Supporting Information for

Reduction of Au^{3+} to Distinctive Au-based Materials by Amphiphilic Sodium Dodecylbenzenesulfonate

Yao-Tsung Hsu[ab, ‡], Hung-Fei Chen[b, ‡], Wei-Jhih Lin[c], Jungshan Chang[*a], and Fu-Der Mai[*ab]

[a]Graduate Institute of Medical Sciences, College of Medicine, Taipei Medical University, Taipei 11031, Taiwan.
[b]Department of Biochemistry and Molecular Cell Biology, School of Medicine, College of Medicine, Taipei Medical University, Taipei 11031, Taiwan.
[c]Department of Forensic Science Department, Central Police University, No.56, Shujen Road, Taoyuan City 33304, Taiwan.

Experimental Section

Materials and characterizations: $HAuCl_4$, SDBS, $NaBH_4$, $P(Ph)_3$, and graphite were purchased from Sigma. TEM experiments were conducted using HT-7700 (Hitachi) under 80 keV. SEM images were recorded using a NovaTM NanoSEM (FEI) operated at a primary energy of 10 keV. UV-visible measurement was carried out by Spark 10M (Tecan).

Measurements of CMC: Electrical conductivities of the SDBS solution with different concentrations were measured under 90 ℃ using a conventional electricity meter. Conductivities- concentrations plots then graphed, and apparent changes, which were corresponded to CMC, could be estimated at 0.0813 wt% SDBS. The experimental results were in accordance with the extrapolation of the literature.[31]

Size-controlled synthesis of AuNPs: For the optimal condition, 100 mL SDBS solutions with 0.03 (below CMC), 0.1, 0.15, 0.2, 1.0 (above CMC) wt% SDBS were prepared and the temperature was raised to 90 ℃. Next, 0.0086 mmol $HAuCl_4$ was added into the solutions (SDBS were 10 equiv for 0.03 wt%, 30 equiv for 0.1 wt%, 45 equiv for 0.15 wt%, 60 equiv for 0.2 wt%, and 300 equiv for SDBS solution). During reactions, the 0.03 wt% SDBS group turned purple with dark brown suspension, 0.1 wt% SDBS group turned violet, 0.15 wt% SDBS group turned violet red, and 0.2 wt% as well as 1.0 wt% SDBS groups turned red. The reaction periods were 20 minutes for

all groups. 30-minute iced baths were subsequently applied and all groups were stored at 4 ℃ for further characterizations. Other conditions are noted in Table S1.

Synthesis of AuNCs: 30 mg $P(Ph)_3$ (10 equiv with respected to $HAuCl_4$) was added to 1.0 wt% SDBS solutions. Similarly, the temperature was raised to 90 ℃, 0.0086 mmol $HAuCl_4$ was added into the solutions, and the reaction periods were 20 minutes. The solutions became transparent, showing that Au^+ complex has formed. 30-minute iced bath was subsequently applied until the solution reached the room temperature. Excess $NaBH_4$ was then added into as-prepared Au^+ complex solution. The solution became apple juice colour immediately, and AuNCs were synthesized and stored at 4 ℃ for further characterizations.

Synthesis of AuNPs/graphene composite: Graphene was synthesized via sonication. Briefly, 0.3 g graphite was dispersed in 100 mL 0.1 wt% SDBS solution and sonicated for 2 hours. A 2000 rpm centrifugation (LMC-3000, Biosan) was applied to separate un-exfoliated graphite for 15 minutes and the black supernatant was collected. 0.0086 mmol $HAuCl_4$ was then added into the as-prepared graphene solution, and the reagents reacted under 90 ℃ for 30 minutes. 30-minute iced bath was subsequently applied until the solution reached the room temperature. Next, AuNPs/graphene composite was collected by vacuum filtration with a polyamide membrane (0.2 μm, Whatman®) and dried under 70 ℃ overnight in a conventional oven.

