

Supporting Information

Synthesis of Multi-Branched Gold Nanoechinus using a Gemini Cationic Surfactant and its Application for Surface Enhanced Raman Scattering

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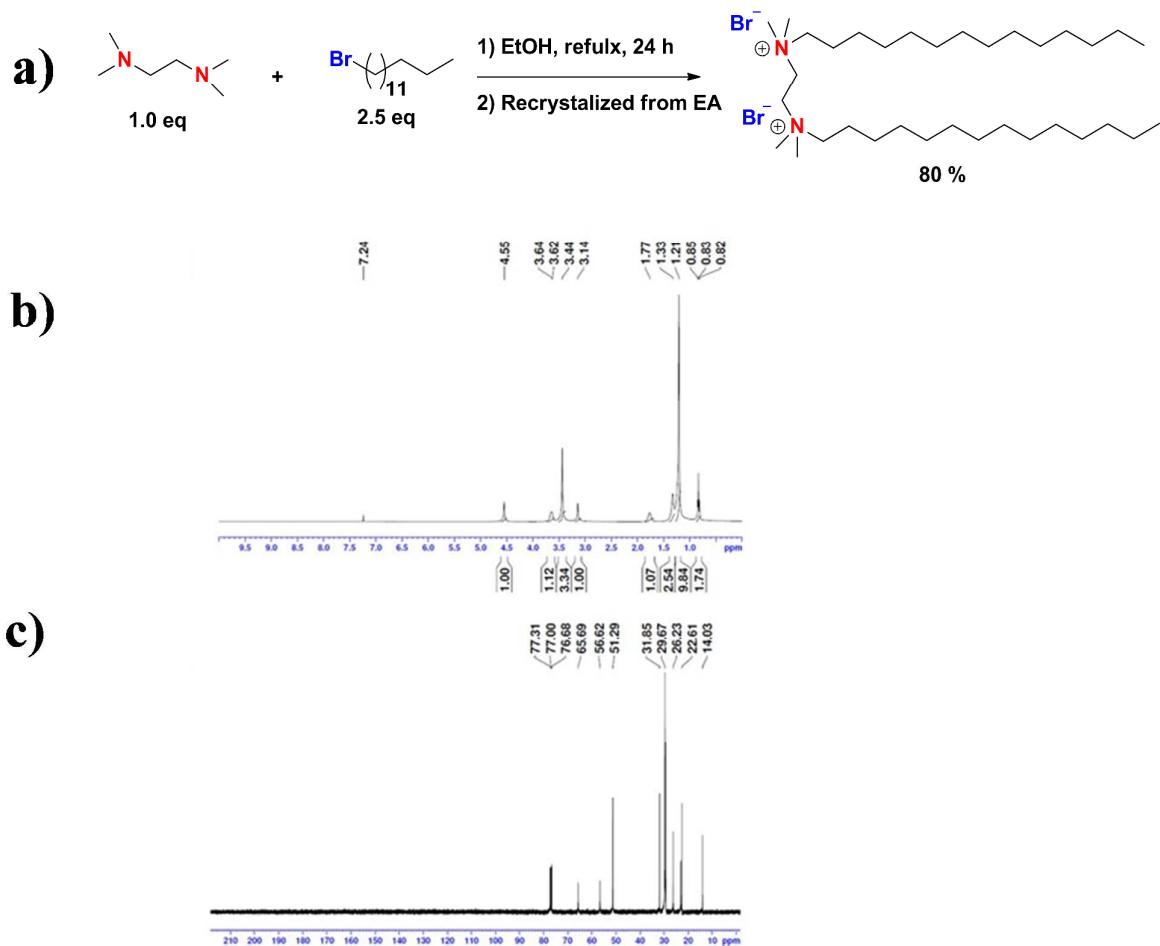


