Photonic Solutions for 21st Century Problems: Full Spectrum Solar Energy Conversion, Two-Dimensional Semiconductors, and Optical Nanoantennas

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Abstract:
Photonic materials and devices hold great potential to address pressing societal challenges related to energy use, environmental monitoring, space exploration, and more. In this talk I will address three key technologies we are developing that harness light-material interactions. 1) We are developing systems designed to more fully harvest the entire solar spectrum; I will discuss one related to >50% solar energy conversion efficiency and another that generates both heat and electricity so that solar energy can be used when the sun is not shining. 2) We are synthesizing novel two-dimensional semiconductor materials at wafer scale and are studying their unique properties for optoelectronic applications. 3) Photonic metamaterials and metasurfaces offer the potential for revolutionary new optical functionality by enabling light manipulation by design. Here I will highlight our development of low-loss, tunable optical metasurfaces featuring nanophotonic antenna arrays.

Biography:
Matthew Escarra is an assistant professor in Physics and Engineering Physics at Tulane University. He received his Ph.D. in electrical engineering at Princeton University in 2011, where he made advances in the performance of quantum cascade lasers and mid-infrared metamaterials. He also received a certificate in Science, Technology, and Environmental Policy while at Princeton. He went on to complete postdoctoral training at the California Institute of Technology in Applied Physics and Materials Science, where he developed new approaches to high efficiency solar energy conversion. He also has worked with two start-up companies, Daylight Solutions and Sentinel Photonics, and larger companies such as Shell and Dow Chemical. Matthew's undergraduate studies were in electrical engineering at Rice University. His current research interests include low-loss and tunable photonic metasurfaces, optoelectronics from two-dimensional semiconductors, and solar energy harvesting utilizing the full solar spectrum.