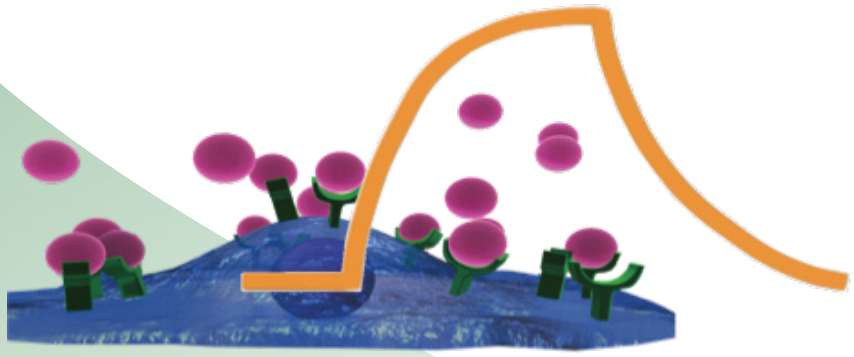
Biosensing Instrument

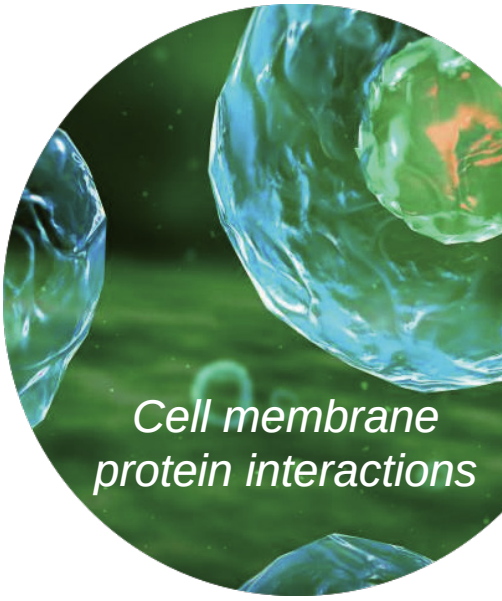
MODULARITY, HIGH SENSITIVITY, FAST DETECTION

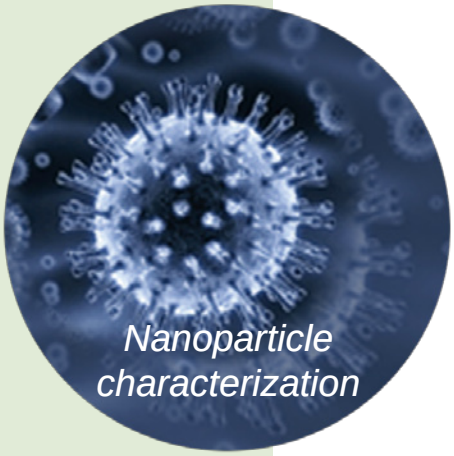


Biosensing Instrument (BI) was founded in 2004 with a vision to create highly sensitive, modular and cost effective SPR instruments for cutting edge research.

Over the past 10 years, BI has gained recognition in developing unique label-free technologies, award winning product development, unparalleled customer service, as well as funding from NIH to continue innovating new SPR technologies.

Surface Plasmon Resonance (SPR) has emerged as a powerful detection technique due to its high sensitivity and label-free capability. This optical based real-time detection method delivers superior results across diverse categories of research. BI SPR suitable for a broad range of applications such as life science, drug discovery, electrochemical analysis, food quality and safety, environmental science, and chemical sensor development.



