UNIVERSITY OF NEBRASKA -LINCOLN COLLEGE OF ENGINEERING

Biomedical Engineering Seminar
Friday, November 8
12:30 – 1:30 PM
237 Scott Engineering Center City Campus

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Lowell E. and Betty Anderson Distinguished Professor
Department of Chemical & Biomolecular Engineering
University of Nebraska-Lincoln

Engineering Toys for Biology and Medicine

Nanostructured material and nanoscale phenomena have revolutionized the development of in vivo and in vitro biomedical devices with unique and far-reaching capabilities that are not possible in equivalent macro-scale systems. I will describe devices based on nanoscale phenomena in water and air to significantly enhance capability of diagnostic and prognostic devices that are not possible at macroscopic lengths above 100 nm. In the first technology we leverage the spontaneously forming ~10 nm thick electrical double layer at an electrode surface in aqueous media to develop a toy to measure local redox. The device allowed us to develop an electrochemical DNA microarray chip to quantitatively profile microRNA in blood at sensitivity of 10 atto-molar and responsivity of 0.5 zepto-moles. The second technology leverages the sensitivity of 10 nm Gold particle(s) to single electron charge to build a toy to non-invasively measure membrane potential of cells. The (natural) nano-roughness of the device allows easy interface with cells to measure electrophysiology of a single microorganisms despite their thick membrane. In the third technology we modulate the mechanical properties by over eight orders of magnitude to build a toy based on electron tunneling phenomena to image palpability by touch for application in breast cancer screening. The sensitivity and resolution of the device is on par with human finger, one of the best tactile sensor nature has built.

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