

北京大学物理学院凝聚态物理与材料物理所

凝聚态物理-北京大学论坛

2017年第 720期 (No.412since 2001)

•Second harmonic generation in two-dimensional materials

甘雪涛 教授

•**报告人简介:** 甘雪涛, 西北工业大学理学院教授, 西北工业大学分析测试中心副主任。2015年获得国家自然科学基金“优秀青年项目”。主要研究方向是: 微纳光子学、新型光电子集成及器件、二维材料光电子器件等。在国际著名SCI期刊上发表论文50余篇 (JCR一区和二区论文30余篇); 以第一或通信作者发表SCI论文包括: 《Nature Photonics》1篇 (被《Nature》、《Nature Photonics》、《IEEE Spectrum》等国际重要学术期刊和网络杂志评论16次), 《Nano Letters》2篇 (均被欧洲物理学会的《Nanotechweb.org》评论), 《IEEE Journal of Selected Topics of Quantum Electronics》1篇 (邀请论文), 《Applied Physics Letters》2篇 (其中1篇入选《Nature Photonics》2012年8月的Research highlights), 《Optics Express》1篇 (其中1篇被《Laser Focus World》专题评论), 《Light Science & Applications》1篇, 《Optica》1篇, 《Optics Letters》2篇。

•**摘要:** Two-dimensional (2D) materials, such as graphene, TMDs and gallium mono-chalcogenides, showing great potentials to complement silicon electronics and optoelectronics, have been widely reported for promising optoelectronic devices including photodetectors, modulator, and light emitters. In virtue of shapeable electronic structures, 2D materials also occupy various distinct second harmonic generation (SHG) characteristics, including extraordinarily high efficiency (three orders of magnitude higher than other common nonlinear crystals), layer-dependence, and electrical tunability. If the extraordinary SHGs were exploited further, 2D materials' optoelectronic applications might be greatly extended into nonlinear regimes for coherent light source generations, image processings, ultrafast laser engineerings, etc. In this talk, we would report our two recent work about SHG in 2D materials.

• First, we report the layer-dependent second harmonic generation (SHG) in atomic layered ReS₂. Different from most of the atomically thin transition metal dichalcogenides, e.g., MoS₂ and WS₂, monolayer ReS₂ has no SHG, and strong SHG can only be obtained from an even-layered ReS₂ flake. From a bilayer ReS₂ flake, we obtain an effective second order nonlinear susceptibilities of 900 pm/V, which is the highest value reported in 2D materials in the telecom-band.

• Second, We demonstrate the first achievement of continuous-wave (CW) pumped second harmonic generation (SHG) in few- and mono-layer gallium selenide (GaSe) flakes, which are coated on silicon photonic crystal (PC) cavities. Because of ultrahigh second order nonlinearity of the two-dimensional (2D) GaSe and localized resonant mode in the PC cavity, SHG's pump power is greatly reduced to microwatts. In a nine-layer GaSe coated PC cavity, while the optical power inside the GaSe flake is only 1.5% of that in the silicon PC slab, the SHG in GaSe is more than 650 times stronger than the third harmonic generation in silicon slab, indicating 2D GaSe's great potentials to strengthen nonlinear processes in silicon photonics. Our study opens up a new view to expand 2D materials' optoelectronic applications in nonlinear regime and chip-integrated active devices.

时间: 10月26日 (星期四) 15:00—16:40

地点: 北京大学物理大楼中212教室

邀请人: 刘开辉 khliu@pku.edu.cn

Photograph by Xiaodong Hu