Highly Efficient SPP Coupler Based on Transparent Meta-surface

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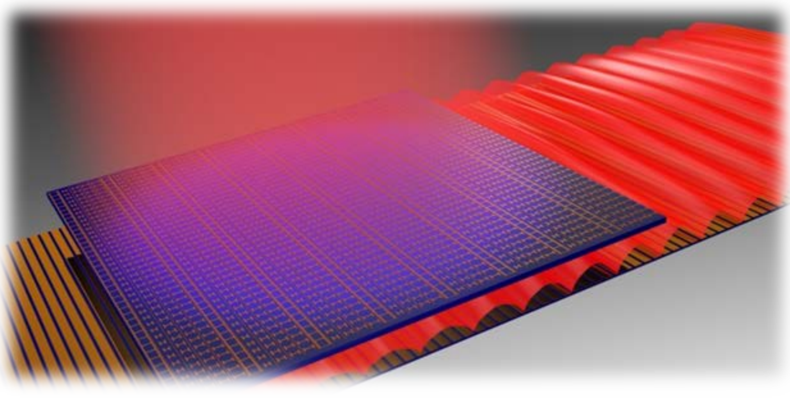
Meta-surfaces, ultra-thin metamaterials composed by planar artificial sub-wavelength units with purposely determined electromagnetic (EM) responses, have drawn much attention recently (1)-(3). By designing meta-surface in such a way that its reflection/transmission phase distribution exhibits certain profile (e.g., linear, parabolic, etc.), various fascinating wave-manipulation effects have been realized, such as anomalous light reflection/refraction satisfying a generalized Snell's law and light focusing by a planar lens. In particular, it was shown in Ref. (1) that when the phase gradient contributed by a meta-surface is larger than a critical value, a carefully designed reflective meta-surface can perfectly convert an incident propagating wave (PW) to a surface wave (SW) bounded on the meta-surface (1). Such a PW-SW conversion mechanism is completely different from conventional techniques such as prism or grating couplers, and thus has attracted lots of efforts to design high-efficiency surface plasmon polariton (SPP) couplers.

However, since the gradient meta-surface (GM) itself is inhomogeneous and thus does not support the eigen SPPs, the converted SW can only exist on the meta-surface under the illumination of the incident PW. To guide such driven SW out of the system, a periodic/homogeneous system supporting eigen SPP has to be placed adjacent to the GM. Unfortunately, it was theoretically argued that the scatterings contributed by the super periodicity on the GM are non-negligible, and the efficiency cannot be very high for a GM with more super cells (4).

Here, the speaker proposes a new design for high-efficiency SPP coupler based on the GM concept, which can overcome the above issues. To verify the idea, the speaker has designed a realist structure working at 10GHz, and found by full-wave simulations that the SPP conversion efficiency of the designed device can be as high as 78%. The speaker compared the proposed scheme with other available methods, and found that the new scheme has the best conversion efficiency. Some experiment results support such excellent performance and also exhibit many other advantageous.



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