Novel Biosensor Platforms Enabled by Graphene

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Graphene, a two-dimensional (2D) allotrope of carbon, is a unique material with many remarkable properties. In particular, graphene has numerous properties that make it ideal for sensing applications, including its high surface sensitivity (it is thinnest material known to exist), chemical stability, mechanical strength, and biocompatibility. While many groups have investigated graphene-based sensors for a variety of applications, the full potential of graphene for biosensing applications has yet to be realized. In this talk, I will describe two novel sensor concepts that exploit properties of graphene that have not been utilized in previous sensor designs. In the first sensor concept, the quantum capacitance effect is used to create variable capacitors, or varactors, that, when integrated with an inductor, form a variable LC resonator circuit whose oscillation frequency can vary with the concentration of an adsorbed analyte. We have utilized these sensors to detect a variety of species, including H2O, VOCs and glucose. More recently, we have shown that graphene edges can form atomically sharp “tweezers” for trapping biomolecules such as DNA. Due to the atomic-scale sharpness of graphene, this trapping can occur at extremely low voltages (< 500 mV), making them suitable for integration with on-chip electronic readout circuits.

Bio: Dr. Koester received his Ph.D. in 1995 from the University of California, Santa Barbara. From 1997 to 2010 he was a research staff member at the IBM T. J. Watson Research Center and performed research on a wide variety of electronic and optoelectronic devices, with an emphasis on those utilizing the Si/SiGe material system. Since 2010, he has been a Professor of Electrical & Computer Engineering at the University of Minnesota where his research focuses on novel electronic, photonic and sensing device concepts with an emphasis on 2D materials. Dr. Koester has authored or co-authored over 250 technical publications, conference presentations, and book chapters, and holds 68 United States patents. He is a Fellow of the IEEE.