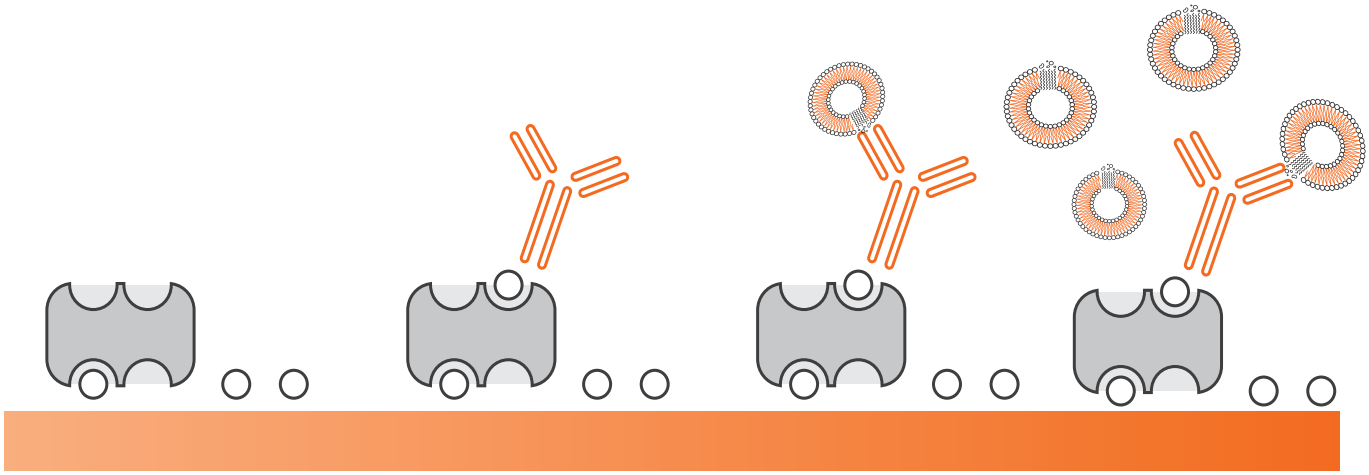
BioNavis

EXPLORING EXTRACELLULAR VESICLES USING MP-SPR

The size and concentration of small extracellular vesicles can be measured using target-specific markers. The uptake of extracellular vesicles by the cells can be studied label-free.



Extracellular vesicles (EVs):

Extracellular vesicles are extensively studied due to their unique characteristics. EVs play crucial roles in intercellular communication by transferring bioactive molecules between cells. This communication mechanism influences various physiological and pathological processes, such as immune response regulation, tissue repair, cancer progression, and neurological function.

EVs can provide insights into disease mechanisms, facilitate early diagnosis, and monitor disease progression and treatment response due to their ability to carry specific cargo from the cell of origin. Moreover, EVs hold promise as therapeutic agents because of their ability to deliver bioactive cargo to target cells. Analysis techniques such as Multi-Parametric Surface Plasmon Resonance (MP-SPR) enable researchers to elucidate the complex roles of EVs in health and disease.

KEY QUESTIONS MP-SPR CAN ANSWER IN EXTRACELLULAR VESICLE RESEARCH:

- What is the size of the EV?
- What is the concentration of the produced EVs?
- Can you measure the EV uptake by cells along with the kinetics of this uptake ?
- Does my novel therapeutic marker bind to EV?
- What is the selectivity and specificity of the novel EV therapeutic?
- How do the purified EVs interact with the plasma proteins?

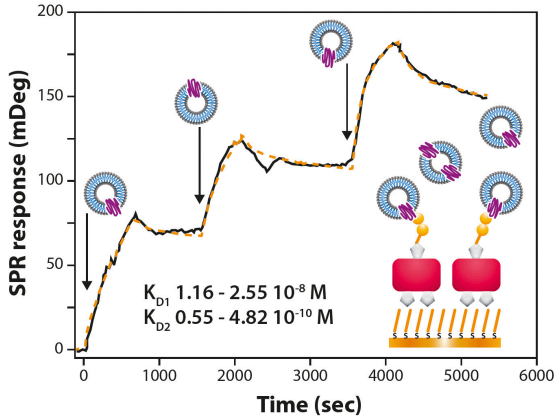
WHY CHOOSE MP-SPR FOR EV RESEARCH?

