

Glutathione- and Cysteine-Induced Transverse Overgrowth on Gold Nanorods

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Supporting Information

Table S1. Average Sizes of Gold Nanorods Grown under Varying Experimental Conditions

| growth conditions | diameter (nm) ^a | length (nm) ^a | aspect ratio ^a |
|---|----------------------------|--------------------------|---------------------------|
| original Au nanorods | 10.3 (0.9) | 36 (4) | 3.5 (0.5) |
| 2.5 mL original Au nanorod solution, 100 μ M glutathione, 2 mL growth solution | 14 (2) | 39 (5) | 2.9 (0.4) |
| 2.5 mL original Au nanorod solution, 100 μ M glutathione, 3 mL growth solution | 15 (2) | 39 (6) | 2.7 (0.5) |
| 2.5 mL original Au nanorod solution, 100 μ M glutathione, 5 mL growth solution | 19 (3) | 39 (6) | 2.1 (0.4) |
| 2.5 mL original Au nanorod solution, 100 μ M glutathione, 7 mL growth solution | 25 (3) | 39 (6) | 1.6 (0.3) |
| 2.5 mL original Au nanorod solution, 100 μ M glutathione, 12 mL growth solution | 34 (3) | 39 (5) | 1.2 (0.1) |
| 2.5 mL original Au nanorod solution, 100 μ M glutathione, 15 mL growth solution | 35 (2) | 39 (10) | 1.1 (0.3) |
| 2.5 mL original Au nanorod solution, no glutathione, 3 mL growth solution | 13 (2) | 41 (4) | 3.2 (0.4) |
| 2.5 mL original Au nanorod solution, no glutathione, 7 mL growth solution | 17 (2) | 46 (7) | 2.8 (0.4) |
| 2.5 mL original Au nanorod solution, no glutathione, 15 mL growth solution | 21 (2) | 55 (5) | 2.6 (0.3) |
| 2.5 mL original Au nanorod solution, 10 μ M glutathione, 10 mL growth solution | 20 (2) | 50 (5) | 2.4 (0.3) |
| 2.5 mL original Au nanorod solution, 50 μ M glutathione, 10 mL growth solution | 21 (2) | 48 (5) | 2.3 (0.3) |

^a The numbers in the parentheses are standard deviations. Size measurements were performed on 200 Au nanorods per sample from TEM images.

