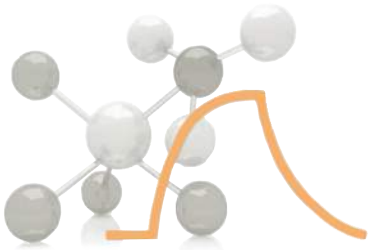
Biosensing Instrument

Surface Plasmon Resonance
Label-Free Analysis System

BI-2500 Series

NEW

Benchtop SPR with analysis modules



- ✧ **Benchtop SPR with 3-channel SPR detection module**
- ✧ **High sensitivity to measure small molecules**
- ✧ **Innovative multi-module design for optimal flexibility**
- ✧ **Broad response time for slow and fast kinetic processes**
- ✧ **Cost effective solution**

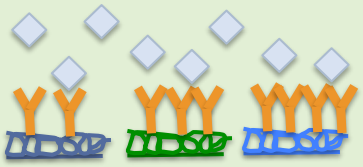
The new BI-2500 benchtop SPR system offers 3-channel flow mode and delivers high quality binding response for low immobilization and small molecule (<100 Da) detection. Its innovative modular design provides users with optimal flexibility to choose amongst various analysis modules for life science, electrochemistry, and biosensing in liquid and gas phase SPR applications. In addition, its fast detection is ideal for the study of fast kinetics of redox-induced conformational changes in proteins and other biomolecules.

Benefits with 3-channel SPR

The BI-2500 provides greater flexibility and faster assay development, doubling the throughput over 2-channel SPR systems.

Improve data fidelity by obtaining more repeated data sets in one injection

Higher throughput with more channels for binding analysis

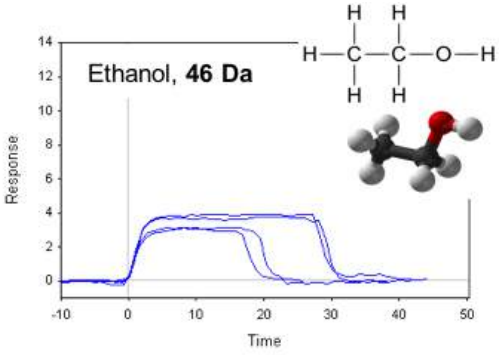


Faster assay development by quickly optimizing immobilization and regeneration conditions

Biosensor Application

Chemical Biosensor Testing with Gas SPR

Gas SPR provides superior sensitivity in small molecule detection, which is critical for characterizing polymers and thin films at solid-gas interfaces. Adsorption of the small molecules onto the sensing materials, such as polymers, can be detected by observing SPR angle shift.

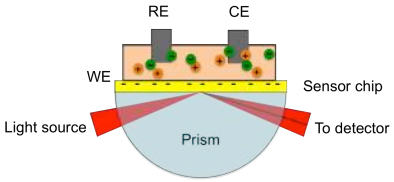


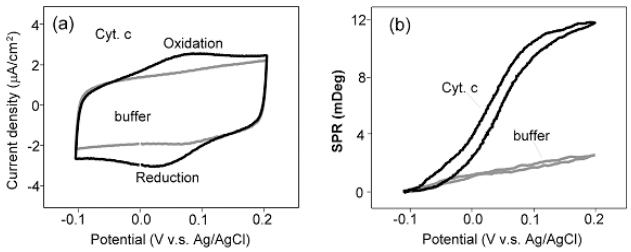
SPR responses of 4 polymerized sensor surfaces exposed to ethanol vapor (46 Da).

Life Science Application

Redox-Induced Protein Conformational Changes

With the electrochemical enhanced SPR, redox-induced conformational changes in surface bound protein molecules such as Cytocrhome c can be studied. By controlling the potential of SPR sensor chip, the simultaneously measured SPR angle shows a sigmoidal change as the protein is switched between the oxidized and the reduced states.

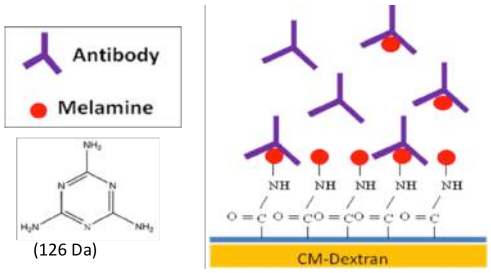




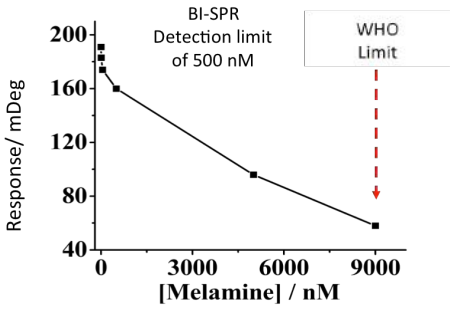
(a) Cyclic voltammogram of cytochrome c, immobilized on a 3-mercaptopropionic acid-functionalized Au SPR sensor chip and (b) the simultaneously recorded SPR angle shift vs. potential. Note that the cyclic voltammogram and SPR response in the absence of cytochrome c are also shown (grey line) for comparison.

Biosensor in Food Safety

Highly sensitive SPR detection has helped to identify illegal alteration of infant milk products with melamine - a small molecule that can boost the detectable protein contents. A competitive binding SPR assay schematic for melamine detection is shown.



