Cuong Cao, Biol Syst Open Access 2015, 4:2
http://dx.doi.org/10.4172/2329-6577.S1.002

OMICS International
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3rd International Conference on
Integrative Biology

August 04-06, 2015 Valencia, Spain

Meta materials-based label-free nanosensor for conformation and bio-affinity sensing

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Analysis of molecular interaction and conformational dynamics of biomolecules is of paramount importance in understanding of their vital functions in complex biological systems, disease detection and new drug development. Plasmonic biosensors based upon surface plasmon resonance and localized surface plasmon resonance (LSPR) has become the predominant work horse for detecting accumulated biomass caused by molecular binding events. However, unlike surface-enhanced Raman spectroscopy (SERS), the plasmonic biosensors are not suitable tools to interrogate vibrational signatures of conformational transitions required for biomolecules to interact. In this presentation, we demonstrate that plasmonic meta-materials consisting of periodic arrays of artificial split-ring resonators (SRRs) can enable capabilities of both sensing and fingerprinting of biomolecules. By engineering geometry of individual SRRs, LSPR frequency of the meta-materials could be tuned to visible-near infrared regimes such that it allows parallel acquisition of optical transmission and highly SERS spectra from large functionalized SRR arrays. This will provide the basis for the development of a dual detection platform that can simultaneously probe conformational states and binding affinity of biomolecules example, G-quadruplexes in different environments. We further present the use of the meta-materials for fingerprinting and detection of arginine-glycine-glycine domain of nucleolin, a cancer biomarker which specifically binds to a G-quadruplex with the picomolar sensitivity. The dual-mode nanosensor will significantly contribute to unraveling the complexes of the conformational dynamics of biomolecules as well as to improving specificity of bio-detection assays.

Biography

Cuong Cao is currently a Lecturer in Advanced Micro and Nanodiagnostics within Institute for Global Food Security, Queen's University Belfast, UK. His research interest includes exploration and exploitation of multifunctional micro and nanostructures, plasmonics based bio-sensing platforms (SPR, LSPR, SERS) and integrated point-of-care analyses with a particular emphasis on detecting and identifying pathogens, biomarkers, food and environment toxins.

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