



UNIVERSITY OF CENTRAL FLORIDA

NANO SCIENCE TECHNOLOGY CENTER
ADVANCED MATERIALS PROCESSING & ANALYSIS CENTER

GRADUATE RESEARCH SEMINAR SERIES

Friday
September 30, 2016

12:15 PM

Research Pavilion
NSTC
Room 169

*Pizza and drinks
will be provided*

Nanostructured Hybrid Cavity-Coupled Plasmonic Biosensor for Dopamine Detection

Abraham Vazquez-Guardado
Dr. Debashis Chanda's Group

Dopamine is a critical neurotransmitter in our nervous system whose abnormal levels is associated with neuropsychiatric disorders (depression, drug and alcohol dependence, Parkinson's disease), pathogenesis of psychosis (schizophrenia) and, potentially, early development of neural cancer (pheochromocytoma, neuroblastoma, or paraganglioma). Detection of dopamine with high sensitivity and specificity could help in basic understanding of the pathophysiology, drug development, and disease management. Current dopamine diagnostic tests, such as the enzyme-linked immunosorbent assay (ELISA) or and High Performance Liquid Chromatography (HPLC) require extensive sample preparation to achieve the required sensitivity and specificity (lower limit 20 μM). Alternative methods for detection are desired that comply with the physiological levels, detection limits and selectivity and sensitivity. We demonstrate that a nanoimprinted plasmonic system with locked-in dimensions exhibits sharp deterministic hybrid resonances when coupled with an optical cavity. At the LSP resonance (LSPR) wavelength the local electron charge oscillation on the metal-dielectric interface induces strong field localization over subwavelength volumes and is very sensitive to minute environmental fluctuations induced by the change in the local refractive index. Selectivity is imposed with the appropriate analyte-specific surface functionalization, i.e., the target analyte is selectively immobilized on the plasmonic sensor's surface through the strong surfactant-analyte binding affinity. We propose to detect dopamine using inorganic ceria nanoparticles (CNPs) sensor surface modification. At nanoscale, CNPs are redox active and CNPs known to protect normal cells (photoreceptor, nerve and skin cells) and tissue against oxidative stress. CNPs selectively form a complex with dopamine due to its unique redox activity at nanoscale. When colloidal CNPs absorb dopamine its optical properties change, which is observed as a spectral shift of the scattering cross section. When CNPs reside on the LSP sensor's surface, such complex formation information is transferred to the LSP resonances experiencing a spectral shift. In our preliminary experiment, we have shown that we can detect dopamine in several buffer solutions as low as 100 fM level using $\sim 50 \mu\text{l}$ of the solution.