The measured SPR response vs. melamine concentration plot for melamine detection in milk has clearly demonstrated the detection limit of the BI instrument (0.5uM) is well below the WHO mandated limit of less than 9uM.



2500 System Specifications

Base Station	Light source	670 nm
	Detection speed	4 ms
	Incident angles	40-47 Deg (gas) 67-81 Deg (liquid)
	Baseline noise	< 0.06 RU RMS (0.01 mDeg RMS)
	Baseline drift	1RU/hr (0.17 mDeg/hr) (when ambient drifts < 1°C/hr)
	PC interface	USB 3.0
	Outer dimension	355(w) x 215 (h) x 365 (d) mm
	Weight	8 kg
	Power supply	110-230 V 50/60 Hz
Fluid Handling	Number of sample flow channels	3 channels
	Flow cell material	PEEK (biologically compatible)
	Flow rate	1.0 to 250 µL/min (application dependent)
	Sample injection volume	>50 µL (application dependent)
	Sample injection method	Manual
	Channel volume	< 32 nL
	Injection rise time	< 0.2 s
	Kinetic constant	k_a <1 X 10^8 $M^{-1}s^{-1}$ k_d >1 X 10^{-6} s^{-1}
	Dissociation constant	K_D = 10^{-3} M (1 mM) to 10^{-12} M (1 pM)
	Molecular weight cutoff	100 Da
	Analysis module	3 channel Flow Injection Analysis Module
Control System	Computer	Windows operating system
	Software	BI-SPR software including Data Analysis and Kinetics Analysis packages

2500 Analysis Modules

Flow Injection

Included

EC-DualFlow™

Optional

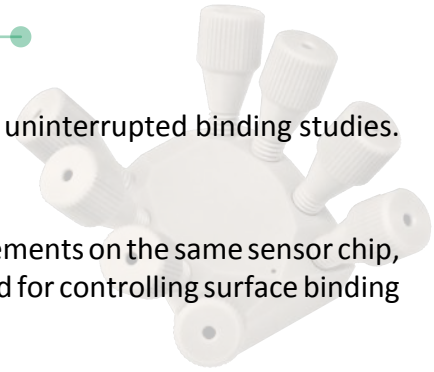
EC SPR

Optional

Gas SPR

Optional

Analysis Modules



Flow Injection
This 3-channel injection module provides continuous flow stream for uninterrupted binding studies.

EC SPR
This module facilitates simultaneous electrochemical and SPR measurements on the same sensor chip, and is ideal for studying various electrochemical processes with SPR and for controlling surface binding and molecular conformational changes via electrochemical means.

EC-DualFlow™
This module provides users with novel capabilities to study molecular binding processes and conformational changes of biomolecules under the influence of applied electrochemical potentials at different flow rates. Its small channel volume facilitates rapid sample exchange and fast kinetic studies, and also drastically reduces consumption of valuable biological samples.

Gas SPR
This module enables the high sensitivity of SPR analysis to be performed in the gas phase, permitting new capabilities for sensor development, thin film analysis, environmental and air quality research, and gas molecule binding studies.

Sensor Chips

Bare Gold Sensor Chip
Highly uniform gold film for reproducible SPR research.

Divided Gold Sensor Chip
Pre-patterned gold surface for EC flow SPR applications.

CM Dextran Sensor Chip
Sensor with COOH- linker groups in a dextran hydrogel, ideal for high capacity amine coupling with low non-specific absorption.

Streptavidin (SA) Sensor Chip
Sensor with streptavidin in a dextran hydrogel for immobilization of biotinylated molecules such as proteins, peptides, nucleic acids or carbohydrates.

Ni-NTA Sensor Chip Sensor Chip
Sensor with NTA used for immobilizing histidine-tagged molecules. NTA surface can be regenerated by injecting EDTA or imidazole.

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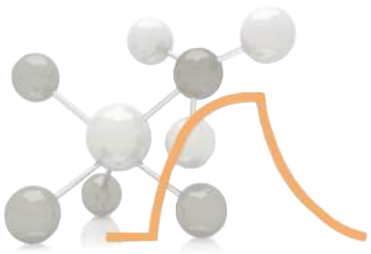
Biosensing Instrument

Surface Plasmon Resonance
Label-Free Analysis System

BI-4500 Series

5 channel SPR with modular design for applications flexibility

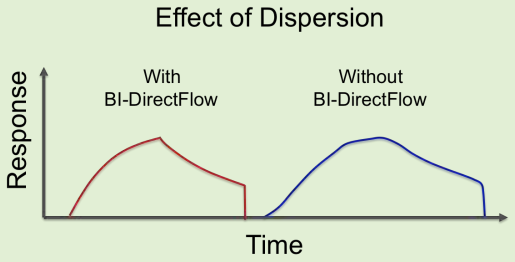


- ✧ **High throughput with 5 channels and fully automated sampling**
- ✧ **High sensitivity to measure small molecules**
- ✧ **Precise sample delivery with BI-DirectFlow™ technology**
- ✧ **Innovative multi-module design for optimal flexibility**
- ✧ **Cost effective solution**

The new BI-4500 SPR system provides multiple channel flow modes and delivers high quality binding response for low immobilization and small molecule (<100 Da) detection. Equiped with BI-DirectFlow™ technology, the BI-4500 system integrates precision sample delivery with near-zero dispersion for fast kinetics and effective removal of various secondary effects. Its modular innovative design gives users with optimal flexibility to choose amongst various analysis modules for life science, electrochemistry, and sensing in liquid and gas phase SPR applications.

