Electronic Supplementary Information (ESI)

One-step growth of triangular silver nanoplates with predictable sizes on a large scale

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Experimental Section

Seed preparation: Ag nanoplates produced by a modified chemical reduction synthesis were employed as the seeds.[1, 2] In a typical synthesis, 12 mL of trisodium citrate dihydrate (TSC, 0.075M), 200 µL of $AgNO_3$ (0.1 M) and 480 µL of H_2O_2 (30wt%) were dissolved in 200 mL of H_2O. After that, 1.2 mL of freshly-made $NaBH_4$ solution (0.1 M) was added by quick injection under vigorous stirring, giving rise to a blue solution of Ag nanoplates, which was then used as a stock solution. Prior to using, a portion of the stock solution was freshly centrifuged, and the Ag nanoplates were redispersed in H_2O of one-fifth of the original volume to serve as the seed solution (*i.e.* the concentration of the Ag nanoplates in the seed solution is 5 times that in the stock solution).

Synthesis of triangular Ag nanoplates: In a typical synthesis of triangular Ag nanoplates with edge length of ~150 nm, 5 mL of acetonitrile, 150 µL of L-ascorbic acid (0.1 M), 100 µL of TSC (0.075M) were added in 10 mL of H_2O at 5°C. Under vigorous stirring, 12 mL of the seed solution was added, followed by injection of 120 µL of $AgNO_3$ (0.1 M) to initiate the seeded growth. The reaction was allowed to proceed under stirring at 5°C for 30 min, followed by centrifugation to collect the triangular Ag nanoplates. A few microliter of diethylamine was added after centrifugation to help improve the dispersibility of the Ag nanoplates in H_2O. To synthesize triangular Ag nanoplates of other sizes, the volume of the seed solution was carefully tuned. Specifically, the volume of the seed solution was chosen to be 6 mL, 4 mL, 2 mL, 1 mL, 200 µL, 100 µL and 40 µL for the synthesis of triangular Ag nanoplates with average edge length of 179 nm, 310 nm, 432 nm, 708 nm, 1.10 μm and 1.50 μm, respectively. Prolonged reaction time was necessary to complete nanoplate growth when a large size is targeted.

Large scale synthesis of triangular Ag nanoplates (0.3 g): The concentration of acetonitrile is increased to ensure a low reaction kinetics in a large-scale synthesis of triangular Ag nanoplates. In a typical synthesis of 0.3 g of triangular Ag nanoplates (target edge length: ~432 nm), 2317 mL of acetonitrile, 34.7 mL of L-ascorbic acid (0.1 M), 23.2 mL of TSC (0.075M) were added in 1158 mL of H_2O at 5°C. Under vigorous stirring, 231.7 mL of the seed solution was added, followed by injection of 27.8 mL of $AgNO_3$ (0.1 M). The reaction was allowed to proceed under stirring at 5°C for 90 min, followed by centrifugation to collect the triangular Ag nanoplates. A few microliter of diethylamine was added after centrifugation to help improve the dispersibility of the Ag nanoplates in H_2O.

Characterization: Transmission electron microscopy (TEM) analysis was performed with a Hitachi HT-7700 electron microscope equipped with a tungsten filament, operating at 100 kV. Atomic force microscopy (AFM) analysis was conducted with an Asylum Research Cypher S microscope. UV-Vis-Near IR (NIR) spectra were measured with a Shimadzu UV-3600 UV-Vis-NIR spectrophotometer. Prior to UV-Vis-NIR test, the nanoplates were deposited onto a glass slide modified by 3-aminopropyltrimethoxysilane for circumventing spectral interference by H_2O.

1. G. S. Métraux and C. A. Mirkin, *Adv. Mater.*, 2005, **17**, 412-415.
2. Q. Zhang, N. Li, J. Goebl, Z. D. Lu and Y. D. Yin, *J. Am. Chem. Soc.*, 2011, **133**, 18931-18939.

