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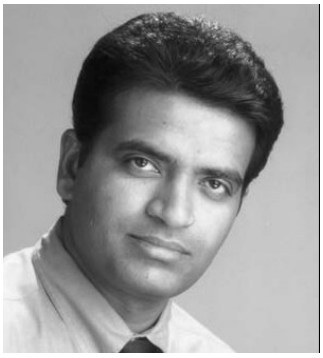

2D Crystals for Smart Life

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The experimental demonstration of *graphene* in 2004, a truly one-atom thick layer of carbon atoms, has opened up a window to the two-dimensional (2D) world of materials. This has subsequently triggered a surge of research activities on various 2D crystals including single layers of hexagonal-boron nitride (*h*-BN), several dichalcogenides (such as MoS_2 and WSe_2), and complex oxides. Atomic scale thicknesses (few Å/layer) of 2D semiconducting crystals and their controllable precise band gaps as a function of number of layers also enable the scaling of electronic devices without inducing performance variations. Moreover, seamless planar synthesis and stacking of various 2D crystals can be exploited to build novel lateral and vertical heterostructures, respectively. This talk will highlight and discuss the prospects of such 2D crystals for designing ultra-low power, low-loss, and ultra-energy-efficient active and passive devices targeted for designing next-generation *green electronics* needed to support the emerging paradigm of *Internet of Things*. More specifically, this talk will examine the genesis of the power dissipation challenge in conventional MOSFETs, and provide an overview of the recently demonstrated 2D-channel tunnel-FET from my group that overcomes this challenge and is a fundamentally different transistor employing several innovations. This talk will also bring forward some applications uniquely enabled by 2D crystals, including sensors and flexible high-frequency electronics for improving quality of life, and discuss related challenges and opportunities.

Biography: Kaustav Banerjee is Professor of Electrical and Computer Engineering and Director of the Nanoelectronics Research Lab at UC Santa Barbara. Initially trained as a physicist, he graduated from UC Berkeley with a PhD in electrical engineering in 1999. His current research focuses on the physics, technology and applications of low-dimensional materials such as graphene and other 2D materials for next-generation green electronics, photonics and bioelectronics.

Professor Banerjee has made seminal contributions in nearly every aspect of nanoelectronics and his ideas and innovations have played a decisive role in steering worldwide research. His research into low-power electronics, including 3D ICs and thermal-aware IC design, has found wide scale implementation in the semiconductor industry. His research group has also spearheaded the use of 2D materials for overcoming power dissipation and other fundamental challenges in nanoscale transistors, interconnects and sensors including the demonstration of world's thinnest channel tunneling transistor with subthermionic turn-on characteristics (Nature, 526, 91-95, 2015). Professor Banerjee's technical contributions have been recognized with numerous awards and honors including the prestigious Friedrich Wilhelm Bessel Research Award, presented to him in 2011 by Alexander von Humboldt Foundation, Germany, for his outstanding contributions to nanoelectronics, and a JSPS Invitation Fellowship from the Japan Society for the Promotion of Science in 2013, for his research on 2D materials and devices. Professor Banerjee is a Fellow of IEEE and the American Physical Society, and a recipient of the 2015 Kiyo Tomiyasu Award, one of IEEE's highest honors.