Recent developments in the synthesis and in situ characterization of graphene grown on liquid metal catalysts.

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Graphene has been established as unique and attractive alternatives to replace current technological materials in a number of applications. However, achieving large, perfect graphene synthesis remains a significant challenge for industrial utilization. Chemical Vapor Deposition (CVD) stands out as the most recognized method for thin film synthesis, meeting the criteria for automated large-scale graphene production. Currently, most CVD approaches utilize solid metal catalysts (SMCat) for graphene growth, yet they often introduce structural imperfections like wrinkles, fissures, and grain boundaries. In contrast, employing Liquid Metal Catalysts (LMCat) for graphene growth could potentially yield defect-free single-domain graphene at accelerated synthesis rates owing to the enhanced atomic mobility, uniformity, and fluidity of LMCat. Effective real-time monitoring of this intricate process is crucial for controlling graphene growth and comprehending growth kinetics. However, the absence of in-situ techniques for direct observation of the growth process has hindered our grasp of process dynamics, leading primarily to empirical growth procedures. In this study, we unveil advancements in real-time monitoring of graphene growth, utilizing in-situ reflectometry for solid substrate graphene growth, and employing in-situ optical microscopy and Raman spectroscopy for graphene growth on liquid metal substrates. Furthermore, we delve into the superior properties of LMCat graphene concerning electrical and mechanical response. Lastly, we discuss current attempts to directly separate graphene from the liquid copper substrate, aiming to achieve wafer-scale single-crystal graphene of pristine quality.

References

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Figures

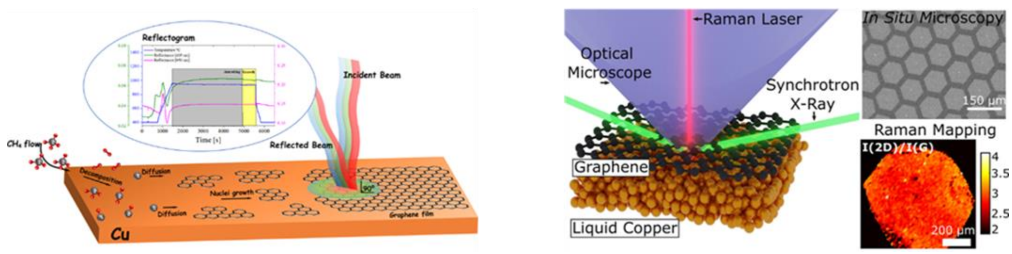

Figure 1: Figure illustrating the different methodologies for in situ monitoring of graphene growth on solid and on liquid Cu.