Precise sample delivery with BI-DirectFlow™

BI-DirectFlow™ technology delivers sample to the sensor surface with near-zero dispersion generating high quality data that more clearly distinguishes true binding events from the secondary effects.

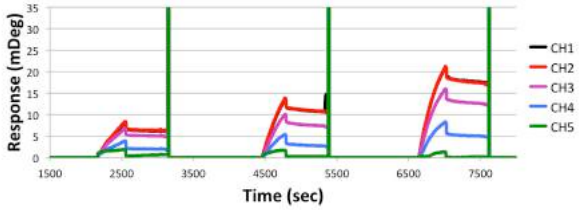


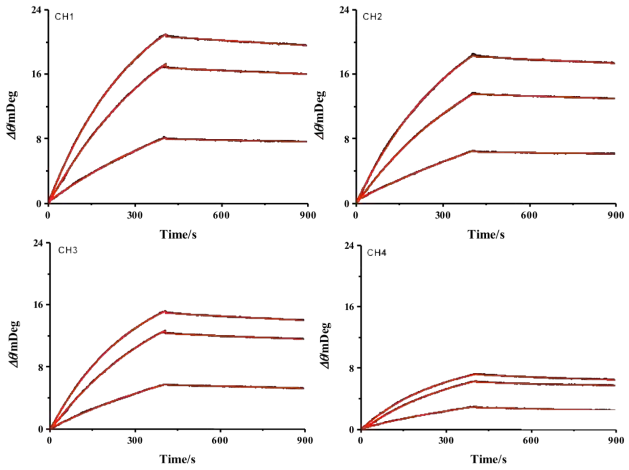
The binding response on the left (without dispersion) has very sharp, well-defined binding analysis regions and generates more accurate and reproducible results. The binding response on the right (with dispersion) has blurred, poorly defined binding analysis regions.

Life Science Applications

Binding Kinetics Analysis

Interaction between Bovine Serum Albumin (BSA) and Anti-BSA can be monitored in real-time by using the flow injection SPR analysis module.



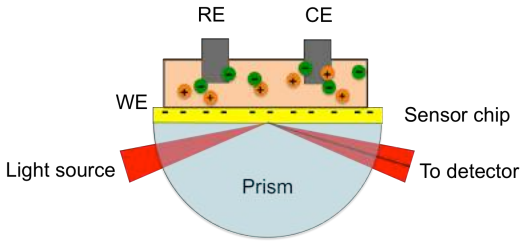


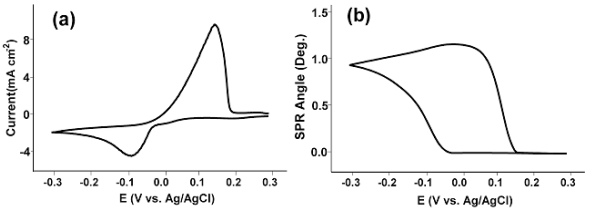
Reference subtracted binding curves of four channels at varying analyte concentrations with kinetic analysis fits showing an associate rate constant ka=8.6×10^4±0.5 $M^{-1}s^{-1}$, dissociation rate constant kd=1.5 × 10^{-4} s^{-1} ± 0.25, and affinity binding constant KD=1.7 nM ± 0.2

Material Science Applications

Metal Deposition/Stripping in EC SPR

Using EC SPR to quantify the amount of metal electrodeposited onto a surface, the thicknesses of the copper film can be determined within sub-angstrom precision. The ability of EC SPR to determine tiny thickness variations down to sub-angstrom level demonstrates its superb sensitivity.





EC SPR study of 5 mM $CuSO_4$/0.1 M H_2SO_4 solution: (a) cyclic voltamagram showing copper redox peaks (b) simultaneous SPR response confirming copper film deposition and stripping corresponding to the redox potentials.

4500 System Specifications

Base Station	Light source	670 nm
	Detection speed	4 ms
	Incident angles	40-47 Deg (gas) 67-81 Deg (liquid)
	Baseline noise	< 0.06 RU RMS (0.01 mDeg RMS)
	Baseline drift	0.30 RU/hr (0.05 mDeg/hr) (when ambient drifts < 1°C/hr)
	Temperature Control Range	6°C to 50°C (10°C below ambient temperature max)
	Outer dimension	355(w) x 250 (h) x 515 (d) mm
	Weight	11.5 kg
	Power supply	110-230 V 50/60 Hz
Fluid Handling	Number of sample flow channels	5 channels
	Flow cell material	PEEK (biologically compatible)
	Flow rate	1.0 to 250 µL/min (application dependent)
	Sample injection volume	>50 µL (application dependent)
	Sample injection methods	Fully automated (Autosampler option) Semi-automated
	Kinetic constant	k_a <1 X 10^8 $M^{-1}s^{-1}$ k_d >1 X 10^{-6} s^{-1}
	Dissociation constant	K_D = 10^{-3} M (1 mM) to 10^{-12} M (1 pM)
	Molecular weight cutoff	100 Da
Control System	Computer	Windows operating system
	Software	BI-SPR software including Data Analysis and Kinetics Analysis packages
Autosampler (option)	Sample capacity	2 x SBS standards (384 / 96), 2 x 48 Vials (1.5mL), 2 x 12 Vials (10mL)
	Sample cooling	Minimum: 4°C +/- 2°C
	Outer dimension	300 (w) x 575 (h) x 360 (d) mm
	Weight	21 kg
Automatic Buffer Exchange Pump and Degasser (option)	Buffer exchange	Automatic buffer exchange up to six sources
	Buffer degasser	In-line
	Buffer delivery	Continuous
	Outer dimension	305 (w) x 191 (h) x 330 (d) mm
	Weight	6.8 kg

Analysis Modules

BI-DirectFlow™

This module enables precise flow control technology that delivers sample to the sensor surface with near-zero dispersion, enabling the study of SPR events in greater detail than ever before.

