Electronic Supplementary Information

Facile synthesis of two-dimensional highly branched gold nanostructures in aqueous solutions of cationic gemini surfactant

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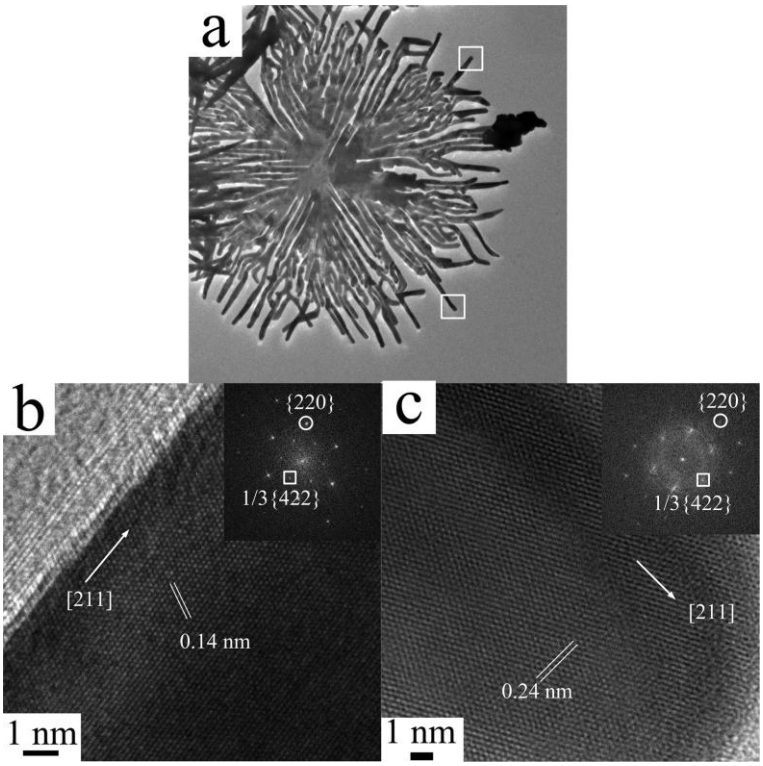

Fig. S1 TEM image of a representative 2DHBN (a), and HRTEM images (b, c) of the tips as marked by white squares in panel a. The insets are the corresponding FFT patterns.

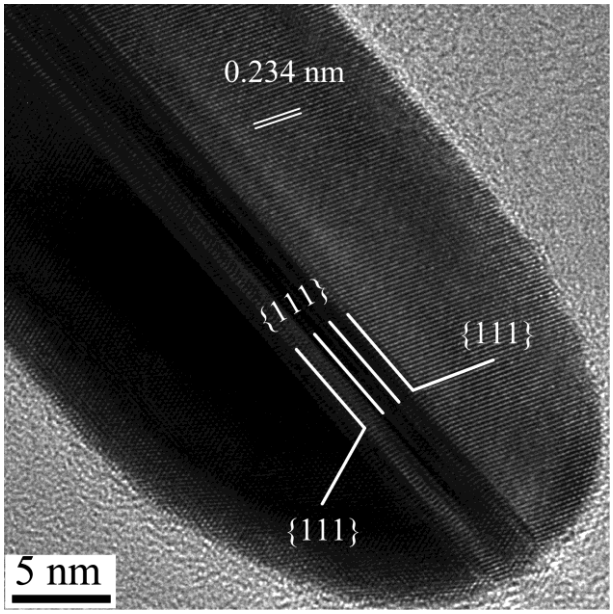

Fig. S2 HRTEM images of the tip of a single arm perpendicular to TEM grid.

