Compound Semiconductor Technology

RWTH AACHEN UNIVERSITY

Master Thesis / Project Thesis

at Compound Semiconductor Technology (CST)

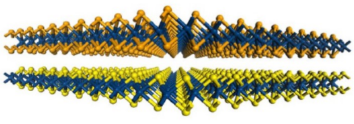
Characterisation and processing of MOCVD 2D-2D TMDC heterostructures

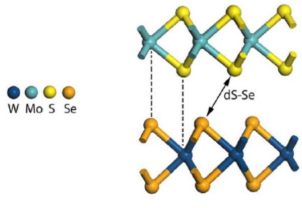
Transition metal dichalcogenides (TMDC) are a compelling class of 2D materials with potential applications in optoelectronics, flexible electronics, chemical sensing and quantum technologies. At the monolayer limit, those materials exhibit a direct band gap from the near-infrared to the visible range. This makes them particularly interesting for optoelectronic applications such as light emitting diodes (LED) or photodetectors One way of improving the performance of (opto)electronic devices based on single 2D materials is to create heterostructures of two or more 2D materials. Vertical heterostructures of different 2D layers can feature many fascinating properties, which are not only defined by the constituent monolayers, but also by their interaction. Without the requirement of lattice matching, a nearly infinite number of material combinations that do not exist in nature are possible.

Our present research focuses on metalorganic chemical vapor deposition (MOCVD) of the semiconducting TMDC (e.g. MX_2 with M=Mo/W and X=S/Se). TMDC monolayers are beyond graphene the most widely studied 2D semiconductors and thus provide a strong basis for understanding the properties of 2D-2D heterostructures.

During your thesis work, you will learn how to process and characterise 2D materials using various techniques such as scanning electron microscopy, Raman spectroscopy, atomic force microscopy and photolithography. Your task includes the (opto)electronic characterisation of different S- and Se-based TMDC heterostructures on sapphire substrates to analyse the interaction between the individual layers and the resulting changes in the optoelectronic properties of the heterostructures. You will work closely with the team responsible for epitaxy to further improve the MOCVD processes based on your findings. For optoelectronic characterisation, it will be necessary to process the heterostructures independently and to perform electrical measurements. The samples will be characterised and processed in our cleanroom facilities at the Zentrallabor für Mikro- und Nanotechnologie.

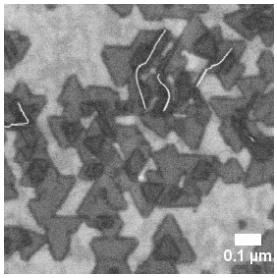
Prior lab work experience is not required, enjoying working independently at the lab and interest in the investigation of 2D materials are beneficial.





H. Terrones, et al. Scientific reports 3.1, 1-7 (2013)

MoS_2 deposited on WSe_2



Thinking the Future
Zukunft denken

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