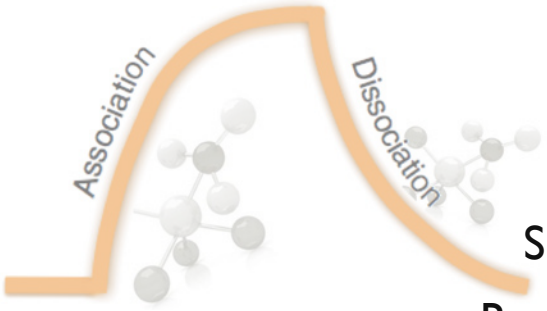


Innovations from Biosensing Instrument

- ✧ Integrated SPR with optical microscopy
- ✧ Precision sample delivery with BI-DirectFlow™
- ✧ New measurement paradigm with analysis modules

SPR Applications

- Protein-protein interactions
- Drug-cell/virus interactions
- Protein-DNA interactions
- Nanoparticle interactions
- Protein conformation changes
- Biosensor development



Why SPR?

Label Free analysis

Small molecule detection

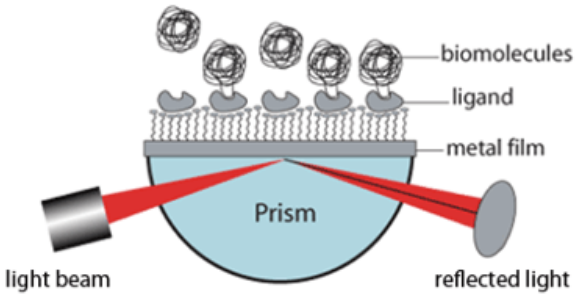
Real time binding information

High sensitivity and simple operation

View our popular *SPR Explained* video

How does SPR work?

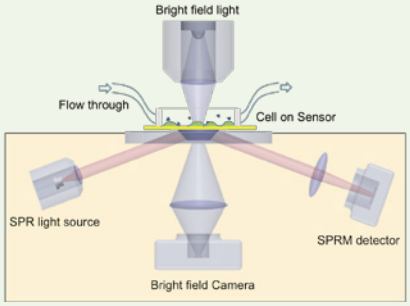
SPR is a phenomenon that occurs when polarized light hits a metal film at the interface of media with different refractive indices. Common SPR techniques excite and detect collective oscillations of free electrons (known as surface plasmons) via the Kretschmann configuration, in which light is focused onto a metal film through a glass prism and the subsequent reflection is detected. By monitoring the reflected beam shifts vs time, molecular binding events can be studied without the hassle of labels.



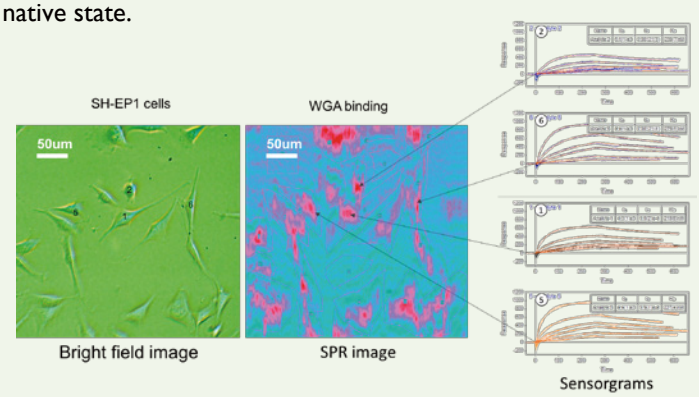
Biosensing Instrument SPR Microscopy

Integrated 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 bright field light condenser illuminates the cells grown on the SPR sensor surface and it captures the bright field image of the cells. Simultaneously, the SPR light source projects its beam at its resonance angle onto the SPR sensor surface and the reflected beam is collected by the SPRM detector.

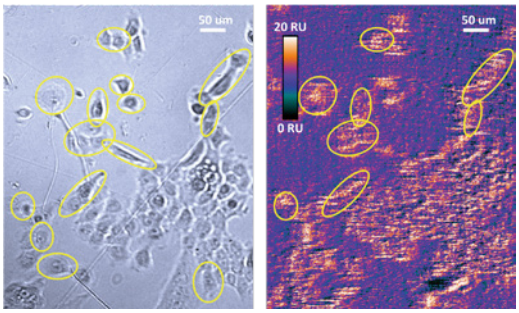


The SPRM detector records a sensorgram at each pixel of the sensing area, providing sensorgram data and SPR mapping for the entire sensing area. SPRM provides much more localized information and makes it possible to study heterogeneous surface binding and interactions of membrane proteins of single or multiple cells in their native state.

