GDR HOWDI 2022 MEETING:
BN GROWTH ON NICKEL UNDER ULTRA-HIGH VACUUM CONDITIONS FROM BORAZINE

J. Hadid, X. Wallart and D. Vignaud [1]

[1] Univ. Lille, CNRS, Centrale Lille, Univ. Polytech. Hauts-de-France, UMR8520 - IEMN - Institut d'Electronique, de Microélectronique et de Nanotechnologie, F-59000 Lille, FRANCE

Graphene is a 2D material, famous for its exceptional electronic properties. However, to exploit these properties in real devices, the electronic coupling with the substrate and with any surrounding material must be strongly reduced. Hexagonal boron nitride (hBN), another 2D material, is very promising for this purpose [1]. It could be used both to insulate graphene from the substrate and as a gate dielectric material. Although devices obtained by mechanical exfoliation and transfer did confirm the strong potentialities of graphene/hBN heterostructures [2], a scalable and reliable growth technique remains to be demonstrated: the development of new approaches to the fabrication of graphene/BN 2D heterostructures is of high importance. If scalable graphene growth is now well documented, this is not yet the case for BN [3]. The ultimate goal is to be able to grow BN film with accurate thickness control from one to few layers on graphene as well as on technologically compatible substrates.

Towards this goal, we have started to study the growth of BN on Ni substrates from the gaseous borazine precursor ($B_3N_3H_6$), used alone [4] or combined with a complementary source of N provided by a plasma cell. Experiments were done in a molecular beam epitaxy chamber. A continuous BN film is obtained using only the borazine precursor, with a self-limited thickness of one monolayer [5]. The strong orbital hybridization between the Ni 3d and BN π states at the interface [6] disappears after transfer on Si. When using combined borazine-nitrogen sources, high quality material is locally obtained but with a rather heterogeneous thickness and a structure dependent on the Ni crystallographic orientation.

References

[1] C.R. Dean et al., *Nat. Nanotech.5, 722 (2010).*
[2] S.J. Haigh et al., *Nat. Mat..11, 764 (2012).*
[3] C. Backes et al., *2D Mater. 7, 022001 (2020).*
[4] J. Hadid et al., *2D Mater. 8, 045007 (2021).*
[5] A. Nagashima et al., *Phys.Rev.B 51, 4606 (1995).*
[6] A.B. Preobrajenski et al., *Phys.Rev.B 70, 165404 (2004).*

corresponding author : dominique.vignaud@univ-lille.fr