Tunable Metasurfaces for Active Manipulations of Electromagnetic Waves

*Lei Zhou**

Physics Department, Fudan University, Shanghai 200433, China

**Email of Presenting Author: phzhou@fudan.edu.cn*

Metasurfaces, ultrathin metamaterials composed by array of planar “meta-atoms” with pre-designed electromagnetic (EM) properties, have attracted extensive attention recently. However, so far the realized metasurfaces are mostly passive systems. Here we briefly summarize our recent efforts in making tunable metasurfaces to actively control EM waves. We first present a complete phase diagram that can describe the functionalities of diversified meta/insulator/metal (MIM) metasurfaces in a unified framework [1]. Inspired by the complete phase diagram, we show that a wide-range dynamical phase modulation in the THz regime can be achieved by combining gate-controlled graphene with MIM metasurfaces, where graphene plays as a tunable loss to drive an underdamped to overdamped resonator transition [2]. Finally, we present our latest experimental efforts in making tunable metasurfaces to overcome several key restrictions that are inherent to their passive counterparts.

[1] Che Qu, *et al.*, “*Tailor the Functionalities of Metasurfaces Based on a Complete Phase Diagram*”, **Phys. Rev. Lett.** (2015) in press.

[2] Ziqi Miao, *et al.*, “*Widely Tunable Terahertz Phase Modulation with Gate-Controlled Graphene Metasurfaces*”, **Phys. Rev. X 5**, 041027 (2015).