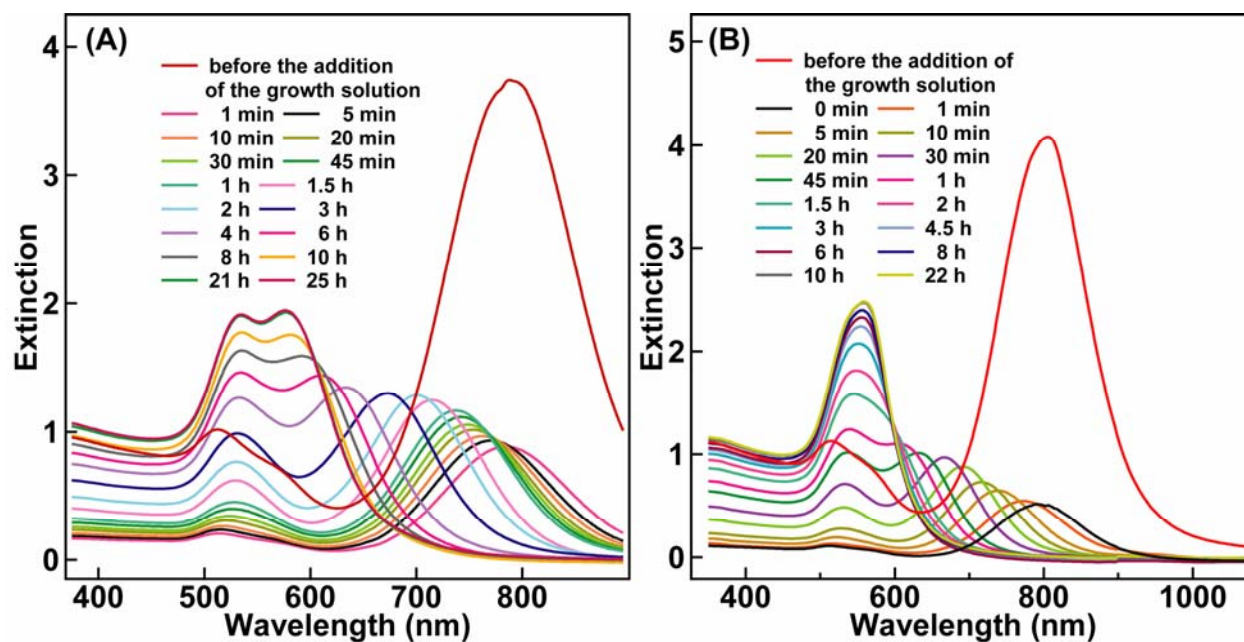


Figure S1. Extinction spectra recorded as a function of time after the addition of the growth solution into 2.5 mL aliquots of the original Au nanorod solution containing 100 μ M glutathione. The volumes of the growth solution for (A) and (B) are 7 and 15 mL, respectively.



Figure S2. Digital picture of the growth products obtained from glutathione-induced overgrowth on Au nanorods. The samples denoted by the numbers from 0 to 12 correspond to the curves from (a) to (m) shown in Figure 2A. The picture was taken with a Panasonic digital camera (DMC FX9).

