INSTANT NanoBiosensors

BIOMARKER ANALYZER

by FOPPR™
Fiber Optic Particle Plasmon Resonance

INB-D200

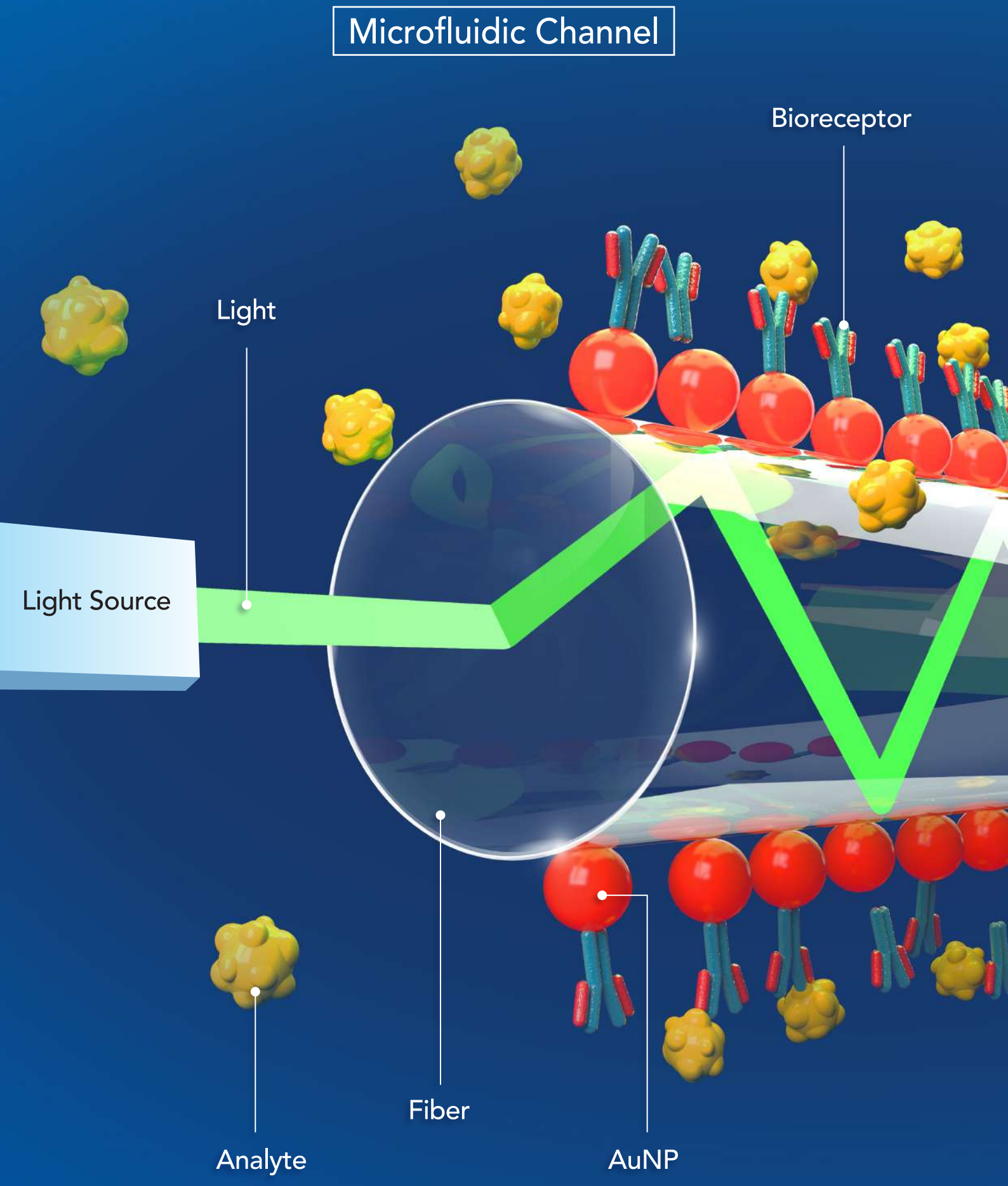
Label-free Ultrasensitive Real-time

Principles of FOPPR™

INB-D200 is a simple-to-use sensing platform that operates on the basis of fiber optic particle plasmon resonance (FOPPR™), a technology combining optical waveguides with noble metal nanoparticles, for the sensitive and reliable detection of molecules. In FOPPR™, gold nanoparticles (AuNPs) are in close proximity to an unclad optical fiber. As light propagates within the optical fiber, total internal reflection (TIR) results in an evanescent field that induces the AuNPs to undergo particle plasmon resonance (PPR).

As a derivation of surface plasmon resonance (SPR), PPR of noble metal nanoparticles is the collective oscillation of conductive electrons at the nanoparticle surface in response to incident light of a particular wavelength. The extreme sensitivity of this optical property to changes in the surrounding environment makes FOPPR™ an ideal technology for monitoring real-time interactions between a wide range of molecular species, including but not limited to organic drugs, oligonucleotides, proteins, and viruses.

