Electronic Supplementary Information

for

One-pot synthesis of silver nanoshell with near-infrared extinction by thiocyanate-assisted approach

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Synthesis of Silver Nanoshell

All the chemicals were commercially available and used as received without any purification. We conducted all the experiments at room temperature. A typical procedure for synthesis of silver nanoshell is as follows. To an aqueous solution of silver nitrate (1.0×10^{-4} M, 5 mL) under stirring was added an aqueous solution of sodium thiocyanate (1.5×10^{-4} M, 5 mL) with a pipette. The solution was stirred for 5 min. Then, an aqueous solution of sodium borohydride (1 mM, 5 mL) that was freshly prepared just prior to use was added to the solution under stirring. Immediately, the color of the solution started to turn blue. After the solution was stirred for several seconds, L-cysteine in water (1 mM, 50 μL) was added to the solution under stirring.

Measurements

Extinction spectra were measured with Hitachi U-3900 spectrophotometer at room temperature. Quartz cuvette with 1-cm path length was used. TEM observation was conducted using JEOL JEM-2100IM. The samples were prepared by dropping an aqueous dispersion of the as-prepared silver nanoshell to Cu grid. The outer and inner diameters of the silver nanoshell were determined by analyzing TEM images using ImageJ software. Dynamic light scattering measurements were carried out with ELSZ-2plus (Otsuka Electronics).

Simulation of Extinction Spectra for Silver Nanoshell

Discrete dipole approximation calculation for the silver nanoshell was performed using DDSCAT software (ver. 7.3).[1] The target nanoshell structures (i.e., hollow sphere) were created using "*calltarget*" command provided by DDSCAT as follows. First, the target file of "*concentric ellipsoid*" with desired outer and inner diameters was created by "*calltarget*". Then, lines for the core part were removed from the target file. The dipole spacing was set to 0.5−1 nm. The dielectric constant of bulk silver used in the calculation was obtained from the literature.[2] The refractive index of the ambient medium was set to the value for water (n = 1.335).

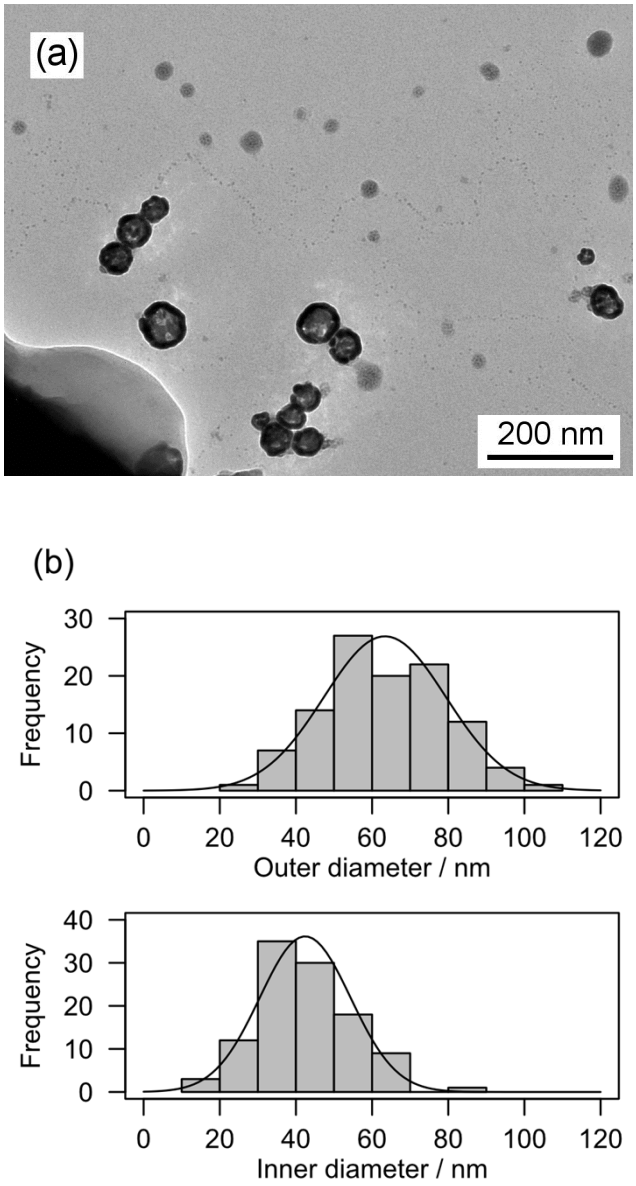

Figure S1. (a) TEM image of as-prepared silver nanoparticles and (b) histograms of outer and inner diameters with Gaussian curves as solid lines.

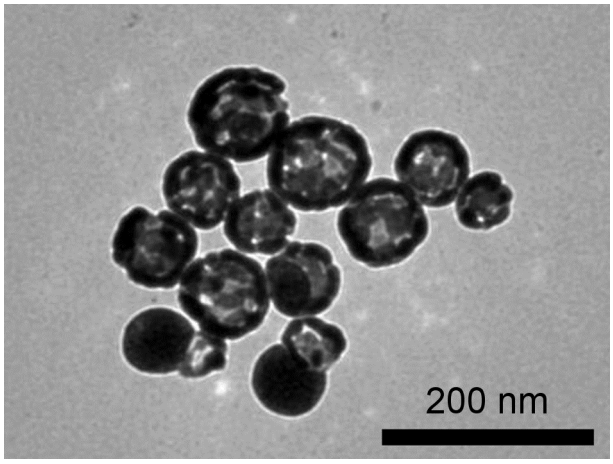

Figure S2. TEM image of silver nanoshells with porosity and surface roughness.

References

[1] B. T. Draine and P. J. Flatau, *J. Opt. Soc. Am. A*, 1994, **11**, 1491.

[2] P. B. Johnson and R. W. Christy, *Phys. Rev. B*, 1972, **6**, 4370.