Figure S1. Synthetic scheme of $\text{C}_{14}\text{C}_2\text{C}_{14}\text{Br}_2$, characterization of $\text{C}_{14}\text{C}_2\text{C}_{14}\text{Br}_2$ using (b) ^1H NMR, and (c) ^{13}C NMR spectra, respectively

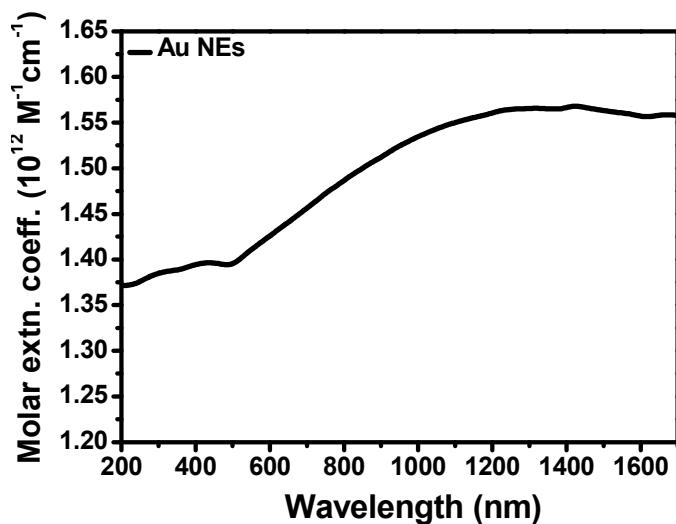


Figure S2: Molar extinction coefficient of Au NEs^{S1}.

