
Electrical property modification of graphene by low energy ion implantation

Noriaki Matsunami*¹, M. Kato¹, Bun Tsuchiya², and S. Bandow²

¹Nagoya University – Japan

²Meijyo University – Japan

Abstract

Graphene has been extensively investigated for both fundamental aspects and applications such as electric devices. For such applications, electrical property modification of graphene by ion implantation is of interest. In this study, modification of the electrical resistivity of graphene has been investigated under low energy N ion implantation.

Graphene was prepared by a mist-chemical-vapor-deposition method. Firstly, graphene was deposited on Cu foil heated at 925 °C for 2 min by thermal decomposition of methanol mist at 950 °C in carrier gas of Ar containing 3% H₂ and then graphene was deposited on SiO₂-glass substrate after Cu foil was chemically etched. Thickness of graphene was evaluated by 1.8 MeV He⁺ Rutherford backscattering spectroscopy and it reasonably agrees with layer thickness derived from optical transmission. The number of graphene layers used in this study is ~10 (3.5 nm). Samples were exposed to 1 keV N₂⁺ and N⁺ ions using a hot-filament type plasma ion source. Fractions of N₂⁺ and N⁺ ions are obtained to be 2:1, by using a similar type ion source. Electrical resistivity was measured by four-terminal method. It is found that the electrical resistivity of 10-3Ωcm increased by more than two order of magnitude at 4x10¹⁶ cm⁻² and steeply increased for further ion implantation, meaning graphene layer loss due to ion sputtering. A similar increase of the electrical resistivity was observed for 30 keV N⁺ ion irradiation. In this case, the ion projected range (60 nm) is much larger than the graphene layer thickness and N's are scarcely remained in graphene layers. Hence, the resistivity increase is more likely due to defects generated by energy deposition during the ion implantation. Carrier density modifications by ion implantation and resistivity modifications of graphene by ion implantation other than N are under way.

Keywords: graphene, low energy ion implantation

*Speaker