Supporting Information

Synthesis of Monodispersed Au-PbS Hybrid Nanocrystals via A Solid-Liquid Interfacial Reaction

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Experimental Section

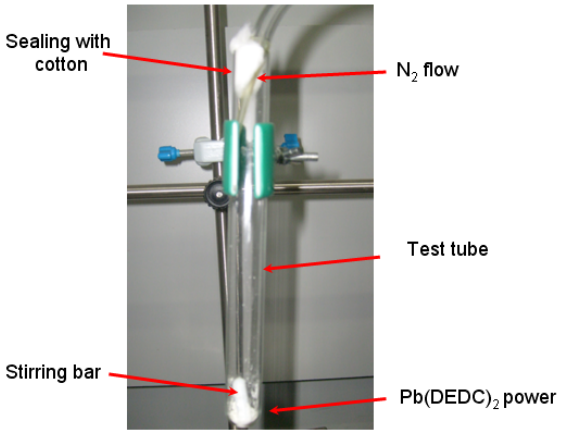
Chemicals: $Pb(NO_3)_2$, $HAuCl_4$, sodium diethyl dithiocarbamate (Na-DEDTC, NaS_2CNEt_2) were purchased from Sinopharm chemical reagent company. Oleylamine (OLA), oleic acid (OA, 90%), mercaptopropionic acid (MPA) were purchased from Aldrich.

Synthesis of $Pb(DEDTC)_2$ precursor: For the synthesis of $Pb(DEDTC)_2$, 20.0 mmol $Pb(NO_3)_2$ were dissolved in 100.0 mL water to form a transparent solution. Then 50.0 mL aqueous solution containing 40.0 mmol Na-DEDTC was added drop-wisely into the above solution under vigorous stirring, which immediately lead to the formation of light yellow precipitate. After finishing adding the Na-DEDTC aqueous solution, the mixture was kept stirring for another two hours. The final products were harvested by filtration and washed with hot water and methanol for three times. The solid was re-dissolved in chloroform, filtered, and collected by evaporation and then dried in vacuum at 70 ^oC for at least six hours.

Preparing of Au-oleylamine solution (Solution 1): Certain amount of $HAuCl_4$ power (10 mg for sample 1, 20 mg for sample 2, 40 mg for sample 3, 80 mg for sample 4) was added in 3 mL oleylamine at 30 ^oC followed by ultrasound-treatment for about 10 min to form a transparent orange solution.

Synthesis of Au-PbS HNCs: In a typical procedure, 100 mg $Pb(DEDTC)_2$ powder was added into a customer designed test tube, which was protected by flowing N_2 and kept in an oil bath with temperature at 160 ^oC. After incubating in the oil bath for 15 min, Solution 1 was injected into the reaction tube and the reaction was allowed to proceed for one more minute. After that, the reaction was quenched using an ice-water bath. Then the product was collected after centrifugation at 4000 rpm, and washed with hexane for three times and with ethanol for another three times to get the pure hybrids that were dried in vacuum at 60 ^oC.

The synthesis system has been shown below:



Characterization: The XRD patterns were recorded on a Rigaku X-ray diffractometer (D/max-2550 with Cu Kα radiation, λ = 1.5418Å. UV -vis absorption measurements were carried out using a Shimadzu UV-3600 Spectrophotometer. The TEM images were recorded with a Philips TF-F20 transmission electron microscope operating at 200 kV. The STEM image was taken by employing the HAADF detector. The TG curves were recorded with a Netzsch STA-449-F3 thermal analyzer at a step of 20 $^{o}C\ min^{-1}$ under nitrogen. ICP-MS analyses were determined using an inductively coupled plasma-atomic emission spectrometer (ICP-MS, $XSeries^{II}$, ThermoScientific, USA).

