Short bio

Professor Alam holds the Jai N. Gupta professorship at Purdue University, where his research focuses on the physics and technology of semiconductor devices. From 1995 to 2003, he was with Bell Laboratories, Murray Hill, NJ, as a Member of Technical Staff in the Silicon ULSI Research Department. Since joining Purdue in 2004, Dr. Alam has published over 250 papers and has presented many invited and contributed talks. He is a fellow of IEEE, APS, and AAAS. His awards include the 2006 IEEE Kiyo Tomiyasu Medal for contributions to device technology and 2015 SRC Technical Excellence Award for fundamental contributions to reliability physics.

Prof. Alam enjoys teaching -- more than 125,000 students worldwide have learned some aspect of semiconductor devices from his web-enabled courses.

Abstract

On Nanonet Electronics, Percolation Doping, and the Limits of Ohm's Law

As the future of Moore's law appears uncertain, Electronics is being reinvented with a broader focus on flexible electronics, bioelectronics, and energy-harvesting. In this regard, a material based on nanonets of Carbon Nanotubes or Si/ZnO/SiGe Nanowires has been used as channel materials for thin-film transistors for flexible/transparent electronics, as sensor elements for label-free bio-sensors, and as transparent top electrode for solar cells. A lack of predictive transport models, however, had stymied the translation of impressive laboratory experiments to practical, disruptive technology. The classical theory of bulk semiconductors, developed over last 50 years in close collaboration with experimentalists, device physicists, numerical analysts, and computer scientists, does no longer apply. In this talk, I will discuss a simple theory of the Nanonet devices based on 2D percolation and fractal dynamics to show how these simple/intuitive approach challenged conventional wisdom and helped us achieve world record performance in several very different technology applications.