Supporting information

Mini Gold Nanorods with Tunable Plasmonic Peaks Beyond 1000 nm

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AR	0.10 M CTAB (mL)	0.010 M $AgNO_3$ (mL)	0.10 M $AgNO_3$ (mL)	1.0 M HCl (mL)	0.10 M ascorbic acid (mL)	0.10 M hydroquinone (mL)	Seed solution (mL)
2.2 ± 0.6	8.0	0.030	N/A	0.20	0.080	N/A	2.0
2.6 ± 0.7	8.0	0.050	N/A	0.20	0.080	N/A	2.0
3.2 ± 0.8	8.0	0.10	N/A	0.20	0.080	N/A	2.0
3.8 ± 1.0	9.0	0.10	N/A	0.20	0.080	N/A	1.0
5.6 ± 1.3	8.0	N/A	0.040	N/A	N/A	0.50	2.0
8.2 ± 2.3	8.0	N/A	0.040	0.013	N/A	0.50	2.0
8.7 ± 1.9	8.0	N/A	0.040	0.019	N/A	0.50	2.0
9.6 ± 2.1	8.0	N/A	0.040	0.025	N/A	0.50	2.0
10.8 ± 2.8	8.0	N/A	0.040	0.036	N/A	0.50	2.0

Table S1. Summary of reagents used for synthesizing mini AuNRs of 9 aspect ratios (ARs). All growth solutions contained 0.50 mL of 0.010 M $HAuCl_4 \bullet 3H_2O$.

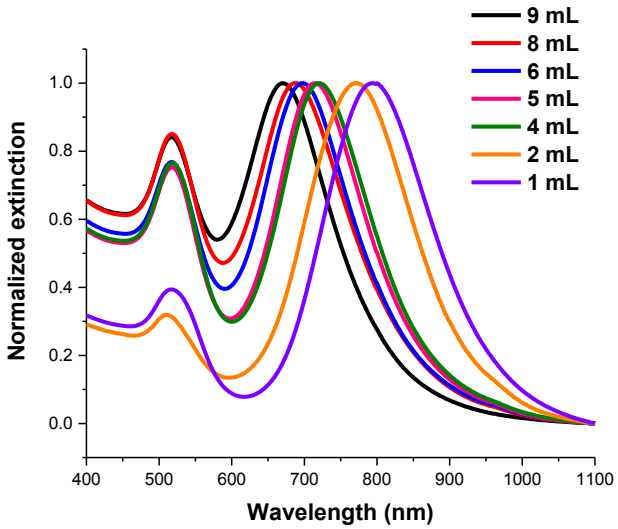


Figure S1. UV-Vis-NIR spectra of ascorbic acid-reduced mini AuNRs made from a seed-growth solution ratio 1:9 to 9:1 but with fixed 92 μM of $AgNO_3$.

Volume of a seed solution in a 10-mL growth solution	9 mL	8 mL	6 mL	5 mL	4 mL	2 mL	1 mL
λ_{max} (nm) of AuNRs	671	688	698	715	721	771	793

Table S2. Plasmon maximal wavelengths of CTAB-coated, ascorbic acid-reduced mini AuNRs resulted from decreasing the volume of a seed solution in a growth solution.