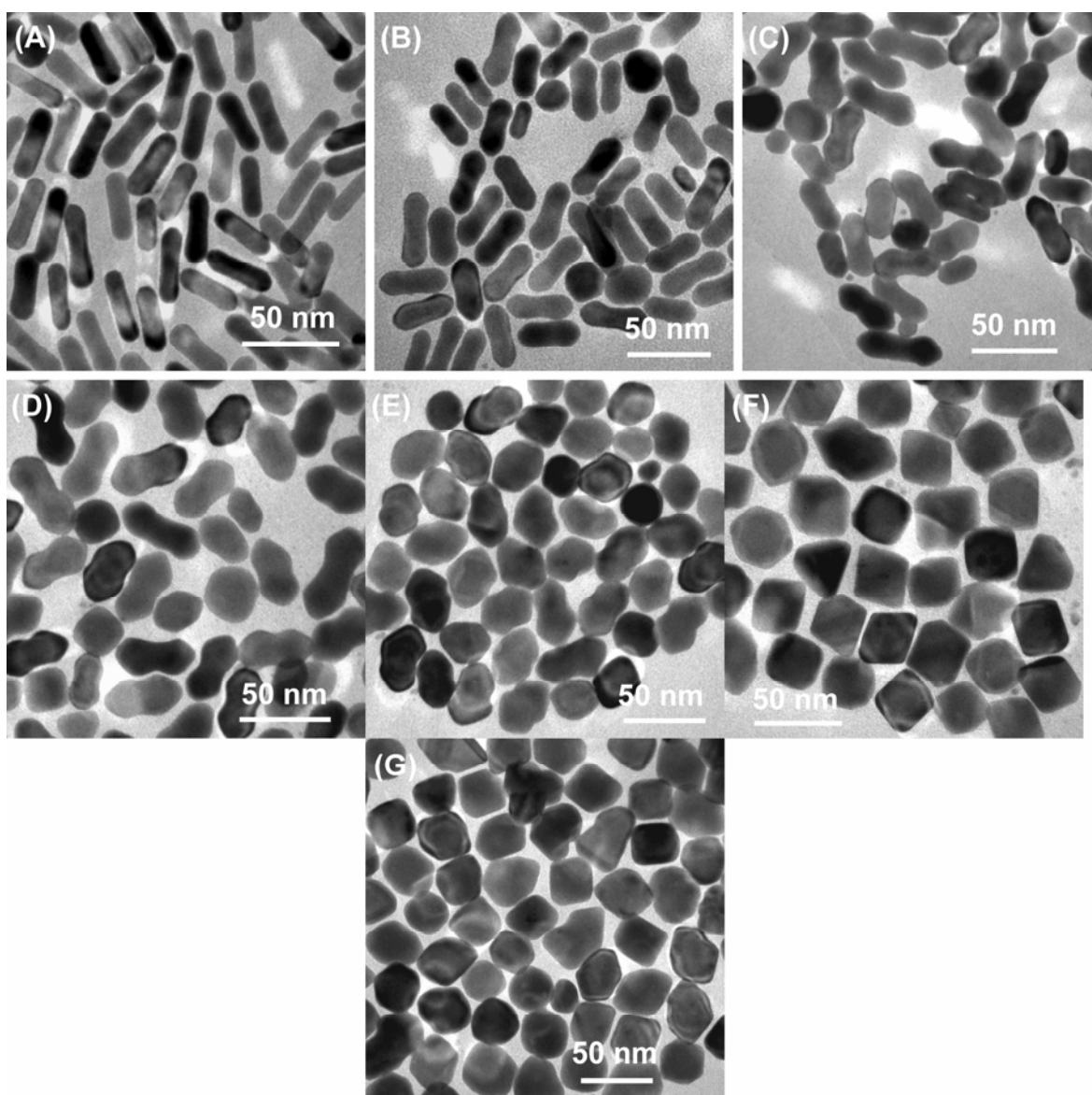


Figure S3. (A) TEM image of the original Au nanorods. (B) – (G) TEM images of the growth products corresponding to the samples (c), (d), (f), (h), (l), and (m) shown in Figure 2A, respectively.

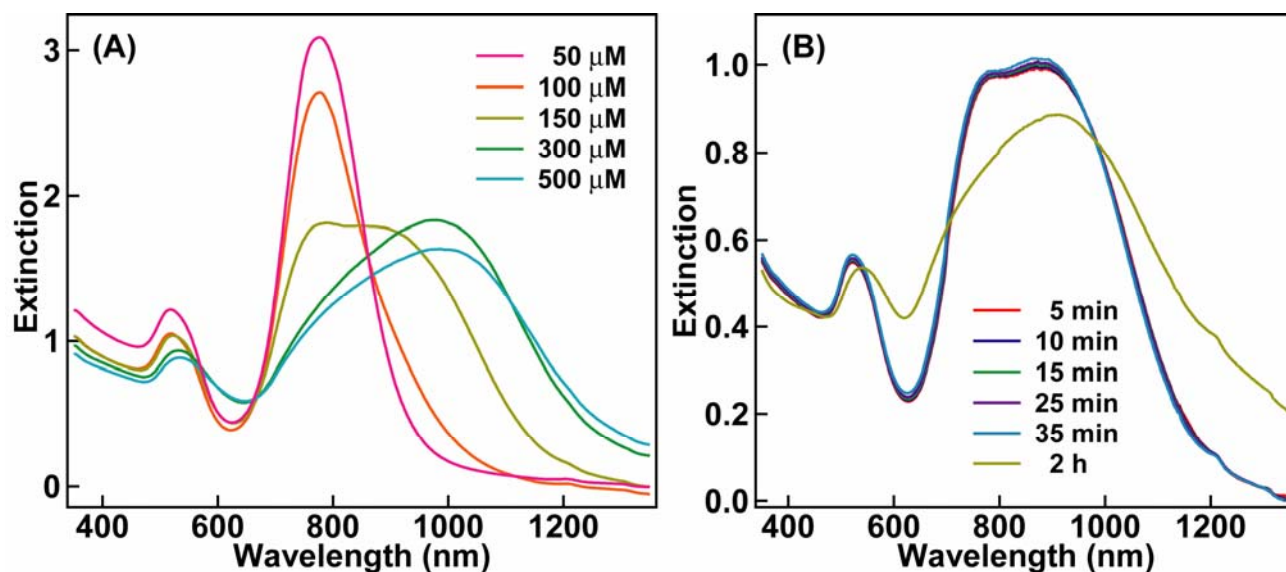


Figure S4. (A) Extinction spectra of the original Au nanorod solutions containing varying concentrations of glutathione. The appearance of a new extinction peak is due to glutathione-induced end-to-end assembly of Au nanorods in the solutions. (B) Time-dependent extinction spectra recorded after the addition of 7 mL of the growth solution into 2.5 mL of the original Au nanorod solution containing 150 μM glutathione. Both the transverse and longitudinal growth are blocked. The extinction spectral change after 2 h is due to the end-to-end assembly of Au nanorods.

