Electronic Supplementary Information for

Zwitterionic Vesicles with $AuCl_4^-$ Counterions as Soft Template for the Synthesis of Gold Nanoplates and Nanospheres

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Materials. 11-Bromo-1-undecanol (98%), 1-bromododecane (98%), 1,3-propanesultone (99%), and imidazole (99%) were purchased from J&K Scientific Ltd. Chloroauric acid (AR), ascorbic acid (99%), sodium borohydride (96%), Sodium hydroxide, acetone and tetrahydrofuran were purchased from Shanghai Chemical Co. All the above materials were used without further purification. Deionized water was used through the experiment. All chemicals were analytical grade and used as received.

Synthesis. HIPS and DIPS (molecular structures are shown in Scheme 1) were synthesized according to the literature method.[1-3] In brief, the first step involved the synthesis of 11-hydroxyundecylimidazole or 1-dodecylimidazole by reacting 11-bromoundecanol or 1-bromododecane with imidazole by a S_N2 reaction mechanism and then the zwitterions were obtained through the quaternization reaction of 11-bromoundecanol or 1-bromododecane with 1,3-propanesultone.

The purity of the HIPS was ascertained by the ^1H NMR (300 MHz) in DMSO. δ

(relative to TMS): 9.180 (1H, s), 7.803 (1H, t, J = 1.8 Hz), 7.784 (1H, t, J = 1.8 Hz), 4.345 (1H, s), 4.297 (2H, t, J = 6.9 Hz), 4.144 (2H, t, J = 7.2 Hz), 3.372 (2H, t, J = 5.4 Hz), 2.393 (2H, t, J = 7.2 Hz), 2.087 (2H, quint, J = 7.2 Hz), 1.781(2H, m) 1.391 (2H, t, J = 6.6 Hz), 1.242 (14H, m).

The purity of the DIPS was ascertained by the ^{1}H NMR (300 MHz) in DMSO. δ (relative to TMS): 9.177 (1H, s), 7.800 (1H, t, J = 1.8 Hz), 7.780 (1H, t, J = 1.8 Hz), 4.298 (t, 2H, J = 7.2 Hz), 4.143 (2H, t, J = 7.2 Hz), 2.392 (2H, t, J = 7.2 Hz), 2.088 (2H, quint, J = 7.2 Hz), 1.804 (2H, m), 1.239 (18 H, m), 0.85 (t, 3H, J = 6.6 Hz).

Characterization

The gold nanostructures were characterized using transmission electron microscopy (TEM) (JEM-100CX II (JEOL)) and scanning electron microscopy (SEM) (JEOL JSM-7600F). The vesicle samples were characterized using Cryogenic temperature-transmission electron microscopy (cryo-TEM) and Freeze fracture transmission electron microscope (FF-TEM).

The cryo-TEM samples were prepared in a controlled environment vitrification system (CEVS) at 25 ºC. A micropipette was utilized to load 5 µL of the solution onto a TEM carbon grid, which was blotted with two pieces of filter paper, resulting in the formation of thin films suspended on the mesh holes. After waiting for about 5 s, the samples were quickly plunged into a reservoir of liquid ethane (cooled by nitrogen) at 165 ºC. The vitrified samples were then stored in liquid nitrogen until they were transferred to a cryogenic sample holder (Gatan 626) and examined with a FEI Tecnai 20 TEM (120 kV) at about 174 ºC. The images were recorded on a

Gatanmultiscan CCD and processed with a Digital Micrograph. The cryo-TEM observations were performed at the Center for Biological Imaging (CBI), Institute of Biophysics, Chinese Academy of Science.

The FF-TEM samples were prepared as follows: a small amount of sample solution was placed on a 0.1mm thick copper disk covered with a second copper disk. Then the copper sandwich with the sample was plunged into liquid propane cooled by liquid nitrogen. Fracturing and replication were carried out on a Balzers BAF-400D equipment at -150 ^{o}C. Pt/C was deposited at an angle of 45^{o}. The replicas were examined on a JEOL JEM-1400 TEM operated at 120 kV. The images were recorded on a Gatan multiscan CCD and processed with digital micrograph.

