Graphene on SiC: Lessons Learned and Future Directions

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Graphene on SiC (epi-graphene) has represented the first truly scalable graphene platform explored by the scientific community, playing a pivotal role in shaping both fundamental understanding and technological perspectives of graphene-based systems. Since its early development, this material has provided key insights into the interplay between growth, interface physics, and electronic properties, many of which continue to guide current research.

In this talk, I will present a critical perspective on impactful discoveries enabled by epi-graphene and how they have shaped the broader field of graphene research. From the role of the graphene-substrate interface in guiding decoupling strategies [1], which remain central to ongoing efforts across different material platforms [2-4], to the possibility of obtaining multilayer graphene systems of interest such as rhombohedral graphene through substrate engineering [5, 6].

I will also discuss how early demonstrations of quantum Hall physics in epi-graphene [7], have contributed to establishing it as a model system for quantum transport and have inspired analogous studies in graphene on other substrates [8]. In addition, epi-graphene has proven to be a remarkable platform for the synthesis of van der Waals heterostructures with potential for applications [9].

Finally, I will highlight more recent advances, including the recognition of buffer layer graphene as an electronic material in its own right [10] and the development of novel characterization approaches, such as Raman spectroscopy combined with deep learning, enabling its rapid identification [11].

By bridging historical milestones with current developments, this talk aims to illustrate how epi-graphene continues not only to provide fundamental lessons, but also to open new directions for scalable, high-quality graphene and to inspire novel concepts and applications in the years to come.

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