2D MATERIALS BY CHEMICAL VAPOR DEPOSITION: FROM COUPONS TO LARGE AREA DEPOSITIONS

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The discovery of graphene has sparked considerable interest from both academic and industrial players around the new possibilities offered by 2D materials. This class of materials, as their name suggests, are formed of a stacking of layers weekly-bonded to one another. What generated the most interest is that their properties tend to dramatically change when their thickness is reduced to a monolayer [1]. These effects have been investigated extensively and while they show great promise, industrial scaling remains challenging [2].

In this talk, the Chemical Vapor Deposition (CVD) growth of monolayer graphene, molybdenum disulfide (MoS_2) and boron nitride (BN) will be presented with large-scale introduction in mind. An emphasis will be put on the degree of control and detection needed and displayed in Annealsys machines to ensure batch-to-batch reproducibility. In particular, SiC sublimation and catalyst-assisted CVD growth for graphene, Direct Liquid Injection MOCVD (DLI-MOCVD) and DLI-ALD of MoS_2 monolayer as well as CVD of hexagonal and amorphous boron nitride (hBN and aBN) will be discussed. Direct liquid injection is a type of precursor delivery that uses liquids as delivery agent [3]. This way, solid precursors diluted in a solvent, and liquid precursors can be used and safely stored at ambient temperature. Furthermore, the feeding rate can be precisely monitored and controlled using fast injectors allowing for very precise tuning of vapor stoichiometry in the reaction chamber.

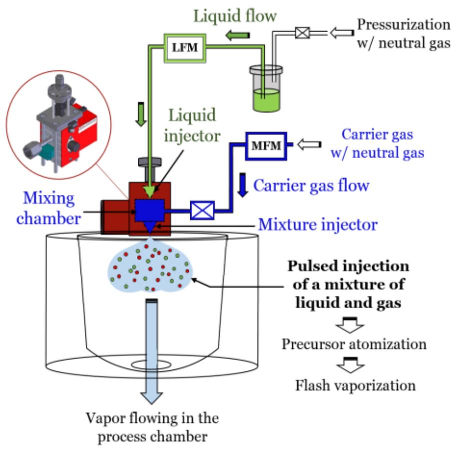

Figure 1. Schematic representation of Kemstream DLI system used in Annealsys' CVD tools

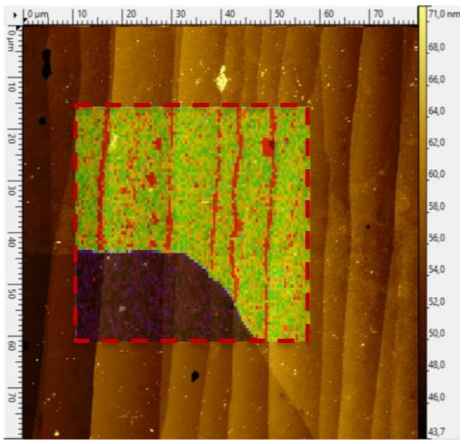

Figure 2. AFM topography image of a ML graphene on top of SiC after lithography with Raman mapping of the graphene 2D peak

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