BN materials for 2D devices: learnings from optical properties

Julien BARJON[1]
S. Roux[1-2], A. Plaud[1-2], I. Stenger[1], L. Sponza[2], F. Fossard[2], F. Ducastelle[2], A. Loiseau[2], B. Toury[3], C. Journet[3], E. Janzen[4], J. Edgar[4], K. Watanabe[5], T. Taniguchi[5]
[1] *Université Paris-Saclay, UVSQ, CNRS, GEMaC, 78000, Versailles, France*
[2] *Université Paris-Saclay, ONERA, CNRS, LEM, 78000, Chatillon, France*
[3] *Université de Lyon, Université Claude Bernard, CNRS, LMI, 69622, Villeurbanne, France*
[4] *Kansas State University, Department of Chemical Engineering, 66506, Manhattan, United States*
[5] *National Institute for Material Sciences, NIMS, Tsukuba, 305-0044, Japan*
julien.barjon@uvsq.fr

These last years, hexagonal boron-nitride (hBN) crystals have become strategic for the research on 2D devices, for either the electron transport in graphene or the optical properties of 2D materials. Up to now, the prototype devices are mostly assembled via mechanical exfoliation and transfer of atomic layers. But active researches are developing worldwide to fabricate the large-surface crystals required for device industrialisation. In this context, optical diagnostics are highly desired to qualify hBN materials for their integration into 2D devices.

In this talk, the recently acquired basic knowledge on the luminescence properties of free excitons in hBN measured by cathodoluminescence [1] and the vibrational properties by Raman spectroscopy [2,3] are exploited for this purpose. The reference data are taken from the high quality hBN crystals mostly used in devices, grown at high pressure and high temperature (HPHT) [4]. They are compared with those of hBN crystals obtained with alternative fabrication methods: either using a chemical process followed by high pressure annealing [5] or a direct synthesis at atmospheric pressure (APHT) with boron isotope control [6, 7].

References

[1] L. Schué et al., Phys. Rev. Lett. 122 (2019) 067401
[2] L. Schué et al., 2D Mat. 4 (2017) 015028
[3] I. Stenger et al., 2D Mat. 4 (2017) 031003
[4] T. Taniguchi, K. Watanabe, J. Cryst. Growth 303 (2007) 525
[5] Y. Li et al., ACS Appl. Nano Mater. 3 (2020)1508
[6] J. Sonntag et al., 2D Mat. 7 (2020) 031009
[7] M. Onodera et al., Nanolett. 20 (2020) 735