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Hot nanophotonics: Light with a phase transition

Gururaj Naik

Assistant Professor,
Rice University

ABSTRACT:

Among many emerging technologies, energy and display are two important technologies poised to revolutionize our current society. Nanophotonics holds the key to both these emerging technologies. While tunable devices enable 3D displays and such other display applications, hot nanophotonic devices enable efficient energy conversion. Phase transition phenomena that arise from the collective behavior of materials enables both these classes of nanophotonic devices. An electronic phase transition leads to a huge optical tunability, while an optical one results in highly selective thermal emitters necessary for efficient thermophotovoltaics. This talk will describe tunable nanophotonic devices based on charge density waves in 1T-tantalum disulfide and frequency-selective thermal emitters based on parity-time symmetric nanophotonics.

At first, the talk will describe an optical phase transition in a nanophotonic system exhibiting parity-time symmetry. Here, an inspiration from quantum optics presents an opportunity to sculpt thermal radiation from hot surfaces in an unprecedented manner. Bright and spectrally narrow thermal emission is the key to efficient heat-to-light-to-electricity conversion, and parity-time symmetric thermal emitters enable it. The second half of the talk focuses on a novel tunable optical material. The tunability arises from an electronic phase transition in 1T-TaS2, a strongly correlated material at room temperature. A MHz, unity order index tuning just by shining 1-Sun intensity white light is promising for low-power adaptive optical applications on mobile platforms.

BIOGRAPHY:

Gururaj (Guru) Naik is an assistant professor at Electrical & Computer Engineering, Rice University. He received an M.E. from the Indian Institute of Science, India, and a PhD from Electrical & Computer Engineering, Purdue University. During his PhD with Shalaev and Boltasseva groups, he developed new plasmonic materials for nanophotonic applications. After pursuing postdoctoral research at Stanford University, Guru joined Rice University in 2016. His research group focuses on topics at the interface of quantum, nanophotonics, and materials. Guru is a recipient of the IEEE Photonics Society Graduate Student Fellowship, an Outstanding Graduate Research Award from Purdue University, and a Gold Medal from the Indian Institute of Science.