Nanocomposite based on reduced graphene oxide decorated with colloidal Au nanoparticles for electrochemical genosensors

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Abstract

A great challenge of modern medicine relays on developing methods for rapid cancer biomarkers detection, formulating early diagnosis and fast prognosis. Combination of Reduced Graphene Oxide (RGO) and Au nanoparticles (NPs) has been widely applied in sensors, due to the their high surface area, capability of binding (bio)molecules, electrochemical stability, electrocatalytic activity and fast heterogeneous electron transfer kinetics in the resulting nanocomposite materials.[1]
A novel hybrid nanocomposite, formed of 3,4-dimethylbenzenethiol (DMBT)-coated Au NPs, bound to RGO flakes by 1-pyrene carboxylic acid (PCA), was obtained with an *in situ* approach that allows overcoming many of the reported limitations.[2] The Au NPs can heteronucleate and grow at the –COOH groups of the PCA linker, by using the short aromatic thiol ligand, thus achieving i. control of NP morphology, narrow size distribution and coating density (Fig. 1A), ii. electron conductivity, enhanced by the π-π interactions among the immobilized NPs, iii) heterogeneous charge transfer rate, and iv) processability from solutions. The nanocomposite shows a LSPR peak of the Au NPs at 564 nm (Fig. 1B). Screen-Printed Carbon Electrodes (SPCEs), modified with the nanocomposite, demonstrate a high sensitivity in detecting biotinylated miRNA-221, a cancer biomarker (Scheme 1), in spiked human blood serum. A LOD of 0.7 pM has been achieved, in line with the best state-of-the-art performance reported for genosensors.[3]

References

[1] Q. Chen t al. Anal. Chem. (2012), 84, 171
[2] X. Yang et al. J. Mater. Chem. (2011), 21, 8096
[3] C. Ingrosso et al. J. Mat. Chem. B (2019), 7, 768

Figures

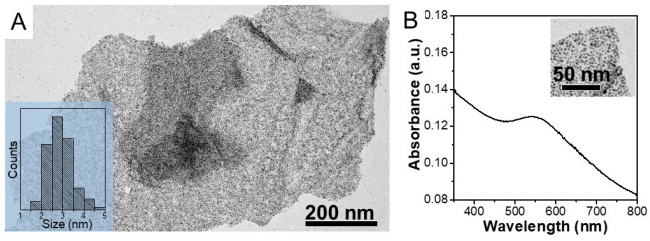
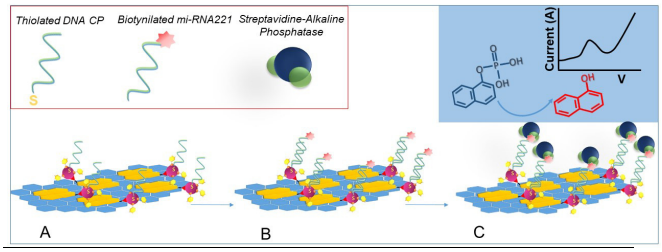


Figure 1: (A) TEM micrograph and (B) UV-Vis absorption spectrum of nanocomposite flakes. (Inset) (A) NP size distribution and (B) close-up view of a hybrid flake (inset).



Scheme 1: (A) DNA capture probe (CP) immobilization and (B) hybridization with the miRNA-221 target. (C) Exposure of the SPCEs to AP, incubation in 1-naphthyl phosphate, generation of 1-naphthol detected by DPV.