Ultra-Sensitive Cardiac Biomarker Detection Using Gold Nanocavity Localized Plasmon Resonance for Early and Rapid Diagnosis of Myocardial Infarction

Guo, Sophie (School: James Clemens High School)

Acute myocardial infarction, otherwise known as a heart attack, is a major cause of death in the United States. Cardiac troponins, which are structural proteins unique to the heart, are sensitive and specific biochemical markers of myocardial damage. Current methods of troponin detection require detection through assays that tend to be low in sensitivity and require large amounts of human blood to be drawn in order for proper detection of troponin levels. Thus, in this project, a highly sensitive Troponin I biosensor, based on optical & nanoplasmonic technology and the employment of antibody-antigen binding, provides a compact system that effectively detects elevated Troponin I levels with as little as a drop of solution through a label-free technique. The biosensor detects the presence of Troponin I through the measurement of the localized surface plasmon resonance (LSPR) shift caused when Troponin I proteins bind onto the gold nanocavity surface. In order the effectively immobilize the Troponin I proteins, the gold surface was first functionalized with anti-Cardiac Troponin I antibodies through the utilization of a self-assembling monolayer created by a thiol cross-linker. Then, successive solutions of Troponin I in a buffer at concentrations as low as 5 ng/mL were incubated on the gold nanocavity surface and allowed to bind to their respective antibodies. Probing light was shined incident to the surface and the reflected light was measured by a spectrometer. A shift in the LSPR wavelength indicates detection of Troponin I. The nanoplasmonic sensor allows for rapid detection of elevated cardiac enzymes that can potentially allow rapid diagnosis of myocardial infarction.

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