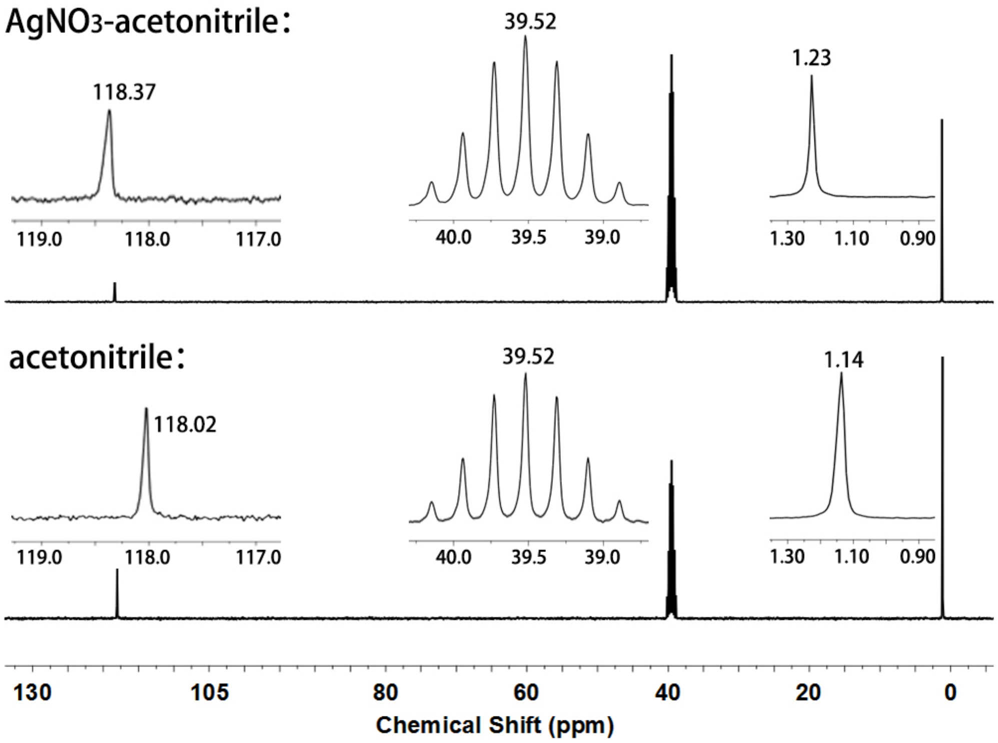

Figure S1. ^{13}C NMR spectrum of $AgNO_3$/acetonitrile dissolved in dimethyl sulfoxide (DMSO)-D6. In 5 mL of acetonitrile was dissolved 2 g of $AgNO_3$, which was then evaporated under vacuum at 40 °C to obtain a solid. The solid was then dissolved in DMSO-D6 for NMR testing. ^{13}C NMR of pure acetonitrile is also listed for comparison. The peaks at 39.52 ppm are solvent residual signals which are then employed to calibrate the chemical shift scales. The ^{13}C in $–CN$ and $–CH_3$ of $AgNO_3$/acetonitrile produce signals at chemical shifts of 118.37 and 1.23 ppm, respectively, which are on the low-field side of the corresponding signals from pure acetonitrile, i.e. 118.03 and 1.14 ppm, respectively. It indicates lower electron density around these carbon atoms in acetonitrile after $AgNO_3$ is introduced, which is consistent with weak coordination between acetonitrile and Ag^+ ions.

