University of Rochester
Department of Electrical and Computer Engineering
Colloquia Speaker Series

Nanostructured materials for optoelectronic devices: applications in infrared light generation and solar energy conversion

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12:00 – 1:00PM
Computer Studies Building, Room 209

Abstract: The ability to control the electrical and optical properties of materials at the nanoscale has enabled unique opportunities in optoelectronic device engineering with a variety of applications ranging from light generation and manipulation to detection and conversion. Here, I present two such applications which take advantage of nanostructures to improve and extend upon existing device modalities. In the first part of this talk I will focus on the generation of infrared light using the quantum cascade laser scheme. In these devices the active medium consists of multiple quantum well heterostructures and light emission is based on intersubband transitions between quantum confined electronics states. The emission wavelength is tunable over a broad spectral range through the design of the layer thicknesses and compositions making this platform ideal for the development of light emitters at wavelengths limited by traditional material constraints. In particular, the GaN/AlGaN and Ge/SiGe quantum-well systems have been investigated for use at specific terahertz and mid-infrared frequencies currently devoid of practical sources of radiation. Potential active medium designs and materials characterization will be presented. In the second part of the talk I will discuss the incorporation of nanostructures into the active region of III-V solar cells as a potential route towards boosting device conversion efficiencies. Specifically these structures may be used to engineer the effective bandgap of the limiting junction of a multi-junction solar cell or in the realization of the intermediate band solar cell concept. Of particular interest to both devices is the use of InAs quantum dots (QDs) in the intrinsic region of a standard pin-GaAs solar cell. This geometry enables an increase in short-circuit current due to the absorption of sub-bandgap light by the confined states of the QDs. The effect of the position of the QDs within the intrinsic region on improved device performance is theoretically and experimentally investigated.

Bio: Kristina Driscoll studied Electrical Engineering at Boston University and received her PhD degree in 2009 from the Semiconductor Photonics Laboratory under the supervision of Prof. Roberto Paiella. Following her PhD, she was a post-doc from 2009-2011 in the Optoelectronics Group in the Cavendish Laboratory at the University of Cambridge. In 2011 Kristina joined the NanoPower Research Laboratory Photovoltaics team at the Rochester Institute of Technology and is on the teaching faculty in the School of Physics and Astronomy at RIT.

Lunch Provided