Two-dimensional Atomic Crystals
with Mid-infrared/THz Polaritonic Response and Potential Application

Huanjun Chen, Shaozhi Deng, Ningsheng Xu

Abstract

Due to the planar confinement of their elementary excitation, two-dimensional atomic crystals exhibit astonishing optical and optoelectronic responses covering a broad spectral range from ultraviolet to microwave region. In particular, recent studies have demonstrated that two-dimensional atomic crystals are able to support a variety of polaritons, the hybrid quasiparticles associated with strong coupling of electromagnetic waves with electric or magnetic dipoles within the materials. These polaritons can greatly facilitate light–matter interactions at nanoscale due to their extreme electromagnetic localizations down to the deep subwavelength regions, which open up new avenue for both fundamental research and potential application, especially in mid-infrared to terahertz range, which are of great importance for both of industrial and military applications, such as remote sensing, security, night vision, wireless communications with high capacity. From a fundamental point of view, mid-infrared/THz technology is also of much use in advanced physics and material research, which is based on the fact that many physical processes associated with the collective excitations and dynamics locate within such frequency ranges. This talk will review some interesting recent progresses.

However, there are important issues need to be addressed before the implementations of the polaritonic two-dimensional crystals into practical devices. First of all, how localized electromagnetic field may be precisely tailored to overlap with functional component in a device, so that enhancement of the light–matter interactions can be maximized. Secondly, interaction between strongly confined electromagnetic field and elementary excitation of the two-dimensional crystals needs to be elucidated. Thirdly, functionalization of two-dimensional polaritonics should be explored. This talk will give an overview on our recent efforts on addressing the above issues.

Biography of Professor Ningsheng Xu

Ningsheng Xu is professor of Fudan University, China, and academician of Chinese Academy of Sciences, and Fellow of the Institute of Physics, UK. He was awarded BSc degree in 1982 from Sun Yat-sen University and PhD degree in 1986 from Aston University, UK. He is the founding director of the State Key Laboratory of Optoelectronic Materials and Technologies, Sun Yat-sen University. He has experienced as chairman and member of steering committees of international academic organizations, including IVMC/IVNC (International Vacuum Micro/Nanoelectronics Conference), IFES (International Field Emission Symposium) and SID (Beijing Chapter, Society of Information Display). His research areas include nanomaterials, miro-nano devices, vacuum micro/nanoelectronics and novel flat panel displays.