# Chemical vapor deposition growth of graphene with millimeter-scale grain size

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In the past decade, chemical vapor deposition (CVD) method has emerged as a promising route for the large scale production of high quality graphene. However, the CVD-grown graphene is always polycrystalline, and has highly variable electrical and mechanical performance, as the grain boundaries dominates its properties.[1] Therefore, the growth of single crystalline graphene with large scale grain size is important for its potential electronics applications.

Here, we'd like to discuss the large scale graphene growth via optimized atmospheric pressure chemical vapor deposition (APCVD) method. By applying Ar-only environment during the heating/annealing stage, the reduction of copper substrate was suppressed. As maintaining the inactive oxide layer on the catalyst surface, the number of graphene nucleation sites can be dramatically decreased from ~ $10^6$ to ~10 $cm^{-2}$, which leading to the controllable growth of millimeter-scale single crystalline graphene (Figure 1). Raman spectroscopy, atomic force microscopy and low-energy electron microscopy (LEEM) were used to evaluate the quality of as-grown graphene. The influence of hydrogen, nucleation/growth temperature, copper substrate and duration of catalyst annealing step on CVD-grown graphene is also discussed.

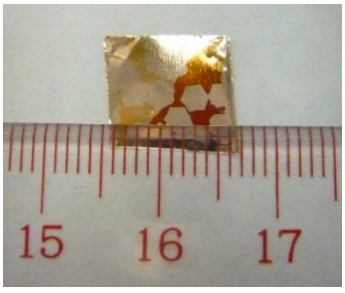


Figure 1 Optical image of APCVD-grown graphene on oxidized copper foil. Each hexagonal domain is single crystalline graphene, as evidenced by LEEM.

**References:**

[1] F. Banhart *et al*., *ACS Nano* **2011**, 5, 26.