表面等离激元涡旋的时空调控

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表面等离激元涡旋的时空表征方面，目前的研究大多集中于对涡旋的客观表征，并未实现对其时空动力学的主观调控。而且，光电发射电子显微镜、非线性光学显微镜等技术受限于系统本身的工作原理和工作波长范围，难以精确地表征表面等离激元涡旋时空演变过程。

天津大学、桂林电子科技大学、美国俄克拉荷马州立大学联合提出了一种表面等离激元涡旋的时空调控方法，通过改变耦合器的设计演示了具有相同拓扑荷的表面等离激元涡旋可以被赋予不同的时域演化特征。利用近场扫描太赫兹显微镜，在超高时间分辨率下直接获得了表面等离激元场的全振幅、相位信息和精确的涡旋演化过程。

研究团队以相互垂直、成对的亚波长金属狭缝谐振器为单元结构组成环形耦合器件，通过引入不同几何相位、传播相位的方式实现相同目标阶数（4 阶）的表面等离激元涡旋激发。为了从理论上揭示表面等离激元涡旋形成、旋转和衰减过程的时空动力学，研究团队将二维惠更斯-菲涅耳原理推广到时域，从而得到表面等离激元场的时空分布结果。

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Tailoring spatiotemporal dynamics of plasmonic vortices

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For plasmonic vortex generation, the most common method is constructing special couplers and utilizing the design degrees of freedoms of propagation phase and geometric phase to convert circularly polarized light carrying spin angular momentum into on-chip plasmonic vortex.

The research group from Tianjin University, Guilin University of Electronic Technology and Oklahoma State University together propose a new method to tailor the spatiotemporal dynamics of plasmonic vortices. It is demonstrated that the plasmonic vortices with the same topological charge can be endowed with distinct spatiotemporal dynamics by simply changing the coupler design. The full amplitude and phase information of surface plasmons fields and the exact evolution dynamics with ultrahigh temporal resolution were directly obtained based on a near-field scanning terahertz microscopy.

Based on the orthogonal slit-pairs, the group designed two plasmonic vortex couplers to generate plasmonic vortices with the same topological charge (l = 4). By introducing different propagation phase and geometric phase, the spatiotemporal dynamics of generated plasmonic vortices can be totally different. In order to numerically reveal the processes of the formation, revolution and decay stages in the lifetime of plasmonic vortex, the group generalized the 2D Huygens-Fresnel principle to time-domain and obtained the time-resolved snapshots of the plasmonic vortices field distributions.

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