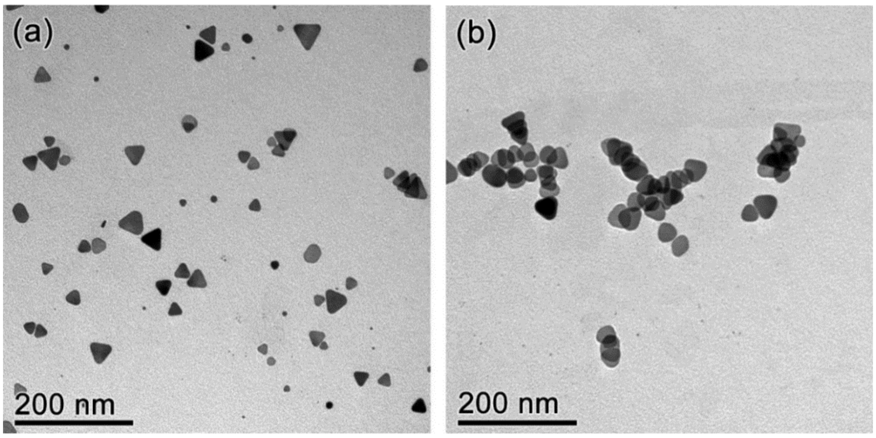

Figure S2. TEM images of the TSC-capped Ag nanoplates. (a) Original Ag nanoplates after a typical thermal synthesis. (b) Ag nanoplates collected after centrifugation, which were then served as the seeds in the synthesis of triangular Ag nanoplates of different sizes. A morphological change of the Ag nanoplates from sharp corners into rounded ones occurred during the centrifugation and washing process, which, however, imposes negligible effects on the seeded growth due to intact structure of the nanocrystals.

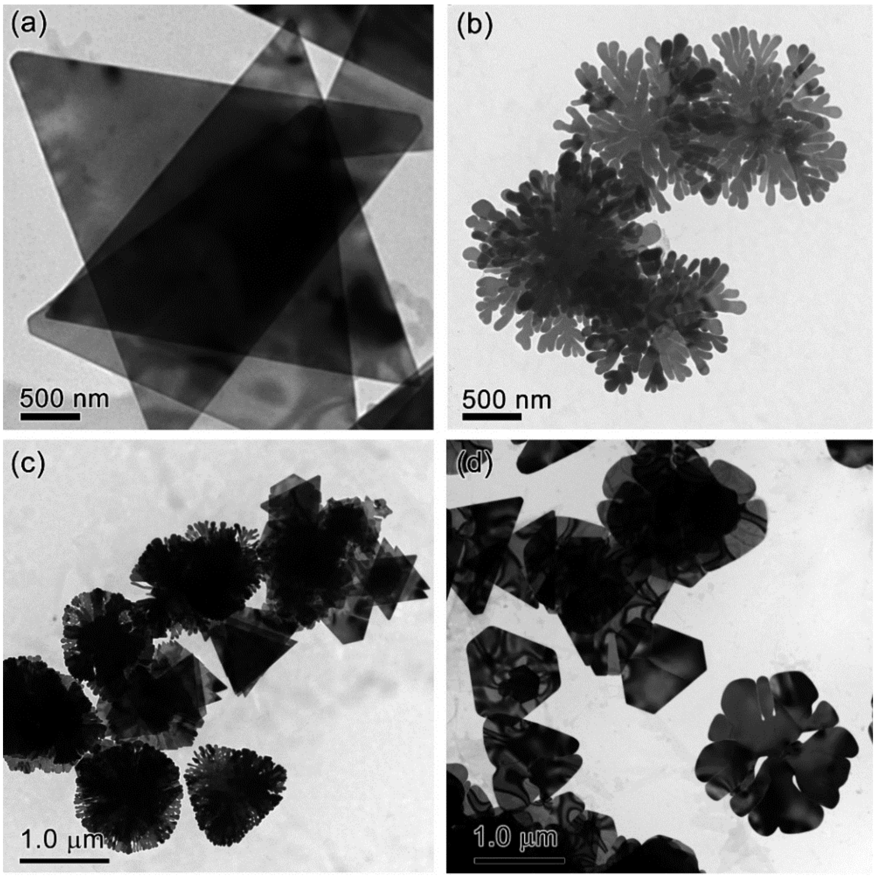

Figure S3. TEM images of Ag nanostructures prepared by a seeded growth at different reaction kinetics. (a) Triangular nanoplates obtained from a seeded growth at an appropriate kinetics. (b) Nanoflowers obtained when the reaction rate was accelerated by increasing the concentrations of precursors. (c) Reaction rate was accelerated by increasing the concentration of ascorbic acid (200 µL, instead of 150µL in the typical synthesis shown in the Experimental Section). (d) Reaction rate was accelerated by increasing the reaction temperature to 28°C (instead of 5°C in the typical synthesis).

