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Graphene-based 3D nanostructures for biosensing applications

Biasotto, G.(1); Zaghete, M.A.(1); Giorgis, F.(2); Rivolo, P.(2);
(1) IQAr-UNESP; (2) POLITO;

Surface-enhanced Raman Scattering (SERS) is increasingly applied to the sensitive label-free detection of biomolecules. This scenario thrived in the last decade due to innovative nanostructured materials based on semiconductors, metal-oxides or graphene decorated by noble metal nanoparticles [1]. Indeed, the obtained plasmonic nanostructures are featured by Localized Surface Plasmon Resonances that are exploited to amplify the Raman scattering of the analytes, thus reaching the very high sensitivity usually required for biomarkers detection. A great research effort has been made to fabricate noble metal (Ag or Au) nanostructures incorporating as much as possible Raman hot spots yielding a huge electromagnetic (EM) field enhancement thanks to the excitation of localized surface plasmons at resonance conditions (LSPR). Moreover, taking advantage of the discovery in 2010 of the graphene-enhanced Raman scattering (GERS), graphene-based structures are of great interest for Raman-enhanced (bio) sensing due to the chemical enhancement effect attributed to a charge-transfer (CT) process in synergy with the EM mechanism [2]. The reduced Graphene Oxide (rGO) can be a suitable and low-cost graphene based-material that can be assembled in 3-D networks and allows to exploit different routes of chemical and biochemical functionalization (physisorption or chemisorption). It can take advantage from the presence of the residual oxygen atoms or the possibility to establish???? non-covalent bonding with the graphene layers. In this work, we report on the synthesis and characterization of a hybrid [1] aerogel based on reduced rGO decorated with silver nanoparticles (AgNPs) exploitable for the SERS detection of biomolecules at very low concentration. In this work, SERS substrates based on plasmonic nanostructures such as 3-D graphene-Ag based aerogels nanostructures on polydimethylsiloxane (PDMS) membranes is presented for biosensing applications. Reference: 1. Fateixa, S.; Nogueira, H. I. S.; Trindade, T. Hybrid nanostructures for SERS: Materials development and chemical detection. Phys. Chem. Chem. Phys. 2015, 17, 21046–21071. 2. Xi L.; Liming, X.; Yuan, F.; Hua, X.; Haoli, Z.; Jing, K.; Mildred S.; Dresselhaus, J. Z.; Zhongfan, L. Can Graphene be used as a Substrate for Raman Enhancement? Nano Lett. 2010, 10, 553-561.