EC-DualFlow™

This module provides users with novel capabilities to study molecular binding processes and conformational changes of biomolecules under the influence of applied electrochemical potentials at different flow rates. Its small channel volume facilitates rapid sample exchange and fast kinetic studies.

EC SPR

This module facilitates simultaneous electrochemical and SPR measurements on the same sensor chip, and is ideal for studying various electrochemical processes with SPR.

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This module enables the high sensitivity of SPR analysis to be performed in the gas phase, permitting new capabilities for sensor development, thin film analysis, and gas molecule binding studies.

BI-DirectFlow™ | Included

EC-DualFlow™ | Optional

EC SPR | Optional

Gas SPR | Optional

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Highly uniform gold film for reproducible SPR research.

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Sensor with streptavidin in a dextran hydrogel for immobilization of biotinylated molecules such as proteins, peptides, nucleic acids or carbohydrates.

Ni-NTA Sensor Chip Sensor Chip

Sensor with NTA used for immobilizing histidine-tagged molecules. NTA surface can be regenerated by injecting EDTA or imidazole.

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QR for Website

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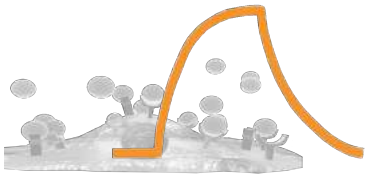
Biosensing Instrument

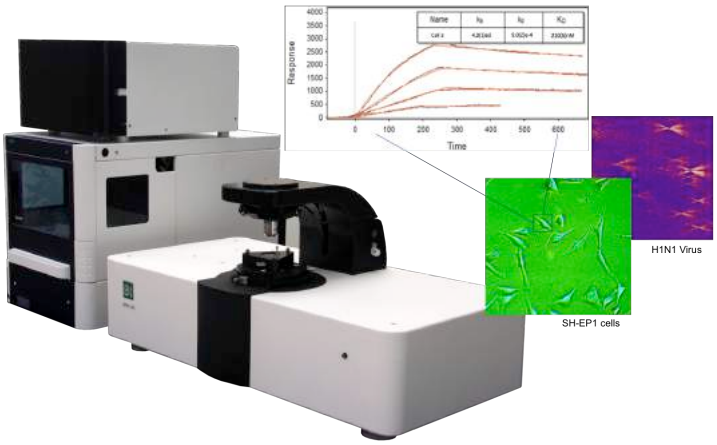
Surface Plasmon Resonance Microscopy
Label-Free Analysis System

SPRm 200 Series

2017 R&D 100 FINALIST

Integrated optical microscopy with SPR
Label-free whole-cell SPR assays



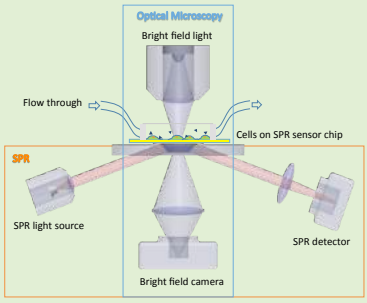


- ✧ **Label-free molecular binding measurement of *in vitro* cell membrane proteins**
- ✧ **Quantitative mapping of binding affinity and kinetics in real time**
- ✧ **Simultaneous optical imaging with SPR measurements**
- ✧ **Direct drug interaction studies of multiple and single cells**
- ✧ **Nanoscale monitoring of virus and bacteria binding events**

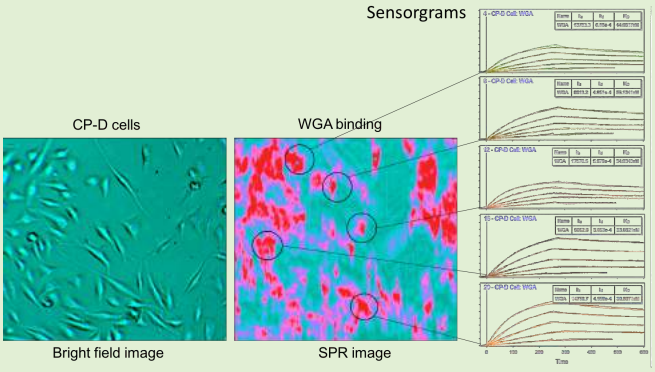
SPRm 200 system opens a new frontier in the study of molecular interactions by integrating optical microscopy with Surface Plasmon Resonance technology. Designed especially for *in-vitro*, label-free measurement of binding activity and cell kinetics, SPRm 200 provides a spatial visualization of cellular structures together with local binding activities. Real-time interactions of the drug and membrane protein can be measured in its native state without needing to extract proteins from the cell. With its outstanding sensitivity and stability, SPRm 200 also measures binding activities of bacteria and virus interactions and enables development of new methods for nanoparticle drug delivery.

