Nano-modulated electronic properties of borophene on Ir(111)

Marin Petrović[1]
Sherif Kamal[1], Pantelis Bampoulis[2], Matteo Jugovac[3], Iva Šarić Janković[4], Marko Kralj[1]
[1]*Institute of Physics, Bijenička 46, 10000 Zagreb, Croatia*
[2]*University of Twente, 7500AE Enschede, Overijssel, The Netherlands*
[3]*Elettra - Sincrotrone Trieste S.C.p.A., Basovizza, 34149 Trieste, Italy*
[4]*University of Rijeka, Radmile Matejčić 2, 51000 Rijeka, Croatia*
mpetrovic@ifs.hr

Detailed insight into electronic properties of 2D materials is crucial for a complete understanding and application of these atomically-thin systems. For borophene, a polymorphic 2D sheet of boron atoms [1], it is challenging to produce large-scale uniform samples, thus hindering thorough characterization of its electronic structure. Here we present core-level and valence band characterization of borophene on Ir(111) substrate (see Fig. 1(a)). Borophene synthesis has been performed by means of segregation-enhanced chemical vapour deposition with borazine as a precursor [2,3], which enables production of large (cm-sized), single-layer borophene samples. Several spectroscopic methods were employed in order to determine the electronic properties of borophene. X-ray photoelectron spectroscopy (XPS) and scanning tunnelling spectroscopy (STS) disclosed different chemical environments of B atoms and indicate inhomogeneous Bo-Ir interaction modulated at the nanoscale. Furthermore, angle-resolved photoelectron spectroscopy (ARPES) mappings in the vicinity of the Fermi level (see Fig. 1(b)) reveal distinct electronic bands which are associated with the borophene monolayer, including signatures of electron scattering on the crystal lattice of borophene. Our data provides a comprehensive insight into the electronic structure of borophene sheets, which could expedite their utilization in future technologies.

References

[1] Z. Zhang, E. S. Penev, B. I. Yakobson, Chem. Soc. Rev. 46 (2017) 6746.
[2] K. M. Omambac, M. Petrović, P. Bampoulis, C. Brand, M. A. Kriegel, P. Dreher, D. Janoschka, U. Hagemann, N. Hartmann, P. Valerius, T. Michely, F. J. Meyer zu Heringdorf, M. Horn-von Hoegen, ACS Nano 15 (2021) 7421.
[3] B. Radatović, V. Jadriško, S. Kamal, M. Kralj, D. Novko, N. Vujičić, M. Petrović, ACS Appl. Mater. Interfaces 14 (2022) 21727.

Figures

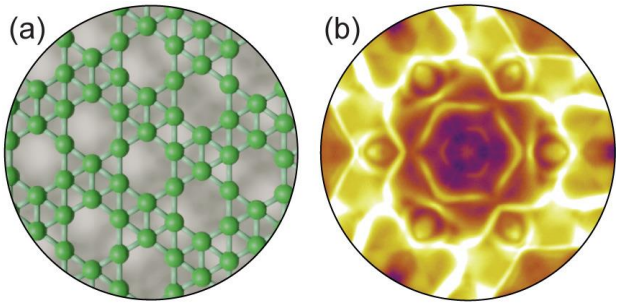

Figure 1: (a) Ball-and-stick model of borophene on Ir(111). (b) Fermi surface of borophene on Ir(111), as determined with ARPES.