Geometrically Enhanced Asymmetric I-V Characteristics in Graphene Tunneling Diode

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Abstract

Graphene has attracted great attention due to its outstanding intrinsic physical properties [1]. Especially, its high carrier mobility and current density make the graphene as a good candidate for advancing electronic devices such as field effect transistor (FET), diode, RF transmission line, transparent electrode [2-4].

Of them, there have been considerable studies on diode based on the graphene. Although the graphene p-n junction diode has been successfully demonstrated with various doping methods, the rectification properties cannot be observed due to the Klein tunneling phenomena in the graphene. More recently, the graphene tunneling diodes have also been developed based on the van der Walls (vaW) heterostructure method. However, in the tunneling diode, it is hard to get asymmetric I-V characteristics because current flows are originated from the bi-directional tunneling phenomena. Herein, we demonstrated the asymmetric geometries in the graphene for enhancing the asymmetric I-V characteristics in graphene tunneling diode.

Figure1 presents schematics of working mechanism of the graphene tunneling diode and its optical and AFM topography image. The tunneling diode was fabricated with asymmetric geometry to enhance the asymmetrical electrical properties.

2-terminal I-V property of graphene tunneling diode is shown in the Figure 2. At negative bias, the maximum current level is 7.3nA at 3V bias. Otherwise, that of the positive bias is 3.0nA. This asymmetric I-V characteristic is originated from the asymmetrical geometry effects of the graphene.

References

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Figures

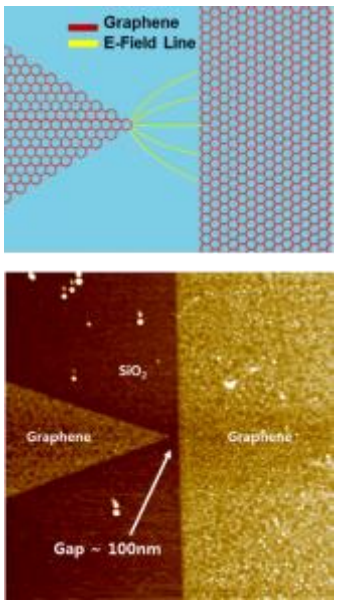

Figure 1. Schematics of the graphene tunneling diode and its working mechanism. The AFM topography image indicates that the fabricated device has 100nm gap.

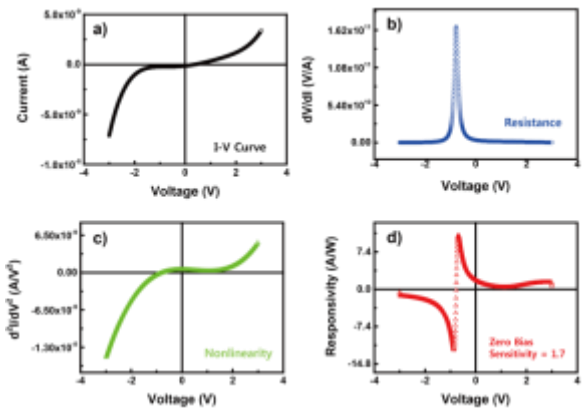

Figure 2. 2-terminal I-V characterisitic of the graphene tunneling diode. The graph shows asymmetric I-V characterisitcs induced by asymmetric geometry effect.