Biaxial hyperbolic phonon polaritons in van der Waals alpha-MoO3 crystal

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Polaritons, the hybrid quasiparticles associated with strong coupling of electromagnetic waves with electric or magnetic dipoles within the materials, enable efficient subwavelength light trapping and manipulation. Such a capability has opened up new avenues for enhancing various light−matter interactions at the nanoscale. In recent years, two-dimensional atomic crystals are demonstrated to support a variety of polaritons, which can greatly benefit the fundamental research and optoelectronic applications in the mid-infrared to terahertz regions.[1,2]
In this talk, I will discuss our recent studies on the electromagnetic field localizations in the mid-infrared regions (9.8~11.0 μm) with biaxial hyperbolic phonon polaritons in van der Waals α-MoO3 crystal.
Due to its low-symmetry crystalline structure, the polar α-MoO3 exhibits rich phonon modes. As a result, the α-MoO3 supports strong hyperbolic phonon polaritons (PhPs) in the mid-infrared range, giving rise to ultrahigh electromagnetic field confinements. The electromagnetic confinements can reach ~ λ0/120, which can be tailored by altering the thicknesses of the α-MoO3 2D flakes and by metal ion intercalation.[3,4] In addition, their PhP characteristics can also be tuned by nanostructuring of the 2D flakes, as well as stacking two layers of α-MoO3 with different twisted angles.[5,6] These results have unveiled excellent electromagnetic field localization performances of the natural two-dimensional atomic oxides, which may have great potentials in nanophotonic devices operating in the mid-infrared region.

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