The Copper for CVD Graphene: its cleaning and oxidation in relation to graphene quality

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Abstract

The efforts toward mass production of large area graphene have stressed even more the need to control and improve the quality and reproducibility of the CVD growth and transfer of graphene [1]. Copper foil is the most common substrate and a variety of work has already allowed to progress in increasing grain size and controlling the nucleation site. Nevertheless, there are still unsolved issues and challenges that make CVD graphene growth and quality irreproducible dependent on copper foil supplier and batch. Furthermore, recently some contradictory results are out about the graphene as a barrier to oxidation of metals underneath. This latter aspect is important in relation also to the adhesion of graphene on copper and consequently to the quality of its transferring. It is clear that a correlation exists between the copper substrate, the growth, the graphene quality and goodness of transferring [2]. This contribution aims at elucidating and controlling this correlation.

We show significant improvement in reproducibility and control of CVD graphene growth and quality by a H_2 plasma processing of copper. Implementation of commercial CVD reactors with a simple H_2 remote plasma configuration will be shown, which is also applicable to other 2D materials. Various copper foils and wafers from different suppliers and with different morphology are tested and discussed. The significant advantage over the common H_2-Ar annealing will be presented, which leads to consistent growth conditions and high-quality continuous graphene.

This step will also be related to properties of graphene as oxidation resistance layer [3], discussing the role of the copper oxides on the adhesion of graphene to the Cu foil and consequences for the quality of the transferring. Therefore, we also correlate results on copper/graphene oxidation to the copper processing and graphene quality.

Acknowledgements

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References

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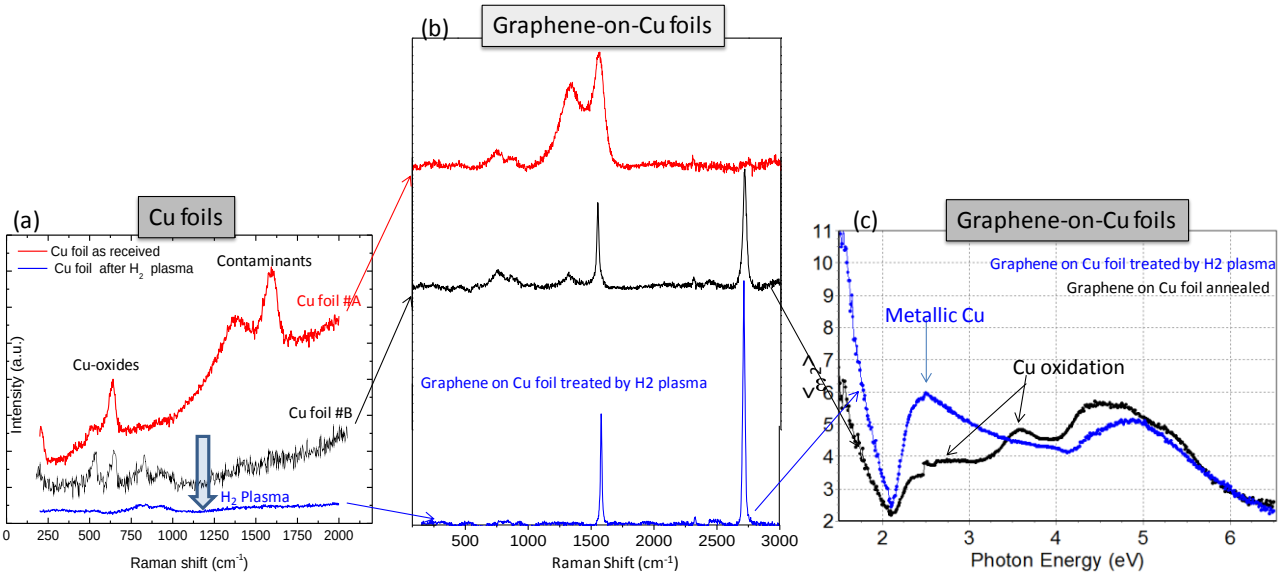

Figure. (a) Raman spectra of various Cu foils after common annealing and after developed H2 plasma treatment (blue line); (b) Raman spectra of the graphene-on-Cu foils (same as in (a)); (c) corresponding optical quality as evaluated by spectroscopic ellipsometry spectra of the imaginary part of the dielectric function, which is sensitive to both graphene quality and Cu oxidation underneath.