Nano-photonics with van der Waals heterostructures

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The project aims at fabricating nano-structures using a new class of material, van der Waals heterostructures. The main building blocks are graphene, a two-dimensional semi-metal, and MoS_2, a two-dimensional semiconductor. Layers of these materials can be stacked on top of each other using boron nitride, BN, as a spacer or tunnel barrier. Unlike conventional semiconductors such as GaAs, there are no dangling bonds. This means that optically-active elements can be defined directly on the surface. For instance, ultra-small quantum dots can be created by placing pristine van der Waals heterostructures on a pre-patterned substrate. The ultimate goal of this project is to create a fully configurable array of on-chip single photon emitters.

The student will learn and master all-dry techniques for the creation of van der Waals heterostructures, and their characterization by optical techniques, notably Raman scattering. The student will also master nano-fabrication with electron-beam and focussed-ion-beam lithography. Nano-devices will be investigated with the full quantum optics tool-kit: cryogenic microscopy, photon anti-bunching and photon indistinguishability experiments.

We are looking for a strongly motivated experimentalist, ideally with a background in one aspect of semiconductor physics. Experience in either nano-fabrication or optical spectroscopy would be helpful. The student will work in a very supportive team backed up by the strongly interdisciplinary environment offered by the SNI.

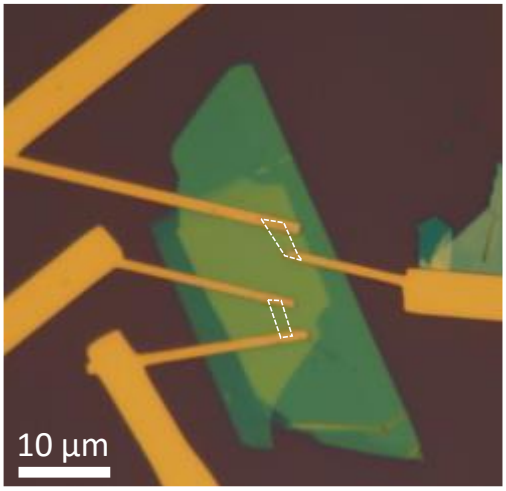

Image of a contacted van der Waals heterostructure. The dashed white lines show regions containing single MoS_2 monolayers.