

Supporting Information for

Stable Magnetic Hot Spots for Simultaneous Concentration and Ultrasensitive SERS Detection of Solution Analytes

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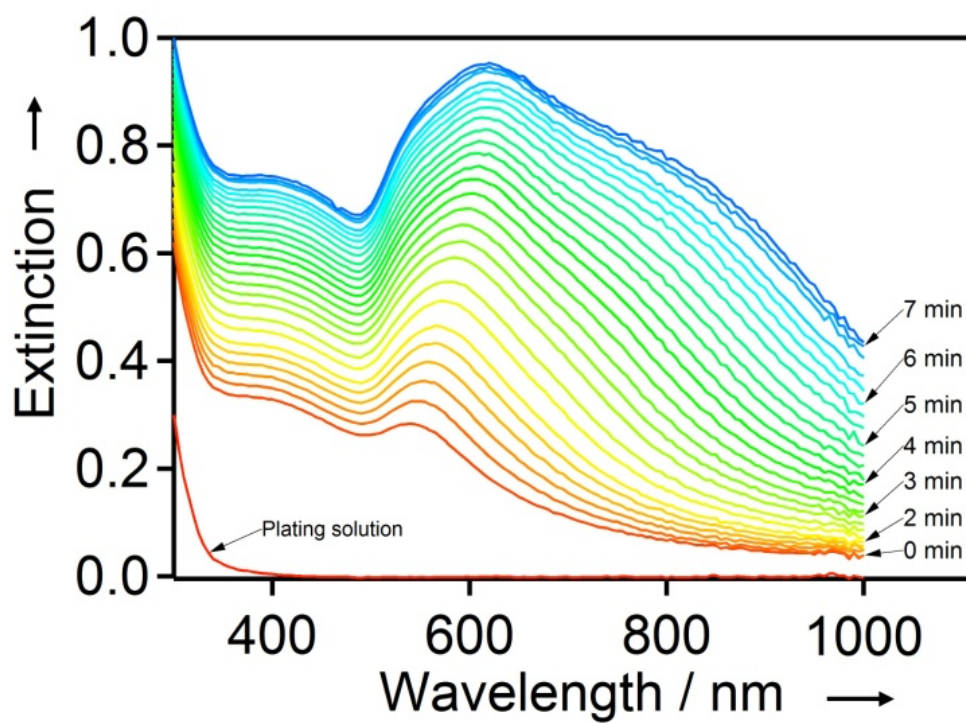


Figure S1. UV-Vis-NIR spectra of the MRMGPs formed at different time during the seeded plating process.

