בס"ד

Plasmonic Graphene-like Topological Metasurface for Modeling 2D Materials

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Topological photonics[1] is a rapidly growing field. Efficient light confinement, guiding and localization have been achieved by using photonic crystals with topological states[2]. Furthermore, it has been shown that optical topological phases can model complex quantum systems[3]. A special interest is focused on systems supporting surface plasmon (SP) modes whose properties and band structure can be manipulated by accurately designed metasurfaces[4]. Exciting SPs by anisotropic scatterers can lead to the topological Berry phase (BP) that further modifies the surface wave's characteristics[5].

We experimentally study the spin-dependent response of a plasmonic graphene-like geometric phase metasurface (GPM). We prepared an array of rectangular grooves in a thin gold film arranged in a honeycombed lattice. The two constituent triangular sublattices are at different spatial orientations giving rise to a BP between them. Using leakage radiation microscopy, we measure the GPM's response to illumination by circularly polarized light in real and reciprocal space. We observe directional helicity dependent SP excitation. Modifying the relative angle between the sublattices gives rise to stronger spin selectivity. We confirmed these results with numerical calculations.

An interesting analogy can be drawn between our structure and so-called 2D materials, such as monolayer transition metal dichalcogenides (TMDs). Many recent studies have explored these materials' properties showing a strong spin-orbit interaction[6]. TMDs have structures similar to ours. The plane separation in analogous to the BP accumulation. Although the fabrication of 2D materials is improving rapidly, it currently remains a complicated procedure. Our structures, by contrast, are easy to prepare and measure. We thus propose a simple way to analyze optical properties of TMDs and possibly make predictions of yet unknown features.

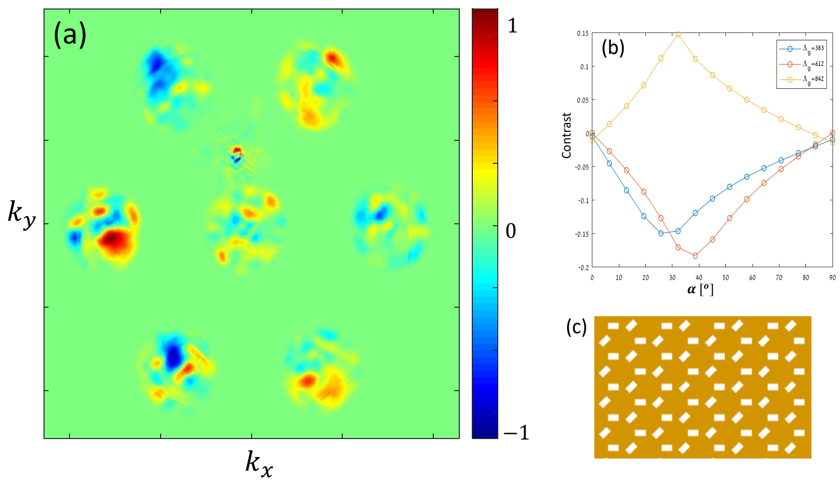

Figure 1. (a) Measured spin contrast in k-space. (b) Calculated relative angle orientation dependence on the spin contrast. (c) Schematic structure of the GPM unit cell.

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