

Tuning van der Waals heterostructures by pressure

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In van der Waals heterostructures the layer distance strongly affects the interaction between the layers. Therefore, pressure is an ideal tool to engineer the band structure of van der Waals materials [1].

Here we will show examples for the versatility of this method. First, I will show, how this allows the tunability of the band structure of multi-layer graphene and how in WSe₂/Gr structures spin-orbit coupling can be boosted using hydrostatic pressure [2]. Finally, I will demonstrate the band structure tuning of magic-angle twisted double bilayer graphene [3]. We have performed thermal activation and magneto-transport measurements to reveal changes in the bandgaps of the system. We have observed a strong tuneability with pressure, which is confirmed by our theoretical calculations. Finally, we have also observed changes in the strength of electron-electron interactions and in the topological phases at the charge neutrality point in magnetic fields.

[1] B. Fülöp et al., Journal of Appl. Phys., 130, 064303 (2021)

[2] B. Fülöp, A. Márffy, S. Zihlmann, M. Gmitra, E. Tóvári, B. Szentpéteri, M. Kedves, K. Watanabe, T. Taniguchi, J. Fabian, C. Schönenberger, P. Makk, Sz. Csonka, npj 2D Materials and Applications 5, 82 (2021)

[3] M. Kedves et al., Nano Letters, 10.1021/acs.nanolett.3c03029

[4] B. Szentpéteri, P. Rickhaus, F. K. de Vries, A. Márffy, B. Fülöp, E. Tóvári, K. Watanabe, T. Taniguchi, A. Kormányos, Sz. Csonka, and P. Makk, Nano Letters, 21, 8777 (2021)