Integration of SPR with optical microscopy

Surface Plasmon Resonance Microscopy (SPRM) combines optical imaging with SPR technology, providing spatial mapping of the binding activity on living cells. A light condenser illuminates the cell grown on the sensor surface, and the optical microscope camera captures the bright field image of the cells. Simultaneously, the SPR light source projects a beam at its resonance angle onto the sensor and the reflected beam is collected by the SPRM detector.



The detector measures the SPR response at each pixel and maps them into a SPR image. At every pixel, a sensorgram is recorded, thus providing much more localized information. SPRM makes it possible to study heterogeneous surface binding and interactions of membrane proteins in their native states.

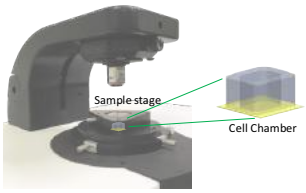


Simultaneous images of bright field (left) and SPR (middle) of Live Barrett's esophagus-derived CP-D cells binding to glycoprotein receptors. Sensorgrams of selected cells on the right.

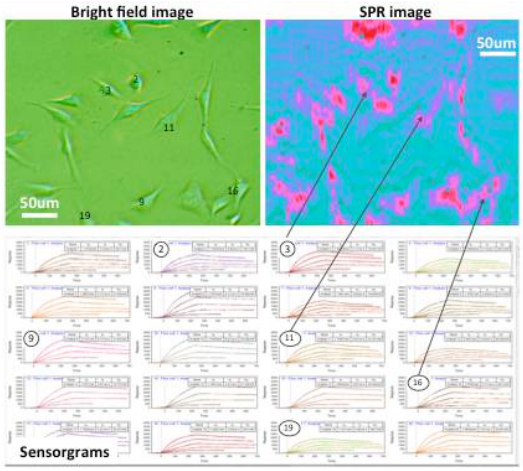
Lectin-Glycoprotein interactions

Basic cellular and therapeutic processes usually start with the binding of ligands to membrane proteins, and the study of the binding activities of membrane proteins in their native states is critical to the understanding of their biological functions.

Binding studies of the cell-surface glycosylation of SH-EP1 human epithelial cells were done with lectins (WGA, wheat-germ agglutinin). The exposure of WGA to the cells resulted in a local increase of SPR, which indicates the presence of these sugar residues on the glycan chains of the membrane proteins where the lectins are bound.



SH-EP1 cells were incubated in the cell chamber on the sensor surface and sensorgrams were recorded at each pixel. By averaging the pixel within the cell image, the binding kinetics for each cell was derived.



Bright field image of SH-EP1 human epithelial cells (top left). SPR image of lectin proteins binding to glycoprotein receptors on cells (top right) . Sensorgrams of selected 20 cells shown. ka=4.3x10^3 M^{-1}s^{-1}, kd=1.1x10^{-3} s^{-1} and KD= 257 nM.

Selected SPRM Publications

1. J Lu, Y Wang, W Wang, J Li, NJ Tao, S Wang, "Label-free Imaging of Histamine Mediated G Protein-Coupled Receptors Activation in Live Cells", Analytical Chemistry, 88, 11498-11503, 2016

2. K Syal, R Iriya, Y Yang, H Yu, S Wang, S Haydel, HY Chen, NJ Tao, "Antimicrobial Susceptibility Test with Plasmonic Imaging and Tracking of Single Bacterial Motions on Nanometer Scale", ACS Nano, 10, 845-852, 2016

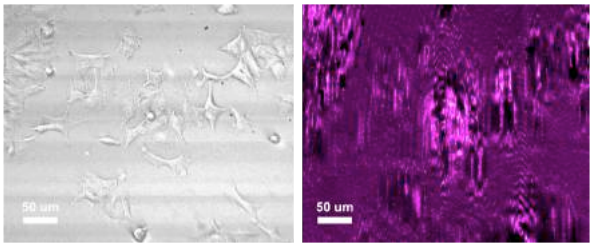
3. F Zhang, S Wang, L Yin, Y Yang, Y Guan, W Wang, H Xu, NJ Tao, "Quantification of Epidermal Growth Factor Receptor Expression Level and Binding Kinetics on Cell Surfaces by Surface Plasmon Resonance Imaging", Analytical Chemistry, 87(19), 9960-9965, 2015

4. L Yin, W Wang, S Wang, F Zhang, S Zhang, NJ Tao, "Measuring Binding Kinetics of Antibody-Conjugated Gold Nanoparticles with Intact Cells", Small, 2015

5. W Wang, L Yin, L G-M, S Wang, X Yu, S Eaton, S Zhang, H Chen, J LaBaer, NJ Tao, "In situ drug-receptor binding kinetics in single cells: a quantitative label-free study of anti-tumor drug resistance", Scientific Reports, 4, 1-7, 2014

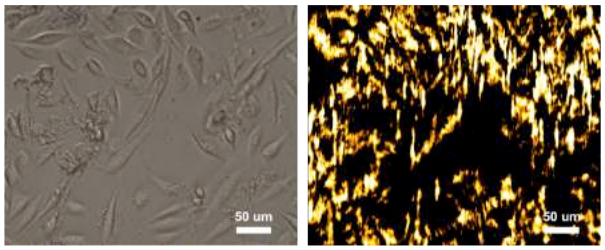
6. W Wang, Y Yang, S Wang, V Nagaraj, Q Liu, J Wu and NJ Tao, "Label-free measuring and mapping of binding kinetics of membrane proteins in single living cells", Nature Chemistry, 4, 846-853, 2012

7. S Wang, X Shan, U Patel, X Huang, J Lu, J Li and NJ Tao, "Label-free imaging, detection, and mass measurement of single viruses by surface plasmon resonance." Proceedings of the National Academy of Sciences 107.37, 16028-16032, 2010



Peptide interactions on A549 cells

Bright field image of A549 adenocarcinomic human alveolar basal epithelial cells (left). SPR image of 8 kDa Affibody peptide binding on cells (right). ka=7.1x10^{4} M^{-1}s^{-1}, kd=7.2x10^{-4} s^{-1} and KD= 10.2 nM.

