Twisted Nano-optics: Manipulating Light at the Nanoscale with Twisted Polaritonic Slabs

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Recent discoveries have shown that when two layers of van der Waals (vdW) materials are superimposed with a relative twist angle between their respective in-plane principal axes, the electronic properties of the coupled system can be dramatically altered. Here, we demonstrate[1] that a similar concept can be extended to the optics realm, particularly to propagating polaritons – hybrid light-matter interactions –. To do this, we fabricate stacks composed of two twisted slabs of a polar vdW crystal (a-MoO3) supporting low-loss anisotropic phonon polaritons (PhPs), and image the propagation of the latter when launched by localized sources (metal antennas). Our images reveal that under a critical angle the PhPs isofrequency curve (determining the PhPs momentum at a fixed frequency) undergoes a topological transition. Remarkably, at this angle, the propagation of PhPs is strongly guided along predetermined directions (canalization regime) with no geometrical spreading (diffraction-less). These results demonstrate a new degree of freedom (twist angle) for controlling the propagation of polaritons at the nanoscale with potential for nano-imaging, (bio)-sensing, quantum applications and heat management.

References

[1] J. Duan et al., Nano Lett., DOI: 10.1021/acs.nanolett.0c01673 (2020).

Figures

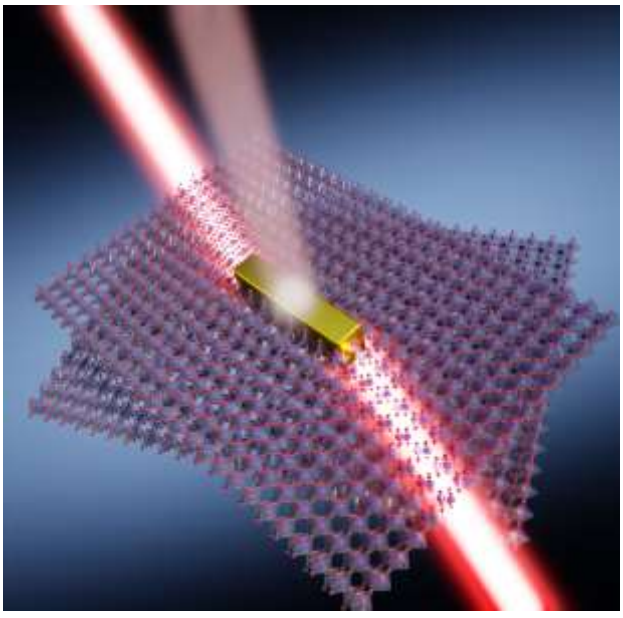

Figure 1: Canalized phonon polaritons in twisted van der Waals layers