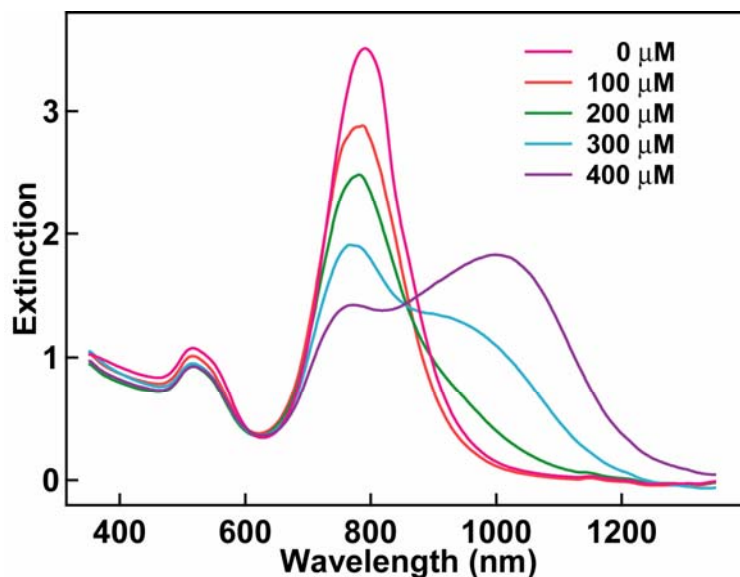


Figure S5. Extinction spectra of the original Au nanorod solutions containing varying concentrations of cysteine. The appearance of a new extinction peak at a longer wavelength is due to cysteine-induced end-to-end assembly of Au nanorods in the solutions.

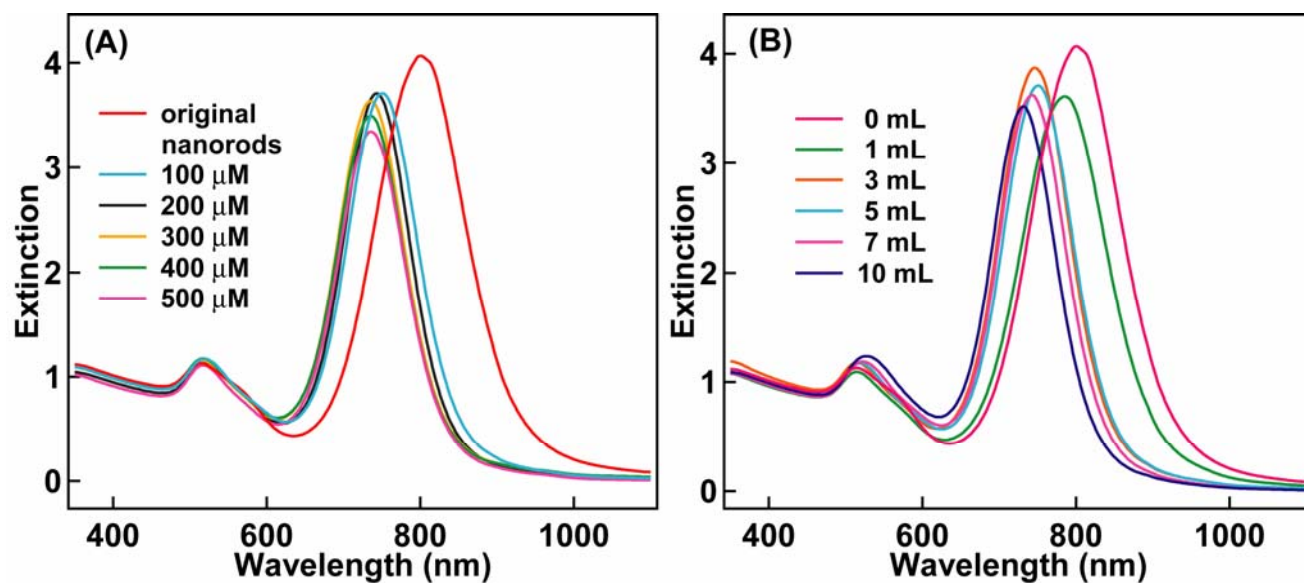


Figure S6. (A) Extinction spectra of the growth products obtained by the addition of 5 mL of the growth solution into 2.5 mL aliquots of the original Au nanorod solution containing 3-mercaptopropionic acid at varying concentrations. (B) Extinction spectra of the growth products obtained by the addition of varying volumes of the growth solution into 2.5 mL aliquots of the original Au nanorod solution containing 200 μM 3-mercaptopropionic acid.

