Seminar

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Institute for Plasma Research

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Title: Investigation of Graphene/silver nanoparticle hetrostructure on silicon ripple substrate for SERS application

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Date: 11th November 2024 (Monday)

Time: 11:00 AM

Venue: Seminar Hall, IPR

Abstract

Detection of wide range of molecules is essential in various fields such as chemical analysis, environmental protection, and food industries[1]. Several materials are studied for the detection of complex molecules such as metal oxides, metal nanoparticles two dimensional materials. Out of these in recent year, graphene demonstrated the excellent Surface Enhanced Raman Scattering (SERS) effect but graphene shows the modest enhancement which is due to the chemical enhancement mechanism. This limitation is caused by poor interaction with the visible light at near infrared frequency with graphene[3]. The hybrid structure of graphene with metal nanoparticle could overcome such issues. Therefore, the understanding of graphene and metal nanoparticle interface is need of time. In this work, graphene is transferred on the silicon ripple substrate by wet chemical process and further the Ag nanoparticle is deposited using ion beam evaporation method. This graphene/silver nanoparticle hetrostructure on silicon ripple substrate is studied by the various characterization tools such as Raman spectroscopy, AFM and FESEM. Raman spectra of graphene/Si-pattern substrate revealed that there is G and 2D modes are appeared due to disorder present in the graphene locally in the layer and I_{2D}/I_G ratio decide the quality of 2D sheet of graphene which is > 2. Further, the AFM and SEM analysis revealed that residue of PMMA are present on the layer of graphene. The thickness of transfer nanosheets is ~ 1 nm which is confirmed by the AFM. The wavelength of ripples is also reduced after the transfer of graphene observed in AFM analysis. From FESEM analysis it confirmed that the graphene sheet follows silicon ripples. This graphene/silver nanoparticle hetrostructure on silicon ripple substrate is further studied for the detection of crystal violet (CV) dye. The prominent change is observed in the Raman signal. There is 4 order enhancement in the gain is observed for 10^{-7} M concentration of CV dye. This could open a gateway for detection of complex molecules.

Keywords: Graphene, Raman spectroscopy, AFM, SERS application

Reference

1. Ferraro, J. R., Nakamoto, K. & Brown, C. W. *Introductory Raman Spectroscopy*. (2003). doi:10.1016/c2009-0-21238-4.
2. Xu, W. *et al.* Surface enhanced Raman spectroscopy on a flat graphene surface. *Proc. Natl. Acad. Sci. U. S. A.* **109**, 9281–9286 (2012).
3. Prasad, A. *et al.* Ripple Mediated Surface Enhanced Raman Spectroscopy on Graphene Alisha. *Carbon N. Y.* **157**, 525–536 (2020).