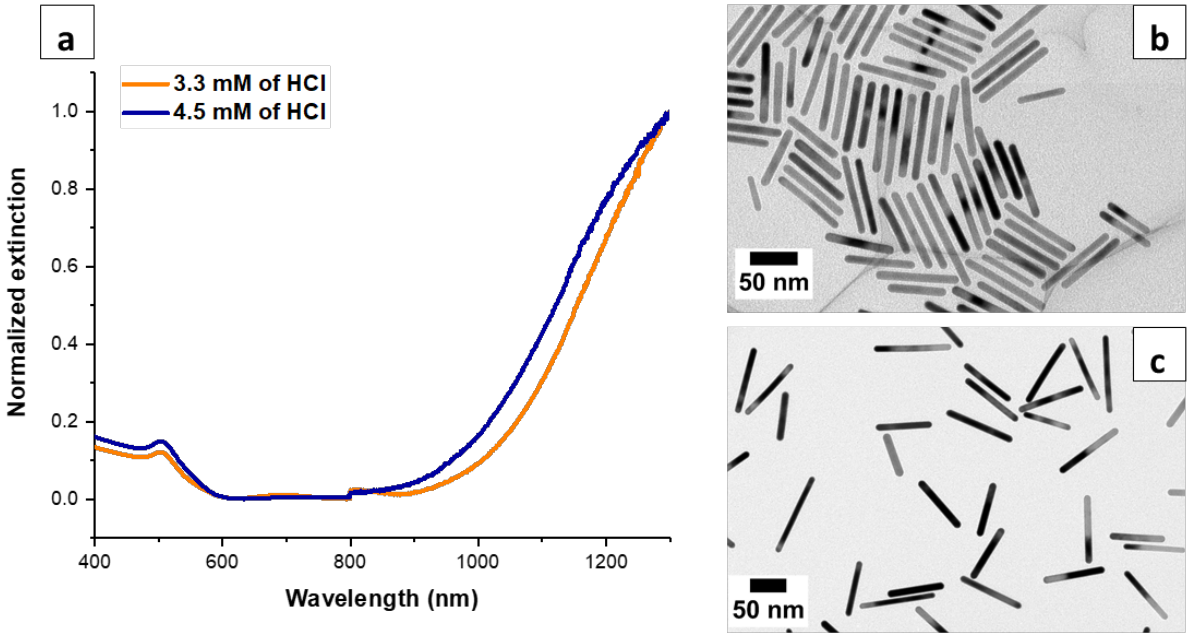
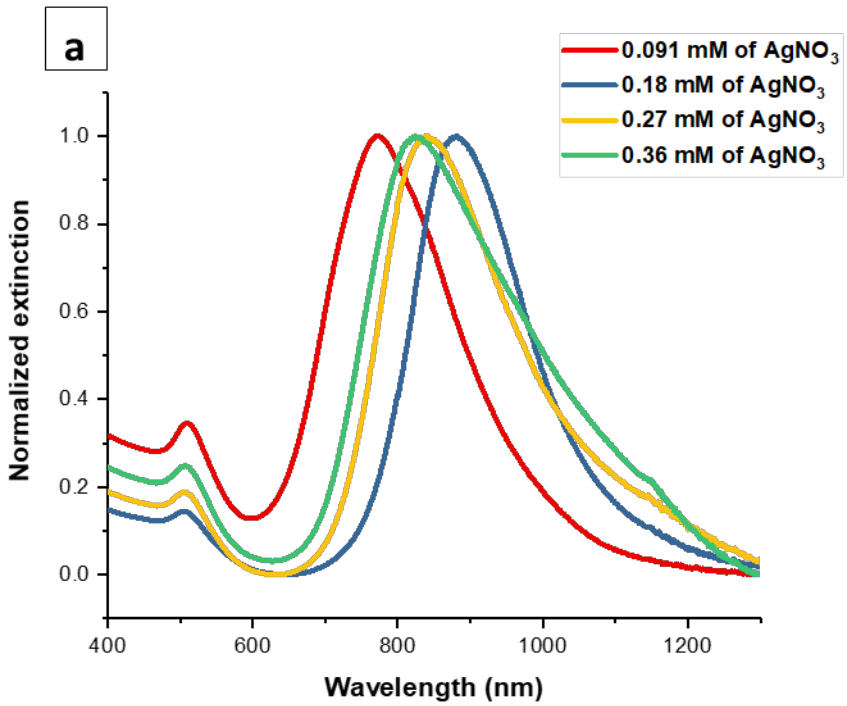


Figure S2. a) UV-Vis-NIR spectra of hydroquinone-reduced mini AuNRs made from 3.3 and 4.5 mM of HCl. All growth solutions contained 0.36 mM of $AgNO_3$. TEM image of mini AuNRs made from b) 3.3 and c) 4.5 mM of HCl.