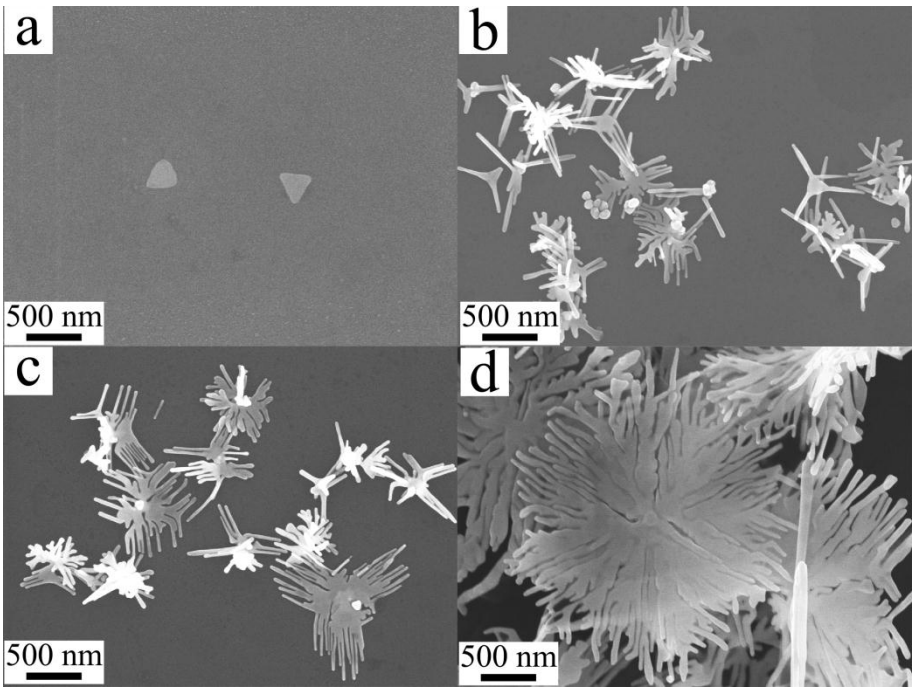

Fig. S3 SEM images of gold products obtained after reaction for 2 min (a), 5 min (b), 10 min (c) and 30 min (d). [$C_{12}C_6C_{12}Br_2$] = 0.1 mM, [$HAuCl_4$] = 0.2 mM, [AA] =0.2 mM, 25 ºC.

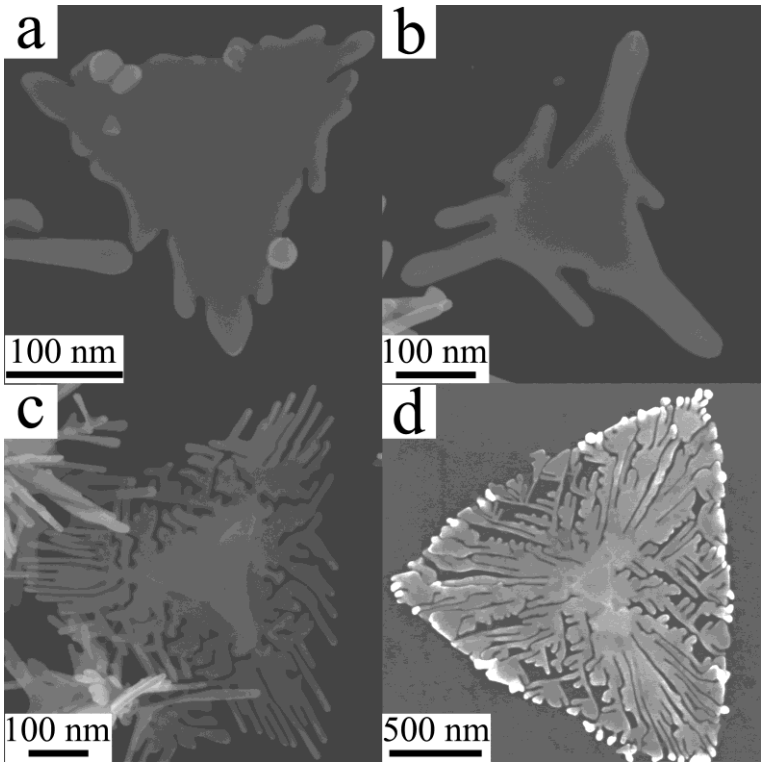

Fig. S4 SEM images of typical intermediates with the inordinate overgrowth occurred both at the tips and the edges of the triangular nanoprism.

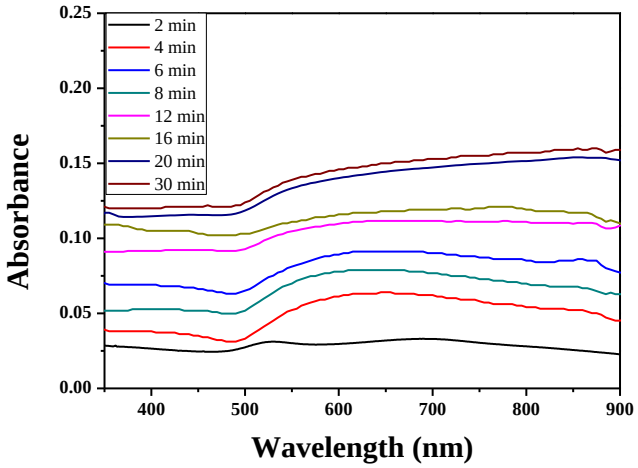

Fig. S5 The typical UV-vis absorption spectra of the 2DHBNs recorded at different reaction times.