Characterize Extracellular vesicles:

- Size >30nm
- Concentration
- Cellular uptake
- Corona measurement
- Affinity and kinetics

Interactions with high precision

MP-SPR measures the binding affinity of EVs and their diagnostic molecules (such as antibodies, peptides, or aptamers) without labels. The dynamic flow principle also provides binding kinetics. The derived kinetic measurements can be used to improve the diagnostic molecule interaction parameters.



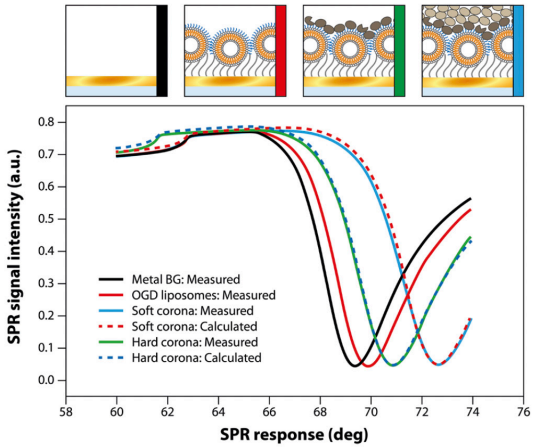
Tumor EVs binding on surface-immobilized peptide for breast cancer detection. Affinity, kinetics, layer thickness and mass acquired based on MP-SPR measurement. Application Note #164

EV size and concentration measurement

EV size can vary from 30 nm to 10 µm. MP-SPR is an ideal tool for measuring EV size, especially for EVs smaller than 100nm due to high sensitivity of the technology. The unique multi-wavelength setup of MP-SPR, along with complete SPR curve measurements, are crucial features for size and concentration measurements. BioNavis EV characterization kit provides straight forward approach for size and concentraion characterization. The sensors can be functionalized by the user, the detection antibodies can be used depending on the EVs under investigation. Detection is not limited by the media used; hence, measurements can be performed also in complex media.

Compatible with cell culture media

MP-SPR measurements can be performed with complex media such as cell culture media, plasma or serum. BioNavis's PureKinetics™ feature enables real-time cross-correlation of parameters and offers simple, in-line correction for potential solvent mismatch caused by complex media. Plasma proteins have been shown to interact with EVs, and MP-SPR has been used to study the interaction between vesicles and serum proteins forming protein corona. As the measurements are performed on dynamic flow, this allows the study of proteins forming soft corona on EVs, which can be obtained for further analysis.



100% serum sample formed soft and hard corona (complex layer of biomolecules) on vesicles. Protein corona layers thickness and refractive index was determined based on MP-SPR measurement. Application Note#151

Interactions with membranes and live cells

MP-SPR allows you to either form a lipid bilayer on the sensor surface to mimic the cellular interaction or culture adherent cells. MP-SPR's flexible sensor slide design allows the use of standard cell culture protocols to form a confluent cell layer on a sensor slide *ex situ*. Dynamic measurements can then be used to observe the uptake of extracellular vesicles in living cells. This unique capability, enabled by the complete SPR curve measurement (multiparametric) of MP-SPR, provides new insights into EV uptake. Additionally, after real-time MP-SPR measurements, the sensor slide can be further validated *ex situ* with microscopy techniques, including AFM and SEM.

Label-free measurement

Since MP-SPR is a label-free technique, EVs are not required to be labeled with fluorescent dyes for EV-cellular interaction. As MP-SPR is unaffected by the culture media's auto-fluorescence, measurements can be performed with any cell culture media with serum.

Further reading

AN#164 Affinity and kinetics of EV - protein interaction

AN#157 Pore forming toxins against lipid vesicles

AN#156 EV Uptake by Cells

AN#151 Protein corona formation on vesicle in 100% serum

Selected publications

Size and concentration of Extracellular Vesicles
(Parkkila *et al*., Colloids and Surfaces, 2022)

Extracellular vesicles uptake by cells
(Koponen *et al*., Biosensors and Bioelectronics, 2020)

Extracellular vesicles kinetics
(Carney *et a*l., Advanced Biosystems, 2017)

Lipid Vesicles corona
(Otto *et al*., Drug Delivery and Translational Research, 2016)

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