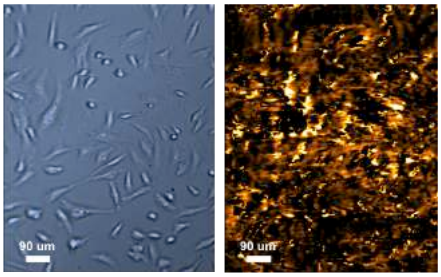


Live CP-D cells interaction

SPR image of Live Barrett's esophagus-derived CP-D (CP-18821) cells binding with WGA, a lectin that can recognize *N*-acetylglucosamine (GlcNAc). KD= 38.7 nM.

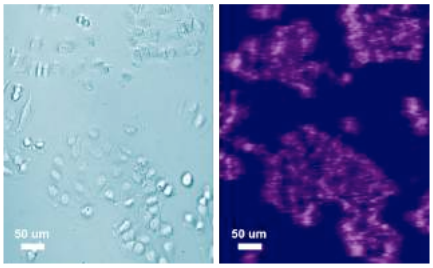
WGA interactions with CHO cells

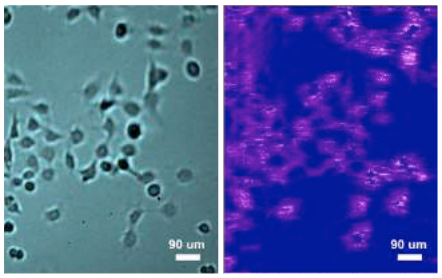
Bright field image of CHO (Chinese hamster ovary) cells (left). SPR image of lectins binding to cells (right). ka=4.8x10^{5} M^{-1}s^{-1}, kd=2.7x10^{-3} s^{-1} and KD= 5.68 nM.



Mapping antibody binding of H4 human neuroglioma cells

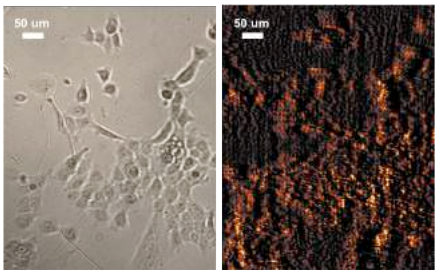
Bright field image of H4 cells (left). SPR image of antibody binding to H4 cells (right). KD= 16.8 nM.





GPCR interaction of HEK 293A cells

HEK 293A cell bright field image (left) and GPCR binding interaction with a 500 Da small molecule drug (right). KD= 7.41 nM.

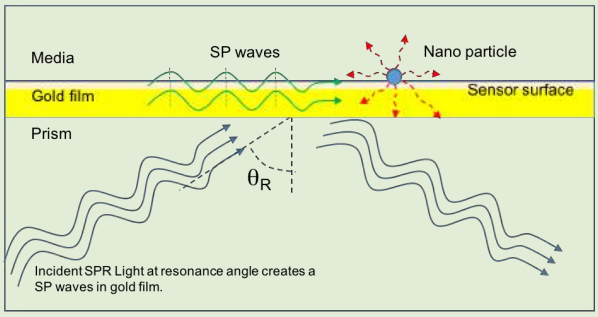


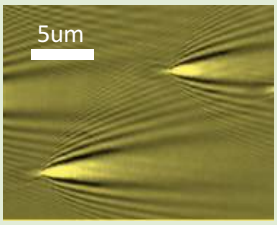
EGFR binding affinity on A431 cells

SPR image of monoclonal anti-EGFR interactions with EGFR over expressed A431 human epidermal cells. KD= 371 pM.

Nanoparticle detection

SPR light projected onto the sensor at its resonance angle creates a propagating surface plasmonic (SP) waves along the metal film surface. When a nanoparticle binds to the sensor surface, it acts as a scattering center in the SP waves, creating a wake pattern with a footprint up to 100X than its actual size. This enlarged footprint enables the detection of particles smaller than the optical diffraction limit, allowing nanometer scale binding activities be monitored and studied by measuring and mapping these footprints.



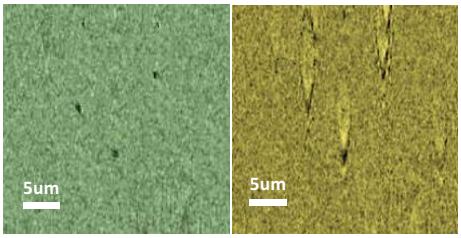


SPR image

The occurrence and intensity changes of the wake patterns in the SPR image provide rich information about binding events between the sensor surface and the nanoparticles, as well as their interactions with other molecules in the media [2,7].