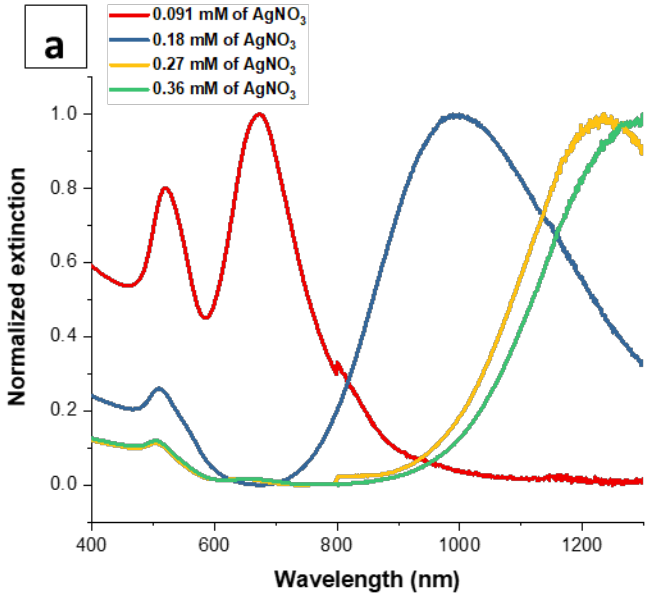
HCl (mM)	AR	Longitudinal LSPR (nm)	Length (nm)	Width (nm)	Shape percent yield
3.3	10.8 ± 2.8	>1300	93.1 ± 18.2	8.7 ± 1.0	95.9 (N = 362)
4.5	10.8 ± 2.8	>1300	92.6 ± 18.3	8.7 ± 1.1	95.9 (N = 410)

Table S3. Comparison of ARs, dimensions, and the shape percent yields of hydroquinone-reduced mini AuNRs made from 3.3 and 4.5 mM of HCl. All growth solutions contained 0.36 mM of $AgNO_3$.



Concentration of $AgNO_3$ (mM)	0.091	0.18	0.27	0.36
λ_{max} (nm) of AuNRs	772	881	838	824

Figure S3. a) UV-Vis-NIR spectra of hydroquinone-reduced mini AuNRs made from various concentrations of $AgNO_3$. All growth solutions are without HCl.



Concentration of $AgNO_3$ (mM)	0.091	0.18	0.27	0.36
λ_{max} (nm) of AuNRs	673	989	1242	>1300