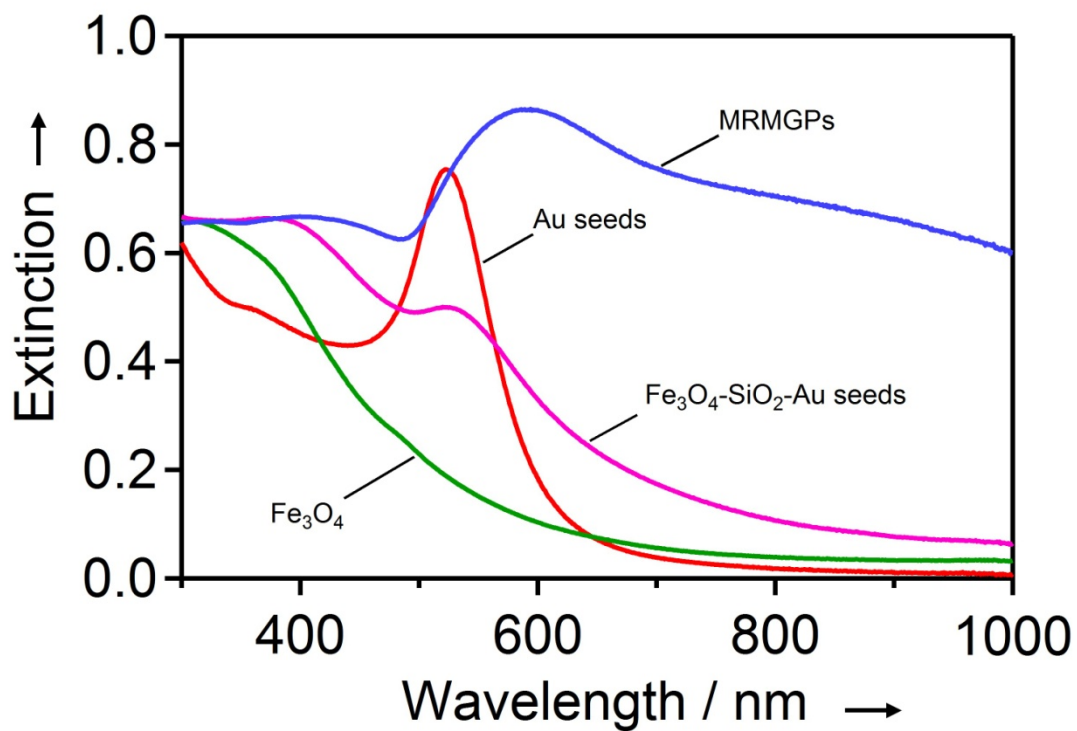


Figure S2. Typical UV-Vis-NIR spectra of the Au seeds (~15 nm), the Fe₃O₄ nanoparticles, the Fe₃O₄-SiO₂ core-shell particles decorated with Au seeds (Figure 2c), and the as-synthesized MRMGPs (Figure 2e), respectively.

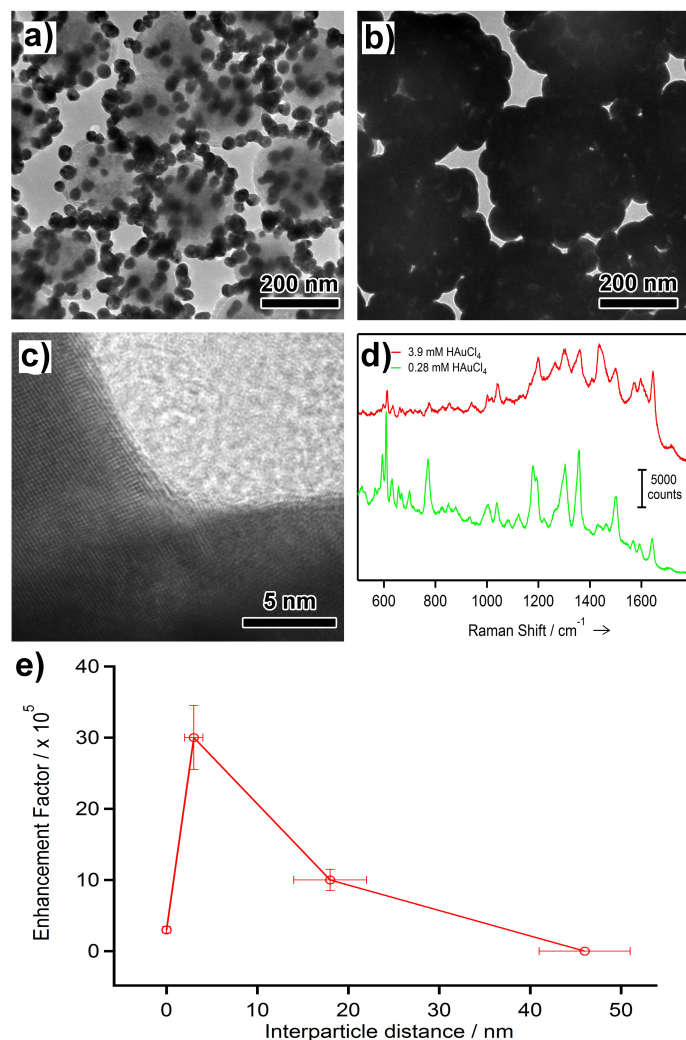


Figure S3. Typical TEM images of MRMGPs formed from the plating reaction with different concentrations of HAuCl₄: a) 0.28 mM HAuCl₄ and b) 3.9 mM HAuCl₄. c) High resolution TEM image of the adjacent position between two neighboring Au nanoparticles shown in (b). d) SERS spectra of R6G (50 nM) obtained with MRMGPs shown in (a) and (b), respectively. The SERS enhancement of the MRMGPs shown in (a) and (b) was not as good as that with MRMGPs in Figure 3d (prepared with 1.7 mM HAuCl₄). The reason was that the relative large gaps between Au nanoparticles in (a) caused the poor coupling of surface plasmons between the Au nanoparticles. For the MRMGPs shown in (b), the number of hot spots was greatly reduced when overgrown Au nanoparticles fused together. e) Dependence of the SERS enhancement and the average inter-particle gap of individual Au nanoparticles on the MRMGPs when they existed in a solution of 50 nM R6G in the presence of an external magnetic field. The interparticle distance for the overgrown MRMGPs that have continuous Au shells is defined as 0. No characteristic SERS signal of R6G can be detected with Fe₃O₄-SiO₂ core-shell particles decorated with Au seeds shown in Figure 2c. For this case, the SERS enhancement is considered as 0.