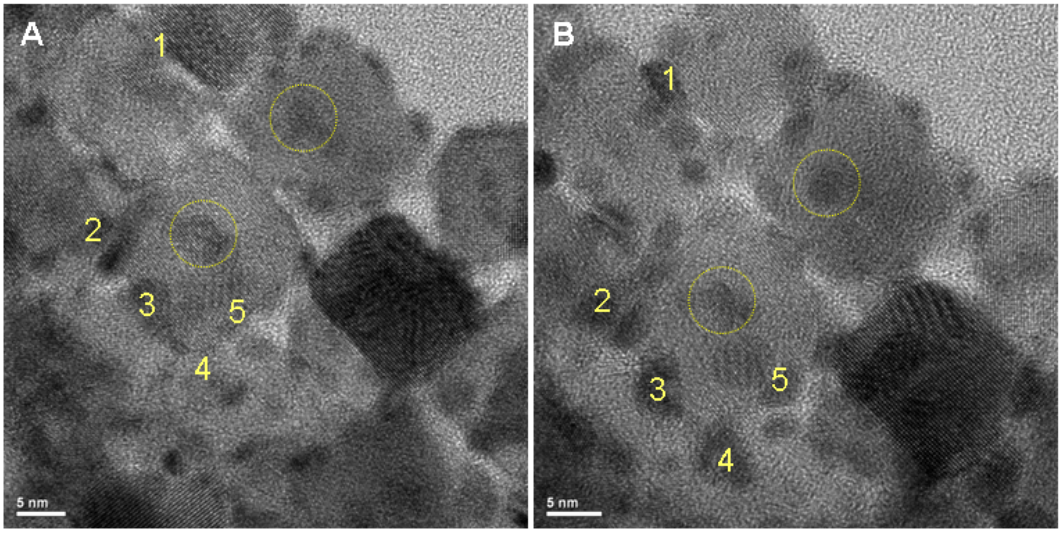


Fig. S1 TEM images of Sample C before (A) and after (B) electron beam irradiation for about 10 min. The typical core and surface Au nanoparticles are indicated by the circles and Arabic numbers, respectively.

