

Interaction between Metal and Graphene: Dependence on the Layer Number of Graphene

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One of important themes in recent graphene-based research is to investigate changes in physicochemical properties of graphene as a function of the layer number.^[1,2] In this presentation we show surface-enhanced Raman scattering (SERS) of graphene was investigated by depositing Au and Ag nanoparticles using thermal evaporation.^[3,4] With increasing the number of graphene layers, the SERS enhancement factor of the G band decreased; 1L > 2L > 3L. Also, the interaction between graphene and metal was investigated by studying the G band splitting in SERS spectra of single-, bi-, and tri-layer graphene. In particular, the G band was split into two distinct peaks in the SERS spectrum of graphene. The extent of the G band splitting was 13.0 cm⁻¹ for single-layer, 9.6 cm⁻¹ for bi-layer and 9.4 cm⁻¹ for tri-layer graphene, whereas the G band in the SERS spectrum of thick multi-layer was not split. These results indicate that there is a correlation between the SERS enhancement factor and the extent of the G band splitting, and the strongest interaction occurs between metal nanoparticles and single-layer graphene. Furthermore, the Ag and Au deposition on graphene can induce doping of graphene. The intensity ratio of 2D and G bands (I_{2D}/I_G) decreased after the metal nanoparticles deposition on graphene, indicating doping of graphene. From changes in positions of G and 2D bands after the metal deposition on graphene, the Ag deposition induced n-doping of graphene, whereas the Au deposition p-doping.

References

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Figure

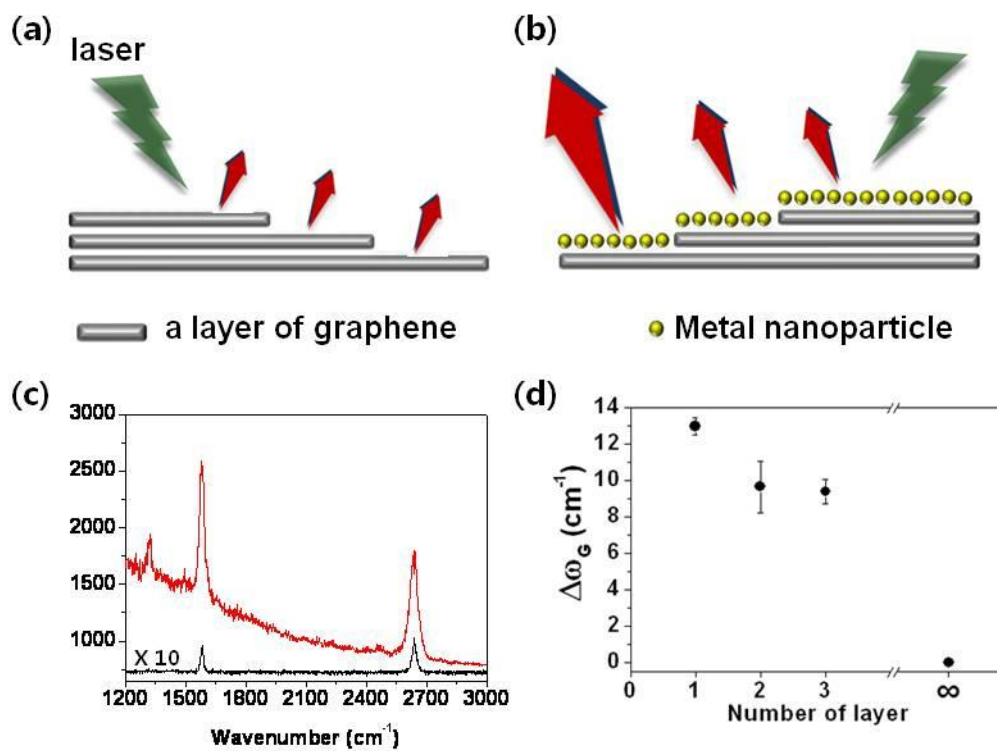


Figure 1. Schematic illustration of the interaction between metal and graphene depending on the number of the graphene layers (a) before and (b) after metal deposition. (c) SERS (red curve) and normal Raman (black curve) spectra of single layer graphene on which Au of 4 nm was deposited and (d) the extent of G band splitting after deposition of Ag nanoparticles depending on the graphene layers.