Molecular detection in INB-D200 is achieved through the capture of free-flowing analytes by bioreceptors chemically bound to the FOPPR™ sensing surface. As target analytes are introduced to the sensing surface by the sample fluid, binding interactions between analytes and bioreceptors lead to a change in refractive index near the sensing surface. This refractive index change local to the sensing surface results in an immediate change in optical response proportional to the mass concentration of bound analytes. The label-free and biointeraction-based detection of FOPPR™ through INB-D200 enables a wide range of applications in biochemical research and development.

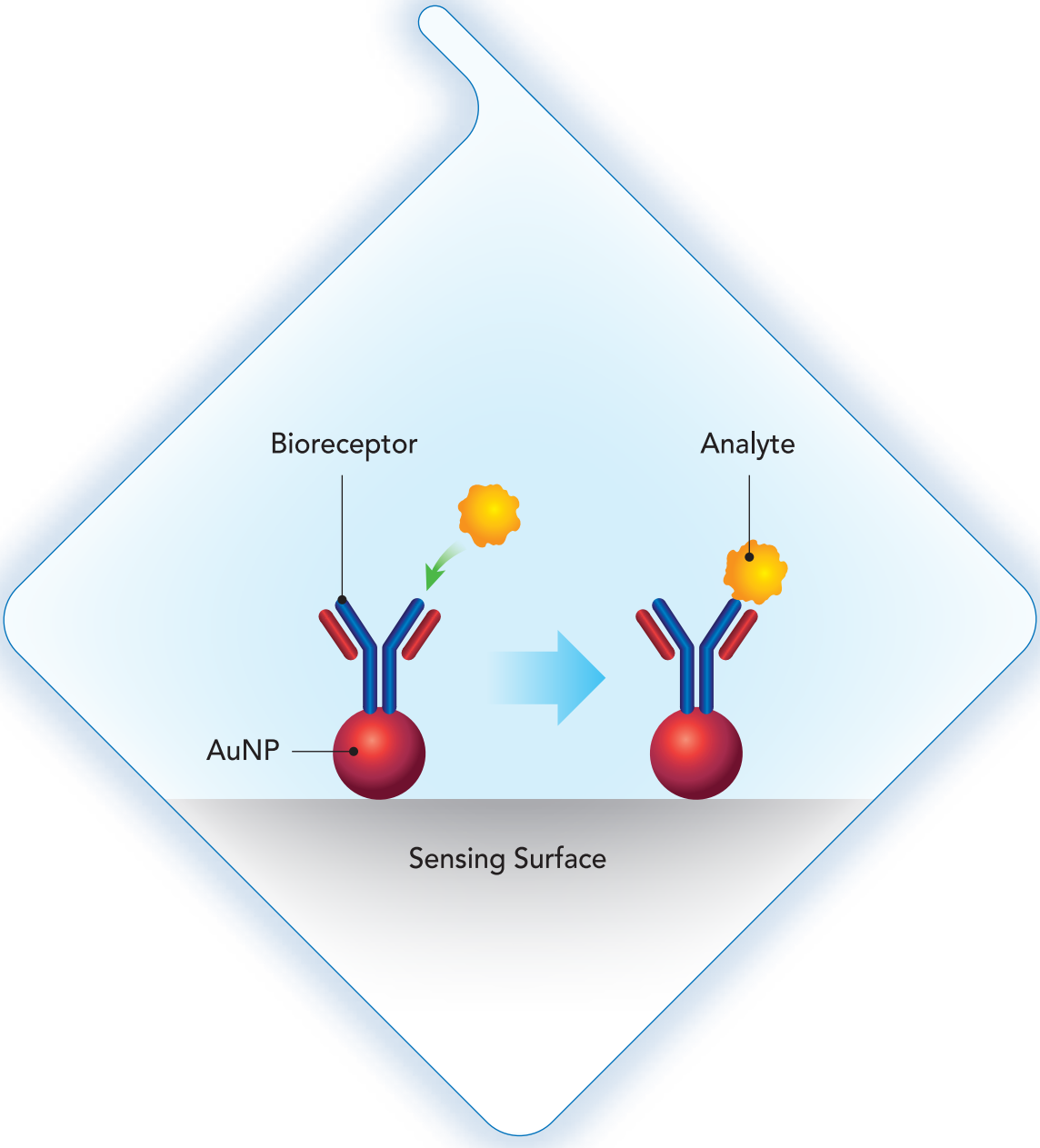

Microfluidic Channel
Bioreceptor
Light
Light Source
Fiber
Analyte
AuNP

Versatility of FOPPR™

Quantitation Assays

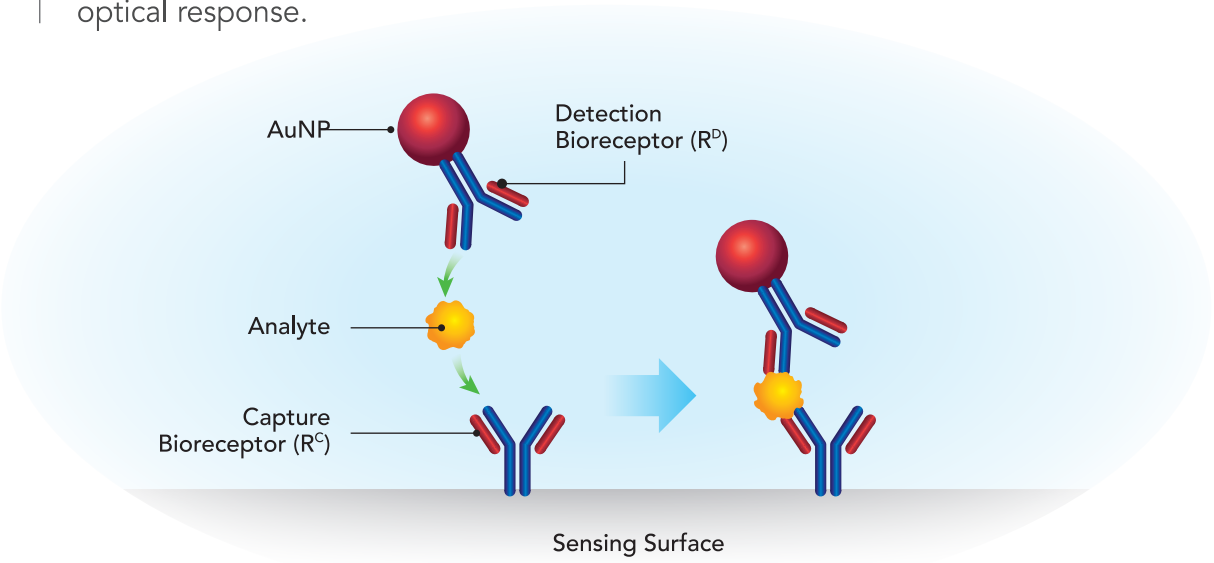
Direct Detection Assays

