PURDUE UNIVERSITY

Birck Nanotechnology Center

Nanomanufacturing Preeminent Team Faculty Seminar

Dr. Deblina Sarkar

Green Electronics to Gray Matter: Ghost Walks, Mind Blowing and Brain Doping

Monday, March 19th, 2018

2:00pm – 3:00pm, BRK 2001

Bio: Deblina Sarkar is currently an MIT Translational Fellow and postdoctoral associate in the Synthetic Neurobiology group, while she had received her M.S. and Ph.D. in Electrical and Computer Engineering at UCSB. Her work has led to more than 40 publications till date (citations: 1965, h-index: 18, i-10 index: 26 according to Google Scholar), several of which have appeared in popular press worldwide.

Her PhD dissertation was honored as one of the top 3 dissertations throughout USA and Canada in the field of Mathematics, Physical sciences and all departments of Engineering by the Council of Graduate Schools in the period 2014-2016. She was UCSB's nominee for this nationwide contest, after winning the Lancaster Award for the best PhD Dissertation at UCSB in 2016. She is the recipient of numerous other awards and recognitions, including the U.S. Presidential Fellowship (2008), Outstanding Doctoral Candidate Fellowship (2008), one of three researchers worldwide to win the prestigious IEEE EDS PhD Fellowship Award (2011), a "Bright Mind" invited speaker at the KAUST-NSF conference (2015), Falling Walls Lab Young Innovator's Award at San Diego (2015), "Materials Research Society's Graduate Student Award" (2015), named a "Rising Star" in Electrical Engineering and Computer Science (2015), invited speaker at TEDx (2016), MIT Translational Fellowship (2017) and Technology Review's one of the Top 10 Innovators Under 35 from India (2018). She has also received the prestigious NIH K99/R00 Pathway to Independence Award.

Abstract: Excessive power consumption and dissipation of electronics with technology scaling, is a serious threat to the Information Society as well as to the environment and especially smacks a hard blow to the future of energy-constrained applications such as medical implants and prosthetics. This impending energy crisis has roots in the thermal distribution of carriers, which poses fundamental limitation on energy scalability of the present transistors.

In this talk, I will demonstrate the quantum mechanical transistor, that I developed, which beats the fundamental thermal limitations of present transistors. I will describe how this can be achieved by unique integration of heterogeneous material technologies including an atomically thin material, to make the electron waves propagate (tunnel) efficiently through an energy barrier (like a ghost walking through a wall). This device is the world's thinnest channel (6 atoms thick) sub-thermal tunnel-transistor. Thus, it has the potential to allow dimensional scalability to beyond Silicon scaling era and thereby to address the long-standing issue of simultaneous dimensional and power scalability.

Going beyond electronic computation, I will discuss about the biological computer: the brain, which can be thought of as an ultimate example of low power computational system. However, understanding the brain, requires deciphering the dense jungle of biomolecules that it is formed of. I will introduce the next-generation expansion microscopy technology, that I have developed, which helps to decipher the organization of biomolecular building blocks of brain by literally blowing out the brain by up to 100-fold. This technology reveals for the first time, a nanoscale trans-synaptic architecture in brain tissue and structural changes related to neurological diseases.

I will conclude with my research vision for how extremely powerful technologies can be built by fusing diverse research fields and how seamless integration of nanoelectronics-bio hybrid systems in the brain (brain doping), can create unprecedented possibilities for probing and controlling the biological computer and in future, help us transcend beyond our biological limitations.

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