# 亮点报道：表面波驱动下片上超构表面构建太赫兹复杂矢量光场

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超构表面作为一种新型光学器件，由一系列超薄的亚波长人工原子按照特定排列方式组成，实现了奇异反射/折射、平面棱镜、全息成像、表面波激发等奇异效应。

复旦大学周磊教授领衔的超构材料光场调控团队提出了一种用于设计超紧凑片上光学器件的通用方法，它们能够在表面波 (SW) 激励下高效生成预先设计的复杂波前矢量光束 (VOFs)，并在太赫兹 (THz) 频段进行了实验验证。他们进一步提出了设计复合超构表面辐射复杂矢量光场的思想。将传统的单个“人工原子”拓展为 2×2“人工分子”，其中内部不同的子单元 (蓝色和紫色) 具有独立的旋转角度及旋转方向，在表面波的照射下可以同时辐射出具有左旋 (LCP) 和右旋 (RCP) 分量。他们还建立了一种通用的设计方法，将目标矢量光场分解为不同波矢和圆偏基矢的求和形式，通过目标总场与人工原子之间的映射关系，最终得到复合超构表面的设计参数，完成原型器件的设计。

该研究为实现高度集成的片上太赫兹器件提供了新的思路，相关研究在生物传感、高速通信、激光雷达、AR/VR 等领域中具有广泛的应用前景。

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# Highlights: Generation of terahertz complex vector light fields on a metasurface driven by surface waves

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Metasurfaces, as a new type of optical device, are composed of a series of ultra-thin subwavelength artificial atoms arranged in a specific manner, enabling unusual effects such as anomalous reflection/refraction, planar prisms, holographic imaging, and surface wave excitation.

Prof. Lei Zhou's "Metamaterial Optical Field Control Team" at Fudan University proposed a general method for designing ultra-compact on-chip optical devices that can efficiently generate pre-designed complex wavefront vector beams (VOFs) under surface wave (SW) excitation, with experimental verification in the terahertz (THz) frequency range. The traditional single "artificial atom" is expanded into a 2×2 "artificial molecule", where the different subunits (blue and purple) have independent rotation angles and directions. Under the illumination of surface waves, these subunits can simultaneously radiate left-handed circular polarization (LCP) and right-handed circular polarization (RCP) components. They have developed a universal design method that decomposes the target vector light field into a sum of different wave vectors and circular polarization basis vectors.

This research provides a new approach for achieving highly integrated on-chip terahertz devices, with broad application prospects in fields such as biosensing, high-speed communication, lidar, and augmented and virtual reality (AR/VR).

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