In direct detection assays, AuNPs are chemically bound to the unclad optical fiber surface. Receptor ligands are subsequently functionalized to the AuNPs. During detection, target analytes bind directly to the receptor ligands. Formation of analyte-receptor complexes induces a local change of refractive index near the sensing surface, producing an optical response proportional to the mass concentration of the bound target analytes.



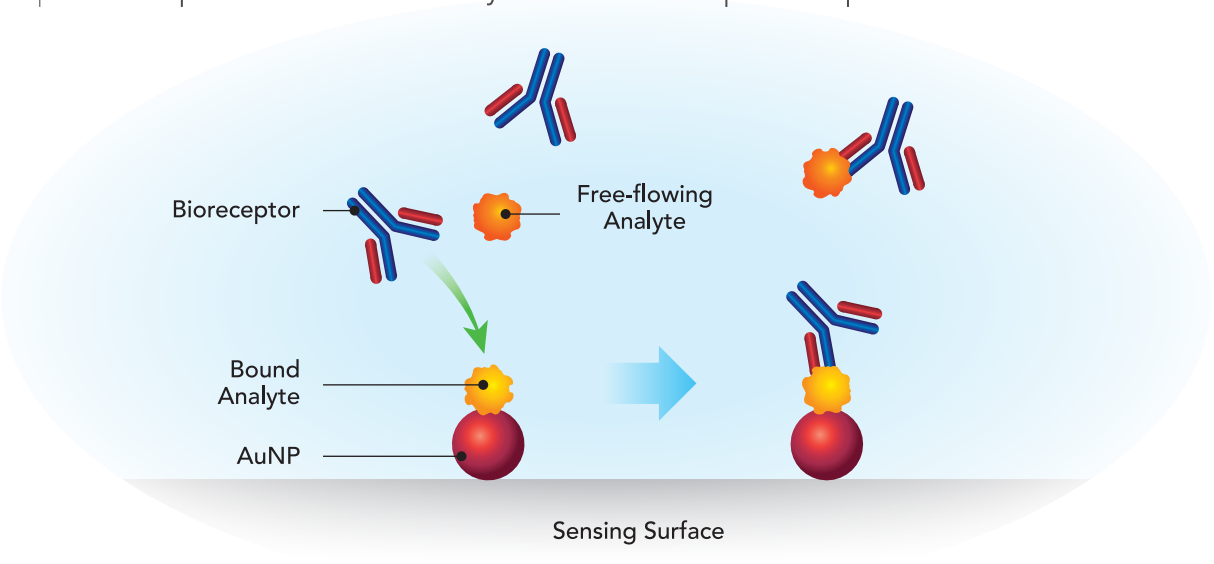
Enhancement Assays

Enhancement assays require the use of two binding partners. Capture receptors (R^C) are fixed onto the unclad optical fiber while detection receptors (R^D) are bound to the AuNPs. During a sensing event, R^D-functionalized AuNPs are introduced to the R^C-functionalized sensing surface with the target analytes (A). AuNPs are brought to the sensing surface through formation of sandwich-like R^D-A-R^C complexes. Presence of AuNPs at the sensing surface results in a dramatic optical response.