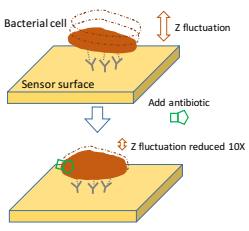
Bacteria and Antibiotics

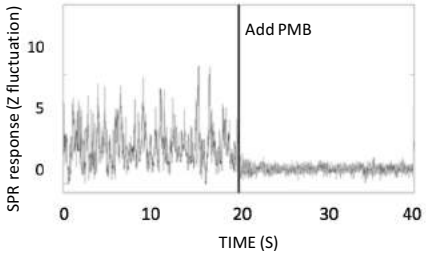
The live *E. coli* O157:H7 cells are tethered on a sensor chip via antibody coupling in a Luria Broth culture medium. They scatter the propagating SP waves creating wake patterns in the SPR image.



Bright field image SPR image

While the bright field image of the bacterial cell (black dots) appears to be constant, the contrast of wake pattern in the SPR image fluctuates significantly.





The fluctuation, caused by the bacterial cell nanomotion provides insight into its metabolism. When bactericidal antibiotic (PMB) is added into the cell chamber, the fluctuation of the bacterial cell reduces drastically, thus revealing lethality [2].

SPRm 200 Specifications

Base Station	Light source	690 nm
	Incident angles	40-76 Deg (continuous)
	Baseline noise	< 0.6 RU RMS (0.1 mDeg RMS)
	Baseline drift	3 RU/hr (0.5 mDeg/hr) (when ambient drifts < 1°C/hr)
	Temperature Control Range	15°C to 40°C (10°C below ambient temperature max)
	Field of view	Bright Field: 1200 x 900 um SPR: 600 x 450 um
	Magnification	Bright Field: x10 SPR: x20
	Resolution	Bright Field & SPR: 1 µm
	Stage translation / rotation	3mm x 3mm / 360 deg
	Outer dimension	690 (w) x 330 (h) x 340 (d) mm
	Weight	23 kg
	Power supply	110-230 V 50/60 Hz
Fluid Handling	Sample volume	1 to 1500 µL (application dependent)
	Kinetic constant	k_a <1 X 10^7 $M^{-1}s^{-1}$ k_d >1 X 10^{-5} s^{-1}
	Dissociation constant	K_D = 10^{-3} M (1 mM) to 10^{-12} M (1 pM)
	Molecular weight cutoff	200 Da
Control System	Computer	Windows operating system
	Software	ImageSPR™ software including Data Analysis and Kinetics Analysis
Autosampler (option)	Sample capacity	2 x SBS standards (384 / 96), 2 x 48 Vials (1.5mL), 2 x 12 Vials (10mL)
	Sample cooling	Minimum: 4°C +/- 2°C
	Outer dimension	300 (w) x 575 (h) x 360 (d) mm
	Weight	21 kg
Automatic Buffer Exchange Pump and Degasser (option)	Buffer exchange	Automatic buffer exchange up to six sources
	Buffer degasser	In-line
	Buffer delivery	Continuous
	Outer dimension	305 (w) x 191 (h) x 330 (d) mm
	Weight	6.8 kg

Sensors and consumables

Gold Sensor Chip

Highly uniform gold film for reproducible SPR research.

Cell chamber kit

Gold sensor chip with a silicone well for growing cells; includes chemicals and other accessories for treating sensor surfaces.

Biosensing Instrument

QR for Website

Email: Info2BI@BiosensingUSA.com
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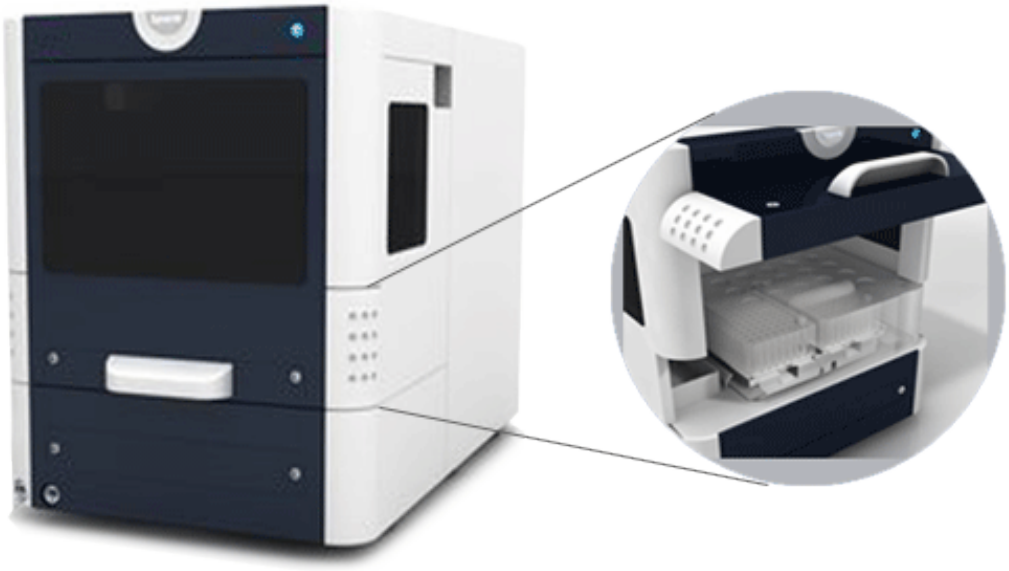
Biosensing Instrument

BI Autosampler

Enhance your SPR research productivity with the BI Autosampler. The BI Autosampler conveniently integrates with the BI SPR instrument, turning your BI SPR instrument into an automated workhorse.



