Gate-Tunable Oxide Plasmonic Nanocircuits and Plasmonic Photonic Crystal Fibers

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Howard Lee

California Institute of Technology

Down-scaling optics to sub-wavelength dimension is one of the key challenges for developing optical nanocircuits and nanodevices. Plasmonics, the sub-wavelength surface electromagnetic waves that are guided on a metal-dielectric interface, enable a promising approach for achieving such down-scaling due to its extreme light confinement. However, current plasmonic devices encounter significant limitations due to high optical losses and the lack of efficient tunability and functionality. In this talk, the speaker will present two examples of plasmonic structures which can overcome these limits: (1) Gate tunable chip-based active plasmonic nanocircuits, and (2) Photonic crystal fiber-based hybrid plasmon waveguides.

The speaker will first present the use of gate-tunable low-loss active materials, transparent conducting oxides, to demonstrate an efficient on-chip nano-scale plasmonic modulation operating via field-effect dynamics. In addition, the speaker will present a plasmonic coherent resonant system used to engineer optical dispersion and to serve as an ultra-compact resonator, color router, and logical device. The speaker will then discuss the integration of plasmonics and “holey” fiber optics for the development of a new class of hybrid plasmonic/photonic waveguides. Such hybrid fibers provide a promising novel platform with controllable optical dispersion and long interaction length for the investigation of plasmonic optical properties and the realization of novel in-fiber devices. These studies open up new directions for enhancing nano-scale light-matter interactions and implementing future nanophotonic communication chips, controllable metamaterials, and hybrid optical fiber systems.