Competition Assays

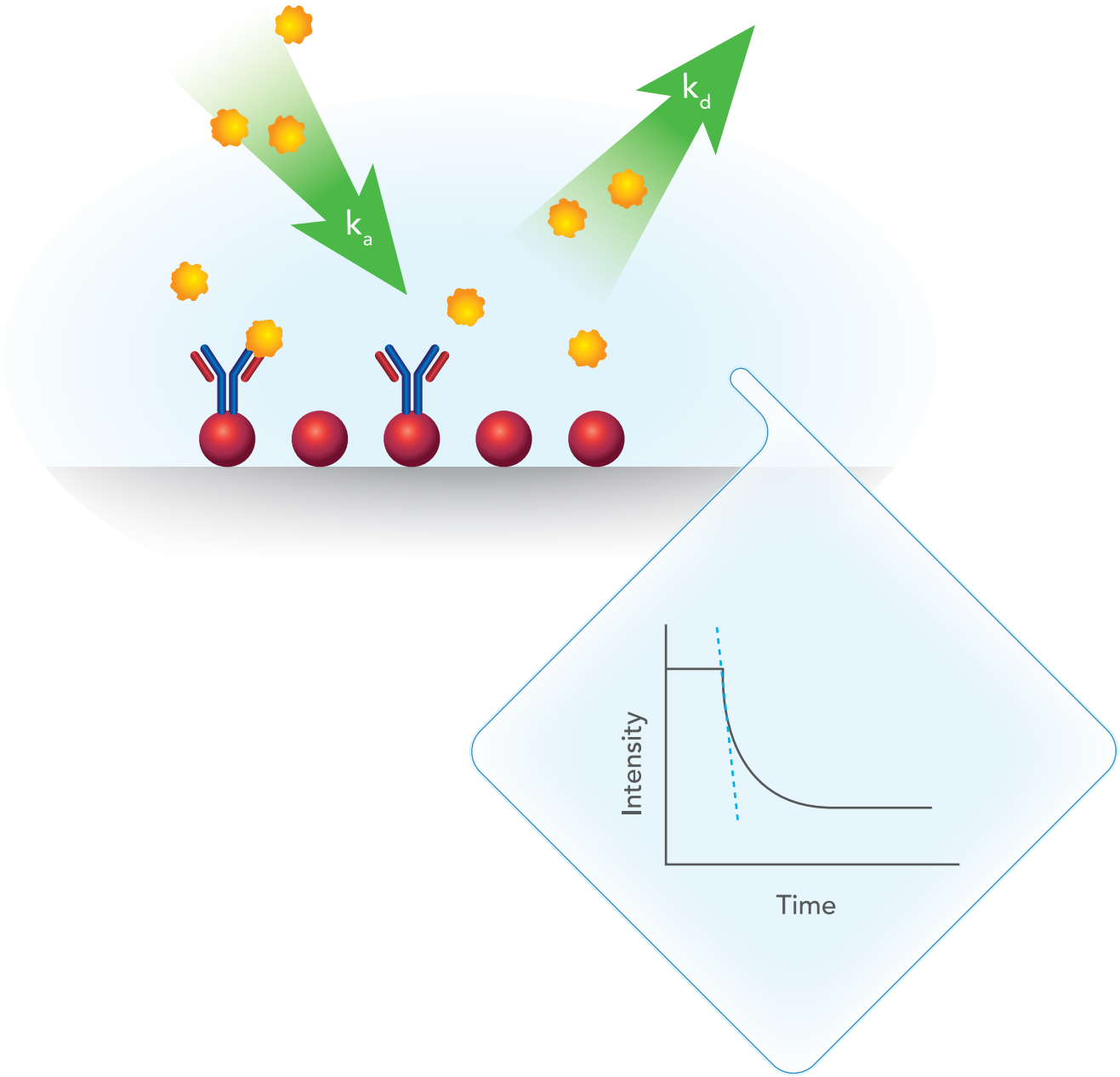
Competition assays are suitable for the detection of small molecules. In this detection scheme, the AuNPs-functionalized sensing surface is modified with target analytes. In a sensing event, a sample of free-flowing analytes are premixed with corresponding bioreceptors followed by introduction to the sensing surface. Free-flowing analytes and bound analytes then "compete" for binding with the bioreceptor. Binding of bioreceptor to the bound analyte results in an optical response.



Versatility of FOPPR™

Binding Kinetics and Affinity Assays

The rate and strength of interactions between molecular species are important in biochemical research. These properties are measured through the kinetic and affinity constants, respectively, of the analyte of interest. The label-free and real-time monitoring of interactions between molecular species through FOPPR™ produces binding kinetic curves unique to the specific analytes. Kinetic and affinity information can be calculated through post-process data deconvolution and curve fitting.