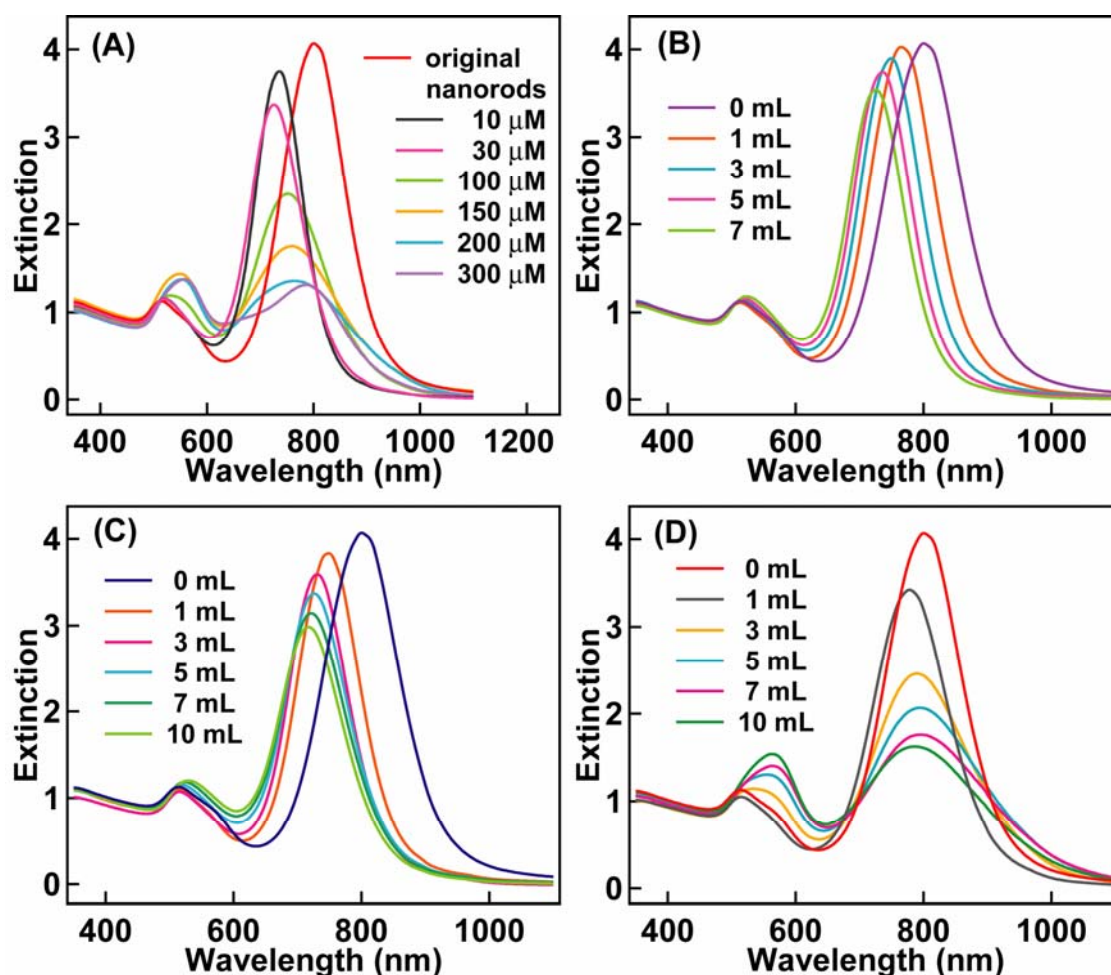


Figure S7. (A) Extinction spectra of the growth products obtained by the addition of 5 mL of the growth solution into 2.5 mL aliquots of the original Au nanorod solution containing 11-mercaptoundecanoic acid at varying concentrations. (B) Extinction spectra of the growth products obtained by the addition of varying volumes of the growth solution into 2.5 mL aliquots of the original Au nanorod solution containing 10 μM 11-mercaptoundecanoic acid. (C) Extinction spectra of the growth products obtained by the addition of varying volumes of the growth solution into 2.5 mL aliquots of the original Au nanorod solution containing 30 μM 11-mercaptoundecanoic acid. (D) Extinction spectra of the growth products obtained by the addition of varying volumes of the growth solution into 2.5 mL aliquots of the original Au nanorod solution containing 100 μM 11-mercaptoundecanoic acid.

