Hybrid GQD/Pd@Ag NPs nanostructured based SERS platform for the detection of Rhodamine 6G

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Abstract

Surface-enhanced Raman spectroscopy (SERS) has received growing attentions due to its superior detection capacity of molecules at a very low molarity [1]. Here, the hybrid GQDs/Pd@Ag HNPs nanostructure-based SERS platform is employed for the detection of Rhodamine 6G (R6G) organic molecule as displayed in Fig. 1(a). The generation of strong localized surface plasmon resonance (LSPR) due to the distinct hybrid core-shell morphology of Pd@Ag NPs with the background Ag NPs leads to the generation of hotspots in the small interparticle gaps for the enhancement of SERS signals [2]. The dangling bonds on the GQD edge adsorb the R6G molecule and effectively enhance the charge transfer, which significantly improves the SERS signals [3]. The considerable SERS enhancement can be attributed to the combined mechanisms of chemical and electromagnetic improvement through GQDs and plasmonic Pd@Ag NPs respectively, as displayed in Fig. 1(b).

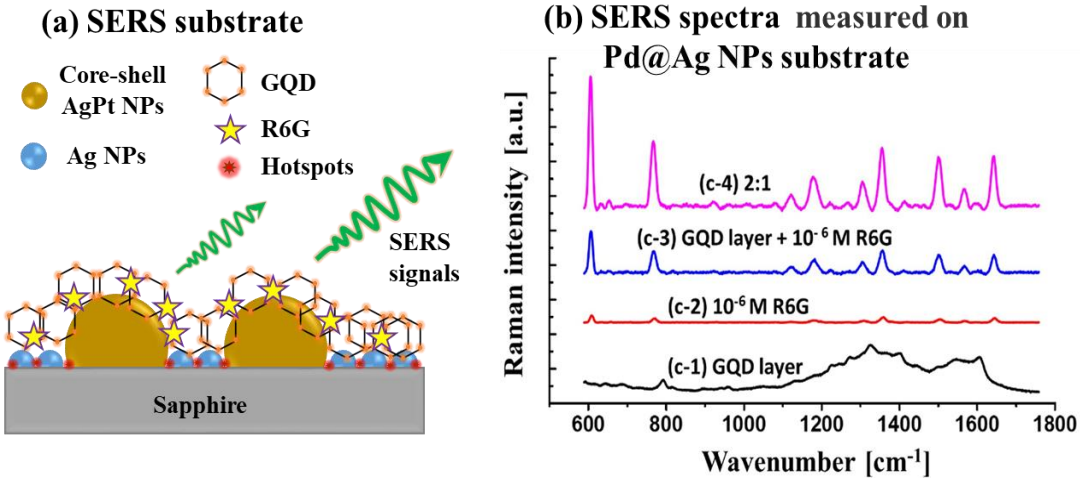

Figure 1. (a) Schematic of SERS detection on hybrid R6G-GQD/AgPt HNPs. (b) SERS intensities measured on Pd@Ag NPs substrate [4].

References:

[1] L. Chen, H. Sun, Y. Zhao, Y. Zhang, Y. Wang, Y. Liu, X. Zhang, Y. Jiang, Z. Hua, J. Yang, Plasmonic-induced SERS enhancement of shell-dependent Ag@ Cu 2 O core–shell nanoparticles, RSC Adv. 7 (2017) 16553–16560.

[2] J. Yang, X.-Y. Wang, L. Zhou, F. Lu, N. Cai, J.-M. Li, Highly sensitive SERS monitoring of catalytic reaction by bifunctional Ag-Pd triangular nanoplates, J. Saudi Chem. Soc. 23 (2019) 887–895.

[3] D. Liu, X. Chen, Y. Hu, T. Sun, Z. Song, Y. Zheng, Y. Cao, Z. Cai, M. Cao, L. Peng, Y. Huang, L. Du, W. Yang, G. Chen, D. Wei, A.T.S. Wee, D. Wei, Raman enhancement on ultra-clean graphene quantum dots produced by quasi-equilibrium plasma-enhanced chemical vapor deposition, Nat. Commun. 9 (2018) 193. https://doi.org/10.1038/s41467-017-02627-5.

[4] S. Pandit, S. Kunwar, R. Kulkarni, R. Mandavka, S. Lin, J. Lee, Applied Surface Science Fabrication of hybrid Pd @ Ag core-shell and fully alloyed bi-metallic AgPd NPs and SERS enhancement of Rhodamine 6G by a unique mixture approach with graphene quantum dots, Appl. Surf. Sci. 548 (2021) 149252. https://doi.org/10.1016/j.apsusc.2021.14922.