Features & Benefits of FOPPR™

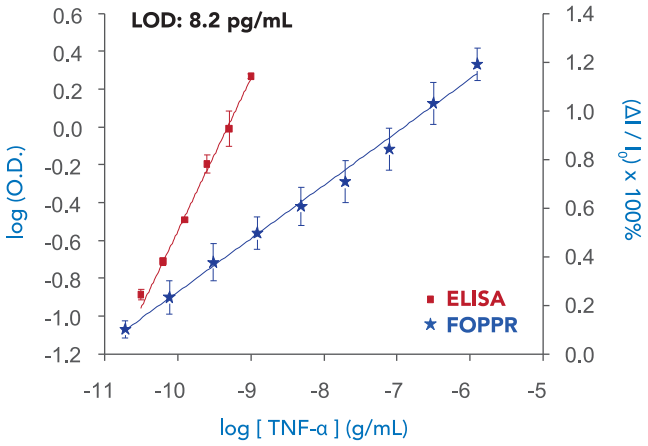
Label-free	Acquisition of data without the need of fluorescent, colorimetric, electrochemical, or radioactive labels
Real-time	Continuous monitoring of biochemical interactions with results available immediately after testing
Specific	Biointeraction-based detection ensures analyte specificity
Sensitive	Nanomolar to picomolar sensitivity of analytes with direct detection assays; femtomolar sensitivity of analytes with enhancement assays
Versatile (Analyte type)	Platform-based sensing to suit different research needs
Versatile (Sample type)	Wide scope of sample types, including but not limited to serum, plasma, synovial fluid, and urine
Broad Concentration Range	Linear concentration range spans 6 orders (pg/mL to μg/mL)
Low Sample Consumption	100 μL of post-treated sample required per sensor chip
Powerless Liquid Flow	No external pumps or valves necessary
Easy-to-operate	Simple pretreatment of sensing samples
Time-saving	10~15 minutes detection time for direct detection assays; 15~20 minutes detection time for enhancement assays
Ratiometric Data Output	Self-calibrated analysis alleviates the need for precise optical alignment of sensor chips

Applications of FOPPR™

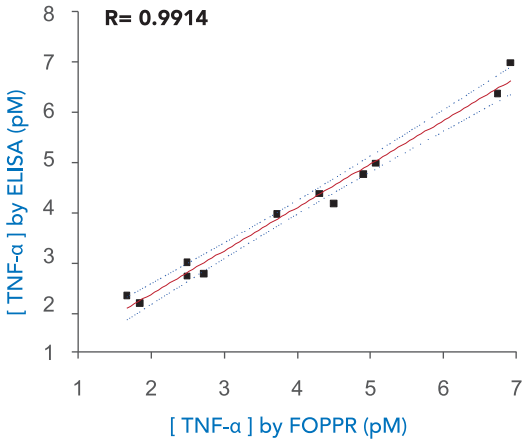
Direct Detection Assay

Tumor Necrosis Factor-α (TNF-α) in synovial fluid

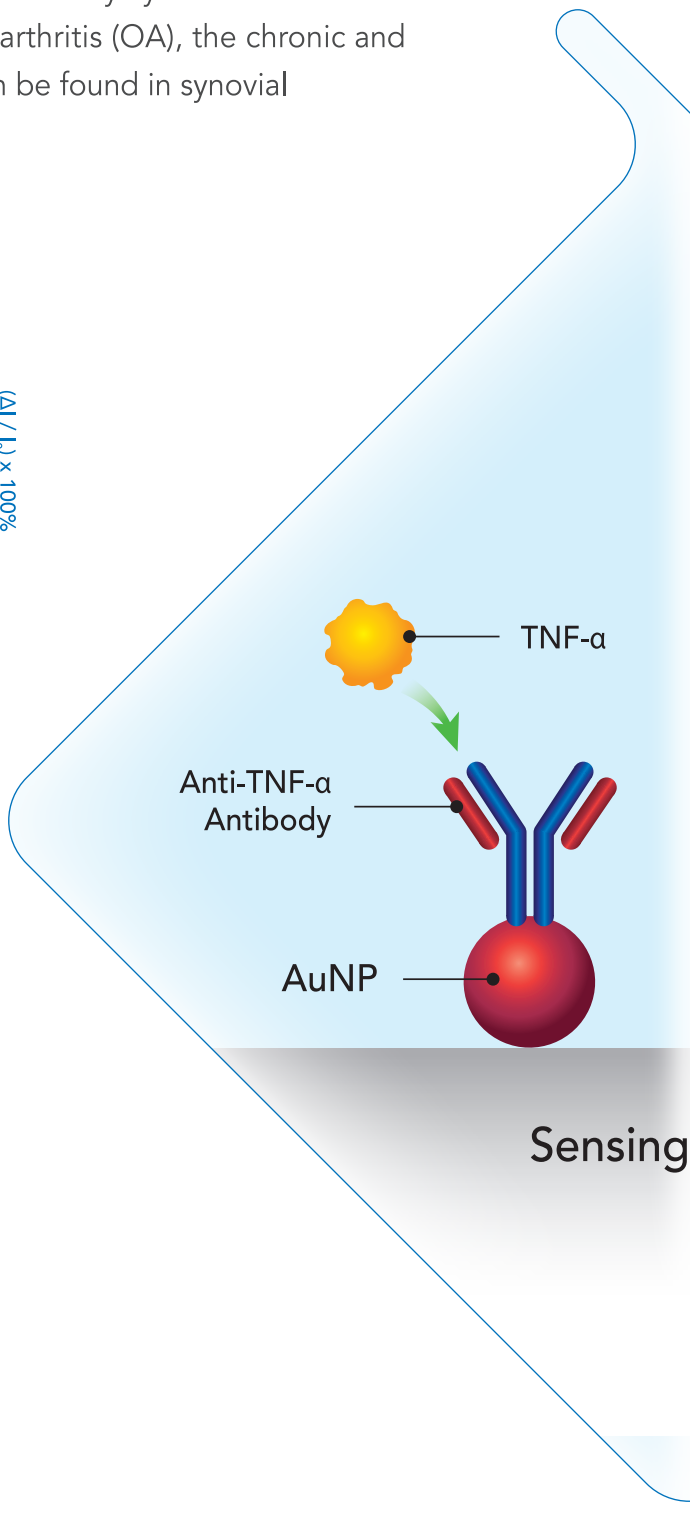
Tumor necrosis factor-α (TNF-α) is a proinflammatory cytokine that can act as a biomarker for the early detection of osteoarthritis (OA), the chronic and systematic inflammation of the joints that can be found in synovial joints of the body.