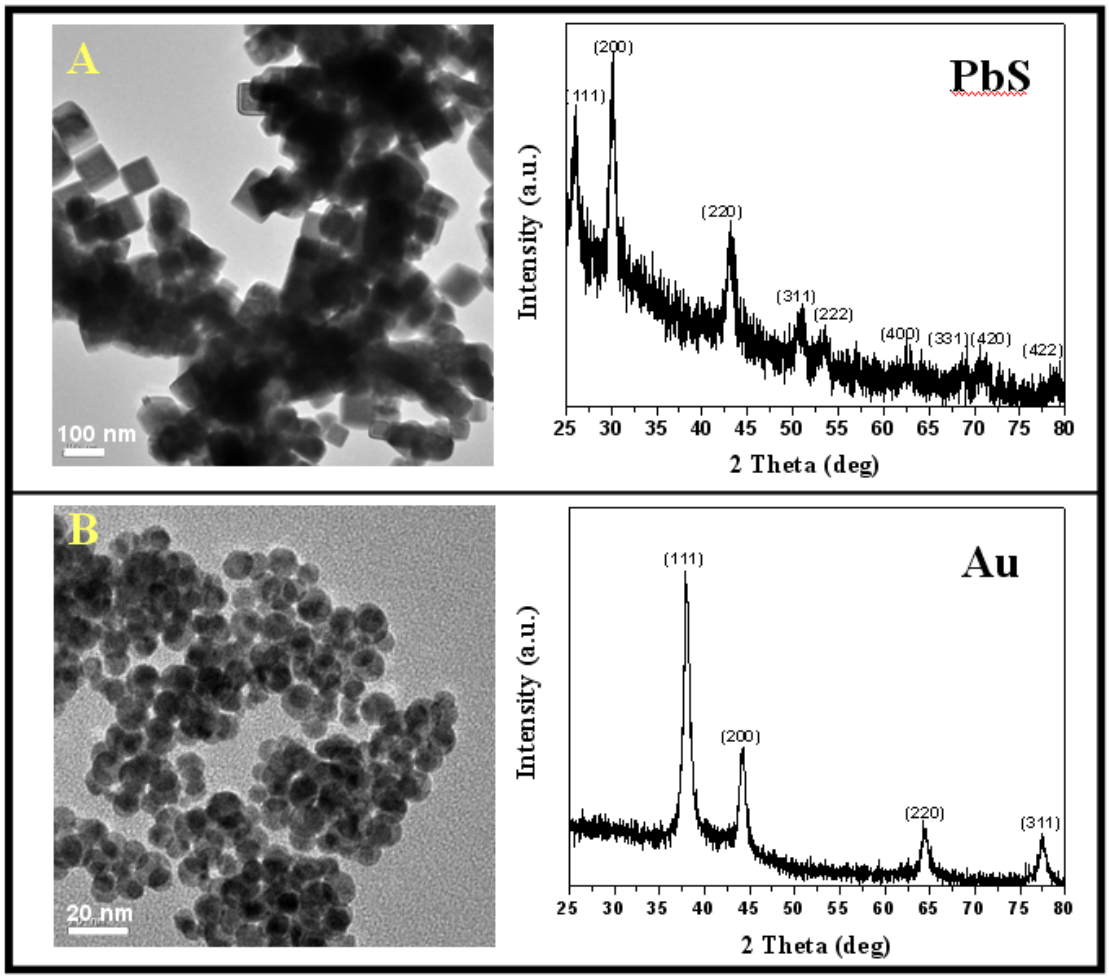


Fig. **S2** TEM images and XRD patterns of pure PbS nanocrystals (A) and Au particles (B).

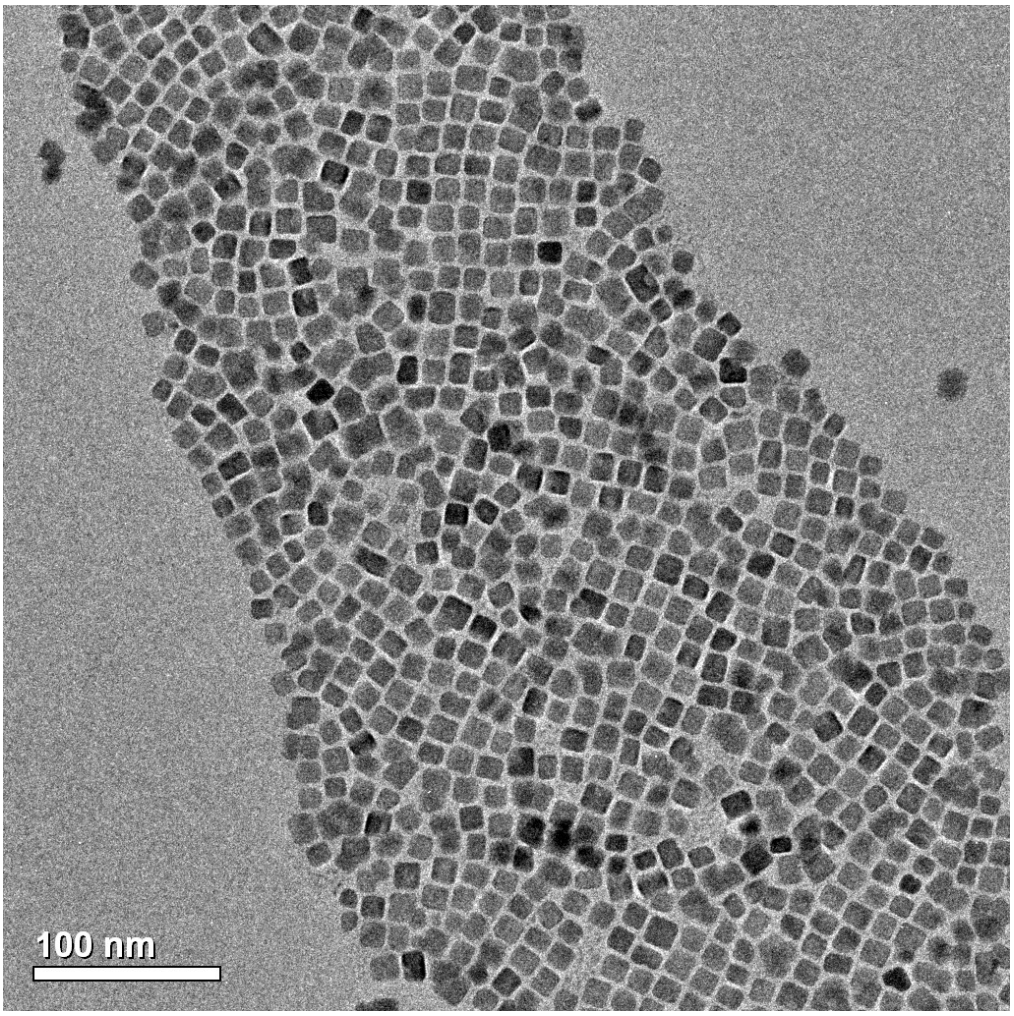


Fig. S3 TEM image of intermediate product of Sample C quenched at 40 s reaction.

