Title : Topological junctions in 2D ternary alloy semiconductors

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Research Area : 1.Condensed Matter
2.Quantum Science and Technology

Methods : Photoluminescence spectroscopy and microscopy
Scanning probe microscopy

PhD track subject :

2D transition metal dichalcogenides (TMDC) are monolayer semiconductors that have received enormous attention [1] over the last decade because of their unprecedented opto-electronic properties. Very recently, ordered 2D TMDC Janus alloys [2] have garnered interest since their properties are expected to be strongly modified by the Rashba effect. Real semiconductor alloys are subject however to compositional disorder – the random placement of isochemical atoms on the lattice during growth [3]. A combination of compositional disorder and a strong Rashba effect in ternary 2D TMDC alloys should result in a novel type of localization in topologically protected domains which we study using our expertise in high quality sample fabrication, [4] and local spectroscopic techniques [5,6].

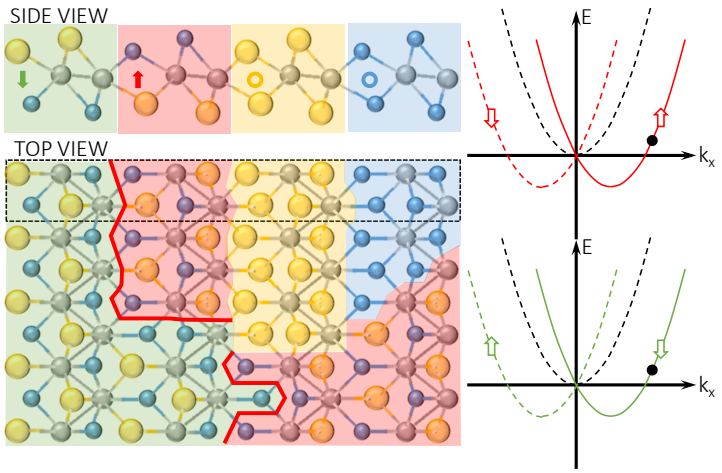

Fig.1 : Figure 2: A ternary 1T phase TMDC alloy exhibiting naturally occurring compositional disorder. In the side view cut 4 phases are visible, two of which (red and green) exhibit a topological junction where they meet. The red and green phases have equal bandgaps but are spin reversed while the yellow and blue phases have different gaps and are spin-degenerate. The dispersion relations for the red and green phases can be used to understand the formation of the topological junction indicated by the red line in the top view.

References :

[1] S. Manzeli et al., Nature Reviews Materials 2, 17033 (2017)
[2] A-Y. Lu et al., Nature Nanotechnology 12, 744 (2017)
[3] H. Masenda et al., Advanced Electronic Materials 2100196 (2021)
[4] F. Cadiz et al. Physical Review X 7, 021026 (2017)
[5] S. Park et al. 2D Materials 8, 045014 (2021)
[6] W. Hahn et al., Phys. Rev. B 98, 045305 (2018)