Sensitive and broad detection range of TNF-α.

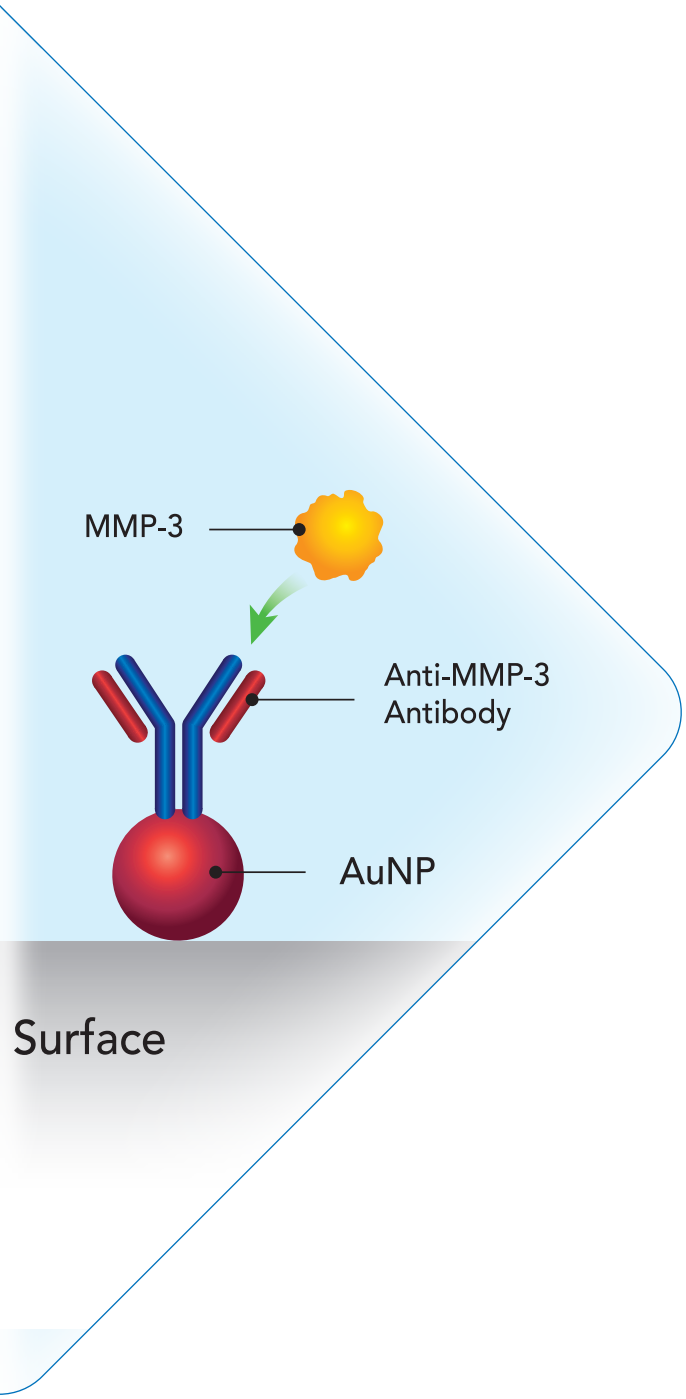


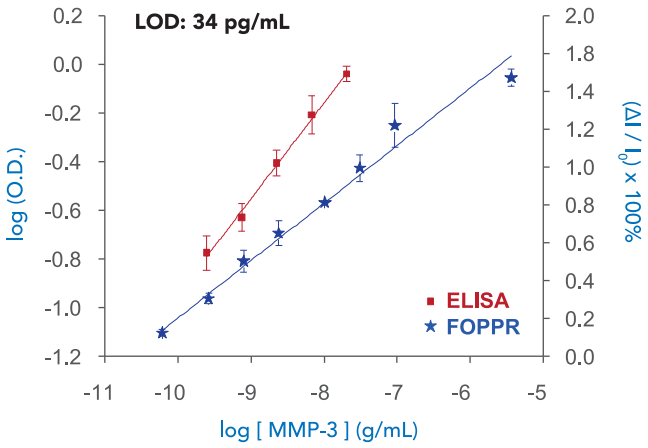
Detection of TNF-α with FOPPR™ is highly correlated with results obtained from ELISA.