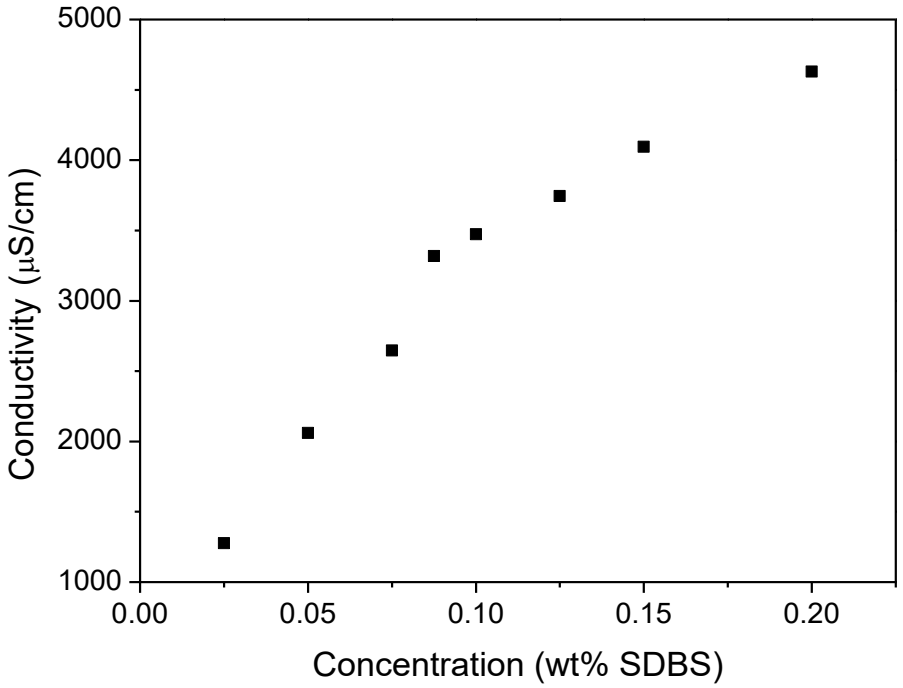

Figure S1. Conductivity-concentration plot for CMC investigation of SDBS-water solution at 90 ℃. Apparent change can be found between 0.75 and 0.0875 wt% SDBS. Thus, 0.0813 wt% SDBS, the average number, was used as CMC for SDBS-water solution at 90 ℃.

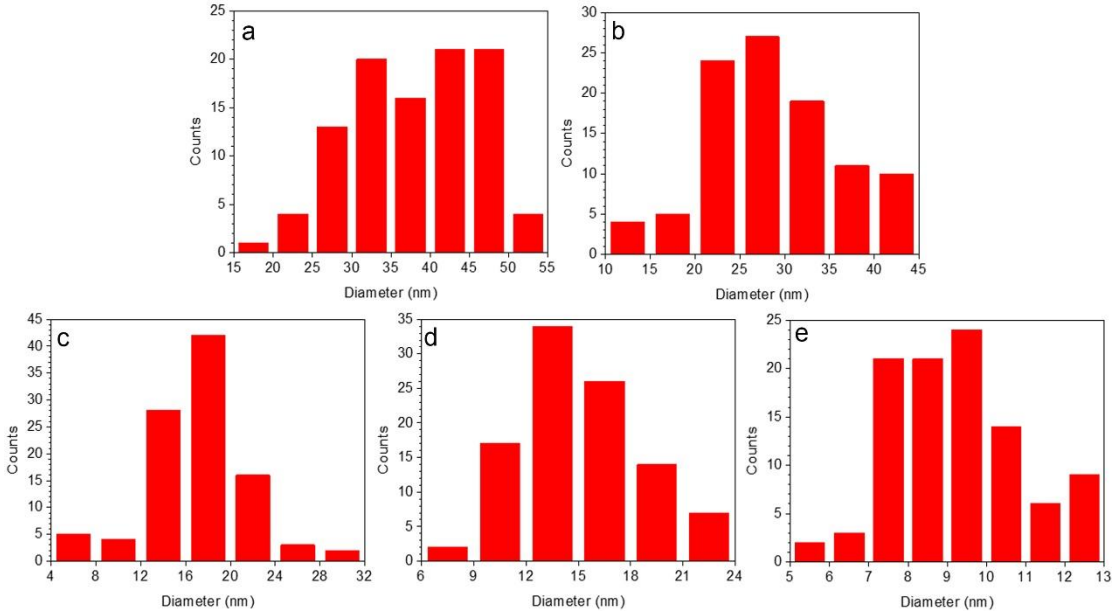

Figure S2. Histogram of the size of AuNPs synthesized under (a) 0.03 (b) 0.1 (c) 0.15 (d) 0.2 (e) 1.0 wt% SDBS.

Table S1. AuNPs prepared under different conditions.

