

# Active Zero-Index/Meta-Optics and “Meta”-Optical Fibers



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**Date: July 26, 2023 (Wednesday)**

**Time: 10 - 11 am**

**Venue: OEE1017, HSH Campus, HKBU**

### ABSTRACT

Controlling the flow of light is fundamental to optical applications. With 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 ultrathin optical metasurfaces and “zero-refractive index” materials which offer unique optical features such as sub-wavelength optical confinement, enhanced optical nonlinear/quantum properties, and advanced wavefront shaping for emerging optical imaging, bio/optical sensing, medical, and communication applications.

This talk will review our research efforts on electrically tunable meta-optics and zero-index optics for developing new optical applications. I will present our recent advances on the use of transparent conducting oxide materials to demonstrate electrically-tunable ultrathin optical metasurfaces that can tune the optical phase and amplitude for light steering and nonlinear/quantum emission control. In addition, strongly enhanced optical nonlinearity and controllable hot electron dynamic of nano-engineered conducting oxide epsilon-near-zero (ENZ) meta-film fabricated by atomic layer deposition technique will be discussed. I will then discuss our study on a new type of “meta”-optical fiber which merges the sciences of optical metasurfaces and optical fibers. The development of the ultrathin optical fiber metalens and color filter for potential laser surgery, medical imaging endoscope applications, and plasmonic optical fiber for tip-enhanced Raman spectroscopy will be discussed. These advanced “meta”-optical fibers open the path to novel in-fiber lasers/spectroscopies, optical imaging/sensing, and optical/quantum communication applications.

### BIOGRAPHY

Dr. Howard Lee is currently an Associate Professor in the Department of Physics and Astronomy at UC Irvine. Before joining UCI, he was an Associated 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 TexasA&M. He was a Postdoctoral Fellow at the 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. His current research focuses on active linear, nonlinear, and quantum plasmonic/metasurface/zero-index optics, quantum biophotonics and imaging, “meta”-fiber optics, and hybrid photonic-plasmonic on-chip optical devices. His work on nano-optics, plasmonics, and photonic crystals has led to 45 journal publications in various journals, such as Science, Nano Letters, Advanced Materials, ACS Photonics, and Laser & Photonics Reviews as well as 80 invited talks and 150 conference papers. Dr. Lee is a recipient of a 2023/2022 Finalist of Moore Inventor Fellow, a 2023 UCI Beall Innovation Award in Physical Sciences, a 2022 iCANX Young Scientist Award, 2021 Finalist of Rising Stars of Light, 2020 SPIE Rising Researcher, a 2020 Baylor Outstanding Professor Award, a 2019 DARPA Director’s Fellowship, a 2019 IEEE OGC Young Scientist Award, a 2018 NSF CAREER Award, a 2017 DARPA Young Faculty Award, a 2018 OSA Ambassador, a 2017 APS Robert S. Hyer Award, and a 2012 Croucher Postdoctoral Fellowship.

He organized more than 20 technical sessions in nanophotonics/metasurfaces in international conferences (CLEO, MRS, META, PQE) and serves as Lead Symposium Organizer for plasmonic/metasurface symposiums at 2019-2023 MRS Fall Meeting and 2020-2024 MRS Spring Meeting. He is a Founding Associate Editor for OSA Continuum and Associate Editor for Scientific Reports and Photonics journals.