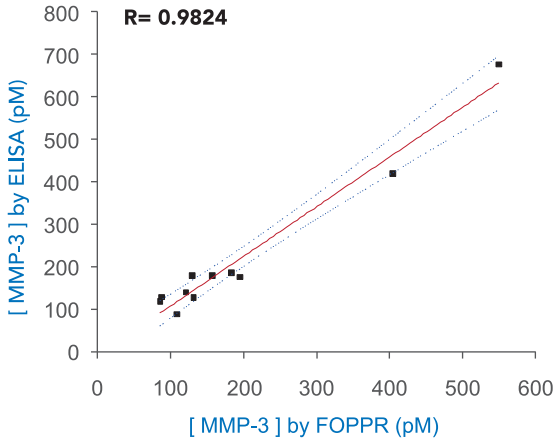
Matrix Metalloproteinases-3 (MMP-3) in synovial fluid

Matrix metalloproteinases-3 (MMP-3) is an enzyme induced by inflammatory cytokines such as TNF-α and interleukin-1β that also indicates OA.





Broad detection range of MMP-3.



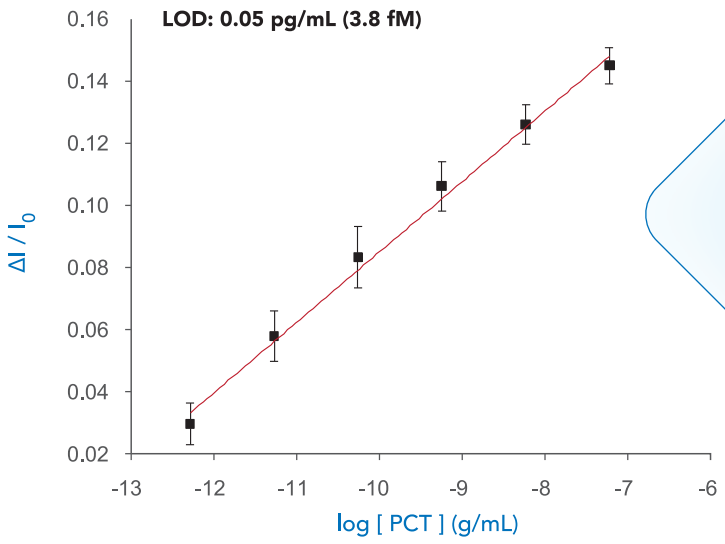
Detection of MMP-3 with FOPPR™ is highly correlated with results obtained from ELISA.

Applications of FOPPR™

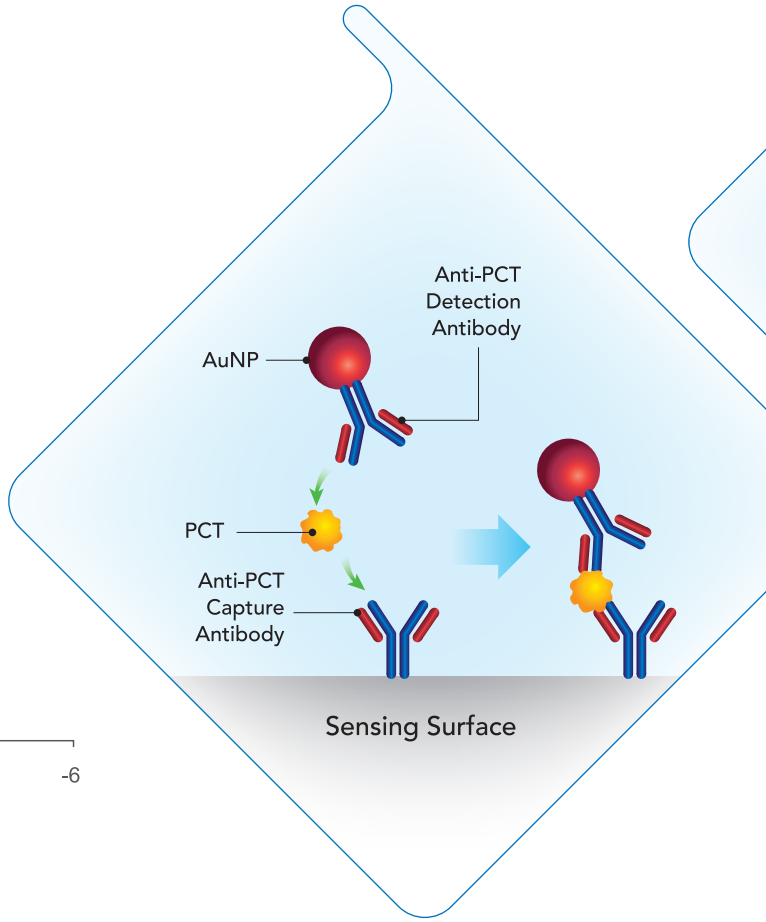
Enhancement Assay

Procalcitonin (PCT) in serum

Septicemia is a life-threatening condition caused by bacterial infection of the blood. This may lead to sepsis, a serious complication that causes inflammation throughout the body, resulting in blood clots to cause organ failure. Procalcitonin (PCT) is a biomarker that can specifically diagnose septicemia and measure its severity with high accuracy.



Femtomolar detection of PCT.

