

# Howard Lee



## EXTREME GATE-TUNABLE OPTICAL METASURFACES AND ZERO-INDEX HETEROSTRUCTURES WITH LINEAR, NONLINEAR, AND QUANTUM RESPONSES

### ABSTRACT

Controlling the flow of light is fundamental to optical applications. With the recent advances in nanofabrication capabilities and new theoretical concepts, ground breaking platforms for the nanoscale manipulation of light have been demonstrated in recent years. These include metasurface and epsilon-near-zero (ENZ) materials and structures, which offer unique optical features such as sub-wavelength field confinement, unusual optical nonlinear/quantum properties and advanced wavefront shaping.

This talk will review our research efforts on tunable meta/ENZ-optics for developing emerging optical applications. I will present our recent development on the use of gate-tunable materials, transparent conducting oxides, to demonstrate an gate-tunable optical metasurfaces that can tune the optical phase and amplitude for ultrathin beam steering devices [1]. In addition, a broadband, field-effect tunable, and ultrathin ENZ perfect absorber enabled by the excitation of ENZ modes will be discussed [2,3]. I will also discuss the active control of emission properties of quantum emitters and enhanced ultrafast optical nonlinearity in hybrid ENZ-plasmonic heterostructures. Finally, I will present our study on "Meta"-optical fiber by integrating metasurfaces and zero-index materials with optical fibers to develop novel and ultracompact in-fiber optical devices such as an optical fiber metalens and a color filter [4,5]. These advanced "meta"/ENZ-optical fibers open the path to revolutionary in-fiber lasers, optical imaging, and optical/quantum communication devices [6].

### BIOGRAPHY

Dr. Howard Lee is currently Assistant Professor in the Department of Physics at Baylor University and IQSE Fellow and visiting professor in the Institute for Quantum Science and Engineering (IQSE) at Texas A&M. He was a Postdoctoral Fellow at the Department of Applied Physics and Materials Science at Caltech, working with Prof. Harry Atwater in active plasmonics/metasurfaces. He received his PhD in Physics from the Max Planck Institute for the Science of Light in Germany in 2012 under the supervision of Prof. Philip Russell (2015 President of OSA). His work on nano-optics and plasmonics has led to publications in various journals, such as Science, Nano Letters, Advanced Materials, and Optics Letters as well as 45 invited talks and 130 conference papers. Dr. Lee is a recipient of 2018 NSF CAREER Award, 2017 DARPA Young Faculty Award, 2017 APS Robert S. Hyer Award, 2018 OSA Ambassador, 2018 Baylor Young Investigator Award, 2016 Baylor Proposal Development Award, and 2012 Croucher Postdoctoral Fellowship. He has organized seven technical conference sessions on advanced optical metasurfaces (META, PQE, and OSA Advanced Photonics 2016-2019) and he will serve as Symposium Chair for Material Research Society (MRS) Fall Meeting 2019. His group has successfully awarded external grants with total amount of ~ \$3M in the first three years at Baylor University.

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**BOURNS HALL A265**



**SEMINAR: 11:10 A.M. - 12:00 P.M.**  
**\* VISION TALK: 12:00 P.M. - 12:30 P.M.**

\*FACULTY ONLY