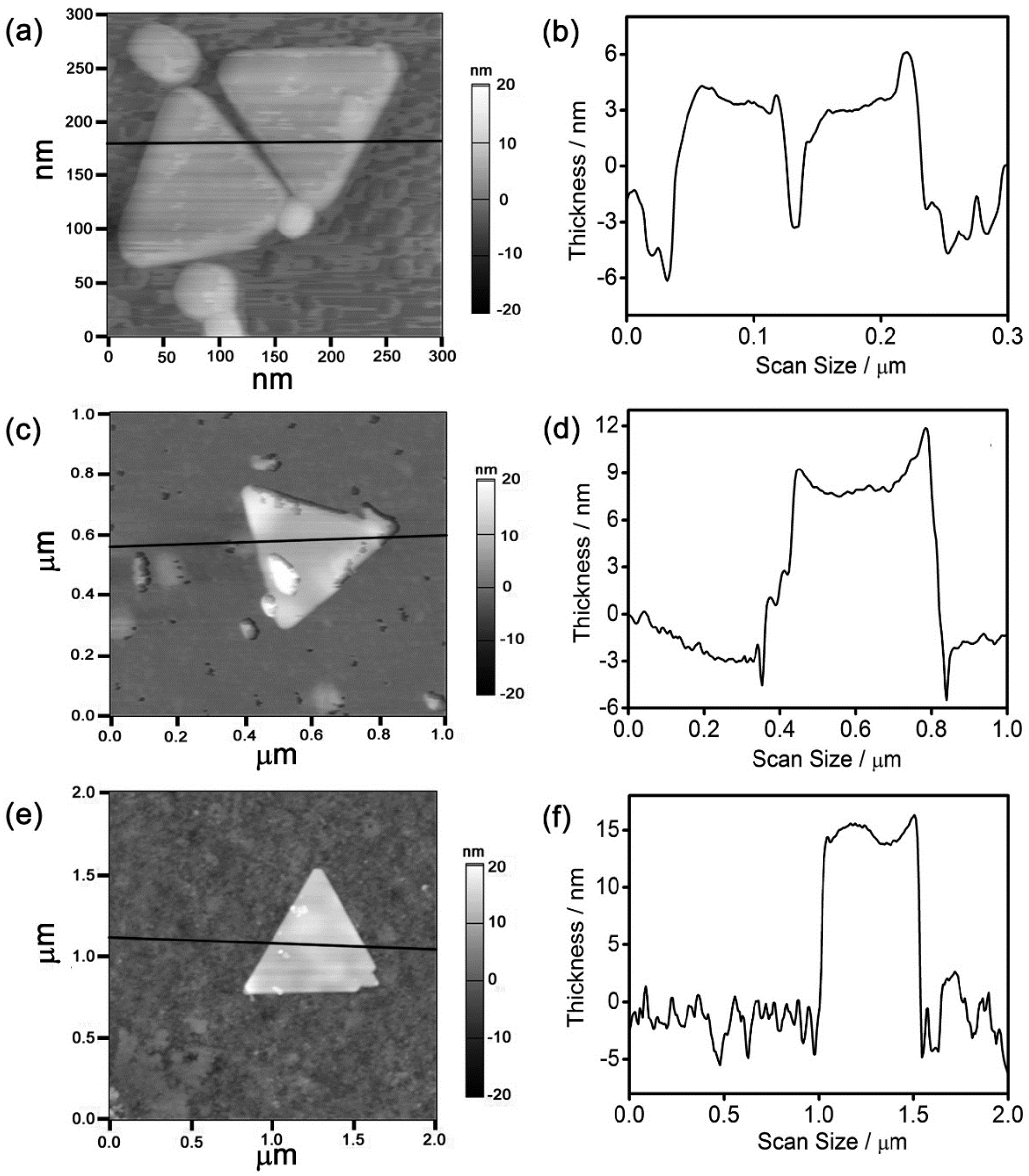

Figure S4. Characterization of the thickness of the triangular Ag nanoplates. (a, c, e) AFM images of the triangular Ag nanoplates with edge length of 150 nm, 432 nm, and 1.10 μm, respectively. (b, d, f) Thickness profiles along the lines indicated in (a, c, e) respectively.

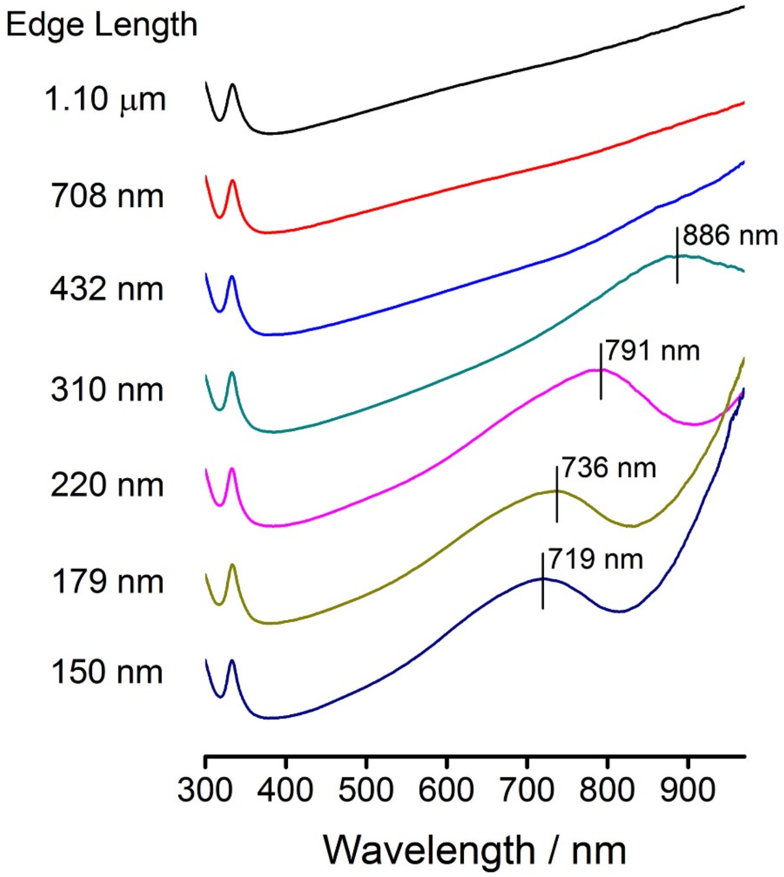

Figure S5. UV-vis spectra of the triangular Ag nanoplates in water. For all the nanoplates investigated, an out-of-plane dipole resonance is observed at ~333 nm. An in-plane quadrupole resonance is also observed in the visible range when the edge length of the nanoplates is no larger than 310 nm, and readily red-shifts as the edge length increases. When the edge length reaches 432 nm, the quadrupole resonance already extends to the near-infrared range. The presence of well-resolved quadrupole resonances confirms that these nanoplates are highly uniform in shape and size. It is worth to note that the in-plane dipole resonances of the nanoplates cannot be observed in the UV-vis range, which have been measured by UV-vis-NIR spectroscopy after the nanoplates being deposited onto a glass slide (see Figure 3 in the text).