THE UNIVERSITY OF ARIZONA
COLLEGE OF ENGINEERING
Biomedical Engineering

BME IS PROUD TO ANNOUNCE THE DOCTORAL DEFENSE OF

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BME PhD Candidate

"Diagnostic Biosensors for Detection of Blood-Derived Biomarkers"

Abstract: Standard diagnostic tools used from patient samples, specifically from blood draws, require specialized equipment, personnel, and facilities. Conventional techniques can often be very laborious and time consuming due to required sample preparation. The evident delay from sample collection to a patient's result immensely impacts their outcome. The aims of this research are to design diagnostic biosensors that decrease time-to-results, minimize reagent and sample handling, and incorporate automated simple optical transduction and user interfaces for the detection of blood-derived biomarkers. Specifically, four biosensing detection mechanisms performed on 3 different point-of-care platforms will be discussed.

First platform is a static loop-mediated isothermal amplification (LAMP) of nucleic acid aqueous droplet on a silicone chip platform immersed in mineral oil. The target-of-interest is a nucleic acid sequence as a biomarker for antibiotic resistant bacteria. The biosensing technique used related changes in interfacial tension (IFT) at the water-oil interface by measuring the change in contact angle (geometrical-effects) over time. Initially the system was characterized as a linear response in relation to concentration of bacteria in a buffer system down to the limit of detection (LOD) of 100 CFU per ?L. Subsequently, with the addition of bacterial infected blood sample models, the system became a binary assay (i.e. yes or no) as low as 10 CFU per ?L within 10 min of reaction.

Secondly, a two-layered, paper microfluidic chip was utilized to quantify cancer cells from a buffy coat sample matrix by two detection mechanisms: 1) on-chip particle enumeration via smartphone microscope and 2) capillary flow dynamics via smartphone video processing. The assay resulted in a LOD as low as 1 cell per ?L for the on-chip imaging aspect of platform and 0.1 cell per ?L for the capillary flow analysis within 13 to 22s post application of blood sample.

Lastly, the same concepts previously described in the first platform utilizes changes in IFT due to amplicon presence in an aqueous solution immersed in mineral oil. An emulsion LAMP platform was investigated to determine the relation between angle-dependent light scatter intensity (based off Mie scatter theory) and nucleic acid amplification progression. The phenomenon attributing to changes in light scatter intensities is due to the interfacial changes occurring in the emulsion droplets, where amplicon amount increases the IFT decreases, resulting in smaller diameter emulsions. Changes in light scatter intensity within 3 min of the reaction shows statistical difference in comparison to no target control (NTC) for 103 CFU per ?L of bacteria dosed into aqueous sample. These four detection mechanisms and three platforms offer but a few alternatives as biosensing methods for blood-derived diagnostic biosensors.

Please join us on
THURSDAY, DECEMBER 5TH, 2019
MARLEY, ROOM 541H
10:00 AM
HOST: DR. JEONG-YEOL YOON

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