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Light-Matter coupling in atomically thin materials

Transition metal dichalcogenides represent a novel emerging material class which seems almost ideal to study light-matter coupling in solid state: They are flexible direct band gap semiconductors which host thermally stable excitons of large oscillator strength. Furthermore, some species (in particular WSe2) are known to host strongly localized excitons which can be used as ultra compact solid state single photon sources.

In this talk, I address two specific cases:

I will first discuss the case of a single monolayer of WSe_2 embedded in a metal-based photonic structure. In such a structure, we observe Tamm-Plasmon Exciton-Polaritons at room temperature. The high thermal stability and large oscillator strength of excitons in monolayers of transition metal dichalcogenides make them ideal candidates for room temperature polaritonics [1].

Surprisingly, monolayers of WSe2 exposed to an open surface have also been identified to host optically active defects which promote single photon emission. Here, we study the properties of such defects in WSe_2, exfoliated on SiO_2 as well as GaInP substrates. We verify, that the integration of monolayers of transition metal dichalcogenides with epitaxially grown semiconductor material leads to a strong reduction of detrimental environmental effects, which paves the way towards a generation of high quality, bright quantum emitters and photon pair emitters in emerging two dimensional materials.

[1] Lundt, N. et al., arXiv:1604.03916 (2016) (2016)

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