References

1 U. H. Choi, M. Lee, S. Wang, W. Liu, K. I. Winey, H. W. Gibson and R. H. Colby, *Macromolecules*, 2012, **45**, 3974.

2 B. S. Souza, E. C. Leopoldino, D. W. Tondo, J. Dupont and F. Nome, *Langmuir*, 2012, **28**, 833.

3 X. Gao, F. Lu, L. Shi, H. Jia, H. Gao and L. Zheng, *ACS Appl. Mater. Interfaces*, 2013, **5**, 13312.

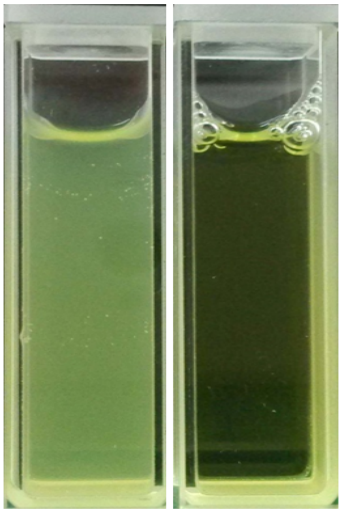

Fig. S1 Optical photograph of HIPS/$HAuCl_4$ aqueous solution (left) and DIPS/$HAuCl_4$ aqueous solution (right) at the same concentration.

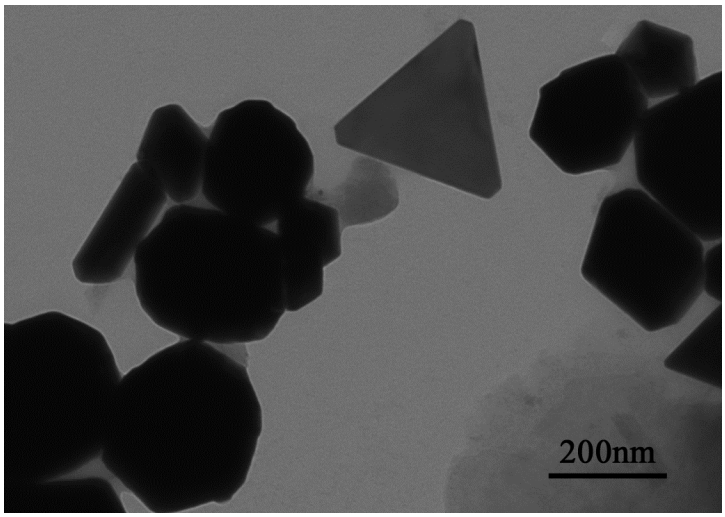

Fig. S2 TEM image of Au nanostructure obtained via AA/HIPS reduction.

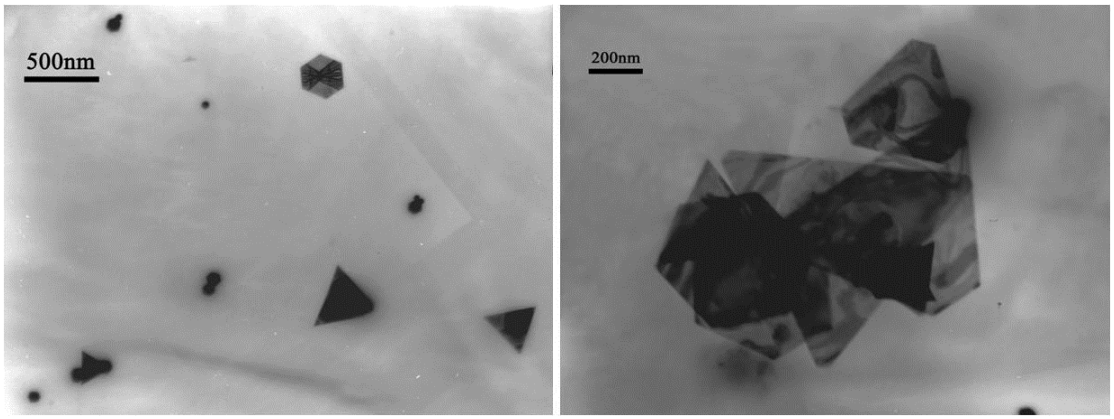

Fig. S3 TEM images of hexagonal, triangular, and truncated triangular Au nanoplates.