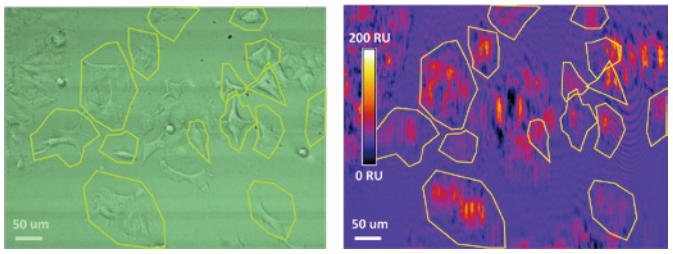


Left: bright field image of SH-EP1 human epithelial cells. Middle: SPR image of lectin proteins binding to glycoprotein receptors on SH-EP1 cells. Right: SPR sensograms of selected cells.

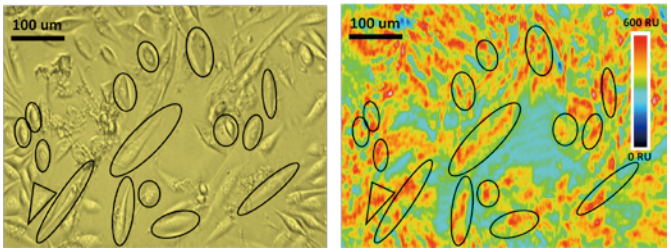
Wang et al. Nature Chemistry 2012, 4, 846-853



Affinity binding study of anti-EGFR on A431 human epidermal cells. Shown are bright field and SPR images of anti-EGFR binding to cells. KD= 371pM.



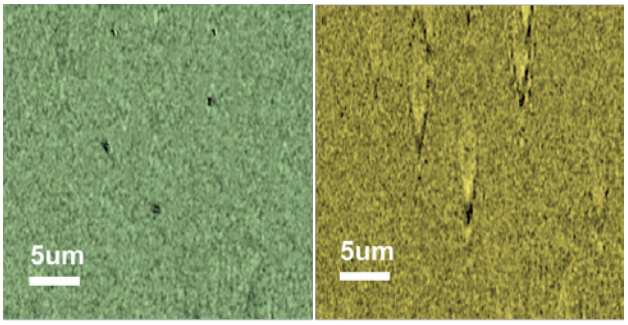
Kinetic binding study of 8 kDa Affibody peptide on A549 adenocarcinomic human alveolar basal epithelial cells. Shown are bright field and SPR images of peptides binding to cells. ka= 7.5 x 10^4 M^{-1} s^{-1}, kd= 7.2 x 10^{-4} s^{-1}, KD= 10.2 nM.



Affinity binding study of WGA (Wheat-germ Agglutinin) on live CP-18821 Barrett's esophagus derived cells. Shown are bright field and SPR images of WGA binding to cells. KD=70.2 nM.

Label-free binding activities on live cells

Quantitative mapping of binding affinity and kinetics



While the bright field image of E. coli O157:H7 bacteria (black dots on left image) appears to be constant, the SPR image on right fluctuates significantly. Monitoring this fluctuation, caused by the bacterial cell nanomotion, provides insight into its metabolism.

