Light matter interaction in tunable 2D materials and artificial van der Waals solids

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Atomically thin two-dimensional layered materials receive great interest because of their unique properties. Particularly, monolayers of semiconducting transition metal dichalcogenides (SC-TMDs), such as MoS2, excel due to their strong light-matter interaction that is dominated by exciton phenomena [1-3]. Key to the integration of SC-TDM and related artificial van der Waals solids into circuitries is the possibility to tune and engineer their properties on demand and on-chip e.g. by defects, dielectric environment or doping [4-7].
We apply inelastic light scattering together with emission, absorption and transport measurements to study the manifold coupling mechanism in van der Waal hetero- and hybrid structures. We introduce the influence of the dielectric environment, the charge carrier density as well as defects on the optical properties of these atomically thin materials and discuss consequences for their integration into optoelectronic circuits [8]. Moreover, optical properties of direct and indirect interlayer excitons in van der Waals heterostructures are addressed.

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