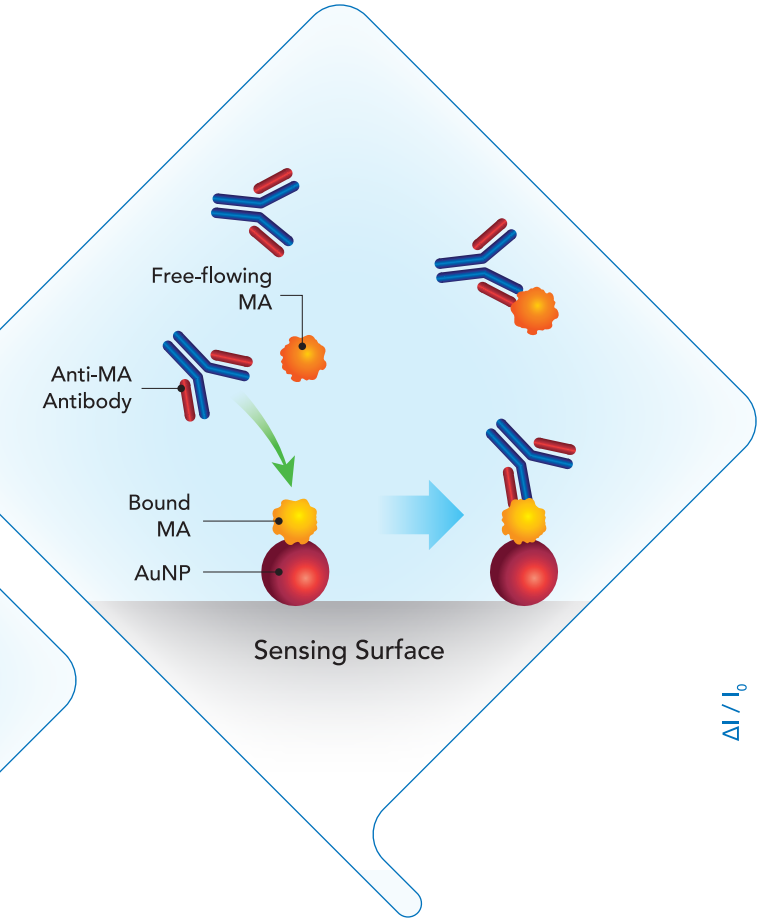


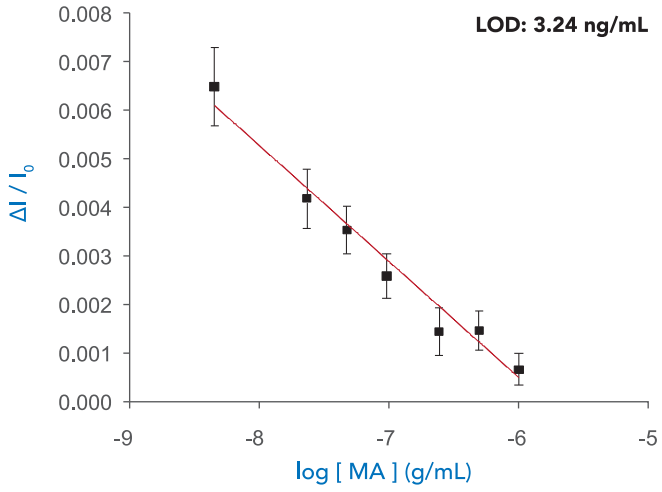
Detection of PCT with FOPPR™ is facilitated through the enhancement assay. Anti-PCT capture antibodies are immobilized onto the sensing surface while anti-PCT detection antibodies are functionalized onto the AuNPs. During detection, presence of PCT results in formation of sandwich-like antibody-antigen-antibody-AuNP conjugates at the sensing surface.

Competition Assay

Methamphetamine (MA) in urine

Methamphetamine (MA) is a highly addictive stimulant drug. Abuse of this illicit drug can lead to an increased risk of contracting infectious diseases, extreme weight loss, severe dental problems, organ failure, or death.





Sensitive detection of MA.

MA can be detected with INB-D200 through an indirect competition assay. In this scheme, known concentration of MA is first functionalized onto the sensing surface. A sample of free-flowing MA with unknown concentration premixed with anti-MA antibodies is then introduced to the sensing surface. Bound MA and free-flowing MA "compete" for the anti-MA antibodies during detection. Binding of anti-MA antibodies to the bound MA results in a refractive index change at the sensing surface and produces an optical response.

Product Specifications *INB-D200*

Detection Technology	Fiber optic particle plasmon resonance (FOPPR™)
Sample Type	Organic drugs, oligonucleotides, proteins, viruses, and bacteria in various environments (e.g. serum, plasma, synovial fluid, and urine)
Information Provided	Concentration, specificity, kinetics (k_a, k_d) and affinity (k_f) data
Operating Temperature	10~40°C
Injection Volume	100 µL
Number of Flow Chips	2 chips; 8 chips (launching in 2019 Q4)
Dimensions	260 mm x 390 mm x 310 mm
Weight	6 kg
PC Operating Systems	Microsoft Windows 7 or above
Software	INB-D200 software for data acquisition and data analysis
Power Consumption	12 W, AC 100~220 V, 50/60 Hz

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FOPPR™ Fiber Optic Particle Plasmon Resonance

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