Syal et al. ACS Nano 2016, 10, 845-85

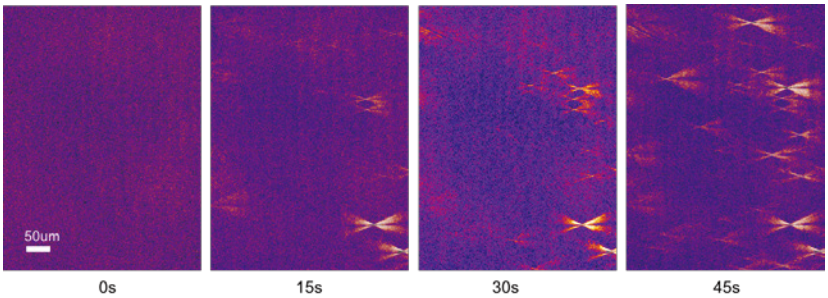
View the SPRM video

SPRm 200 Series

Light source	690 nm
Incident angles	40-76 Deg
Molecular weight cutoff	200 Da
Baseline noise	< 0.6 RU RMS (0.1 mDeg RMS)
Temperature Control Range	6°C to 50°C (10°C below ambient temperature max)
Field of view	Bright Field: 1200 x 900 um SPR: 600 x 450 um
Resolution	Bright Field & SPR: 1 um
Stage translation/rotation	3 mm x 3 mm / 360 deg
Sample injection method	Fully automated (Autosampler option) Manual
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)
Outer dimension	690 (w) x 330 (h) x 340 (d) mm
Weight	23 kg

Consumables	Bare Au Cell chamber kit Autosampler
Accessories	• Automated sample mixing and diluting • Two 384, 96, 48, and 12 plate formats

Nanometer scale binding monitoring



Kinetic binding study of protein modified nanoparticles. Edge detection enhances particle detection. Time lapsed SPR images of 0.5um nanoparticles binding to modified sensor surface are useful for developing drug delivery *systems*.

Our customers

Cornell University · USDA United States Department of Agriculture · Sandia National Laboratories · UCLA · The University of Manchester · IIT Kanpur · ASU Biodesign Institute, Arizona State University · Penn, University of Pennsylvania · Tsinghua University · Children's Hospital & Research Center Foundation · Mayo Clinic · University of Alberta · Nanjing University · Chinese Academy of Sciences · Universidade Federal de Santa Catarina · The University of Texas at Austin · Nagoya University · intel

Our awards

NIH Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR)

2016 R&D 100 Winner · Flinn Foundation · Frost & Sullivan 2010 Best Practices Award

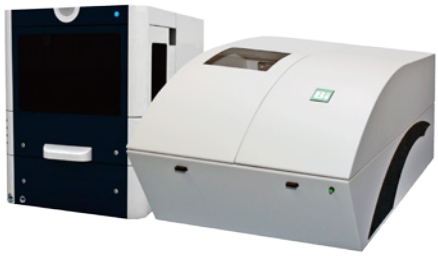
Biosensing Instrument SPR Solutions

BI-4500 Series

BI-4500 offers 5 channel flow modes and delivers high quality binding response for low immobilization and small molecule (<100 Da) detection. Equipped with BI-DirectFlow™ technology, it integrates precision sample delivery with near-zero dispersion for fast kinetic measurement. Combined with precise temperature control, autosampler and many analysis modules, it provides fully automated operation.

BI-2500 Series

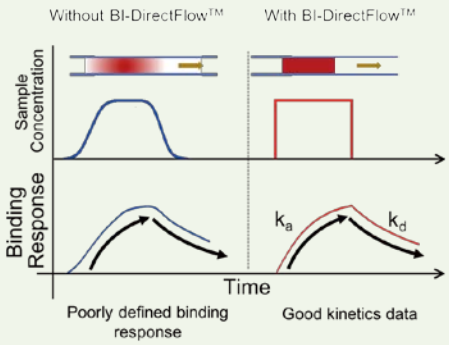
The BI-2500 SPR system is a compact, cost effective, 3 channel flow SPR system. It is capable of measuring small molecules (<100 Da) for the study of protein binding interactions. Its innovative modular design gives users the flexibility to choose amongst various analysis modules for biosensor development, electrochemistry SPR, and various liquid and gas phase SPR applications.



