



复旦大学物理系 物质科学报告

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Metasurfaces: Physics and Applications

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The arbitrary control of electromagnetic (EM) waves is a key aim of photonic research. Conventional optical materials have limited abilities to manipulate EM waves due to their narrow variation ranges of material parameters. Metamaterials, artificial materials constructed by subwavelength-sized microstructures (e.g., meta-atoms) exhibiting tailored EM properties, can in principle possess arbitrary values of electric permittivity and magnetic permeability, and thus exhibit unprecedented capabilities to control EM waves. However, the inevitable wave-transportation losses in such complex media hinder their practical applications. Very recently, metasurfaces, the two-dimensional version of metamaterials composed by *planar* meta-atoms arranged in specific macroscopic orders, have attracted extensive attention, as they can not only largely avoid the losses but also exhibit even stronger capabilities to control EM waves. Many fascinating wave-control phenomena were discovered based on metasurfaces, such as anomalous refraction/reflection based on the generalized Snell's law, planar-lens focusing and optical vortex generalizations. In this Colloquium, I will present a brief overview on the historical development of this fast-developing research field, focusing particularly on our recent efforts in employing meta-surfaces to control EM waves in various aspects. Specifically, I will describe how to realize utilize gradient metasurfaces to convert propagating waves surface waves with nearly 100% efficiency, how to combine gate-controlled graphene with metasurfaces to achieve wide-range active phase modulation on THz waves, and how to realize photonic spin-Hall effects with carefully designed meta-surfaces with nearly 100% efficiency in both reflection and transmission geometries.



周磊，1997 年获复旦大学博士学位，随后在日本东北大学（1997-2000）及香港科技大学（2000-2004）从事博士后研究，2004 年至今为复旦大学物理学系教授。获国家杰青（2007），长江学者（2010），万人计划“领军人才”（2017），中国光学重要成果奖（2012），上海市自然科学牡丹奖（2015），上海市领军人才（2016），上海市自然科学一等奖（2016），美国光学学会（OSA）青年科学家奖（2016），美国物理学会（APS）杰出审稿人（2017），复旦大学本专科毕业生“我心目中的好老师”（2010-2012，2015-2017，其中 3 次为提名奖）；上海市教学成果二等奖（2013），宝钢优秀教师奖（2015），复旦大学本科教学贡献奖（2015）等奖励或荣誉。

在电磁超构材料等领域从事理论实验研究，发表包括 Nature Materials 在内的论文 150 余篇，累计被引 7700 余次，单篇最高引用 800 余次。作为大会主席组织超构材料相关的国际会议 6 次，作为中方主席发起并组织中日韩三国超材料学术论坛，100 余次在国际会议上做大会/主旨/特邀报告。

