Formation of Graphene Bilayers in CVD Growth

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Abstract

Understanding the fundamental aspects of graphene chemical vapor deposition (CVD) on copper is a key towards the mass production of this carbon allotrope. One way in which this understanding can manifest itself is through controlled growths of graphene layer, that is, time to completion, defect density and morphology.[1,2,3] Layer thickness trigger to a large extent the graphene properties and the presences of bilayer islands may be desirable or detrimental upon selected applications and nowadays needs to be controlled. Bilayers islands appear with no clear-cut explanation in sight and even those who specifically study graphene bilayer growth often do not provide a mechanism for this phenomenon.[4,5,6,7] We have shown in previous studies that at trace level, oxidizing impurity can totally govern the growth kinetics. In this study, by exercising a strict control over gas impurity in the furnace, we grow in a regime where impurities effects are minimized and no longer limits the growth. This gain of control over the growth allowed us to identify that bilayers formation, to a large extent, occur during the cool down phase. A mechanism is proposed for these inverted wedding cake bilayers invoking the thermal expansion coefficient mismatch between copper and graphene, causing a delamination and buckling of the later. By controlling the cooling parameters, we gained control over the presence or not of bilayer islands and to some extent their coverage and density. By getting rid of “cooling down” bilayers, we were able to identify a second category of bilayer with different origins. Interestingly while the “cooling down” bilayer appears to be random the second category is commensurate. While understanding bilayer growth is interesting from a fundamental point of view, this controlled growth also enables the development of graphene-bilayer related technologies, which are particularly enticing for their intrinsic bandgap.

References

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