Crystal growth of 2D materials: from model systems to integrated manufacturing

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The commercial potential of 2D materials hinges on the development of growth and process techniques that are scalable and allow an adequate level of structural control. Chemical vapor deposition (CVD) can uniquely serve the demand for integrated manufacturing of electronic-grade large-area 2D material films as well as potentially allows the direct growth of vertical, stacked or unique in-plane 2D heterostructures. Understanding the underlying crystal growth mechanisms is a current bottleneck and key future enabler. This talk will review our current understanding of graphene and h-BN CVD based on model catalyst systems, including results from a range of in-situ characterization methods such as environmental scanning and transmission electron microscopy, high-pressure X-ray photoelectron spectroscopy, X-ray diffraction and scanning tunneling microscopy [1-3]. We will outline the potential of direct CVD of various 2D heterostructures as well as current challenges for integrated manufacturing and industrial device integration of these 2D materials [4,5].

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[2] Caneva et al., *Nano Lett* **16**, 1250 (2016).
[3] Weatherup et al., *JACS* **137**, 13698 (2014).
[4] Piquemal-Banci et al., *Appl. Phys. Lett.* **108**, 102404 (2016).
[5] Braeuninger et al., *Chem. Mater.* **asap**, asap (2016).