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Multiplexed proteomics using ultra dielectrophoresis (uDEP)

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In this talk we will present a low cost electronic platform for multiplexed detection of protein biomarkers in a complex sample. Our platform is based on performing a bead based immunoassay, where along a single channel an array of antibodies is patterned. Below each element of the array is a pair of adressable interdigitated electrodes, which can detach the immunobound beads through negative dielectrophoresis (nDEP) force. The beads are detached region by region and then transported downstream where they are quantified electrically or optically. The main challenge with this technique lies in providing a strong enough force to detach the beads. When applying high voltages at the electrodes (> 10 V) that are in direct contact with the buffer, DEP force magnitude is limited by electrode corrosion due to electrochemical reactions at the interface of the electrodes and the solution. Using Atomic Layer Deposition we deposited a pinhole free nanometer-scale thin film oxide as a protective layer to prevent electrodes from corrosion. By exciting the electrodes at high frequency, we capacitively coupled the electrodes to the buffer in order to avoid reduction in nDEP force due to the presence of the insulating oxide layer. Our fabricated electrodes are able to withstand voltages up to 120 Vpp, beyond which bubble formation inside the channel becomes the limiting factor. This results in two orders of magnitude improvement in DEP force, than what was possible with bare gold electrodes. Using this ultra-DEP device, we demonstrated 100% detachment of anti-IgG and IgG bound beads. The enhanced switching performance shows orders of magnitude of improvement in on-to-off ratio and switching response time, without need for chemical eluting agents, as compared to previous work.

Biography

Sam Emaminejad is a Ph.D. candidate at Stanford University, and is currently working at Stanford Genome Technology Center to develop low-cost point of care diagnostic tools. His research is focused on design and implementation of a multiplexed protein biosensor that integrates microfluidics with electrical impedance sensing technology.