

- Title:

Plasmonic biosensors based on singular phase-enhanced lateral position shift for real-time detection of RGD-binding Integrins.

- Author(s) information:

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- Speaker biography (1000-character max including spaces)

Speaker biography: Shaodi ZHU is currently an exchange research student at Laboratory Light, nanomaterials and nanotechnologies – L2n, French National Centre for Scientific Research (CNRS EMR 7004), France under the supervision of Dr. Shuwen ZENG (CNRS Permanent Researcher). He is also a PhD student with the Department of Biomedical Engineering at the Chinese University of Hong Kong under the supervision of Prof. Aaron Ho-Pui HO. His main research interests focus on plasmonic biosensors and lab-on-fiber technologies for circulating tumor cell detection.

- Abstract for technical review:

In this paper, we have designed and fabricated an atomically thin two-dimensional phase change material Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub> on silver (Ag-GST). The ultra-thin GST materials were optimized to precisely tune the optical absorption of the sensing substrate. Another advantage of the 2D GST is to

protect the silver thin film to be oxidized from the ambient environment. Here, we have optimized the thickness of the GST thin film from 1 nm to 3 nm on top of the silver and gold substrate ranging from 30nm to 50 nm. The fabricated sensing chips with 32 nm silver and 1nm GST led to an ultra-low reflection in the SPR curves and a strong phase singularity. We have used our custom-built SPR sensing setup to directly measure the phase-singularity-induced lateral position shift. When we performed the measurement, the incident angle of light is fixed at the SPR resonance angle of buffer solution followed by the injection of the biological liquids. A large position shift of 7611  $\mu\text{m}$  can be achieved with the designed Ag-GST substrate, which is 2 orders of magnitudes higher than pure silver thin film. Also, the peak of position shift verses angle has a narrow width of  $0.0011^\circ$ . The sensitivity of position shift to refractive index change is  $9.9577 \times 10^7 \mu\text{m}/\text{RIU}$ . Consequently, a high Q factor of  $9.304 \times 10^8$  is obtained (in the unit of  $\mu\text{m}/(\text{RIU} \cdot \text{degree})$ ), which is 6 orders of magnitudes higher compared to pure silver and Au-GST substrate with same thickness configuration. For the biological calibration experiments, we have tested the large protein molecules - bovine serum albumin (BSA) with a molecular weight of 66 kDa. A detection limit of  $10^{-16}$  mol/L for BSA was obtained. For cell adhesion experiments, over  $100\mu\text{m}$  position shift was found after 20 minutes incubation with 10 Human retinal pigment epithelial-1 (RPE-1) cells. The binding dynamics of RGD peptide and switchable integrins of liposomes are very important for understanding the protein functions of extracellular matrix. It is for the first time that we are able to study the binding process between peptide and integrins directly from un-purified liposomes. The concentrations of  $\text{Mn}^{2+}$  ions ranging from 1fM to 1mM on the binding dynamics have been systematically monitored with our developed phase-sensitive surface plasmon resonance biosensors.

- Summary of abstract for display in the program:

In this paper, we have designed and fabricated an atomically thin plasmonic sensing substrate based on two-dimensional phase change material Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub> and silver (Ag-GST). This substrate offers an ultra-low reflection in the SPR curves and a strong optical phase singularity. A custom-built SPR setup was developed here to directly measure the phase-singularity-induced lateral position shift. We have obtained a SPR sensitivity regarding the lateral position shift of  $9.9577 \times 10^7 \mu\text{m}/\text{RIU}$ , which is 3 orders of magnitudes higher than current position shift sensing scheme based on hyperbolic metamaterial. Due to the ultra-high SPR sensitivity, the binding processes between peptide and integrins directly from un-purified liposomes were real-time monitored. The concentrations of Mn<sup>2+</sup> ions ranging from 1 fM to 1 mM on the binding dynamics have been systematically monitored with our developed phase-sensitive surface plasmon resonance biosensors.

- Keywords used in search for your paper (optional):

Plasmonic Biosensor, Nanomaterials, Phase Change Material, Biomedical Sensing