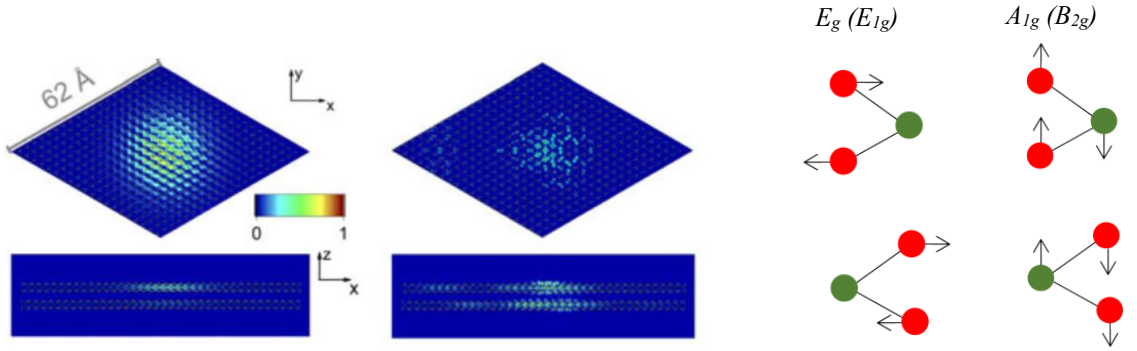
Investigation of the Interlayer Coupling of Twisted Bilayer CVD-Grown MoS_2 *via* Raman Spectroscopy

E. Schneider[1], N. Moses Badlyan[1], Y. Koval[1] and J. Maultzsch[1]

[1]*Department Physik, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany*

eileen.schneider@fau.de

Stacking two monolayers of TMDCs on top of each other with a twist angle introduces several novel phenomena as, e.g., the formation of moiré phonons and modifications of the band structure. In addition, the fabrication process and the twist angle both influence the coupling between the two layers. Here, this interlayer coupling will be investigated *via* Raman spectroscopy. By exciting the *C* exciton resonance, interlayer Raman modes are activated that are not visible in a single layer but become active in few-layer systems (cf. Fig. 1 (c)). [1,2] This is because the *C* exciton - in contrast to *A* and *B* excitons - expands over both layers and, therefore, couples the layers electronically as shown in Fig. 1 (a) and (b). [1] Taking well-coupled twisted MoS_2 bilayer samples as a starting point we investigate the influence of the twist angle on the *C* exciton resonance by taking Raman spectra of several samples with different twist angles at different laser excitation energies. In the next step we will test our results by using another TMDC, e.g., $MoSe_2$, where the *C* exciton resonance can be studied using laser energies in the visible spectrum because of the smaller bandgap.



(a) *A* exciton (b) *C* exciton (c) Interlayer Raman modes

Fig. 1: (a), (b) Real space wave functions of the *A* and *C* exciton, respectively. The *C* exciton expands over both layers of the bilayer system. Images taken from Ref. [1]. Therefore, the two interlayer Raman modes (c) are activated in multilayers of MoS_2 at 285 cm^{-1} and 471 cm^{-1}, respectively. Image based on Ref. [2].

References

[1] R. Gillen and J. Maultzsch, IEEE **23.1**, pp. 219-230 (2017).

[2] N. Scheuschner et. al., Phys. Rev. B **91.23**, p. 235409 (2015).