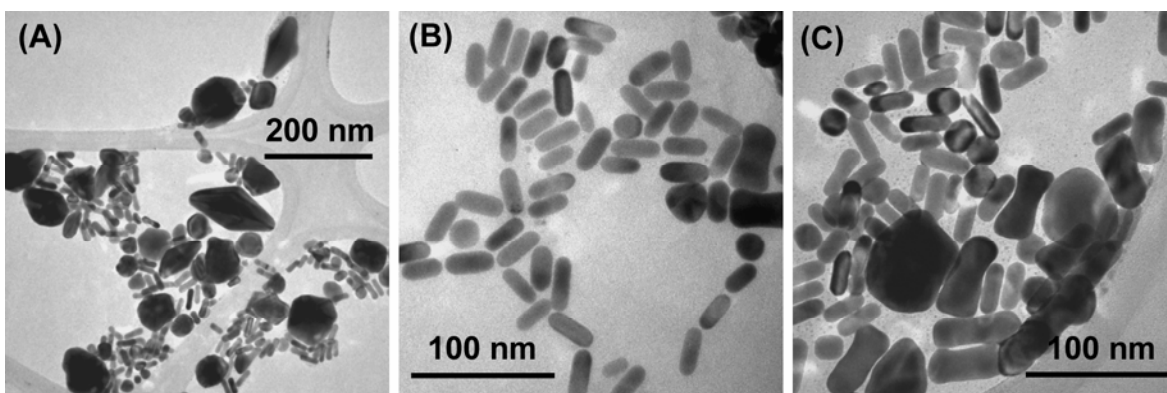


Figure S8. (A) TEM image of the growth products obtained by the addition of 10 mL of the growth solution into 2.5 mL of the original Au nanorod solution containing 100 μ M 11-mercaptoundecanoic acid. (B) and (C) TEM images of the growth products obtained by the addition of 5 mL of the growth solution into 2.5 mL of the original Au nanorod solution containing 300 μ M 11-mercaptoundecanoic acid.