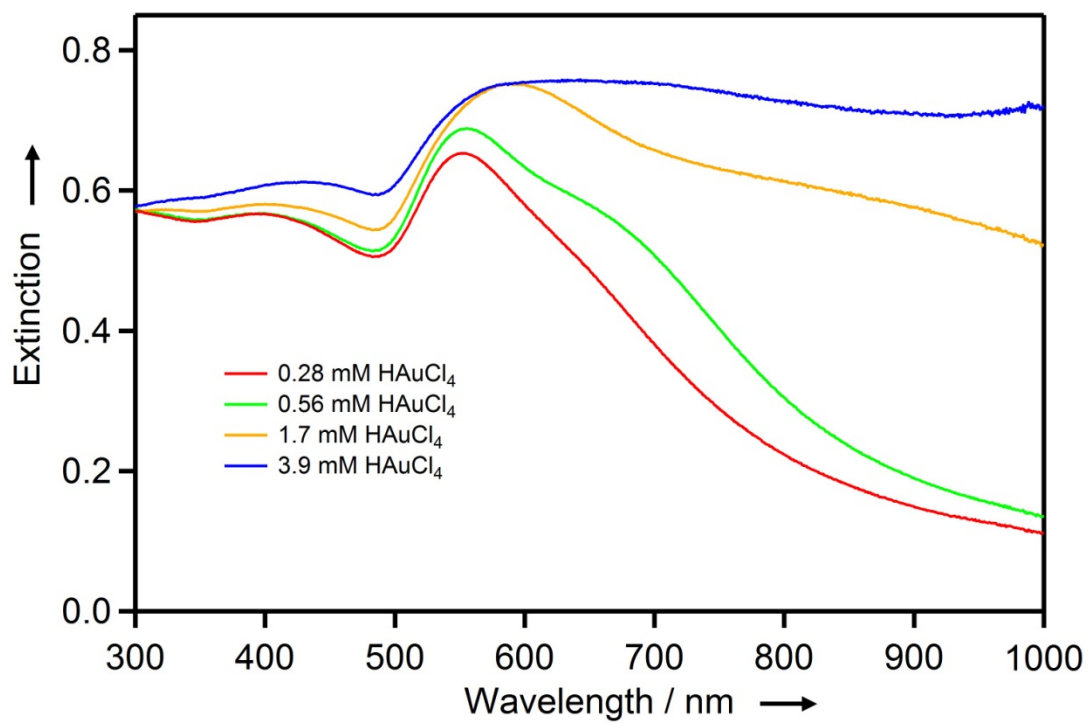


Figure S4. UV-Vis-NIR spectra of the MRMGPs formed from plating reactions with different concentrations of HAuCl_4 .

