Epitaxial growth of 2d materials by catalytic hexagonalization of diamond and boron nitride.

D.A. Evans[a], Di Hu[a], S.P. Cooil[b], B.P. Reed[a], R.E. Cross[a]

[a]Department of Physics, Aberystwyth University, Aberystwyth SY23 3BZ, UK
[b]Department of Physics, NTNU, Trondheim, Norway

There is considerable interest in the fabrication and electronic properties of graphene and related 2d materials such as BN for low-dimensional materials engineering. Like graphene, 2d BN can be fabricated by CVD growth and exfoliation[1]; here we show that it can also be produced by metal-catalysed hexagonalization of cubic BN, in a similar way to the graphitization of diamond.

Advantages of metal-catalyzed graphitization of diamond include the lower temperature in comparison with metal-free graphitization and CVD growth (~ 500°C) and the use of the substrate as a source of material in addition to its use as a lattice-matched substrate. Using photoelectron-based methods[2], we have shown that epitaxy is maintained throughout the process as illustrated schematically in Fig. 1 for graphene growth on the (111) face of diamond.

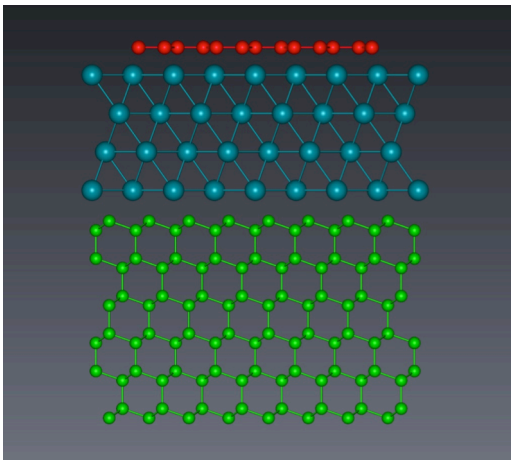

Fig. 1. 2-D growth of graphene (top layer) on a diamond substrate with an interlayer metal catalyst

The graphene grows from below rather than above as in CVD and therefore it is possible to controllably grow single and multilayer films. In a bilayer structure, the inner layer is bound strongly to the metal catalyst, but the second layer exhibits the electron dispersion characteristic of quasi-free graphene with Dirac points at the Fermi level. Using a similar method, we have monitored the hexagonalization of crystalline cubic BN with the same metal catalyst.

Keywords: 2d materials; BN; photoemission

References

[1] Y. Lin, T.V. Williams, J.W. Connell, *The Journal of Physical Chemistry Letters* **2010**, *1*, 277-283.

[2] S.P. Cooil, J.W. Wells, D. Hu, Y.R. Niu, A.A. Zakharov, M. Bianchi, D.A. Evans, *Applied Physics Letters* **2015**, *107*, 181603.