WWU MÜNSTER

Aktuelle Fragen
der Nanophysik

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Site-selectively generated photon emitters in monolayer MoS_2 via helium ion irradiation

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Atomically thin TMDCs are well known for their strong light matter interaction and exciton dominated spectral response. Here, we demonstrate the deterministic and site-selective generation of single defect emitters in a monolayer MoS_2 van der Waals heterostructure by bombarding it with a nanometer-focused beam of helium ions. [1] Encapsulation of the defective MoS_2 within hBN greatly enhances the optical quality and reveals narrow spectral lines with emission energies 100-220 meV below the neutral 2D exciton. [2] We spectroscopically investigate single emitters by performing photoluminescence excitation spectroscopy. The emitter line shape reveals a strong asymmetry resembling the interaction with LA/TA phonons. We attribute the emission to atomistic defects induced by the helium ion bombardment and discuss their origin in the light of ab-initio calculations and scanning tunneling microscopy measurements. Finally, we demonstrate the deterministic positioning of optically active defects within the monolayer. We thank the DFG for funding via the cluster of excellence e-conversion.

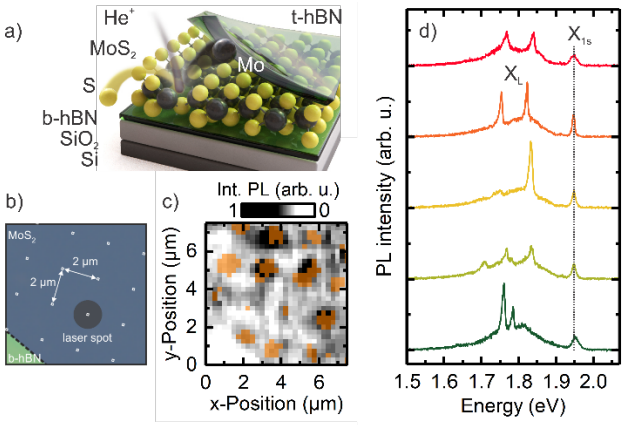

Figure 1: a) Schematic illustration of the exposed MoS_2/hBN van der Waals heterostructure. b) Optical micrograph of a monolayer MoS2/hBN van der Waals heterostructure. A matrix of 100nm x100nm fields is exposed with a pitch of 2 µm by He Ions. c) Corresponding spatially resolved and spectrally integrated PL mapping (grayscale). d) Selected spectra taken from c).

[1] J. Klein et al., 2D Mater. **5**, 1 (2017)
[2] Klein et al., arXiv:1901.01042v2 under review (2019)