Comparison of CVD graphene grown on copper foil and PVD copper

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Abstract

One of the most effective methods for obtaining graphene for low-cost and large-scale applications is its synthesis by CVD performed on the surface of copper. The bonding of a single graphene layer to a metal surface depends on factors such as the metal surface itself, the quality of the substrate and the grain size [1]. At present, foil is treated as the most suitable and, at the same time the most frequently used Cu substrate for graphene growth. Nevertheless, new substrates ought to be introduced and the quality of the obtained graphene layers has to be enhanced. Sputtered Cu films on insulating substrates have emerged as a promising alternative.

In this work we draw a comparison between graphene grown by the CVD method on 12μm thick copper foil and on sputter-deposited copper on a Si/SiO_2 substrate. We collect information on the properties of graphene films transferred from different copper substrates onto dielectric substrates. We show that the grain size in the case of sputtered Cu films is much smaller than for Cu foil. In addition, we present the micro-Raman maps of graphene, which reveal that these characteristics cause significant changes in the 2D band position for graphene on both substrates (Figure 1). Moreover, we demonstrate differences in the crystallographic orientation of the copper grains on Cu foils and sputtered Cu films (Figure 2). We note that the PVD Cu film is highly textured and the preferred grain orientation is (111). We present how these features influence the quality of the grown and transferred graphene films.

The assessment of the properties of graphene grown on both Cu substrates and transferred graphene has been performed with Raman spectroscopy, confirming the formation of graphitic structures, as well as AFM and SEM imaging, showing the morphology of the graphene/Cu interaction.

References

[1] Gang Hee Han, Fethullah Gunes, Jung Jun Bae, Eun Sung Kim, Seung Jin Chae, Hyeon-Jin Shin, Jae-Young Choi, Didier Pribat, and Young Hee Lee, Nano Lett. **11** (2011) 4144.

Figures

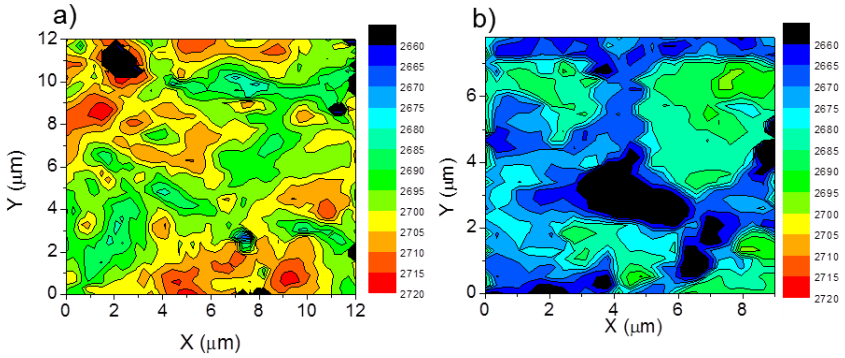

Fig. 1. Raman maps of 2D band position for graphene on a) Cu foil and b) PVD Cu film.

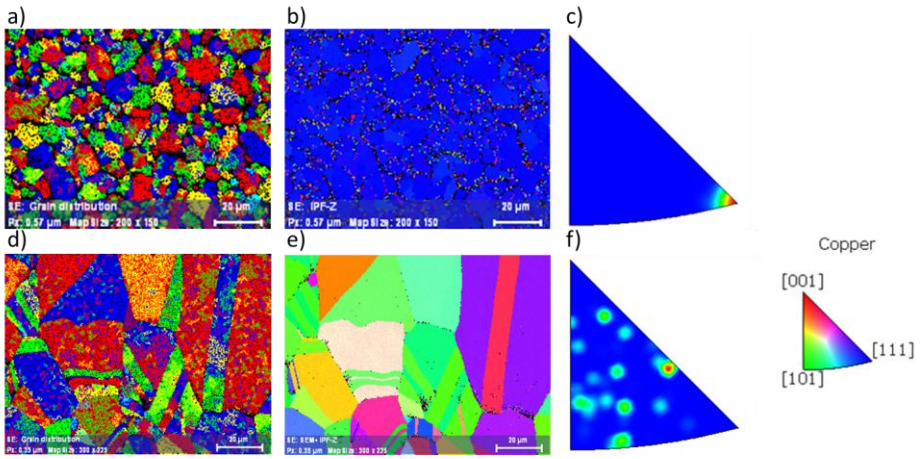

Fig. 2. EBSD maps of Cu grains distributions of a) PVD Cu film and d) Cu foil. Inverse pole figure EBSD maps of b) PVD Cu film and e) Cu foil. Stereographic projection for c) PVD Cu film and f) Cu foil.