Interface electrical properties of graphene/SiC junction explored by conductive AFM

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Abstract

An ohmic contact formation at the metal/wide-gap semiconductor junction by inserting graphene layers into the interface has been reported [1-3]. However, the mechanism and the details of the electrical state are still open questions. Especially in the case of SiC as a semiconductor [1, 2], it is difficult to understand the situation, since the formation of the buffer layer at the graphene/SiC interface makes the interface electronic state rather complicated. In this study, in order to deduce the mechanism of this phenomena, CVD-grown graphene was transferred onto SiC surface to form the interface state without buffer layer and the interface electrical state was evaluated by conductive AFM (hereinafter C-AFM) method.

The CVD graphene were transferred on n-type SiC substrate by a conventional wet transfer method with PMMA supporting layer. In the SEM image, as shown in Fig. 1, the transfers are confirmed to be uniform. However, the existence of graphene is not so clear in Fig. 2 (a), which is a topographic image taken by C-AFM at the border between the surface with and without graphene. The current image, by contrast, shows graphene apparently as an area with significant current as shown in Fig. 2 (b) (bright region). The *I-V* characteristics of the dark region in Fig. 2 (b) where the current does not flow much show rectifying behavior, which is considered to be the effect of the Schottky barrier formation between a rhodium tip and n-SiC. At the bright area where graphene covers, on the other hand, linear *I-V* characteristics were obtained, which supports the formation of an ohmic contact between the tip and n-SiC. In comparison to our previous results, the graphene/n-SiC interface with buffer layer shows similar *I-V* tendency.

From these results, the mechanism of ohmic contact formation was assumed: the work function of graphene approaches near the Fermi level of n-SiC, which results in an ohmic behaviour regardless of the work function of rhodium.

By investigating further to control the interface properties, this phenomenon is expected to be applied to some electric devices in the future.

References

[1] S. Hertel et.al., Nature Communications 3, (2012) 957.
[2] W. Lu, et.al., Solid-State Electronics, 47, (2003) 2001
[3] H. Zhong et al., APL 104, (2014) 212101

Figures

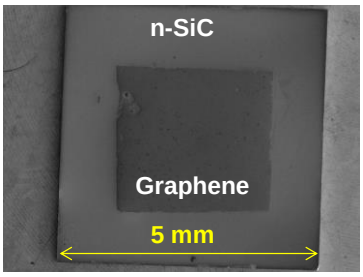

Figure 1: SEM image of CVD graphene transferred onto SiC

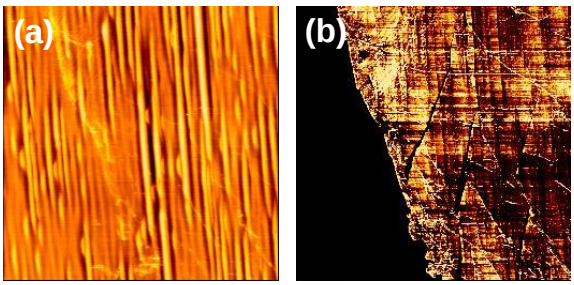

Figure 2: C-AFM image of (a) Morphology and (b) current in n-SiC/graphene border (measurement size: 10 μm).