	BI-4500 Series	BI-2500 Series
Light source	670 nm	670 nm
No. of sample flow channels	5 channels	3 channels
Detection speed	4 ms	4 ms
Incident angles	40-47 Deg (gas) 67-81 Deg (liquid)	40-47 Deg (gas) 67-81 Deg (liquid)
Molecular weight cutoff	100 Da	100 Da
Baseline noise	< 0.06 RU RMS (0.01 mDeg RMS)	< 0.06 RU RMS (0.01 mDeg RMS)
Temperature control range	6°C to 50°C (10°C below ambient temperature max)	N/A
Sample injection volume	>50 µL (application dependent)	>50 µL (application dependent)
Sample injection method	Fully automated (Autosampler option) Semi-automated	Manual
Kinetic constant	k_a <1 X 10^8 $M^{-1}S^{-1}$ k_d >1 X 10^{-6} S^{-1}	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)	K_D = 10^{-3} M (1 mM) to 10^{-12} M (1 pM)
Analysis modules	BI-DirectFlow™, EC-DualFlow™, EC SPR, Gas SPR	Flow Injection, EC-DualFlow™, EC SPR, Gas SPR
Outer dimension	355(w) x 250 (h) x 515 (d) mm	355(w) x 215 (h) x 365 (d) mm
Weight	11.5 kg	8 kg
Consumables	Bare Au Divided Au CM Dextran (Dx) Streptavidin (SA) Ni-NTA	
Accessories	Autosampler • Automated sample mixing and diluting for hands-free operation • Holds two trays compatible with 384, 96, 48, and 12 plate formats	Gas Diluter • Used with gas analysis module • Built-in precision gas pump and diluter

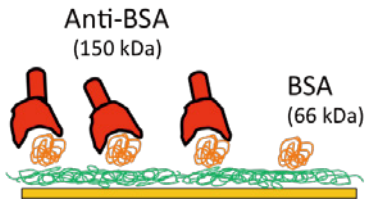
BI-DirectFlow™ Technology

BI-DirectFlow™ technology delivers sample to the sensor surface with near-zero dispersion, enabling ultra-fast kinetics and high resolution binding analysis. This unique technology enables finer observation and removal of secondary effects such as bulk refractive index shift, mass limited transport, and non-specific binding. As a result, high quality data that is more representative of true molecular binding behavior can be obtained.