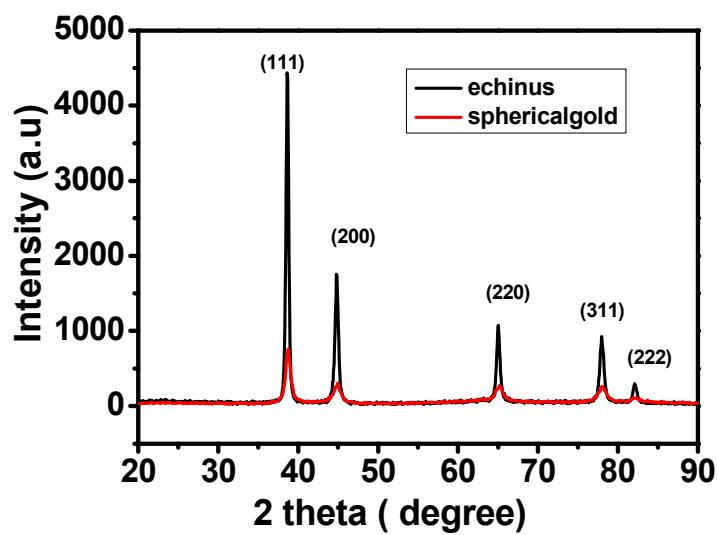


Figure S3. XRD pattern of Au nanoparticle and Au nanoechinus

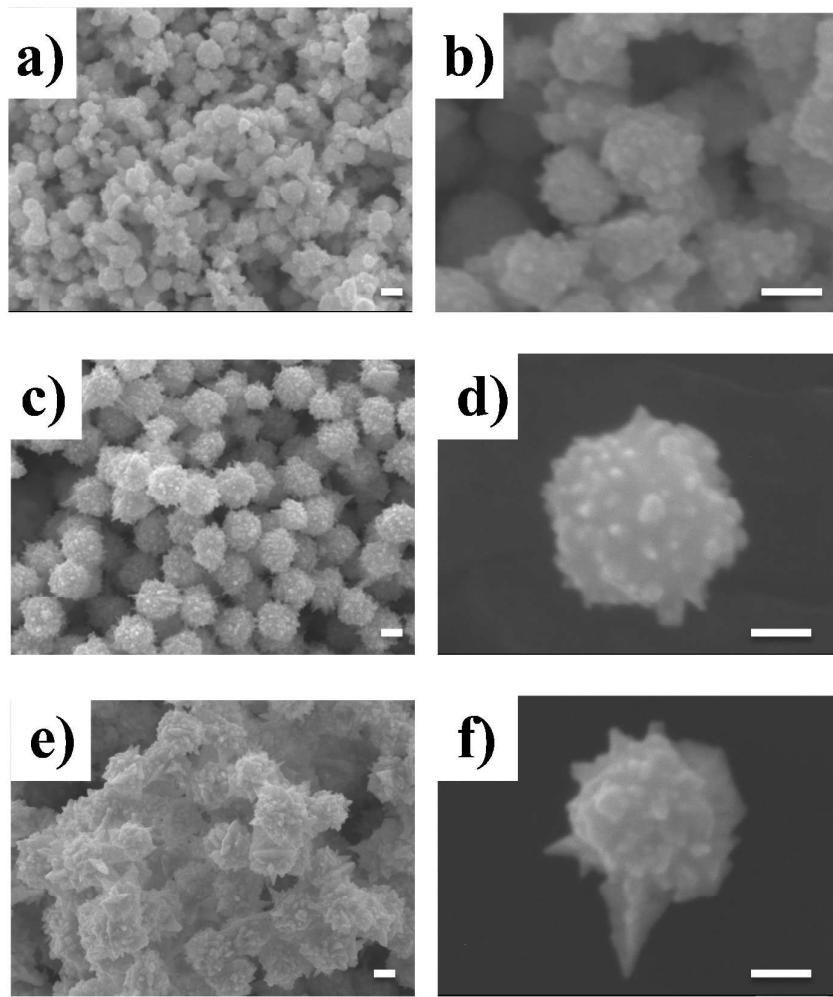


Figure S4. SEM images Au nanoparticle obtained at different concentrations of $C_{14}TAB$: (a) & (b) 1 mM; (c) & (d) 10 mM; (e) and (f) 0.1 M. Scale bar: 100 nm.

