Rapid Growth of Large Single-crystal Graphene by Cooperative Passivation Method towards High-quality Film

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Abstract

Chemical vapor deposition (CVD) on copper foil is a promising method to produce large scale graphene. However, the polycrystalline structure and high density of grain boundaries dramatically weaken the intrinsic properties of graphene film. Moreover, the recently developed methods by which large-size graphene domains on copper foils have been successfully obtained are of low efficiency [1-3]. A high-efficiency and low-cost method to fast synthesis high-quality graphene films with large domain size is highly desired. Here we develop a novel method to suppress the graphene nucleation and then enlarge the domain size at a considerable fast speed. On one hand, the nucleation density was well controlled by the external passivation of the active nucleation sites by using triazine-based compound and trace amount of oxygen. On the other hand, the expedited growth rate was obtained by rational precursor feeding process and accelerating the decomposition rate of precursors via confined space. And the graphene film with controllable domain size can be quickly obtained by optimized growth parameters. A series of characterization methods demonstrate the high quality of the as-obtained graphene film. Our work provides an alternative design of process engineering to fast synthesis high-quality graphene film to satisfy the practical application.

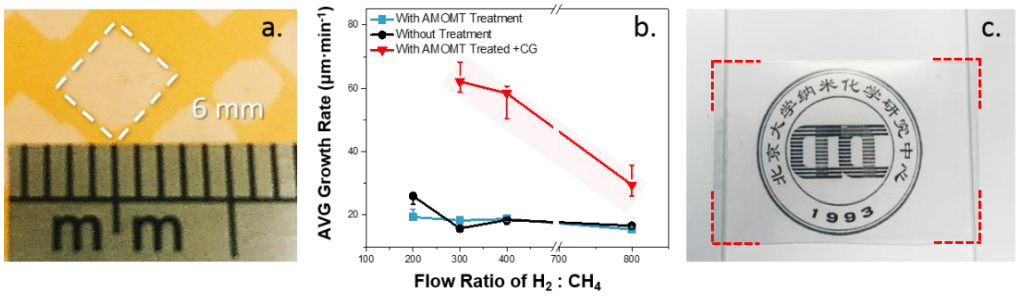
References

[1] Mohsin, A. ; Liu, L.; Gu, G. et al. *ACS Nano*. 2013, 7, 8924-8931.

[2] Hao, Y. F.; Bharathi, M. S.; Colombo, L. G.; Ruoff, R. S. et al. *Science* 2013, 342, 720-723.

[3] Lee, J. Y.; Lee, E. Y.; Joo, W. J. et al. *Science* 2014, 344, 286-289.

Figures



Figures a) Discrete large single-crystalline graphene domains on copper foil **b)** Average linear growth rate as a function of hydrogen to methane flow ratio by cooperative passivation graphene growth method with (red) and without (blue) rising feeding process and untreated growth (black) respectively. **c)** High quality transparent graphene film transferred on PET/EVA