
Marcin Mucha-Kruczynski¹

L. S. Hart¹, J. L. Webb¹, S. Dale¹, S. J. Bending¹, D. Wolverson¹, C. Chen², J. Avila², M. C. Asensio²

¹ Centre for Nanoscience and Nanotechnology and Department of Physics, University of Bath, Bath BA2 7AY, United Kingdom

² SOLEIL, Saint Aubin, and Université Paris-Saclay, BP 48 91192 Gif-sur-Yvette, France

m.mucha-kruczynski@bath.ac.uk

Electronic band structure and van der Waals coupling of ReSe2 revealed by high-resolution angle-resolved photoemission spectroscopy

The layered transition metal dichalcogenides (LTMD) family includes a rich palette of superconductors, metals and semiconductors with direct and indirect gaps [1], and offers fascinating possibilities for the realization of nanoscale electronic, optoelectronic and photonic devices through the assembly of heterostructures [2]. Within this group, ReSe2 (and closely related ReS2) is an unusual LTMD with only one symmetry operation – inversion, which is preserved even in monolayers (as opposed to, for example, MoS2 [1]). In ReSe2, the low symmetry arises due to a distortion – shift of the metal ions away from their positions in the centres of octahedrons formed by the selenium atoms – what leads to the formation of characteristic quasi-1D in-plane rhenium ‘chains’ [3].

Using direct nanoscale angle-resolved photoemission spectroscopy supported by density functional calculations, we study the electronic band structure of bulk ReSe2 [4]. We find a highly anisotropic in- and out-of-plane electronic structure. In the plane, the effective mass doubles its value perpendicular to the rhenium chains as compared to the value along the chains. Also, the interlayer van der Waals coupling generates significant electronic dispersion normal to the layers. Interestingly, we find that the valence band maxima are located away from the Γ point (including a shift along the k_z -axis) but not in any particular high-symmetry direction.

References

- [1] Q. H. Wang et al., *Nature Nanotechnology* 7, 699 (2012).
- [2] A. K. Geim and I. V. Grigorieva, *Nature* 499, 419 (2013).
- [3] H. J. Lamfers et al., *J. Alloys Compd.* 241, 34 (1996).
- [4] L. S. Hart et al., *arXiv:1704.00175* (2017).