Aachen
Graphene &
2D-Materials
Center

Aachen-Graphene Flagship-Seminar

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ONLINE -- ONLINE -- ONLINE

at 12:00h by ZOOM

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

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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).

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