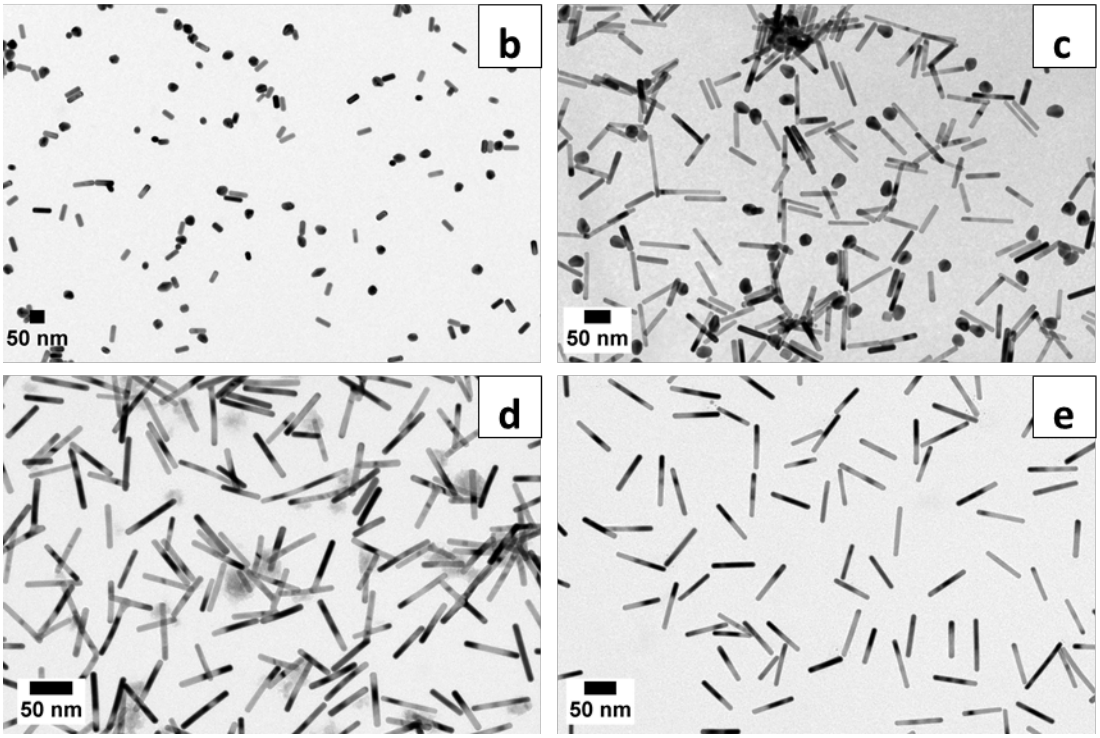


Figure S4. a) UV-Vis-NIR spectra of hydroquinone-reduced mini AuNRs made from various concentrations of $AgNO_3$. All growth solutions contain 2.3 mM of HCl. TEM image of mini AuNRs made from b) 0.091, c) 0.18, d) 0.27 and d) 0.36 mM of $AgNO_3$.

Figure S5 shows both ascorbic acid-and hydroquinone-reduced mini AuNRs are single crystals. Two planes (200) and (220) were identified in mini AuNRs of AR 3.2 with interplanar spacings d_{200} = 0.2042 nm and d_{220} = 0.1424 nm, which correspond to the reported values of face-centered-cubic (fcc) gold d_{200} = 0.2039 nm and d_{220} = 0.1442 nm, respectively (Joint Committee on Powder Diffraction Standards, No. 04-0784). In addition to (200) and (220), two planes (111) and (222) show in mini AuNRs of AR 5.6. Interplanar spacings d_{111}= 0.2234 nm in Figure S5c and d_{222} = 0.1116 nm in Figure S5b agree with fcc structure of metallic gold d_{111}= 0.2355 nm and d_{222} = 0.1177 nm. Interplanar angles are (200) ∧ (220) = 45.5° in Figure S5a, (200) ∧ (222) = 84.1° and (222) ∧ (422) = 26.1° in Figure 5b, (200) ∧ (111) = 55.3° and (111) ∧ (220) = 38.2° in Figure S5c. Interplanar angles (200) ∧ (220) = 45.5°, (200) ∧ (111) = 55.3° and (111) ∧ (220) = 38.2° correspond well our previous results (200) ∧ (220) = 45°, (200) ∧ (111) = 54.7° and (111) ∧ (220) = 35.3°.[1]

