

## Nanoscale opto thermo electric energy conversion devices and measurements

### GUEST SPEAKER

**Prof Ali Shakouri**

University of California, Santa Cruz

When: **7<sup>th</sup> July 2010, 10.30 a.m. to 11.30 a.m.**

Where: **Institute of Microelectronics, Singapore**

11 Science Park Road Singapore Science Park II Singapore 117685

### **Abstract**

Energy consumption in our society is increasing rapidly. A significant fraction of the energy is lost in the form of heat. In this talk we introduce solid-state thermionic/ thermoelectric devices that allow direct conversion of heat into electricity. Novel metal-semiconductor nanocomposites are developed where the heat and charge transport are modified at the atomic level. Theory and experiment are compared for the case of rare-earth semimetal nanoparticles in a semiconductor matrix as well as in nitride metal/semiconductor multilayer films. Potential to reach energy conversion efficiencies exceeding 20% is discussed. We also describe how similar principles can be used to internally cool semiconductor lasers and to make micro refrigerators on a chip with cooling power densities exceeding 500 watts per centimetre square. Finally, we describe some recent advances in nanoscale thermal characterization and modeling. Thermoreflectance imaging is used to measure the transient temperature distribution in active electronic and optoelectronic devices with 800ps time and submicron spatial resolution. In analogy with image blurring, a new technique is developed to estimate the temperature profile in integrated circuit chips with calculation speeds hundreds of times faster than the standard finite element methods. Image de-blurring techniques can also be used to solve the inverse problem and estimate the power dissipation profile from the measured temperature maps.

### **Speaker Biography**



Ali Shakouri is Professor of Electrical Engineering at University of California Santa Cruz. He received his Ph.D. from California Institute of Technology in 1995. His current research is on nanoscale heat and current transport in semiconductor devices, high resolution thermal imaging, micro refrigerators on a chip and waste heat recovery. He is also working on a new sustainability curriculum in collaboration with colleagues in engineering and social sciences. He has initiated an international summer school on renewable energies sources in practice. He is the director of the Thermionic Energy Conversion center, a multi-university collaboration aiming to improve direct thermal to electric energy conversion technologies. He received the Packard Fellowship in Science and Engineering in 1999, the NSF Career award in 2000 and UCSC School of Engineering FIRST Professor Award in 2004.

### **Registration**

Pre-registration is required. Closing date is 5<sup>th</sup> July 2010. To register, please log on:

[http://eastar.eventshub.sg/ems\\_wb\\_Details.aspx?CallID=28&EventID=125965](http://eastar.eventshub.sg/ems_wb_Details.aspx?CallID=28&EventID=125965)

### **Location Map**

