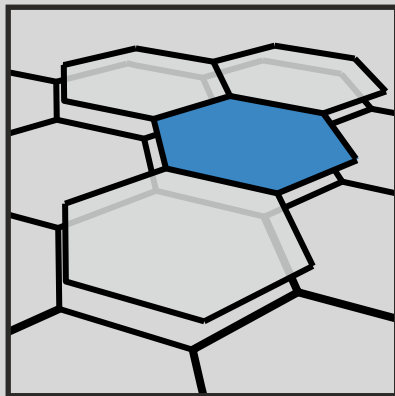




**Aachen
Graphene &
2D-Materials
Center**

Aachen-Graphene Flagship-Seminar

May 26, 2020

ONLINE -- ONLINE -- ONLINE

at 12:00h by ZOOM

On the Fundamental Mechanisms that underpin CVD Technology for Atomically Thin 2D Films

Stephan Hofmann, Department of Engineering, University of Cambridge, UK

Driven by the industrial demand for “electronic-grade” 2D material films (2DM), we focus on developing scalable process technology, and in this talk I will review our recent progress in scalable (MO)CVD and device integration approaches for highly crystalline graphene, hexagonal boron nitride (h-BN) and transition metal dichalcogenide (WS₂) films [1]. The systematic use of in-situ metrology, ranging from high-pressure XPS to environmental electron microscopy, allows us to reveal some of the mechanisms that dictate crystal phase, micro-structure, defects, and heterogeneous integration control at industrially relevant conditions.

We explore 2DM applications ranging from THz detectors/modulators, single photon sources, and photodetectors to membranes and biosensors [2], for which we target a holistic process optimisation bringing together a understanding of fundamental 2D crystal growth as well as 2DM transfer, processing and interfacing [3]. Critical for such new materials technology are also adequate characterisation and quality monitoring techniques, with atomic resolution and high-throughput, particularly as single crystal 2DM layers now reach wafer scale. I will highlight our efforts on the use of ellipsometric contrast micrography, super-resolution imaging and THz ime-domain spectroscopy [4]. We introduce the concept of solid catalysts for epitaxial growth of a semiconductor onto a 2D substrate, using the example of Ge growth on graphene or h-BN with an Au catalyst [5]. Free-standing graphene and h-BN membranes allow us to study such forms of epitaxy directly by environmental TEM.

[1] Wang et al., ACS Nano 13, 2114 (2019); Babenko et al. 2D Mat. 7, 024005 (2020).

[2] Kindness et al ACS Photonics, 6 , 1547 (2019); Stern et al., ACS Nano, 13 , 4538 (2019); Yang et al. Science, 365 , 1017 (2019); Caglar et al. ACS Nano, 14 , 2729 (2019); HexagonFab.com

[3] Burton et al., J. Phys. Chem. C, 123 , 16257 (2019); De Fazio et al., ACS Nano 13, 8926 (2019); Tanoh et al., Nano Lett. 19, 6299 (2019).

[4] Braeuninger-Weimer et al., ACS Nano 12, 8555 (2018); Stern et al., ACS Nano 13, 4538 (2019); Lin et al. Appl. Phys. Lett., 116, 021105 (2019).

[5] Periwal, Ross et al, submitted (2019), Panciera et al., Adv. Mater. 31, 1806544 (2019).