

Tuning of natural hyperbolic plasmons in Van der Waals thin films

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Hyperbolic polaritons and their associated optical topological transitions can be naturally achieved in anisotropic Van der Waals thin films without the need for nanostructuring. In contrast to their artificial metasurface counterparts, these natural hyperbolic surfaces offer superior electromagnetic confinement and a more extensive photonic density of states. These plasmon polaritons, although rare, have recently been experimentally observed in WTe₂ Van der Waals thin films. Unlike phonon polaritons, which have limited tunability due to fixed Reststrahlen bands, hyperbolic plasmonic regimes depend on the interplay of intraband and interband transitions, presenting significant tuning potential through both intrinsic and extrinsic methods.

In this presentation, we will discuss experimental findings on the tunability of the hyperbolic regime and its associated optical topological transitions in WTe₂ thin films. We will explore how chemical doping, temperature variations, and adjustments in the twist angle and film thickness ratio in twist bilayer structures can be employed to modify the hyperbolic plasmon behavior. These results open the door to the development of reconfigurable photonic devices based on anisotropic natural materials.

Reference:

- (1) Nat. Commun. 2020, 11 (1), 1158.
- (2) Light: Sci. Appl. 2023, 12 (1), 193.
- (3) Nano Lett. 2023, 23 (15), 6907-6913.