Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Ultra-stable 4H-gold nanowires at up to 800^0C in vacuum

Qi Wang, Zhiliang Zhao, Chao Cai, Hui Li, Meng Gu
Department of Materials Science and Engineering, Southern University of Science and Technology, No. 1088 Xueyuan Blvd, Shenzhen, Guangdong 518055, China

This supporting information contains information regarding to the following items.

1. Detailed synthesis procedure of ***fcc*-**Au nanorods
2. Representative XRD pattern of the synthesized 4H Au nanowires (Figure S1)
3. Structure characterization of *fcc*-Au nanorods
4. In-situ heating experiment and melting process of *fcc*-Au nanorods

1. Synthesis of *fcc*-Au nanorods

The synthesis of ***fcc***-Au nanorods were synthesized according to a previous reported method.[1] Briefly, a seed solution was was prepared by the addition of a freshly prepared, ice-cold aqueous $NaBH_4$ solution (0.01 M, 0.6 mL) into an aqueous mixture solution composed of $HAuCl_4$ (0.01 M, 0.25 mL) and CTAB (0.1 M, 9.75 mL). The resultant solution was mixed by rapid inversion for 2 min and then kept at room temperature for at least 2 h before use. The growth solution was made by first mixing together aqueous solutions of $HAuCl_4$ (0.01 M, 2 mL), $AgNO_3$ (0.01 M, 0.4 mL), and CTAB (0.1 M, 40 mL). A freshly prepared aqueous ascorbic acid solution (0.1 M, 0.32 mL) was then added, followed by the addition of an aqueous HCl solution (1.0 M, 0.8 mL). After the resultant solution was mixed by inversion, the seed solution (0.01 mL) was then added. The reaction mixture was subjected to gentle inversion for 10 s and then left undisturbed for at least 6 h. The Au nanorods were harvested after centrifuging and washing with water and ethanol for 4 times.

(1) Ming, T.; Zhao, L.; Yang, Z.; Chen, H.; Sun, L.; Wang, J.; Yan, C. Strong Polarization Dependence of Plasmon-Enhanced Fluorescence on Single Gold Nanorods. *Nano Lett.* **2009**, *9* (11), 3896–3903.

2. XRD characterization of 4H wires

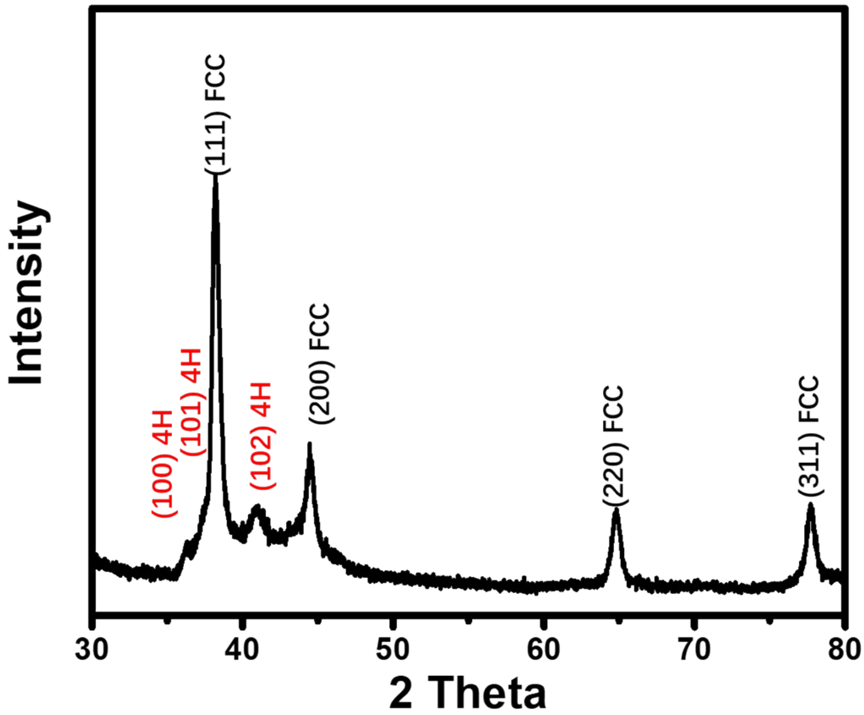

Figure S1 A representative XRD pattern of the synthesized 4H Au nanowires. Please note that there are *fcc* nanoparticles in the synthesized sample, and the 4H – nanowires contains *fcc* twins as shown in Figure 1. These *fcc* nanoparticles and twins results in *fcc* peaks in the XRD pattern.