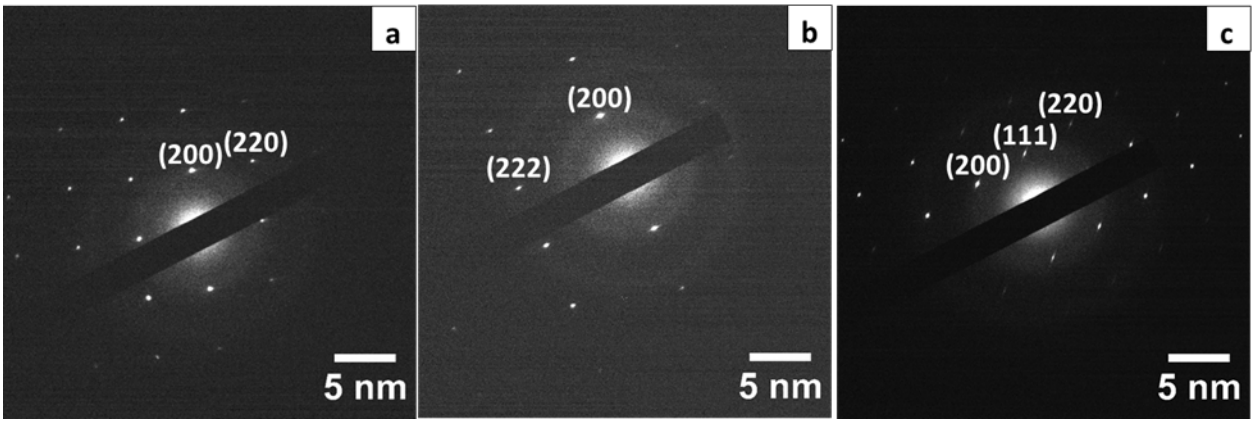


Figure S5. Single-crystallinity of ascorbic acid-and hydroquinone-reduced mini AuNRs. a) ascorbic acid-reduced mini AuNR AR 3.2, b) and c) hydroquinone-reduced mini AuNR AR 5.6.

