Chemical Identification of Topological Defects in Graphene by Carbon Isotope labeling

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Abstract

Recent progress on large scale chemical vapor deposition (CVD)-grown graphene provides a promising opportunity to scale up the fabrication of graphene-based nanoelectronics.[1] However, such large scale graphene samples tend to be polycrystalline, that is, composed of micrometer-size single-crystalline domains of varying lattice orientation and related structural irregularities. These structural irregularities, including point defect, grain boundary, and dislocations, inevitably affect the chemical and physical properties of graphene.[2] Elucidating the topological structure in CVD graphene is crucial for its potential technological applications in electronics and related fields.

Here we demonstrate a method to identify the topological defects in CVD-grown graphene by carbon isotope labeling. In a stepwise CVD process, the introduction of isotopic carbon source induced the surface exchange of ^{13}C-^{12}C atoms in graphene on copper substrate. Taken the advantage of the separation of the ^{12}C and ^{13}C Raman modes, the spatial structure of CVD graphene are observed with confocal Raman spectroscopy (as shown in Figure 1). The ^{13}C-rich regions form a network-like structure, indicating the atom exchange is probably along the grain boundary of graphene. This isotopic labeling method provides an effective way to investigate the topological defects in graphene, and also gives new insight for understanding the growth mechanism of graphene on copper catalyst.

References

[1] X. Li et al., Science, 324 (2009) 1312.
[2] F. Banhart et al., ACS Nano, 5 (2011) 26.

Figures

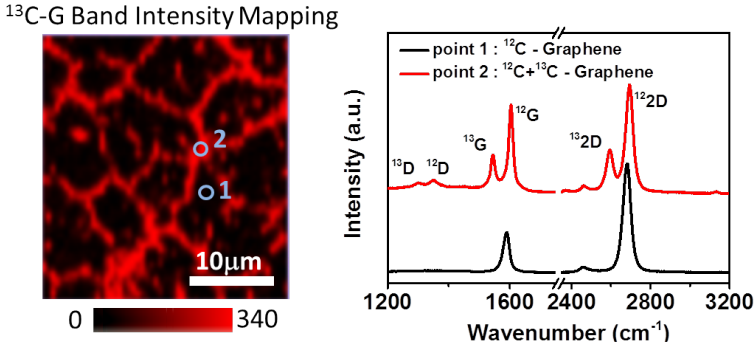

Figure 1 Raman evidence for isotope labeling of CVD graphene