Condition	Size control	Speed
90 ℃, 0.086 mM $HAuCl_4$	good	fast (20 minutes)
60 ℃, 0.086 mM $HAuCl_4$	poor	medium (60 minutes)
30 ℃, 0.086 mM $HAuCl_4$	poor	slow (24 hours)
90 ℃, 0.86 mM $HAuCl_4$	poor (formation of bulk gold)	fast (20 minutes)

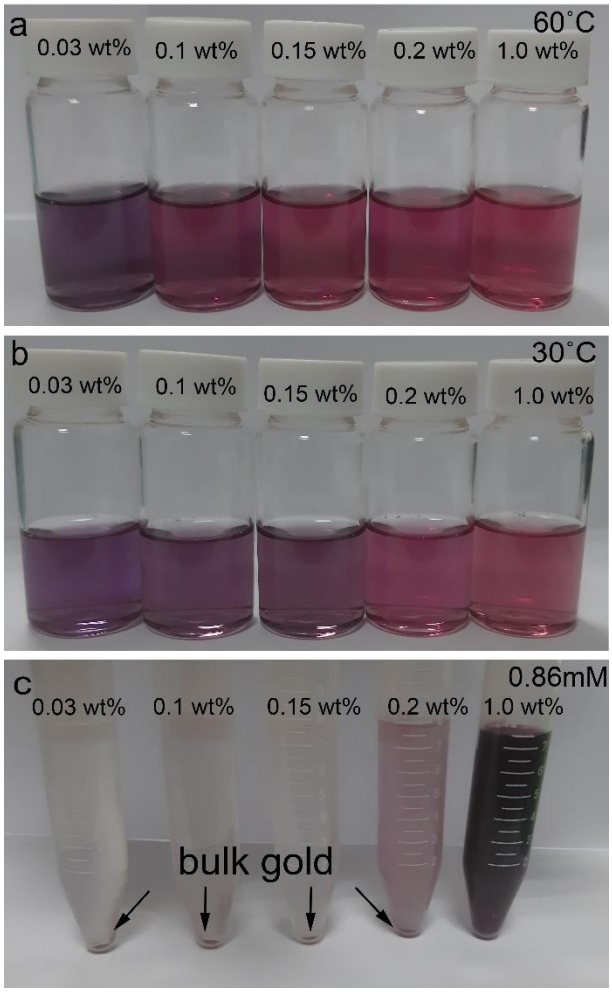

Figure S3. Optical pictures of different conditions showing inferior synthetic results. (a) The condition of lower temperature 60 ℃. (b) The condition of even lower temperature 30 ℃. (c) The condition of higher concentration of precursors (0.86 mM). Bulk gold will form. For 1.0 wt% SDBS, dark purple nanoparticles will form.

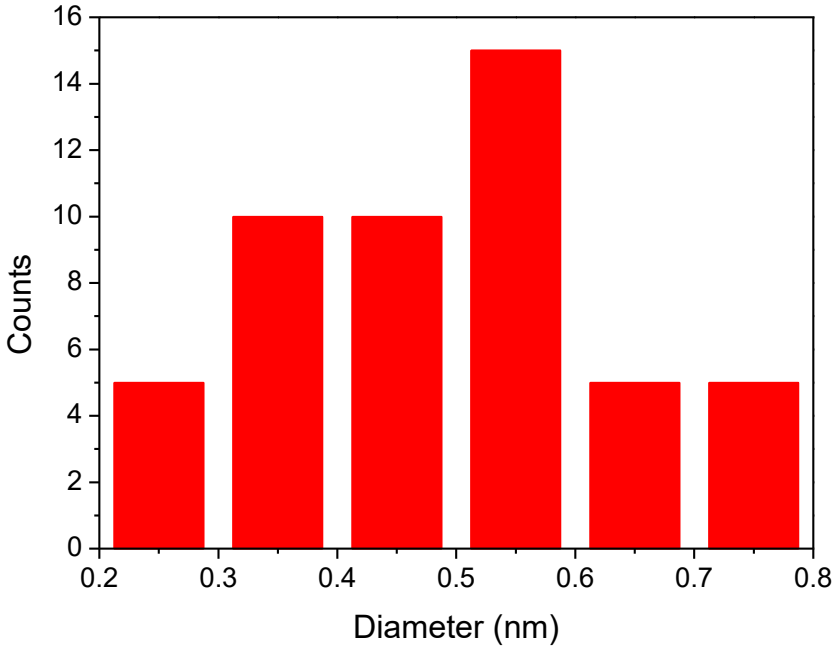

Figure S4. The histogram of the size of AuNCs.