3. Structure characterization of *fcc*-Au nanorods

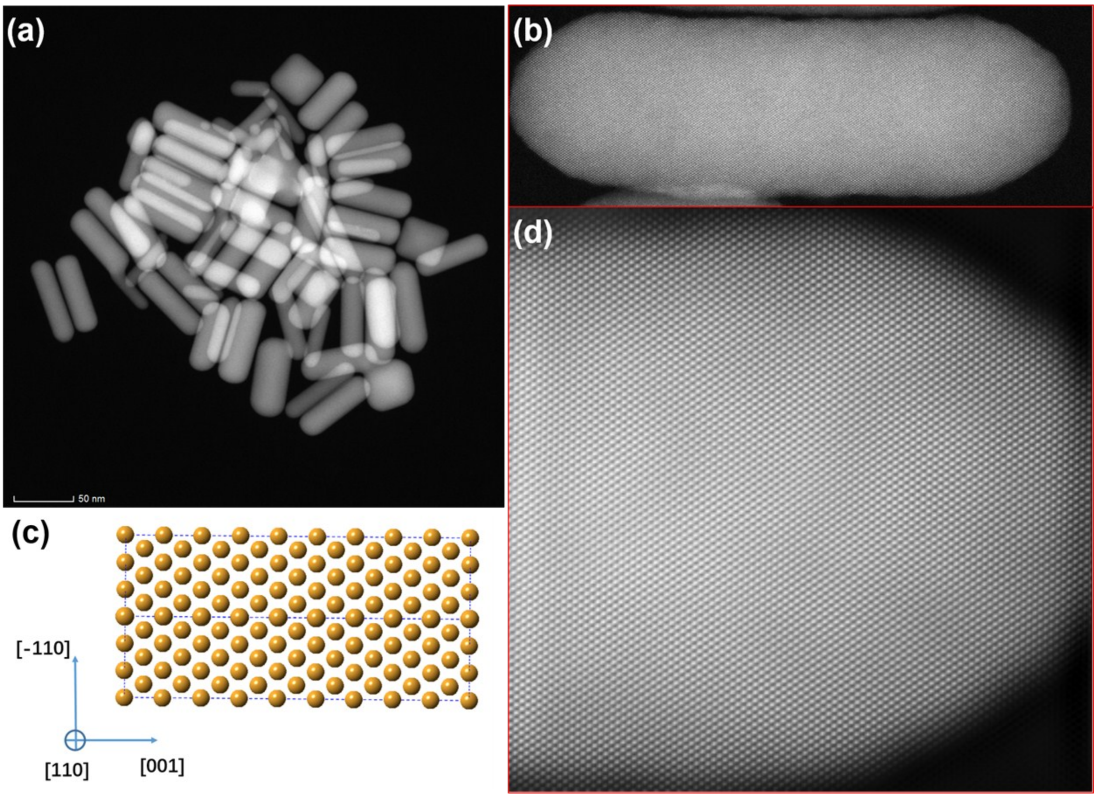

Figure S2 (a-b)STEM images of *fcc* Au nanorods.(c) atomic model of *fcc* nanorods, indicating the growth direction of nanorods and (d) atomic resolution STEM of the *fcc* nanorods.

As observed by STEM, the *fcc*-Au nanorods have a diameter distribution from 12 to 20 nm with a rod shape. The HRSTEM image in Figure S2 revealed the longitudinal direction to be [001].