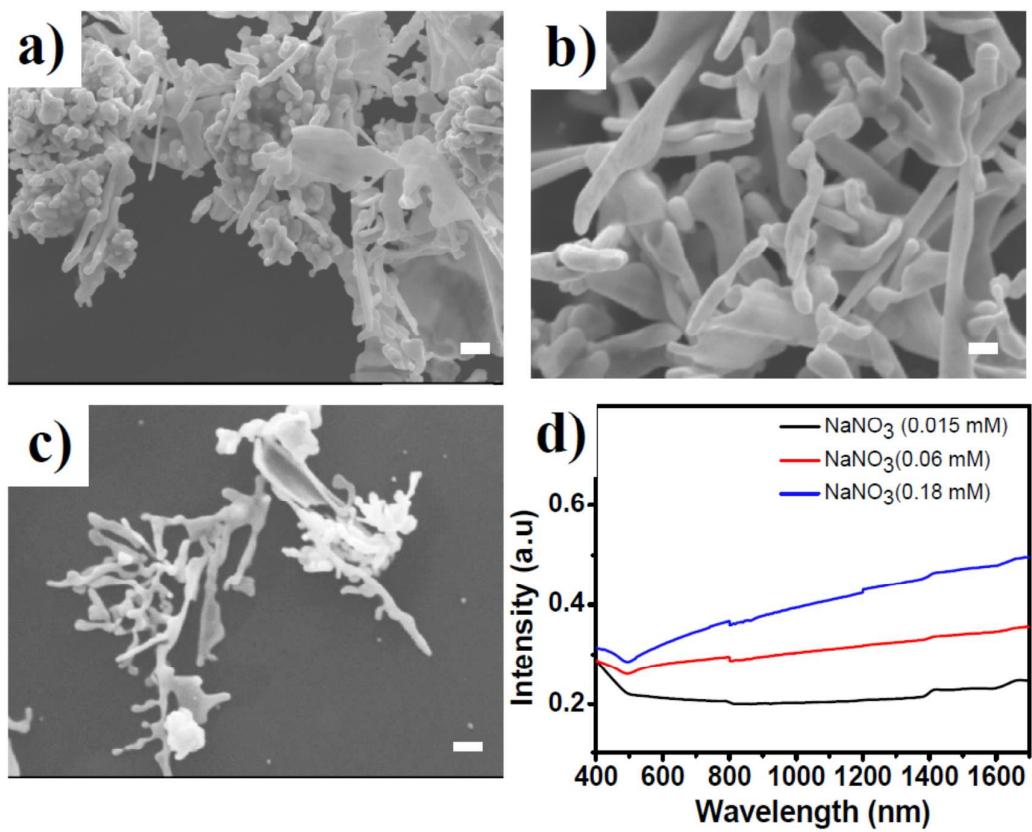


Figure S5. SEM images of Au nanostructures obtained at different concentrations of NaNO₃: (a) 0.015 mM, (b) 0.06 mM, (c) 0.18 mM, and (d) the corresponding uv-visible-NIR absorption spectra.

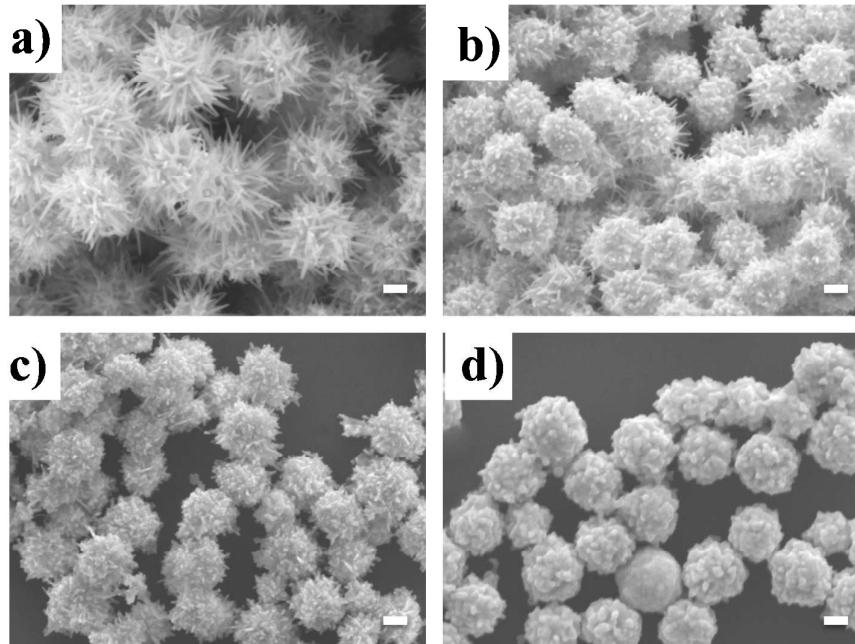


Figure S6. SEM images of Au nanostructures obtained at different concentrations of NaI: (a) 0.02 μ M, (b) 1.2 mM, (c) 1.8 mM, and (d) 2.4 mM, respectively. Scale bar: 100 nm.