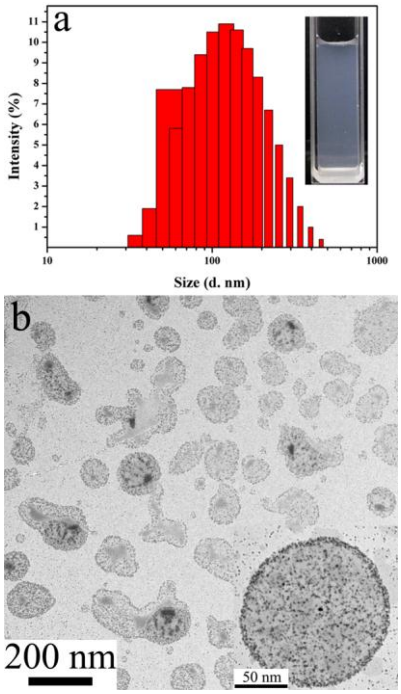

Fig. S6 DLS data (a) and TEM image (b) of the vesicles formed in the solution containing 0.2 mM $C_{12}C_6C_{12}Br_2$. The vesicles constructed by $C_{12}C_6C_{12}$-$(AuCl)_2$ complexes were easily reduced in-situ under the irradiation of TEM electron beam.

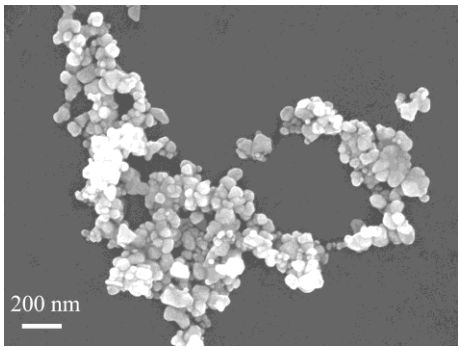

Fig. S7 SEM image of the obtained gold product through reduction of 0.2 mM $HAuCl_4$ by 0.2 mM AA in the presence of 0.1 mM dodecyltrimethylammonium bromide (DTAB).

The calculation of enhancement factor (EF) [S1]**:**

The enhancement factor (EF) value was calculated using the equation (1):

$$EF = (I_{SERS}/N_{ads}) / (I_{bulk}/N_{bulk}) \quad (1)$$

I_{SERS} and I_{bulk} are the vibration intensity in the SERS and normal Raman spectra, respectively. N_{bulk} and N_{ads} are the number of molecules of solid and number of molecules of adsorbed R6G on the SERS substrate in the laser spot volume, respectively.

N_{abs} can be calculated according to the equation (2):

$$N_{ads} = N_d A_{laser} A_N/\sigma \quad (2)$$

where N_d is the number density of the Au 2DHBNs, A_{laser} is the area of the focal spot of laser, A_N is the 2DHBNs footprint area, and σ is the surface area occupied by an adsorbed R6G molecule, which is about 4 nm^2.[S2] Due to the complex geometry, it is difficult to calculate the accurate surface area of the 2DHBNs. It could be regarded the 2DHBNs as a compact flat surface, then the total number of surface adsorbed molecules (N_{ads}) within the illuminated laser spot was about 1.96×10^5. N_{bulk} is the molecule number of the solid R6G in the laser illumination volume. In our experiment, the laser spot diameter and penetration depth were ~1 μm and ~2 μm, respectively. N_{bulk} of R6G was calculated to

be 2.49×10^9 using its density of 1.26 g/cm^3.

Finally, the EF values were estimated by considering the 1510 cm^{-1} Raman band using the equation (1). The calculated EF values were range from 2.83×10^5 to 1.46×10^6, and the average value was 6.29×10^5.

References

S1. S. Guo, S. Dong and E. Wang, *Cryst. Growth Des.*, 2008, **9**, 372.

S2. X. Bai, Y.Gao and L. Zheng, *CrystEngComm*, 2011, **13**, 3562.