Multi-Scale Technologies for the Integration of Room Temperature Quantum Electronics

Paul L. Bergstrom
Department of Electrical and Computer Engineering
Multi Scale Technologies Institute
Michigan Technological University
e-mail : paulb@mtu.edu

Research on quantum electronic devices has been undertaken at Michigan Technological University for the past decade. With the formation of the Multi Scale Technologies Institute at Michigan Tech. in 2006, research on quantum-scaled electronic devices based on nanotubes, quantum dots, and molecular systems has been focused toward the realization of functional integrated electronic and sensing systems over multiple scales. Research undertaken in this Institute has recently demonstrated a novel technology to realize high-density single electron transistors (SETs) operating at room temperature utilizing tungsten quantum islands of less than 8nm in diameter. The fabricated SET devices show well-behaved coulomb blockade and Coulomb oscillations at room temperature. The junction tunnel resistances of the device are over five orders of magnitude higher than the quantum resistance, demonstrating a high degree of electron confinement on the tungsten quantum dots. The successful fabrication of SET devices is a promising candidate for future generations of low power and high-density integrated circuits.

In this talk, I will present results for quantum dot based electronic devices, discussing room temperature single electron transistor technologies and exploring its behavior. I will discuss some of the system and technology challenges that must be overcome for the integration of quantum electronic devices into multiscaled systems, leading toward the ultimate utility of fully integrated quantum electronic computing with micro-, meso-, and macro-scaled electronic systems.