

Supplementary Information

Bio-inspired *in situ* growth of monolayer silver nanoparticles on graphene oxide paper as multifunctional substrates

Preparation of GO aqueous colloid solution.

The graphene oxide (GO) was prepared by chemical oxidation and exfoliation of natural graphite under acidic conditions according to the modified Hummer's method.¹ Briefly, graphite (5.0 g) was added to concentrated sulfuric acid (150 mL) under stirring at room temperature, then sodium nitrate (3.75 g) was added, and the mixture was cooled to 0 °C. Under vigorous agitation, potassium permanganate (20.0 g) was added slowly to keep the temperature of the suspension lower than 20 °C. Successively, the reaction system was transferred to a 35 °C water bath for about 30 min until forming a thick paste. Then, 140 mL of water was added, and the solution was stirred for another 15 min. An additional 500 mL of water was added followed by a slow addition of 30 mL of H₂O₂ (30%), turning the color of the solution from brown to yellow. The supernatant was decanted, and the remaining product was repeatedly centrifuged and washed with distilled deionized water until pH of the solution became neutral. The resulting solid was dispersed in distilled water by ultrasonication for 1 h to make a GO aqueous dispersion (0.5 wt %). The obtained brown dispersion was then subjected to 15 min of centrifugation at 4000 rpm to remove any aggregates. Finally, it was purified by dialysis for one week to remove the remaining salt impurities for the following experiments.

Reference

1. Hummers, W.S.; Offeman, R.E. *J. Am. Chem. Soc.* **1958**, *80*, 1339–1339.

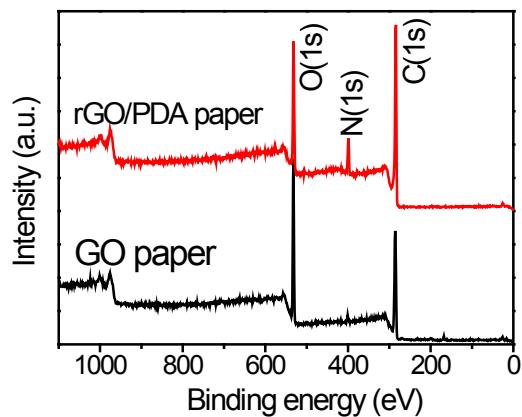


Figure S1. XPS spectra of GO paper and PDA modified rGO paper.

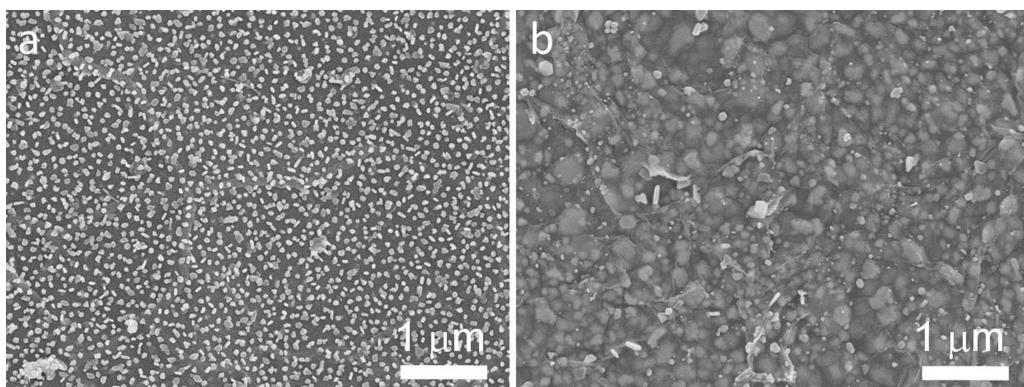


Figure S2. SEM images of rGO/Ag hybrid paper after immersed in mercaptoethanol solution (a) and in 2 M NaOH solution (b).

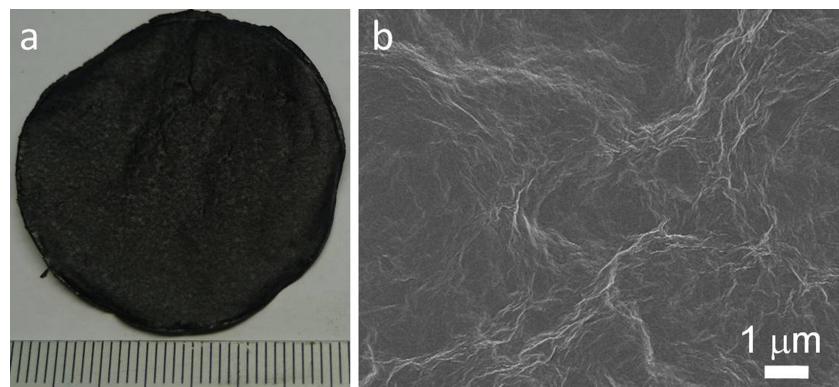


Figure S3. Photograph (a) and SEM image (b) of pure rGO paper after reaction with AgNO_3 solution.

