

595h Development and Optimization of a Lab-on-a-Chip Device for Multiplexed Ultra-Sensitive Detection of Proteins

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This work is motivated by the need to develop integrated point-of-care devices that can quickly and accurately screen users for possible health risks ranging from cancer to biological agent exposure. Commercially available screening techniques, such as ELISA, take several hours to complete and are not capable of achieving the sensitivities necessary for early detection of many diseases. The use of microfluidics is a possible solution to overcome these limitations, but much is still unknown about this area. We are investigating the role of mass-transfer, the behavior of nanoparticles, and the complex interactions of biomolecules in microchannels ranging from 10 to 100 micrometers.

One result of our efforts is the employment of the Bio-Bar-Code Assay, developed by the Mirkin Group, in a microfluidic device. We have successfully demonstrated the detection of prostate-specific antigen (PSA) down to concentrations as low as 500 attomolar in complex biological media. The Bio-Bar-Code protocol employs magnetic microparticles functionalized with monoclonal antibodies and gold nanoparticles functionalized with polyclonal antibodies and unique barcode DNA sequences. Recent advancements include the development of approaches for multiplexed detection of target analytes through the use of multiple barcode DNA and microarrayed complementary sequences.