

# ***In situ* observation of graphene formation on polycrystalline Cu substrate**

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As a stable 2-dimensional material, graphene has been extensively studied. Currently, most of explanations on growth mechanisms are based on the experimental results after graphene formation, and the direct observation on the whole growth process is still lacking. To produce single-crystal graphene as large as possible and finally control its growth, the deep understanding on the growth mechanisms is indispensable. By *in situ* technique, it is possible to observe the whole process including the morphology change of the substrate surface, formation of graphene crystal and so on during growth. *In situ* scanning tunneling microscopy (STM) analyses have showed this process at atomic scale [1]. Complementary to *in situ* STM, *in situ* scanning electron microscopy (SEM) observation provides a larger field of view, which may help us to better understand the growth mechanisms [2].

In this study, the whole graphene growth process on polycrystalline Cu substrate is observed by *in situ* SEM. The morphology changes of Cu surface and graphene structures formed under various conditions are carefully investigated. The influences of experimental parameters including temperature and growth time on the layer number of graphene as well as its quality are also discussed. According to our experimental observations, graphene is not created directly on the surface of Cu substrate but on an adsorbed gas layer over the surface, which is formed during graphene growth. The removal of this gas layer leads to the disappearance of graphene from SEM observation. Therefore, to finally obtain high quality graphene, the adsorbed gas layer on the surface of substrate has to be carefully considered. This result may suggest a possible direction for future research on graphene formation.

## References

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