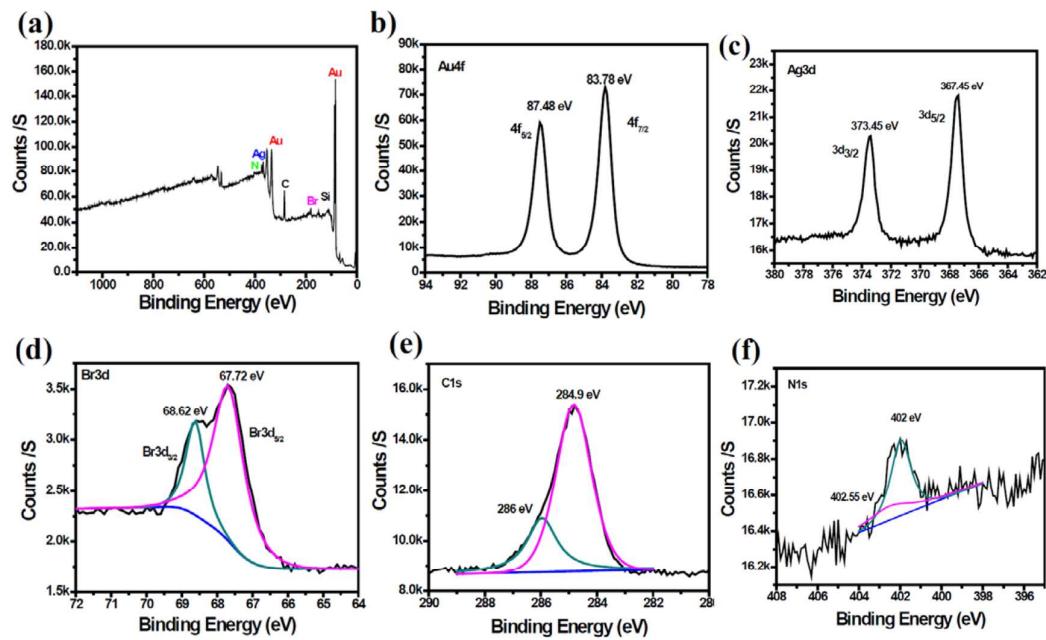


Figure S7. (a) Representative XPS survey scan, and high resolution spectrum of (b) Au 4f, (c) Ag 3d, (d) Br 3d, (e) C1s, and (f) N1s of Au NEs.

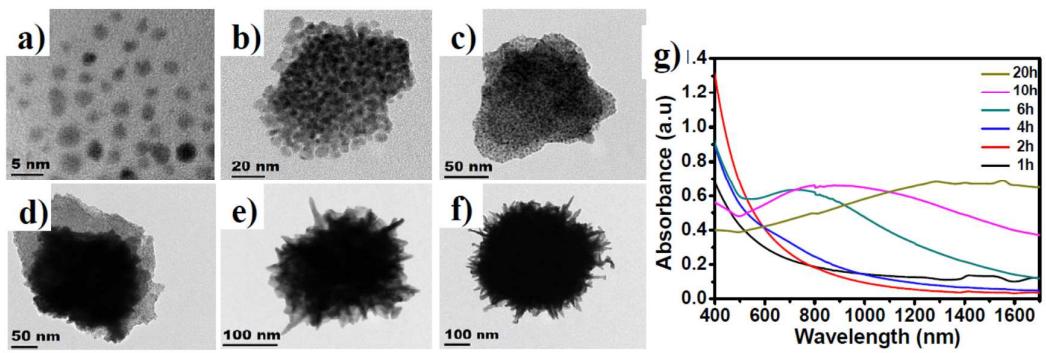


Figure S8. TEM images of intermediate products at various time points during synthesis of Au NEs: (a) 1 h, (b) 2 h, (c) 4 h, (d) 6 h, (e) 10 h, and (f) 20 h, respectively. g) UV-visible-NIR spectra of the intermediate products.

