Hyperbolic phonon polaritons in hexagonal boron nitride
(Conference Presentation)

Siyuan Dai, Univ. of California, San Diego (United States); Qiong Ma, Massachusetts Institute of Technology (United States); Zhe Fei, Mengkun Liu, Michael D. Goldflam, Univ. of California, San Diego (United States); Trond Andersen, Massachusetts Institute of Technology (United States); William Garnett, Will Regan, Univ. of California, Berkeley (United States); Martin Wagner, Alexander S. McLeod, Univ. of California, San Diego (United States); Alexandr Rodin, National Univ. of Singapore (Singapore); Shou-En Zhu, Technische Univ. Delft (Netherlands); Kenji Watanabe, T. Taniguchi, National Institute for Materials Science (Japan); Gerado Dominguez, Mark Thiemens, Univ. of California, San Diego (United States); Antonio H. Castro Neto, National Univ. of Singapore (Singapore); Guido Č. A. M. Janssen, Technische Univ. Delft (Netherlands); Alex Zettl, Univ. of California, Berkeley (United States); Fritz Keilmann, Ludwig-Maximilians-Universität München (Germany); Pablo Jarillo-Herrero, Massachusetts Institute of Technology (United States); Michael M. Fogler, Dmitri N. Basov, Univ. of California, San Diego (United States)

ABSTRACT

Uniaxial materials whose axial and tangential permittivities have opposite signs are referred to as indefinite or hyperbolic media. While hyperbolic responses are normally achieved with metamaterials, hexagonal boron nitride (hBN) naturally possesses this property due to the anisotropic phonons in the mid-infrared. Using scattering-type scanning near-field optical microscopy, we studied polaritonic phenomena in hBN. We performed infrared nano-imaging of highly confined and low-loss hyperbolic phonon polaritons in hBN. The polariton wavelength was shown to be governed by the hBN thickness according to a linear law persisting down to few atomic layers [1]. Additionally, we carried out the modification of hyperbolic response in meta-structures comprised of a monolayer graphene deposited on hBN [2]. Electrostatic gating of the top graphene layer allows for the modification of wavelength and intensity of hyperbolic phonon polaritons in bulk hBN. The physics of the modification originates from the plasmon-phonon coupling in the hyperbolic medium. Furthermore, we demonstrated the “hyperlens” for subdiffractional focusing and imaging using a slab of hBN [3].

References

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