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Nanostructured Thermoelectric Generators for Topping Cycle Applications

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 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. Potential to increase the energy conversion efficiency and bring the cost down to $0.1-0.2/W will be evaluated. Methods to reduce thermal stress in thermoelectric modules under large temperature gradients and applications to topping cycle power generation will be discussed. We also describe how similar principles can be used to make high speed micro refrigerators integrated with electronic and optoelectronic devices. Thermoreflectance imaging is used to localize hot spots and separate Peltier cooling and Joule heating in the chip. Full field transient thermal imaging with submicron spatial and 800ps time resolution is achieved.

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Biography: Ali Shakouri is the Mary Jo and Robert L. Kirk Director of the Birck Nanotechnology Center and a Professor of Electrical and Computer Engineering at Purdue University. He received his Engineering degree from Telecom Paris, France in 1990 and 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 systems. He is also working on a new interdisciplinary sustainability curriculum in collaboration with colleagues in engineering and social sciences. He received the Packard Fellowship in Science and Engineering in 1999, the NSF Career award in 2000, and the UC Santa Cruz School of Engineering FIRST Professor Award in 2004.