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SERS over ELISA for rapid and label-free detection of the response of stress markers to environmental toxins

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Abstract

Monitoring environmental toxicant contamination demands portable environmental sensor technology (PEST) comparable or better than the gold-standard enzyme-linked immuno sorbent assay (ELISA). We have developed a label-free surface enhanced Raman scattering (SERS) sensor to detect the dose dependent response of stress protein markers (HSP70 and RAD54) to environmental toxins, U.V. and hydrogen peroxide with fewer intervening washing and binding steps compared to ELISA. The SERS sensor was fabricated by conjugating glycosylated monoclonal antibodies to silver nanoparticles (AgNPs) of roughly 50-nanometer size (SERS substrate) for selective detection of stress markers. The extracellular detection of markers in cell extract from yeast exposed to toxins, usingthe SERS showed good correlation with commercial ELISA. Both sensors had comparable sensitivity and accuracy in end-point detection of the markers. The successful extracellular detection using SERS and its good correlation with ELISA encouraged us attempt to detect the markers intracellular. In efforts towards intracellular detection, we examined three possible techniques to efficiently deliver the SERS sensor to yeast. Active delivery using low voltage electroporation caused physical damage to the cells as evident by SEM. Passive diffusion of the sensor on the basis of their inherent physico-chemical properties resulted in very slow and low uptake compared to facilitated delivery using the cell permeability fusogenic peptide TATHA2 as measured by inductively coupled plasma-mass spectrometry, confocal and *in situ* TEM images of the AgNPs in ultra-thin yeast sections. The long-term goal of our group is to develop a novel portable environmental whole-cell biosensor chip based on label-free SERS detection.

Biography

VinayBhardwaj completed his bachelors (honors) in animal sciences and masters in Biotechnology from India. He was a lecturer in Department of Biotechnology and Bioinformatics in GeetaVidya Mandir Girl's College (Haryana, India) for almost one year before he was invited to join Dr. Anthony McGoron's BIGT lab in FIU as a visiting research scholar (link below). Presently, he is doing his Ph.D. in area of biosensor working on a USDOD sponsored project on developing a whole-cell portable-biosensor chip for US military. He is expecting to graduate in another one year. He presented his work in various reputed conferences including IEEE, BMES etc. and submitted two papers (One is accepted this month).

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