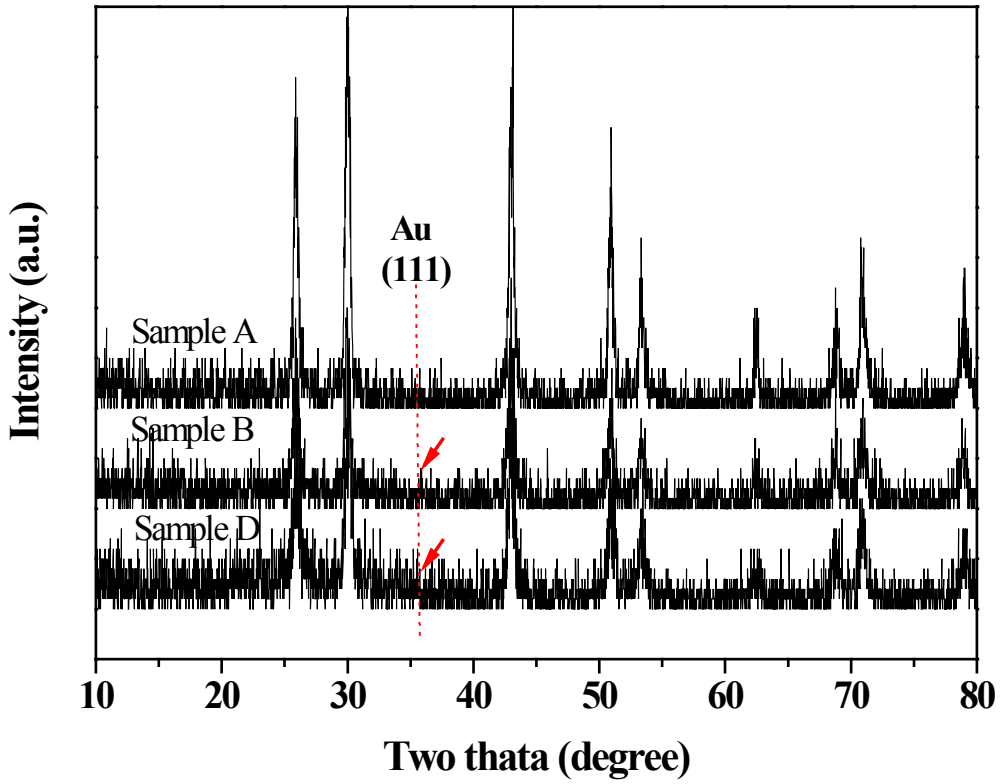


Fig. S4. XRD patterns of sample A, B and D. Noticed that, a very weak peak assigned to the (111) plane of Au was marked by red arrowheads. Because of the lowest content of Au in sample A, there was almost no obvious diffraction peak at the angle of 35.5 ^{o} (Au (111)) in the XRD pattern of sample A, but the other auxiliary characterizations, such as TEM images, EDX, XPS and ICP analysis have been proved that the presence of Au island in sample A.

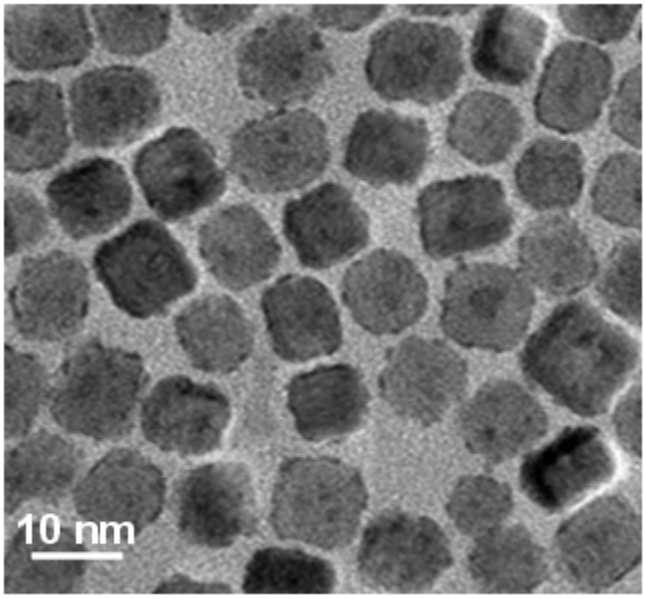


Fig. S5. TEM image of 1 min product of sample C.