Epitaxial Graphene Growth and Shape Dynamics on Copper

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Abstract
Synthesis of graphene on catalytic surfaces leads to formation of nuclei that can exhibit a variety of shapes from dendrites, squares, stars, hexagons, to butterflies and lobes. These shapes can further change over the growth time. Understanding the underlying mechanism which dictates the shape of the nuclei and their evolution over time has enabling potential for the engineering synthesis of wafer-scale single crystals. Here, we have studied the shape dynamics of graphene nuclei onto a variety of Cu facets [high symmetry facets such as (111) and (001) as well as for high-index surfaces such as (221) and (310)] under different growth parameters (CH_4 flux, H_2 flux and growth time) [1] with an objective to identify the role of different parameters. We have used a phase-field model to study the shape dynamics where we introduced anisotropies in the energies of growing graphene edges, in the kinetics of attachment of carbon at the edges and in the crystallinity of the underlying copper substrate (through anisotropy in surface diffusion). Our results show that anisotropic diffusion plays a critical role in determining the shape of islands, and the model can predict the growth shapes as a function of growth rate for different copper facets and synthesis conditions.

References

[1] Esteban Meca, John Lowengrub, Hokwon Kim, Cecilia Mattevi, and Vivek B. Shenoy *Nano Lett.*, *Nano Lett.*, 2013, 13 (11), pp 5692–5697