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Biosensors for Early Cancer Detection Based Upon Electrical Interfaces to Virus Particles

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Abstract: In this talk I'll describe a new approach to biosensors that has as its objective the development of ultra-cheap, disposable biosensors that are able to detect cancer markers directly in urine. The realization of this biosensor is made possible by two new developments in our laboratory and that of our collaborator – Professor Gregory Weiss of UCI: The first is a nanowire fabrication technique called Lithographically Patterned Nanowire Electrodeposition (LPNE) that permits very long (> 1 cm), very uniform noble metal nanowires as small as 6 nm x 20 nm to be patterned on glass surfaces. Previously, such nanowires could only be obtained using electron beam lithography – a tedious and expensive fabrication method. The second is the demonstration that filamentous bactiophage particles, that have been engineered using phage display to selectively recognize and bind a particular analyte molecule, can immobilized onto electrode surfaces. The resulting "virus surfaces" retain the ability to recognize and bind molecules from a buffer solution. In fact, these surfaces show kinetic and thermodynamic binding properties for selected analyte molecules that are comparable to immobilized monoclonal antibodies, the gold standard receptors for biosensing. How can LPNE and virus particles be used in conjunction to prepare a biosensor? Three experimental approachs will be described. In one of these, nanowires of the conductive polymer PEDOT (polypoly(3,4-ethylenedioxythiophene)) are fabricated in which virus particles are entrained. These composite nanowires show a change in their electrical impedance upon exposure to peptides – upregulated by cancers - that selectively bind to the entrained virus particles.

Biography: Reginald Penner is Chancellor's Professor and Chairman in the Department of Chemistry at the University of California, Irvine (UCI). At UCI, he has appointments in the Department of Chemistry and the Department of Chemical Engineering and Materials Science. Professor Penner attended Gustavus Adolphus College in Saint Peter, Minnesota where he obtained B.A. degrees in Chemistry and Biology in 1983. He studied at Texas A&M University beginning in 1983 with Professor Charles R. Martin and he received a Ph.D. in Chemistry in 1987. He proceeded to postdoctoral appointments at Stanford University and Caltech working with Professor Nate Lewis, before being appointed at UCI in 1990. Professor Penner is an electrochemist whose research group develops methods based upon electrodeposition for making nanomaterials, such as nanowires, composed of metals and semiconductors. With his students, he has more than 150 research publications to date. He is an A.P. Sloan Fellow, a Camille and Henry Dreyfus Teacher-Scholar, an NSF and ONR Young Investigator, and a Fellow of the American Association for the Advancement of Science (AAAS). He received the 2009 Faraday Medal from the Royal Society of Chemistry of the UK.