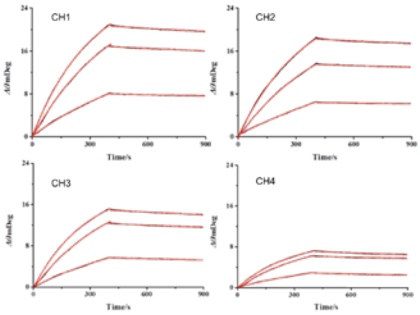


Life Science Applications

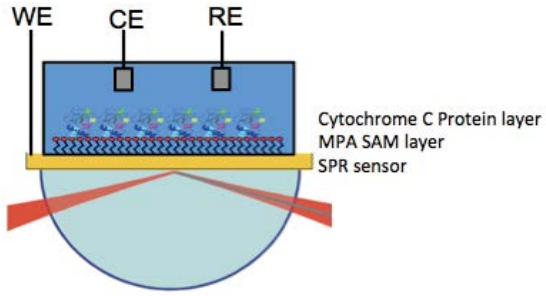
Kinetic Analysis of Anti-BSA/BSA



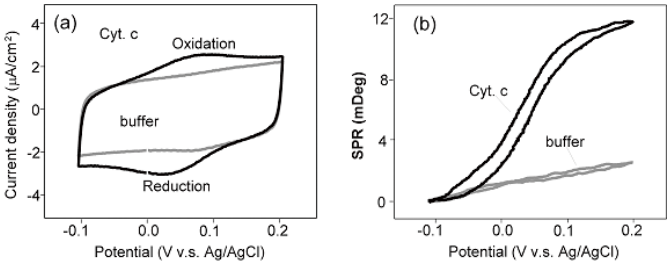
Formation of the anti-BSA/BSA immune complex is relevant to studies of the receptor site of the red blood cells. The reference subtracted binding curves for 4 channels at varying analyte concentrations with kinetic analysis fits are overlaid in red below. ka= 8.6 x 10^4 $M^{-1}s^{-1}$, kd= 1.5 x 10^{-4} s^{-1}, KD= 1.7 nM.



Electrochemical SPR Applications



Redox reactions in proteins and other molecules are known to cause conformational changes in the proteins. Such conformational changes are often too small to be monitored using structural analysis techniques, but they can be studied using electrochemical SPR.

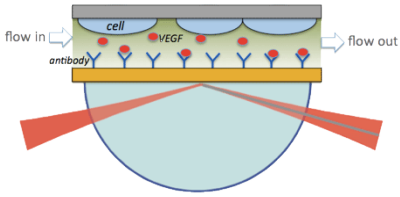


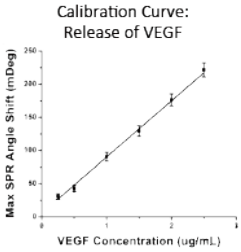
(a) Cyclic voltammogram of cytochrome c, immobilized on a 3-mercaptopropionic acid-functionalized Au SPR sensor chip and (b) the simultaneously recorded SPR angle shift vs. potential.

Boussaad et al. Anal. Chem. 2000, 72, 222-226

Biomarker Expression of Carcinoma Cells

Vascular endothelial growth factor (VEGF) is a protein biomarker produced by oxygen-hungry cells to stimulate the growth of blood vessels. Certain types of tumor cells produce abnormally large amounts of VEGF to block the action of angiogenesis inhibitors. This action is termed as "angiogenic switch", which leads to the metastasis of the tumor by providing blood supply for new tumors to grow. In this application, SKOV-3 ovarian cancer cells were cultured on the ceiling of the BI Flow Injection analysis module and VEGF secretion was measured using the SPR.

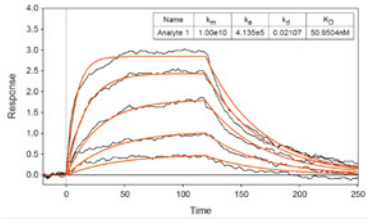




Liu et al. Anal. Chem. 2014, 86, 7305−7310

Small Molecule Applications

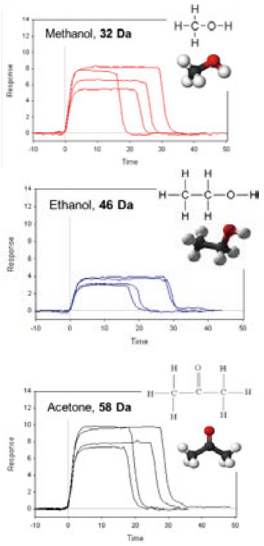
Carbonic anhydrase inhibitors are a class of pharmaceuticals that inhibit the activity of carbonic anhydrases (CA II). Clinically, these inhibitors have been used as antiglaucoma agents to alleviate mountain sickness and to manage neurological disorders. Acetazolamide (molecular weight = 222 Da) is one of the commonly used small molecule carbonic anhydrase inhibitors.

