Advancements in Wafer-Scale MOCVD Growth and Characterization of 2D Materials

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To enable integration of 2D materials in future nanoelectronics devices, it is crucial to employ wafer scale production methods, such as metal-organic chemical vapor deposition (MOCVD). In this study, we present our recent advancements in synthesizing transition metal dichalcogenides (e.g., MoS_2) and hexagonal boron nitride (hBN) on substrates up to 300 mm scale using a Close Coupled Showerhead® (CCS) MOCVD system. To ensure the quality and uniformity of the MOCVD-grown 2D materials, we evaluate their electronic, optical, and structural properties across the entire substrate. We present measurement standards for wafer-scale mapping of 2D materials properties using Raman spectroscopy (**Figure 1**), atomic force microscopy, spectroscopic ellipsometry (**Figure 2**), and electrical transport measurements (**Figure 3**). For the latter, we propose a method for rapid screening of electronic properties to preselect MOCVD grown 2D materials for in-depth electronic property analysis with established fabrication methods such as lithography. The improvements in the characterization of 2D materials allows optimizing the growth of 2D materials on substrates up to 300mm, which is essential for the integration of 2D materials in future nanoelectronics devices.

Figures

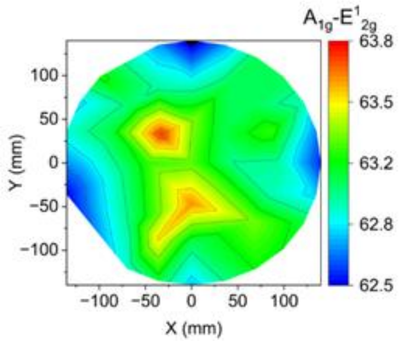

Figure 1: Raman spectroscopy map of WS2 on 300 nm sapphire with a uniformity of σ = 0.27 1/cm

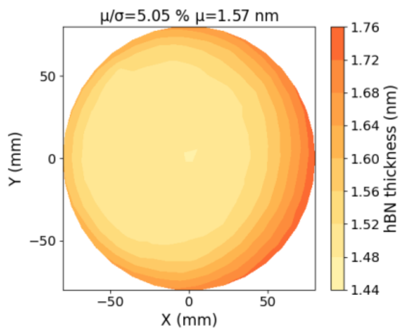

Figure 2: Ellipsometry thickness mapping of hBN on 200 mm sapphire

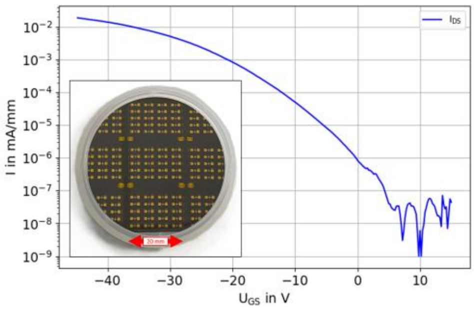

Figure 3: Transfer curve for WSe_2 on 50 mm SiO_2

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