FROM SENSING TO MAKING SENSE

Detection Of Dimethyl Methyl Phosphonate (dmmp) By Acetylcholinesterase (ache)-grafted Plasmonic Sensor

Olga Baturina Naval Research Laboratory **Dipendu Saha** Widener University **Qin Lu** US Naval Research Laboratory **Kurt Kolasinski** West Chester University **Alexander Govorov** Ohio University

Organophosphorus-based substances are highly toxic to humans and therefore an early detection system is needed to recognize their possible presence. In this work, we have fabricated a plasmonic sensor to detect the presence the dimethyl methylphosphonate (DMMP) as a model for organophosphorus-based substances in the liquid medium. The sensor was fabricated by functionalizing Au nanostructures in an inexpensive Surface Enhanced Raman Spectroscopy (SERS) strip with 3-mercaptopropionic acid (3-MPA) and acetylcholinesterase (AChE). The sensor was characterized with atomic force microscopy (AFM), Z-contrast scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), and UV-Vis absorption spectroscopy. The localized surface plasmon resonance (LSPR) excitation peak wavelength of the Au nanostructure is centered around 536 nm. It was observed that the sensor element underwent a blue shift in LSPR excitation wavelength with DMMP concentration as low as 10 parts per billion (ppb) and continued to increase the blue shift up to the concentration of 50 ppb. A linear calibration was made with the response in blue shift and DMMP concentration and the corresponding statistical analysis revealed that the limit of detection (LOD) and limit of quantification (LOQ) of DMMP were 12.08 ppb (97.40 nM) and 36.61 ppb (295.15 nM), respectively. Theoretical calculations were performed to determine the local dielectric function of the sensor element and it was observed that plasmon peaks were linearly correlated with matrix dielectric function.

D.S. acknowledges the sabbatical award from Widener University. Q.L. and O.A.B. are grateful to Naval Research Laboratory for financial support of this work. Y.E.S. and A.O.G. are supported by the ARO grant (contract W911NF-19-20081) and the Nanoscale & Quantum Phenomena Institute at Ohio University.