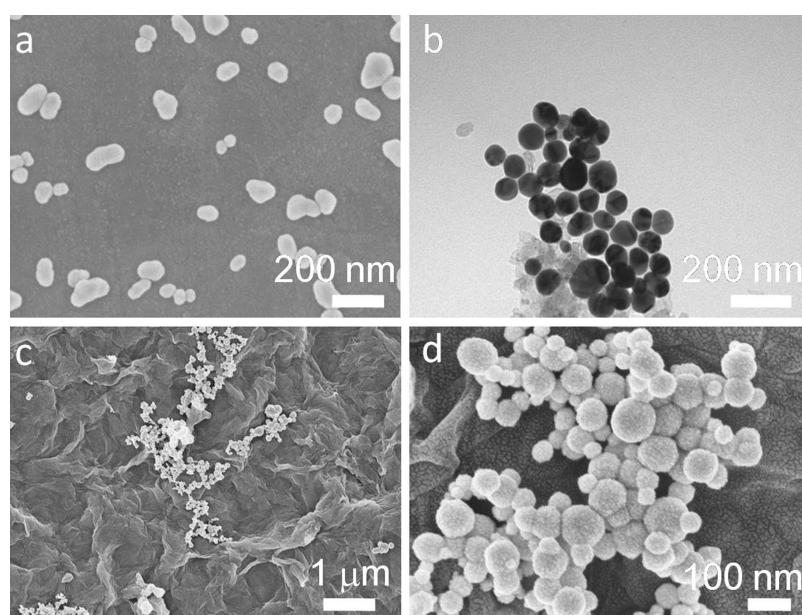


Figure S4. SEM image (a) and TEM graph (b) of the pre-synthesized Ag NPs obtained from polyethylene glycol by solvothermal reaction, (c, d) SEM images of pre-synthesized Ag NPs incubated with PDA modified rGO paper.

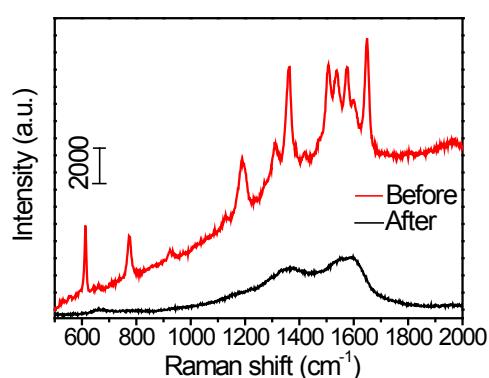


Figure S5. SERS spectra of R6G (1.0×10^{-4} M) molecules before and after clean by concentrated hydrochloric acid liquid taken on rGO/Ag hybrid paper obtained by reaction with 1.0 M AgNO_3 solution.

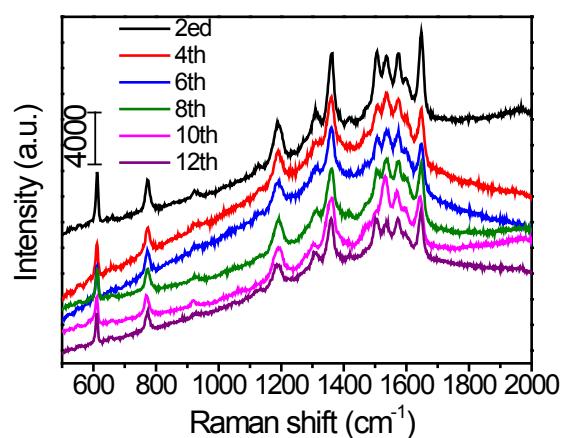


Figure S6. SERS spectra of R6G (1.0×10^{-4} M) molecules with different reusable cycles taken on rGO/Ag hybrid paper obtained by reaction with 1.0 M AgNO₃ solution.

Table S1. The comparison between different kinds of substrates with the detection limit toward R6G molecules

Material kinds	Detection limit for R6G	Cited reference
Ag nanowire film	5.0×10^{-9} M	1
Ag nanoneedles array	2.7×10^{-8} M	2
Sea-urchin like Fe ₃ O ₄ @C@Ag nanostructure	1.0×10^{-7} M	3

1. J.-W. Liu, J.-L. Wang, W.-R. Huang, L. Yu, X.-F. Ren, W.-C. Wen and S.-H. Yu, *Sci. Rep.*, 2012, **2**, 987-931.
2. Y. Yang, Z.-Y. Li, K. Yamaguchi, M. Tanemura, Z. Huang, D. Jiang, Y. Chen, F. Zhou and M. Nogami, *Nanoscale*, 2012, **4**, 2663-2669
3. Y. Ye, J. Chen, Q. Ding, D. Lin, R. Dong, L. Yang and J. Liu, *Nanoscale*, 2013, **5**, 5887-5895