Nanoscale Science and Technology Division
Room 304 - Session NS1+BI-WeA

Nanopore Sensing and Fabrication, Operation and Metrology of Biodevices

Moderators: David Czaplewski, Argonne National Laboratory, **Georg Fantner**, EPFL, Switzerland

2:20pm **NS1+BI-WeA-1 Single Cell and Single Molecule Biophysics with Glass Nanopores**, ***Georg Fantner***, *A. Radenovic, S. Leitao, V. Navikas, B. Drake,* EPFL, Switzerland **INVITED**

Scanning ion conductance microscopy (SICM) has been around for decades, yet it has not received as much attention as other forms of scanning probe microscopy. Recently, this true non-contact techniquehas kindled renewed interest among biophysicists and biologists because it is ideally suited for label-free imaging of fragile cell surfaces where it achieves exquisite resolution down to the nanometer regime without distorting the cell membrane. SICM uses a glass nanopipette as a scanning probe and measures the current through the glass nanopore as a proximity detection of the sample surface. The challenge to harness this technique for time resolved 3D nanocharacterization of living cells lies in the relatively slow imaging speed of SICM. In this presentation I will show how we apply what we have learned from high-speed AFM to the field of SICM. By reengineering the SICM microscope from the ground up, we were able to reduce the image acquisition time for SICM images from tens of minutes down to 0.5s while extending the imaging duration to days.

SICM, however, is much more versatile than just an imaging tool. I will also discuss our recent results using SICM as a single molecule characterization tool. We term this method scanning ion conductance spectroscopy (SICS). Using capillaries with exceptionally small nanopores, we are able to detect and manipulate single molecules in a repeatable and high throughout manner.

3:00pm **NS1+BI-WeA-3 Ultrasensitive Nanoporous Gold Substrates for SERS Detection in Liquids or Gases**, ***Issraa Shahine***, *B. Humbert, J. Mevellec, M. Richard-Plouet, P. Tessier,* Nantes Université, CNRS, Institut des Matériaux de Nantes Jean Rouxel (IMN), France

The design of three-dimensionally structured, gold nanoporous membranes is described. Our aim is to design surface enhanced Raman scattering (SERS) substrates to detect very low concentrations of molecules in liquid or gaseous phases. The SERS substrates are constituted of stacked ultrathin nanoporous gold thin layers. They are obtained in a two-step process: first deposition of alternative copper and gold stacked nanolayers by magnetron sputtering, and second, chemical etching to dissolve copper, resulting in the nanoporous morphology. The obtained thin layers of gold give rise to superior surface enhanced Raman scattering (SERS) capability using 2,2-bipyridine (BP) as probe molecules for detection. The SERS intensity mapping confirm the presence of hot spots with a low detection limit down to 10^{-18} mol.L^{-1} of BP concentration. The ultrasensitivity at low concentration molecules is assigned to the effects of the localized enhanced electromagnetic fields around the nano ligaments. An additional Raman mechanism is also highlighted by μ-Surface Enhancement Spatially Offset Raman spectroscopy (μ-SESORS): gold ligaments inside nanoporous layers act as waveguides for the incident light, leading to a significant increase in the size of the active SERS area. These SERS substrates have the ability to detect low BP vapor pressure in air.

This process is a reliable method for fabricating uniform, highly reproducible and efficient SERS substrates, with a robust SERS response at extremely low detection limits.

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