

Single layer boron nitride: From Nanomesh to smart membranes in liquids

Thomas Greber, Physik-Institut, University of Zürich, Switzerland

In the slipstream of graphene, hexagonal boron nitride emerged as another important two-dimensional material with similar stability and lattice constant, though as an insulator with different affinity to ions. I will briefly review the single layer of h-BN superhoneycomb on rhodium metal (nanomesh) as a significant modifier of the surface properties [1] with strong lateral electrical fields on the nanometer scale [2].

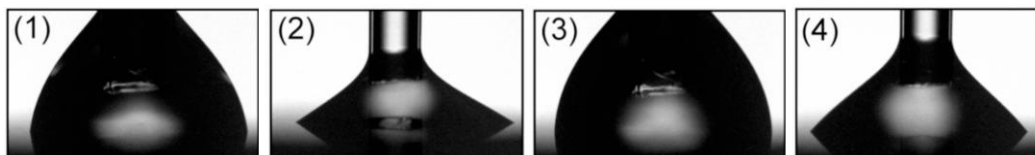


Fig. 1. Dynamic contact angle measurements. (1) Advancing, (2) receding for corrugated and (3) advancing (4) receding for flat h-BN/Rh(111). The contact angle hysteresis is evident, and is due to the switching of the 0.1 nm h-BN corrugation upon hydrogen intercalation. Capillary outer diameter 850 μm . From [4].

Then recent results of the use of this interface system in view of an ultimately thin membrane are discussed. Intercalation of hydrogen in vacuum [3] and in a liquid electrolyte (see Figure 1) [4] are first examples. I will also show on to produce 2 nm holes (nanovoids) in the nanomesh with the can-opener effect [5], how such single domain h-BN may be exfoliated and how it may eventually be applied as smart membranes in liquids.

Financial support by the Swiss National Science Foundation and the European Commission Future and Emerging Technologies Flagship Graphene is gratefully acknowledged.

[1] M. Corso et al. *Boron nitride nanomesh*, Science, 303 (2004) 217.

[2] H. Dil et al. *Surface trapping of atoms and molecules with dipole rings*, Science 319, (2008) 1824.

[3] T. Brugger et al. *Nanotexture switching of single-layer hexagonal boron nitride on rhodium by intercalation of hydrogen atoms*, Angewandte Chemie Int. Ed. 49 (2010) 8120.

[4] S. Mertens et al. *Switching stiction and adhesion of a liquid on a solid*, Nature (2016).

[5] H.Y. Cun et al. *Immobilizing Individual Atoms beneath a Corrugated Single Layer of Boron Nitride*, Nano Letters 13 (2013) 2098, *Two-Nanometer Voids in Single-Layer Hexagonal Boron Nitride: Formation via the “Can-Opener” Effect and Annihilation by Self-Healing*, ACS Nano 8 (2014) 7423.