BIOE 451/452: Bioengineering Design

An opportunity for students to tackle and solve a design problem in bioengineering

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Optical Nanoshell Immunoassay

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Bioengineering Design Challenge

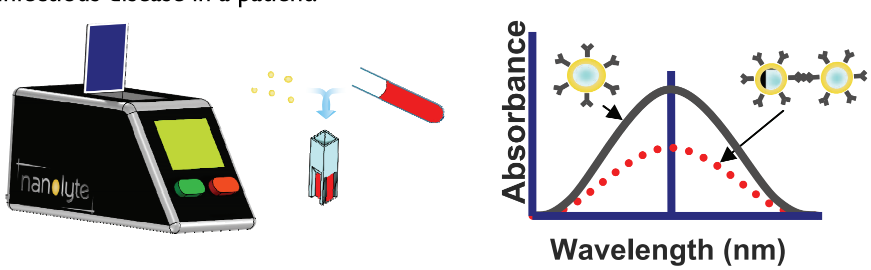
Medical diagnostic tools provide the first line of defense in preventing the spread of disease in any setting. While traditional immunoassays provide adequate sensitivity and accuracy, the cost, administration, necessary equipment, and sample preparation of these tests have severely inhibited the spread of these diagnostics to low-resource settings such as developing countries and long-term spaceflight. Thus, there is a need for an affordable, portable diagnostic system that offers point-of-care versatility to stem the spread of disease in these resource-deficient settings.

Appropriate Solution

To address this need, Team Phoenix is optimizing a nanoshell-based immunoassay for whole-blood and designing an optical device for use in a point-of-care setting. The use of antibody-conjugated nanoshells (immunonanoshells) for whole-blood immunoassays hinges on the differences in extinction peaks between free nanoshell particles and aggregated nanoshell clusters, which occur when immunonanoshells bind to analyte. By measuring the change in immunonanoshell extinction in the sample, the analyte concentration in whole-blood is able to be determined (See figure below). Compared to traditional immunoassays, this immunoassay requires minimal preparation steps and provides results in 15 to 30 minutes. To measure and report concentrations, the team is designing an optical device that uses a photodiode circuit to measure the light absorbance at a particular wavelength. The optical device will be lightweight, portable, and very user-friendly in order to minimize the technical expertise required for usage.

Current Status

A proof-of-concept experiment has shown that the nanoshell immunoassay is sensitive to nanogram analyte concentrations. In addition, the optical device using an LED as the light source has been shown to provide readings very similar to that of a normal lab spectrophotometer. Currently, the team is attempting to perform the immunoassay experiment in the optical device in order to show proof-of-concept for the entire portable immunoassay system. Pending the completion of these experiments, actual diseases and health conditions can be tested using the assay. As this project is in collaboration with NASA, bone density levels in space astronauts can be determined by using the assay to detect for osteocalcin, a bone growth biomarker. Moreover, the project also has terrestrial usage in developing countries where it could potentially be used to test for and track the progression of HIV/AIDS, tuberculosis, or any other infectious disease in a patient.



"**Science can amuse and fascinate us all, but it is engineering that changes the world.**" —*Isaac Asimov*

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Awards
-NASA/TSGC Top Design Team (Fall 2007)
-NASA/TSGC Best Paper, Best Poster, Best Presentation

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