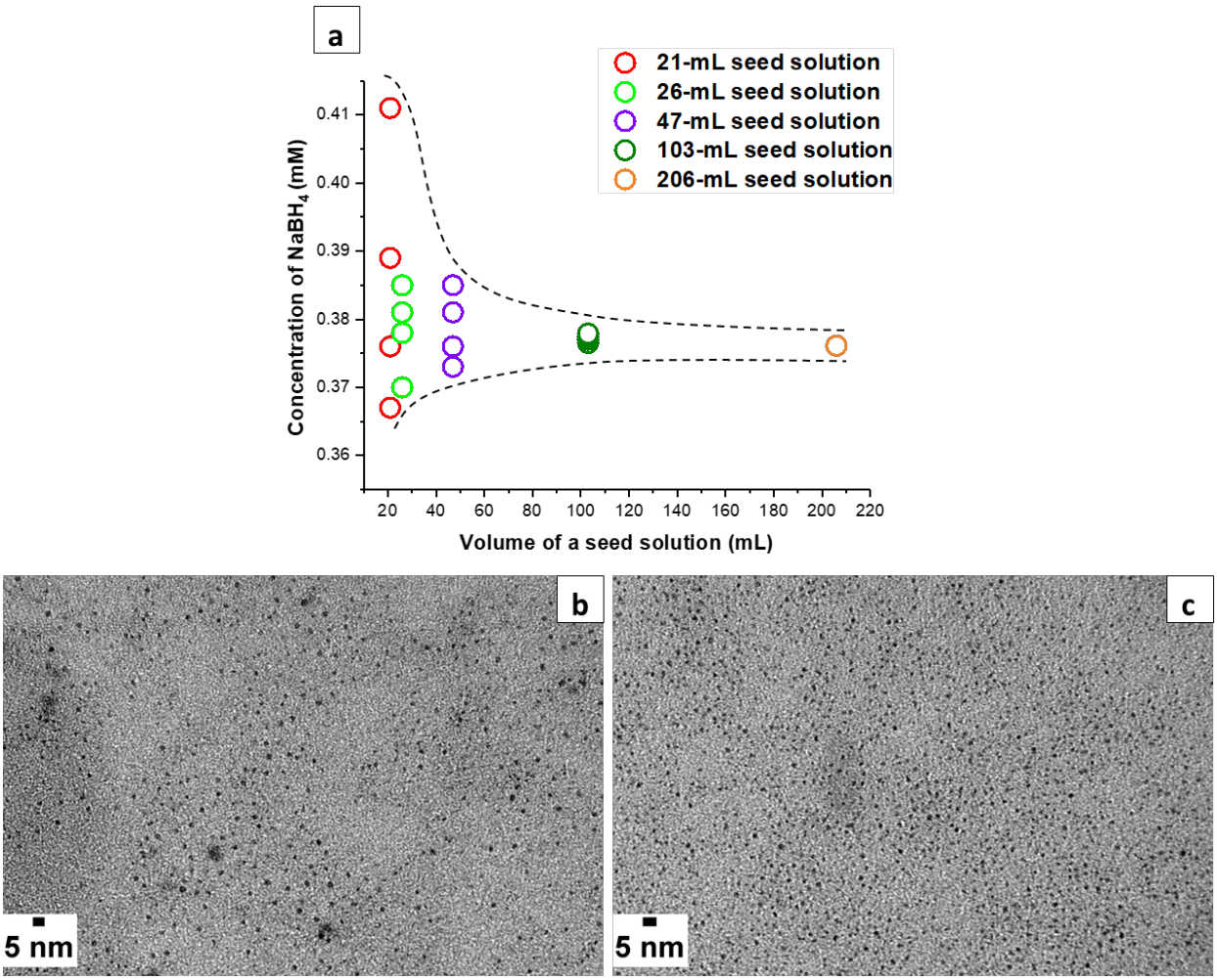


Figure S6. a) Ranges of $NaBH_4$ concentrations required to produce acceptable seed solutions from 21 to 206 mL. TEM image of CTAB-capped Au seeds made from b) 10-mL and c) 206-mL seed solutions.

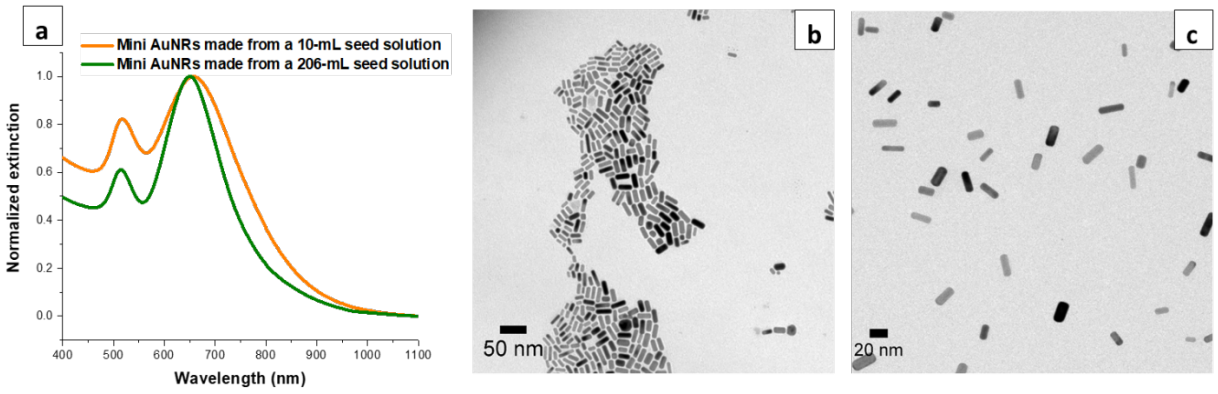


Figure S7. a) UV−Vis−NIR spectra of two 10-mL mini AuNRs made from 10-and 206-mL seed solutions. TEM images of mini AuNRs made from b) 10-mL and c) 206-mL seed solutions.

Mini AuNRs made from different seed solutions	Longitudinal LSPR (nm)	Length (nm)	Width (nm)	AR	Shape percent yield (%)
10 mL	658	19.2 ± 5.3	7.6 ± 1.7	2.6 ± 0.7	96.1 (N = 672)
206 mL	650	19.6 ± 4.3	8.0 ± 1.7	2.5 ± 0.7	97.6 (N = 336)

Table S4. ARs, dimensions, and the shape percent of two 10-mL mini AuNRs made from 10-and 206-mL seed solutions. The shape percent is defined by $\frac{\#\text{ of NRs}}{\#\text{ of all shapes}}$ x 100%. N refers to the number of particles been measured.

Reference

(1) Johnson, C. J.; Dujardin, E.; Davis, S. A.; Murphy, C. J.; Mann, S. Growth and Form of Gold Nanorods Prepared by Seed-Mediated, Surfactant-Directed Synthesis. *J. Mater. Chem.* **2002**, *12*, 1765-1770.