Planar refraction and lensing of nano-light in an anisotropic van der Waals material

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Refraction between isotropic media is characterized by light bending towards the normal to the boundary when passing from a low- to a high-refractive-index medium. However, refraction between anisotropic media is a more exotic phenomenon which remains barely investigated, particularly at the nanoscale. Here [1], we visualize and comprehensively study for the first time the general case of refraction of electromagnetic waves between two strongly anisotropic (hyperbolic) media, and we do it with the use of nanoscale-confined polaritons (hybrid light-matter waves) in a natural medium: a-MoO_3 [2-4]. The refracted polaritons exhibit non-intuitive directions of propagation as they traverse planar nanoprisms, enabling to unveil an exotic optical effect: bending-free refraction. Furthermore, we develop a brand-new nano-optical element: the first in-plane refractive hyperlens, yielding foci as small as $\lambda_p/6$, being λ_p the polariton wavelength ($\lambda_0/50$ compared to the wavelength of free-space light). Our results set the grounds for planar nano-optics in strongly anisotropic media, with potential for effective control of the flow of energy at the nanoscale.

References

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Figures

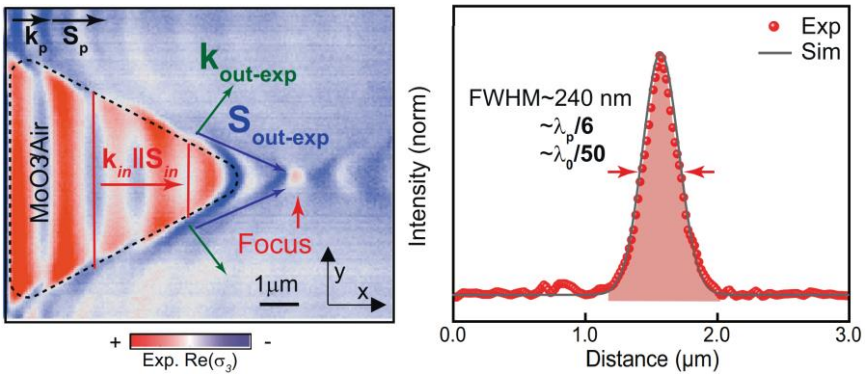

Figure 1: Sub-diffractional planar lens based on refraction of nano-light in an anisotropic vdW material.