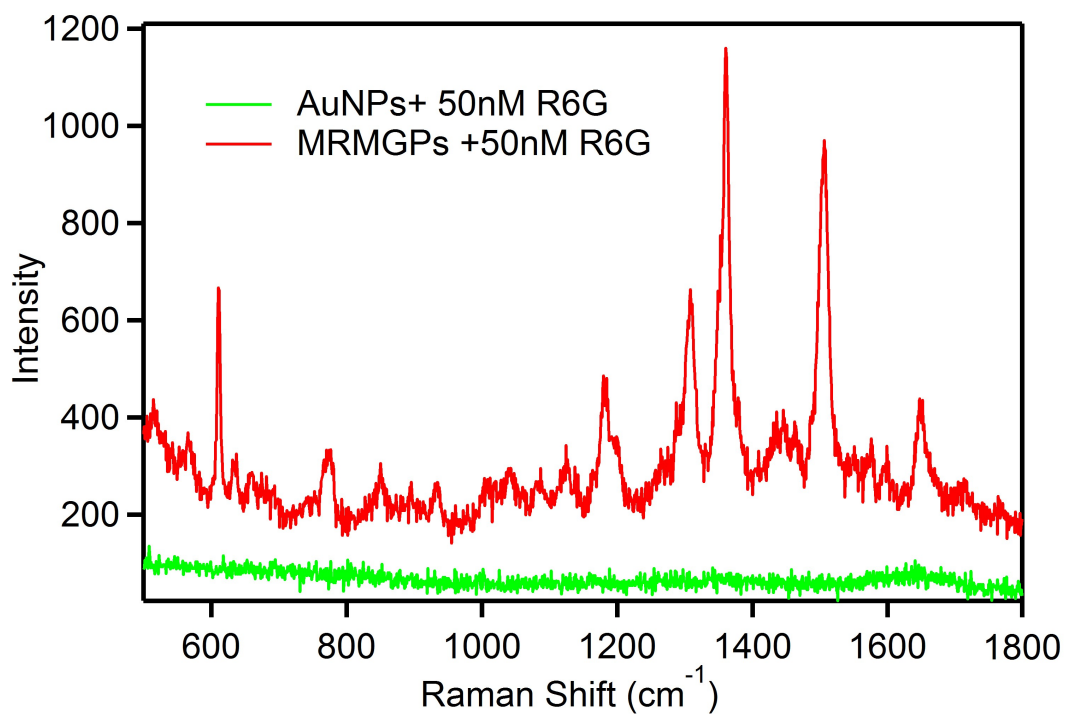


Figure S5. Comparison of SERS spectra of 50 nM R6G solution with isolated Au nanoparticles (green curve) and the MRMGPs shown Figure 3d (red curve) in absence of external magnetic field.

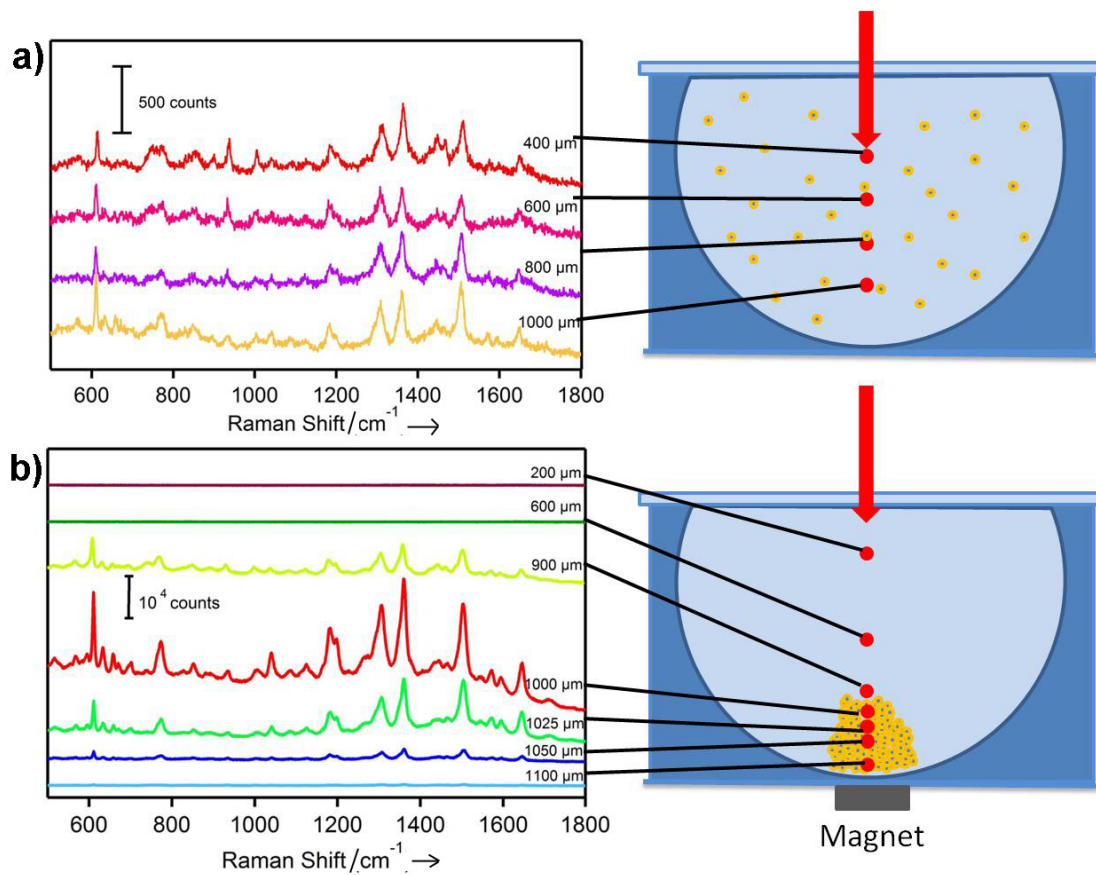


Figure S6. SERS spectra of R6G (2 nM) with MRMGPs at different positions in the solution a) before and b) after an external magnetic field was applied. The red spots in the right schemes highlight the positions focused by the excitation laser.