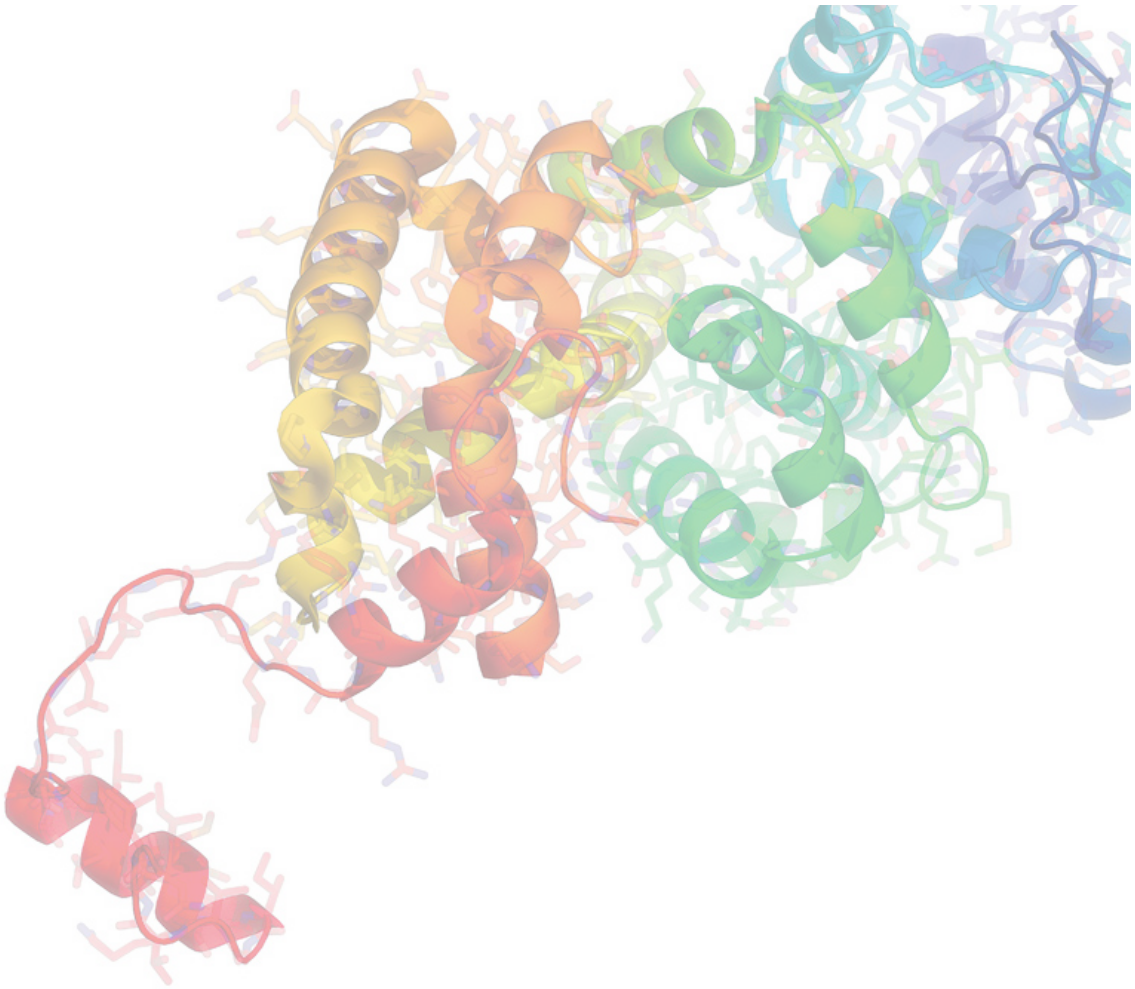


Binding curves (black) and simulation results (orange) of acetazolamide to pre-immobilized CAII. KD= 14.7 nM, ka= 84.1 x 10^6 $M^{-1}s^{-1}$, kd= 6.1 x 10^{-2} s^{-1}.

Gas SPR Applications for Biosensor Development

BI 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. The effect of three gases (Ethanol, Methanol and Acetone) were studied on four different sensing surfaces, resulting in quantitative characterization of the sensing polymers used for the gas sensors development.





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