4. In-situ heating experiment and melting process of *fcc*-Au nanorods

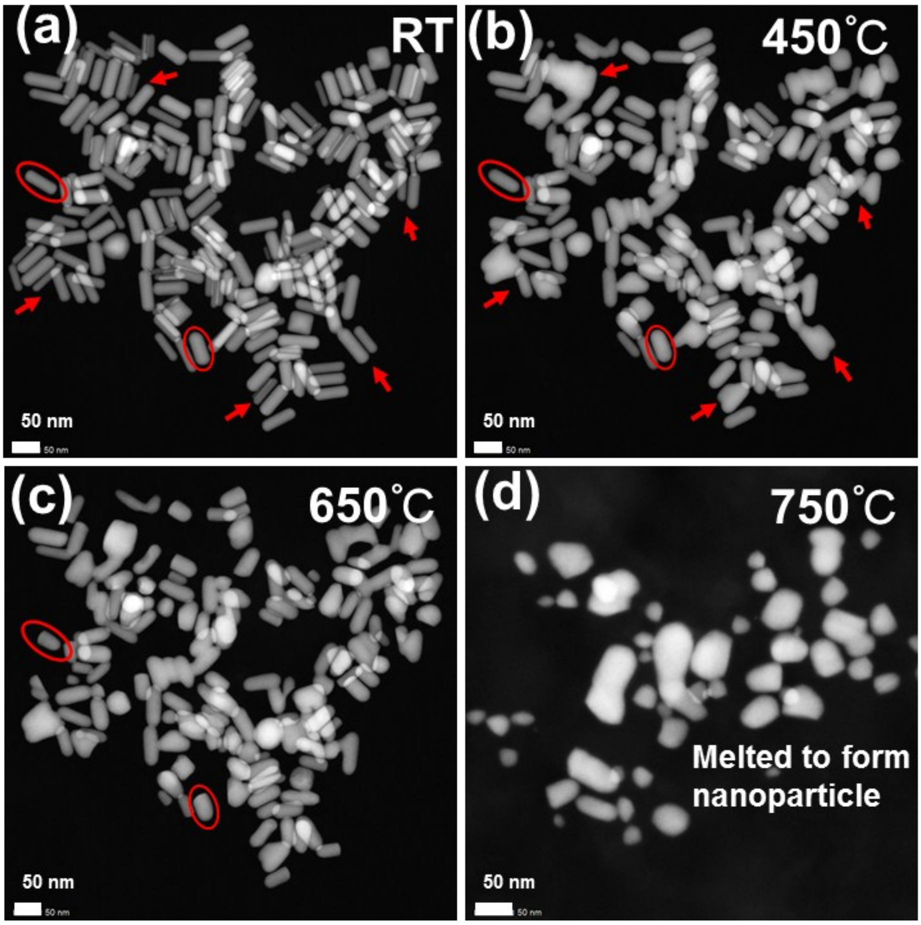

Figure S3 morphology evolution of *fcc*-Au nanorods. The heating conditions and electron dosage were the same compared to the 4H-Au nanowires. It was clear that *fcc*- nanorods started to melt at ~ 450^0C, which is lower than 4H-Au nanowires

It was evident in Figure S3 that some nanorods with 13-15 nm began to melt quickly after temperature rising to 450℃as shown by red arrows. Other rods become fat and more spherical – bigger in diameter and shorter in length with rising temperature. Most rods became spherical nanoparticles after heating at 750℃ for 10 min. Figure S4 showed the schematic drawing of the melting process.

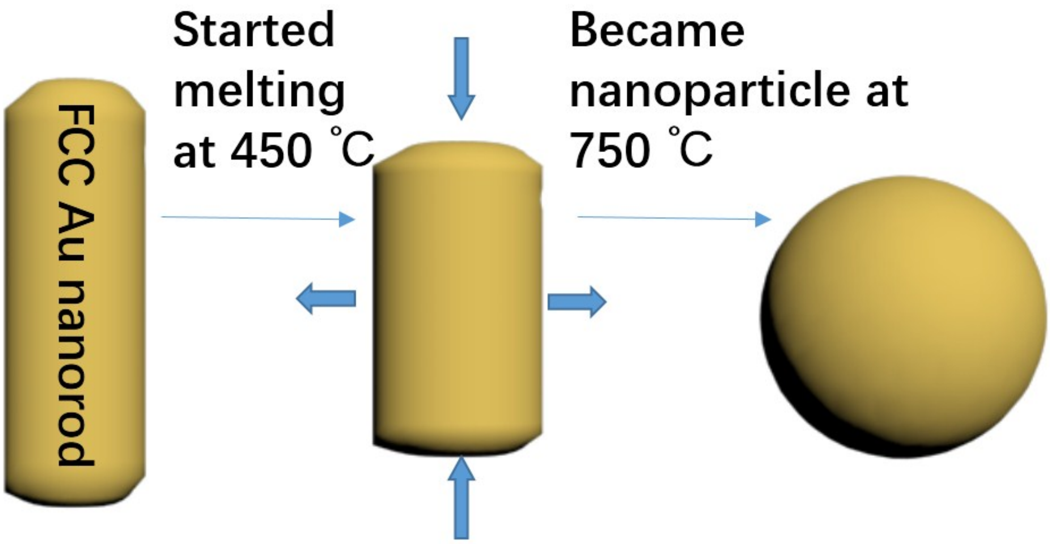

Figure S4 Melting process of *fcc*-Au nanorods