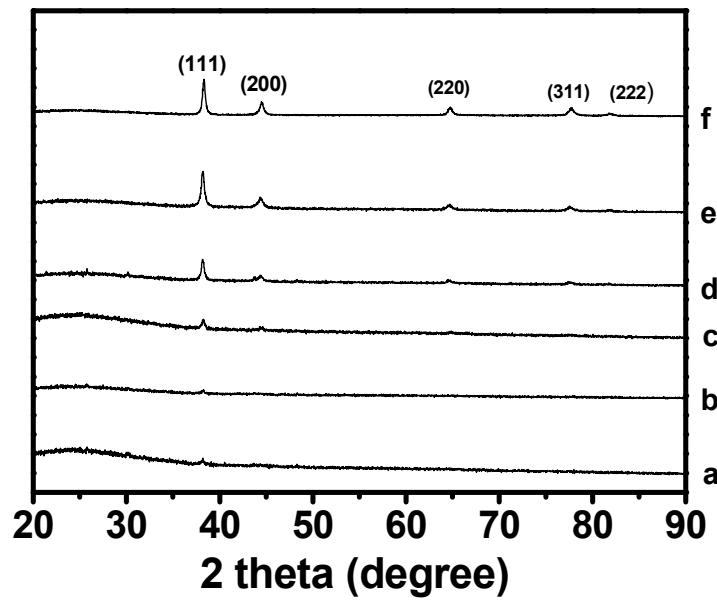


Figure S9. XRD pattern of intermediate Au NEs products collected at various time points during synthesis: (a) 1 h, (b) 2 h, (c) 4 h, (d) 6 h, (e) 10 h, and (f) 20 h, respectively

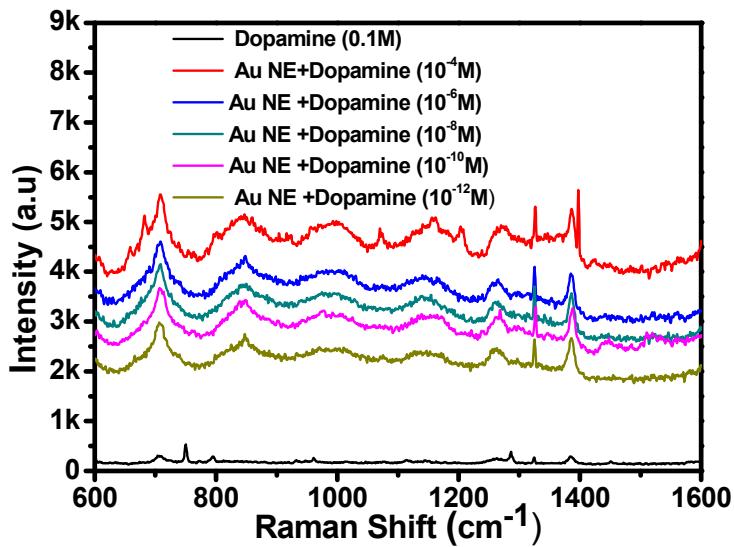


Figure S10. Determination of SERS signals of different concentrations of dopamine with Au NEs in an aqueous solution.

The surface enhancement factors were calculated according to the equation^{S2}

$$\frac{I_{SERS}/N_{Surf}}{I_{Ref}/N_{vol}},$$

Where I_{SERS} is the intensity of the analyte molecule and I_{Ref} is the Raman intensity of the bulk molecule in the solution in the absence of Au NEs. N_{surf} and N_{vol} represent the number of adsorbed analyte on the surface of the SERS substrate and the number of molecules in the bulk sample, respectively. The enhancement factor was calculated according to 10^{-12} M concentration of dopamine adsorbed on the SERS substrate when excited by 633 nm laser beam with a spot size of 0.8 mm. Under the assumption that probe molecule was adsorbed uniformly on the whole surface of Au NEs, and by choosing 1279 cm^{-1} , the SERS enhancement factor of Au NEs for dopamine was calculated to be 10^9 .

Reference

- (S1) Vijayaraghavan, P.; Liu, C. H.; Vankayala, R.; Chiang, C. S.; Hwang, K. C. Designing Multi-Branched Gold Nanoechinus for NIR Light Activated Dual Modal Photodynamic and Photothermal Therapy in the Second Biological Window *Adv. Mater.* 2014, 26 (39), 6689-6695.
- (S2) Wang, P.; Xia, M.; Liang, O.; Sun, K.; Cipriano, A. F.; Schroeder, T.; Liu, H. N.; Xie, Y. H., Label-Free SERS Selective Detection of Dopamine and Serotonin Using Graphene-Au Nanopyramid Heterostructure. *Anal. Chem.* 2015, 87 (20), 10255-10261.