Towards far-field light coupling to hyperbolic polaritons in CrSBr through nanoscale patterning

Adrián Dewambrechies Fernández[1]
Niclas S. Mueller[2], Aleksei Tsarapkin[3], Samuel Mañas-Valero[4,5], Alexander Paarmann[2], Katja Höflich[3], Eugenio Coronado[4], Kirill I.Bolotin[1]
[1]*Freie Universität Berlin, Berlin, Germany*
[2]*Fritz-Haber Institut, Berlin, Germany*
[3]*Ferninanf-Braun Institut, Berlin, Germany*
[4]*Universidad de Valencia, Insituto de Ciencia Molecula (ICMol), Valencia, Spain*
[5]*Delft University of Technology, Delft, The Netherlands*
a.dewambrechies.fernandez@fu-berlin.de

Two-dimensional Van der Waals materials have proven an interesting and tunable platform to study the coupling of light to different dipolar excitations, leading to polariton formation in different coupling regimes. In particular, hyperbolic polaritons are exotic modes which provide an interesting plethora of physical phenomena in anisotropic materials with permittivities having different signs along different crystallographic axes. Such anisotropy, combined with the advances in twist angle control of the 2D materials, has been used to control light propagation via the shaping of its dielectric function, showing topological behaviour, polariton canalization or sub-diffractional wave guiding [2][3].
However, such modes showing in-plane behaviour can't be studied with far-field optical light, missing the required momentum to couple to the non-radiative mode. Near-field techniques decrease performance at cryogenic temperatures and pose limitations in the preparation of Van der Waals heterostructures due to their surface sensitivity. Here we show our recent developments of far-field light coupling to self-hybridized exciton-polaritons in a 2D magnetic semiconductor CrSBr [1][4], through a nanopatterned superlattice in its crystallographic structure that provides the necessary momentum to couple to in-plane hyperbolic modes. Such technique overcomes the limitations imposed by near-field techniques and is compatible with recent developments in the in-situ angle control of 2D materials towards the development of twist angle dependent optical phenomena in the NIR-VIS range.

References

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