Isolation of Highly Stable Antimonene under Ambient Conditions. Optical and Electrical Properties

J. Gómez-Herrero[1,4]
P. Ares[1], F. Aguilar-Galindo[2], D. Rodríguez-San-Miguel[3], C. Gibaja[3], D.A. Aldave[1], W. Silva[1], S. Pakdel[1], J. J. Palacios[1,4], S. Díaz-Tendero[2,4], M. Alcamí[2,5], F. Martín[2,4,5],
F. Hauke[6], A. Hirsch[6], G. Abellán[6], F. Zamora[3,4,5]

[1] Department of Condensed Matter Physics, Universidad Autónoma de Madrid, Spain
[2] Department of Chemistry, Universidad Autónoma de Madrid, Spain
[3] Department of Inorganic Chemistry, Universidad Autónoma de Madrid, Spain
[4] Condensed Matter Physics Center (IFIMAC), Universidad Autónoma de Madrid, Spain
[5] Instituto Madrileño de Estudios Avanzados en Nanociencia (IMDEA-Nanociencia), Spain
[6] Department of Chemistry and Pharmacy, University Erlangen-Nürnberg, Germany

julio.gomez@uam.es

Graphene paved the way for the rising of a whole family of 2D materials. Graphene is a semimetal with zero-gap and transition metal dichalcogenides present a band gap in the range 1.5-2.5 eV [1], inappropriate for some optoelectronics applications where 0.1-1.5 eV are preferred. Few-layer black phosphorous (BP) [2] presents an energy gap within this range. However, it is highly hygroscopic [3]. In the same group in the periodic table we also find antimony, a silvery lustrous, non-hygroscopic element with a layered structure similar to that of BP. Theoretical calculations [4] point towards a band gap suitable for these optoelectronics applications. We report micromechanical and liquid-phase exfoliation of antimony down to the single-layer regime and experimental evidence of its high stability in ambient conditions [5, 6]. We also present optimized optical identification [7] and preliminary results on the conductive properties of few-layer antimonene, which point to be governed by topologically protected surface states. In this context, Probe-Assisted Nanowire (PAN) lithography is introduced; a novel technique to create nanoelectrodes that has allowed probing the electrical properties of tiny few-layer antimonene flakes.

References

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Figures

Figure 1. Atomic force microscopy image of an antimonene flake representing its stability in ambient conditions.