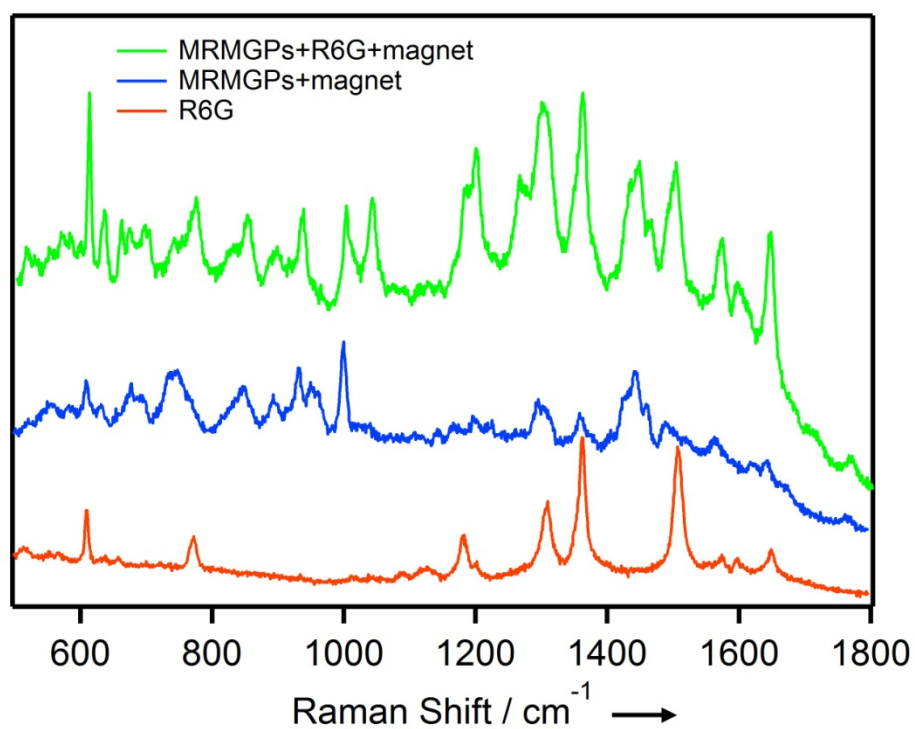


Figure S7. SERS spectra of an aqueous solution of pure R6G (1 mM, red curve), the MRMGPs (Figure 3d) in pure water concentrated by an external magnetic field (blue curve), and the MRMGPs in a R6G (200 pM) solution after concentration with an external magnetic field.

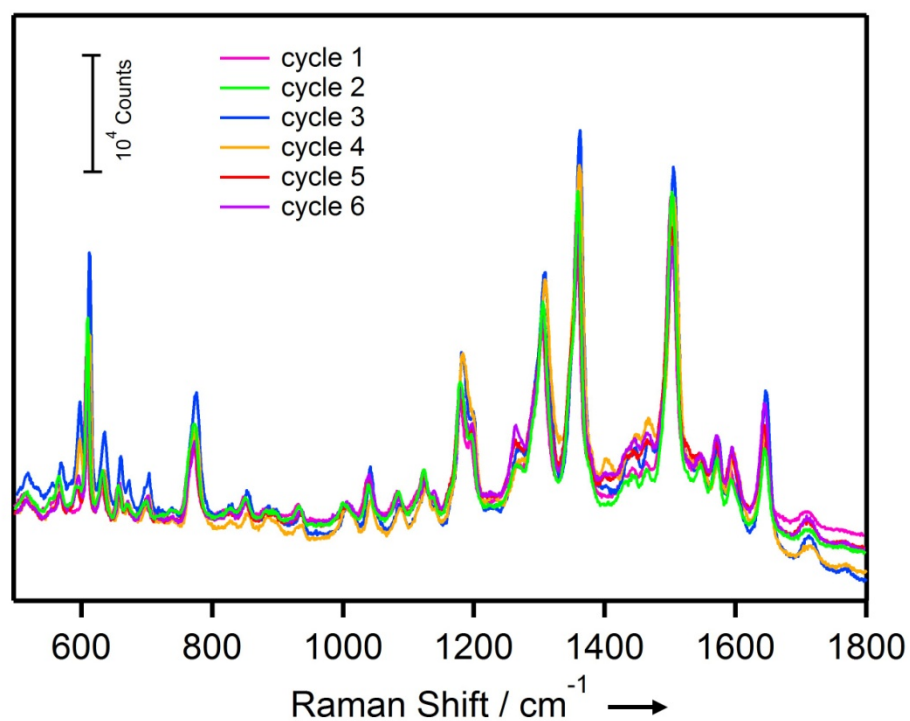


Figure S8. The SERS spectra collected when the MRMGPs were concentrated and re-dispersed for 6 cycles. The MRMGPs (Figure 3d) can be concentrated by applying an external magnetic field and re-dispersed after removal of the magnetic field. The concentration of R6G solution was 2 nM.