2D Nanophotonics group (UvA)

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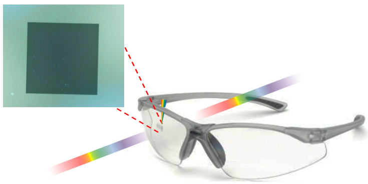
Science Park 904 – Room C4.251

Research theme. The *2D Nanophotonics* group focuses on the understanding and control of resonant light-matter interactions in optical metasurfaces and two-dimensional (2D) quantum materials. We study fundamentally new mechanisms to actively steer light, develop optical elements composed of a single atomic layer, and use quantum mechanical effects to control light-matter interactions with small electrical signals.

Project 1. Atomically-thin optical elements as beam-tapping metasurfaces

Supervisors: Ludovica Guarneri and Jorik van de Groep

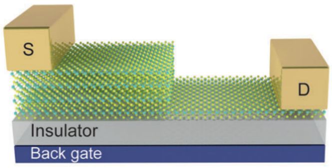


ACS Phot. 4, 2544 (2017)

Optical metasurfaces enable steering and manipulation of light beams using nanoscale patterns. Using highly transparent optical elements, users can redirect a very small amount of signal from a light beam to read out information without disturbing the beam ("beam tapping"). This requires ultra-transparent metasurfaces that operate in a narrow wavelength range. In this project, you will study how diffractive gratings in monolayer WS_2 (a semiconductor with a thickness of a single layer of atoms) can function as a beam-tapping metasurface. You will construct a new optical laser setup in which we perform Fourier microscopy at low temperatures to study the angular light scattering profile and optical efficiency of the metasurface. You will combine the experimental results with numerical simulations to determine the optical efficiency of the metasurface.

Project 2. Measuring light fields with a single layer of atoms

Supervisors: Ludovica Guarneri and Jorik van de Groep

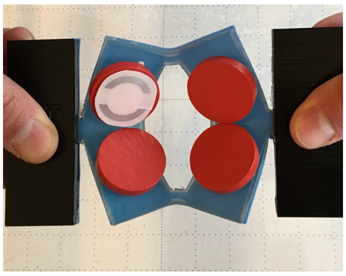


Chem. Soc. Rev. 47, 3339 (2018)

Monolayer 2D semiconductors are unique materials to realize tunable photodetectors, due to the material's highly-tunable optical properties. However, the role of tightly-bound excitons in the tuning process is poorly understood. In this project, you will fabricate nanoscale 2D photodetectors by contacting individual flakes of monolayer material using nanoscale electrodes. Next, you will use a home-built laser setup to perform nanoscale photocurrent mapping and spectroscopy in our confocal microscope to study the light absorption and photocurrent generation. You will use low-temperature measurements to study the tunability of the exciton absorption in the photocurrent signal.

Project 3. Mechanical tuning of coupling between RF optical resonators (joint project)

Supervisors: Jorik van de Groep and Corentin Coulais



Optical resonators are particles that can efficiently store and scatter light. The resonance frequency and phase strongly depend on the local geometry, and thus also on the distance between neighboring particles. In this *joint project* with the Machine Materials Lab (Corentin Coulais), you will use mechanical metamaterial platforms to actively control the coupling between optical resonators (red particles in image). By controlling the inter-particle geometry, you systematically study the coupling strength between two particles that are resonant in the radio-frequency regime. In particular, you will study how the out-of-plane reorientation influences the optical backscattering signal using numerical simulations and RF optical experiments.