3rd Asia-Pacific Conference on Plasma Physics, 4-8,11.2019, Hefei, China

Fabrication of graphene-based plasmonic nanostructure using argon plasma

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Graphene, a monolayer of carbon atoms packed into a hexagonal lattice, has become one of the most intriguing hotspots of scientific research not only because of its unique structure and extraordinary properties but also the convenience of functionalizing it for various applications. Graphene-based plasmonic structures where graphene or its derivatives (e.g., graphene oxide, GO or reduced graphene oxide, rGO) is embedded between two layers of metal components (e.g., metal films and metal nanoparticles) have demonstrated their applications in a wide spectrum including optoelectronics, energy generation and storage, sensing and so on.

Traditional methods of synthesizing plasmonic structures include chemical reduction, bottom-up synthesis, thermal annealing and so on, but they exhibit obvious drawbacks: toxicity to the environment, harm to the performance and time-consuming process, respectively. In this talk, I will introduce a green and facile strategy to prepare a plasmonic structure of Au nanoparticles (Au NPs)/rGO/Au film with the merit of performance-tunability using UV/ozone treatment followed by argon plasma reduction. By composition analysis and morphology characterization, we found that UV/ozone treatment can increase the oxygen functional groups on the GO basal plane, which can act as nucleation sites during the following argon plasma reduction process. By changing the lengths of UV/ozone treatment, the size and density of Au NPs can be easily tuned and so can the performance of the plasmonic structure. The as-prepared plasmonic sandwiched nanostructure can serve as sensitive surface-enhanced Raman scattering (SERS) substrates with long range linear region from 5×10^{-5} to 5×10^{-8} M and lowest detection limit of 5×10^{-8} M using Rhodamine 6G (R6G) as the analyte. We believe this technique will provide a facile, energy-saving and performance-tunable route to fabricate graphene-based plasmonic structures.

References
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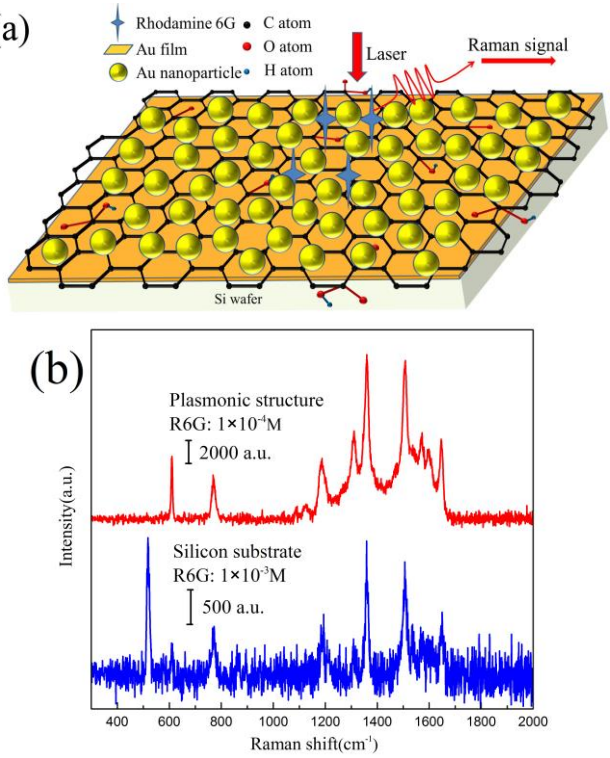

Figure 1. (a) A schematic diagram of the Au NPs/rGO/Au film plasmonic nanostructure (b) Comparison of Raman spectra of R6G on Au NPs/rGO/Au film plasmonic (1×10^{-4} M) and silicon substrates (1×10^{-3} M)

Acknowledgement: This work was supported by the National Natural Science Foundation of China (51677031, 61705042) and Shanghai Sailing Program (16YF1400700).