



## Prof. Kaustav Banerjee

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### 2D Materials for Next-Generation Ultra Energy-Efficient Electronics

**FRI FEB 10** | Bldg. 101  
**14:00** | Seminar room on the 1<sup>st</sup> floor

The experimental demonstration of graphene in 2004 has opened up a window to the two-dimensional (2D) world of materials (*Physics Today*, Vol. 69, No. 9, pp. 38-44, 2016). 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<sub>2</sub> and WSe<sub>2</sub>), and complex oxides, with novel electronic properties. 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 2D crystals on various substrates can be exploited to build novel lateral and vertical heterostructures, respectively.

My talk will highlight and discuss the prospects of such 2D crystals and their heterostructures for designing ultra-low power, low-loss, and ultra-energy-efficient active and passive devices as well as interconnects targeted for designing next-generation green electronics needed to support the emerging paradigm of *Internet of Everything*. More specifically, I will bring forward applications uniquely enabled by 2D materials for realizing ultra-energy-efficient electronics, including the world's first 2D-material based band-to-band tunneling transistor demonstrated by my group (*Nature* 2015) that overcomes a fundamental power consumption challenge in all electronic devices since the discovery of the first transistor in 1947. I will also discuss a novel interconnect material based on graphene that we have recently demonstrated (*Nano Letters* 2016), which overcomes the fundamental limitations of conventional metals and provides an attractive pathway toward a low-power and highly reliable interconnect technology for next-generation integrated circuits. This talk will also bring forward some other applications uniquely enabled by 2D crystals, including a new class of ultra-sensitive and low-power sensors as well as high-performance/low-loss radio-frequency electronics for improving quality of life, and discuss related challenges and opportunities.

***You are cordially invited to attend!***

Special Guest Speaker