Key Features:

✧ Automated sample mixing and diluting for greater hands-free operation

✧ Two plate holders, each compatible with 384, 96, 48, and 12 plate formats

✧ Handles well plates, open vials, and sealed vials

✧ Sample cooling, ranging from 4 °C to 3 °C below ambient

✧ Multi-solvent needle wash virtually eliminates all carry-over

✧ Pressure assisted sample aspiration for minimal sample needle contact

✧ Silica coated steel needles for metal-free sampling

BI Autosampler System Specification

Performance	Carry-over	< 0.05% with standard wash Typically <0.01% with extra wash
	Injection precision	Full-loop < 0.3% RSD Partial loop-fill < 0.5% RSD
Injections	Injection modes	Full-loop and Partial loop-fill (Capable of Pressure Assisted Sample Aspiration)
	Injection volume	0 µL to 9999 µL (depends on installed sample loop size)
	Injection cycle time	< 60 seconds
Samples	Sample Capacity	2 x Microtiter plates (SBS standards) 2 x 48 Vials (1.5 mL) 2 x 12 Vials (10 mL)
	Sample viscosity	0.1—5 cP
	Max vial / MTP height	47 mm
Components	Needle wash	Inside and outside needle wash with drying 250uL wash reservoir
	Valve switching time	60 msec
	Wetted parts	Coated steel needle, glass, PEEK
	Sample cooling	Minimum: 4 °C +/- 2 °C
System	Dimensions	300 x 575 x 360 mm
	Weight	21 kg
	Power requirements	95 - 240 Volt AC +/- 10%, 50 - 60Hz; 200 VA

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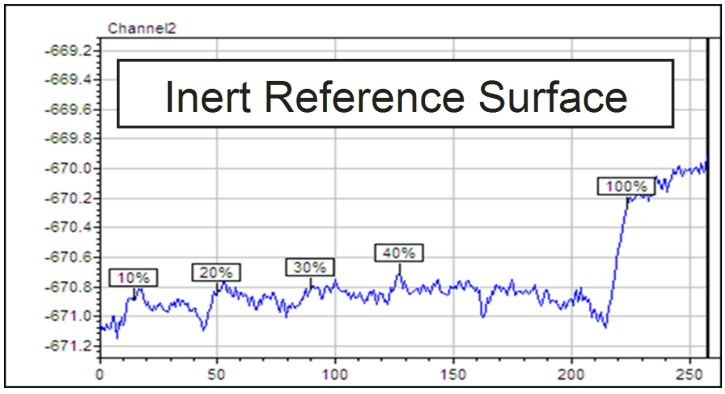
Biosensing Instrument

BI Precision Gas Diluter GD-100

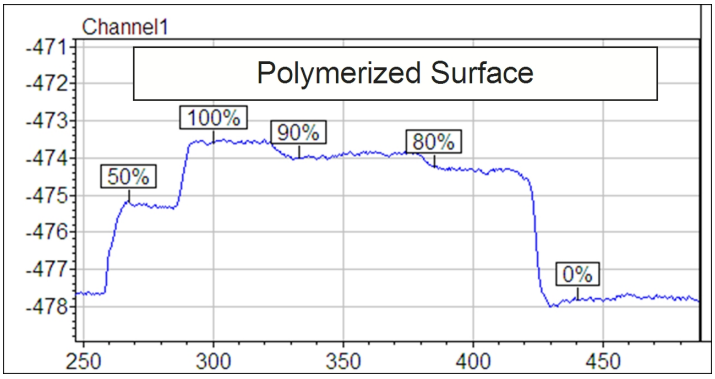
The GD-100 is a simple and cost effective option for gas sample dilution and delivery. Its robust and compact design conveniently integrates with all BI SPR instruments for gas phase SPR detection and analysis.

Alcohol vapor detection with BI SPR Technology



Notice that the alcohol gas molecules have a higher binding affinity for the polymerized surface than for the reference surface.

The GD-100 Precision Gas Diluter is used to dilute and deliver gas samples. Integrated with the BI-SPR instrument, a variety of gas binding affinities can be analyzed.



Key Features:

- ✧ Simple and easy to use
- ✧ Designed with chemically inert and robust components
- ✧ Built-in precision gas pump and mixer
- ✧ Local and remote control of sample mixtures

BI Precision Gas Diluter Specification

Dilution range	0%, 2% - 100%
Accuracy	3% of final concentration over 5% - 100% range
Flow range	0, 20 to 1000 µL/min
Inlet pressures	Atmospheric only (at both inlets ports)
Materials contacting gas	Stainless steel, polypropylene, polyethylene, Viton, and graphite composite
Compatible gases	All concentrations of air, oxygen, nitrogen, carbon dioxide, and inert gases Carbon monoxide (0.1 - 10,000 ppm) Nitrogen dioxide (dry only, 0.005 - 100 ppm) Nitric oxide (dry only, 1 - 100 ppm) Hydrogen sulfide (dry only, 0.005 - 100 ppm) Sulfur dioxide (dry only, 1 - 500 ppm) Ethylene oxide (0.1 - 1000 ppm) Most hydrocarbons and chlorohydrocarbons above 1 ppm
Incompatible gases	Hydrogen chloride, bromide, iodide, fluoride, combustible mixtures of all gases Benzene and other hydrocarbons below 0.5 ppm

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