Account of the diversity of tunneling spectra at the germanene/Al(111) interface

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Interest has risen recently in 2D materials for IV group elements, whose stable structure is three-dimensional, but can be forced in a two dimensional shape via epitaxial deposition on a substrate. The resulting sp_3-like bonding, which results in a buckled structure, is one of the responsibles for the significant spin-orbit coupling in Si and Ge structures, which is expected to open a gap at Fermi level in the free-standing layers of 1.55 and 23.9 meV respectively [1]. This would be of great interest for fields like spintronics and the study of Quantum Spin Hall Effect [2]. Previous reports of germanene successfully grown on Al(111) indicate a weak charge transfer from the substrate to the 2D layer [3], but the resulting electronic properties of the material are still in discussion. Here, we prepared sub- and monolayer germanene on Al(111) and studied their morphology and their electronic properties with scanning tunneling microscopy and spectroscopy. The comparison of the spectroscopic results between germanene and the bare Al(111) surface measured at low temperature shows the same characteristics, suggesting a significant electronic interaction between both materials. However, strong deviations from a metallic behaviors are observed between experiments. We will rationalize these observations based on the weak mechanical coupling deduced from the manipulation of the surface.

References

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