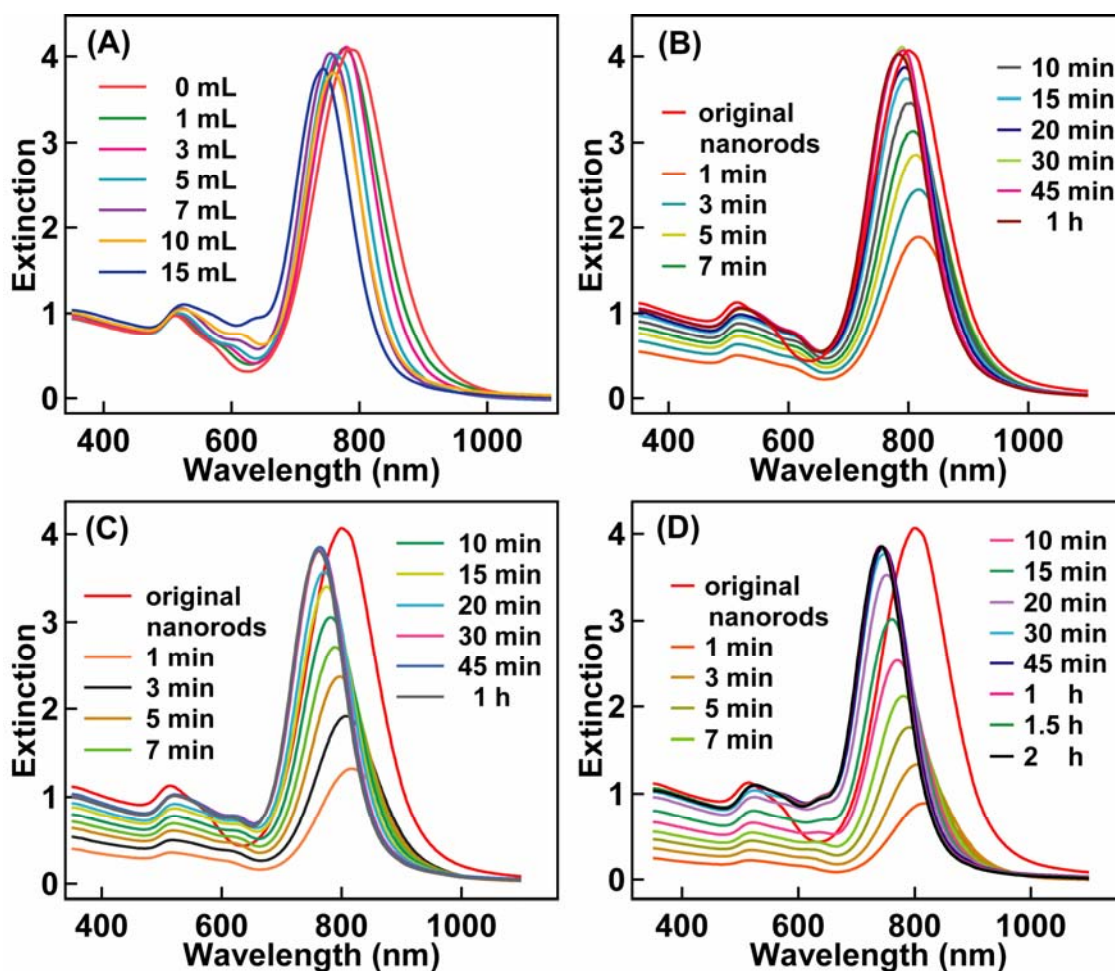


Figure S9. (A) Extinction spectra of the growth products obtained by the addition of varying volumes of the growth solution into 2.5 mL aliquots of the original Au nanorod solution. (B),

(C), and (D) Time-dependent extinction spectra recorded after 5, 10, and 15 mL of the growth solution were added into 2.5 mL aliquots of the original Au nanorod solution, respectively.

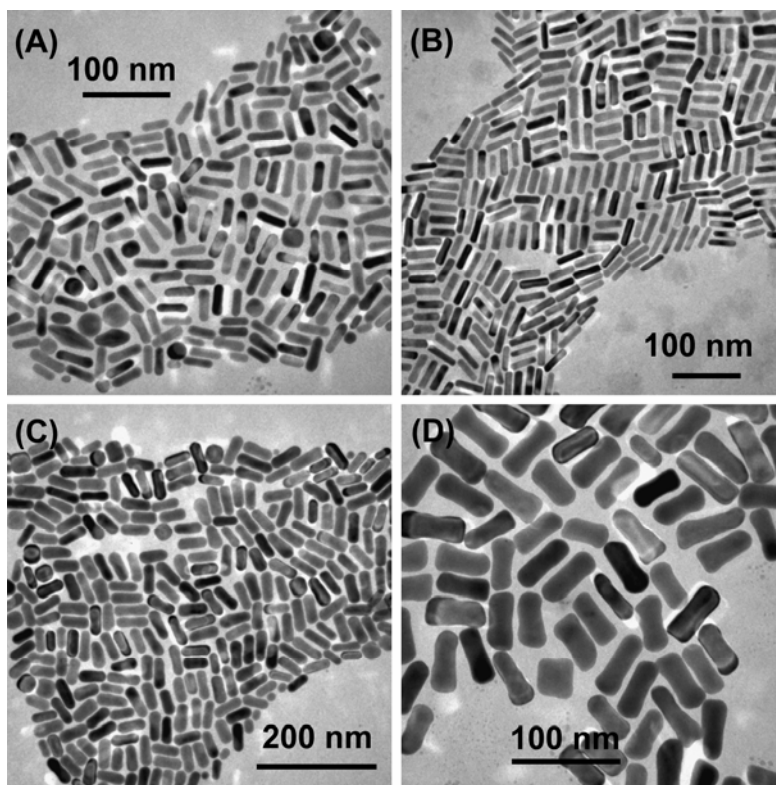


Figure S10. (A) TEM images of the original Au nanorods. (B) TEM images of the Au nanorods obtained by the addition of 3 mL of the growth solution into 2.5 mL of the original Au nanorod solution. (C) TEM images of the Au nanorods obtained by the addition of 7 mL of the growth solution into 2.5 mL of the original Au nanorod solution. (D) TEM images of the Au nanorods obtained by the addition of 15 mL of the growth solution into 2.5 mL of the original Au nanorod solution.