

Supporting Information

Au@Cu Core–Shell Nanocubes with Controllable Sizes in the Range of 20–30 nm for Applications in Catalysis and Plasmonics

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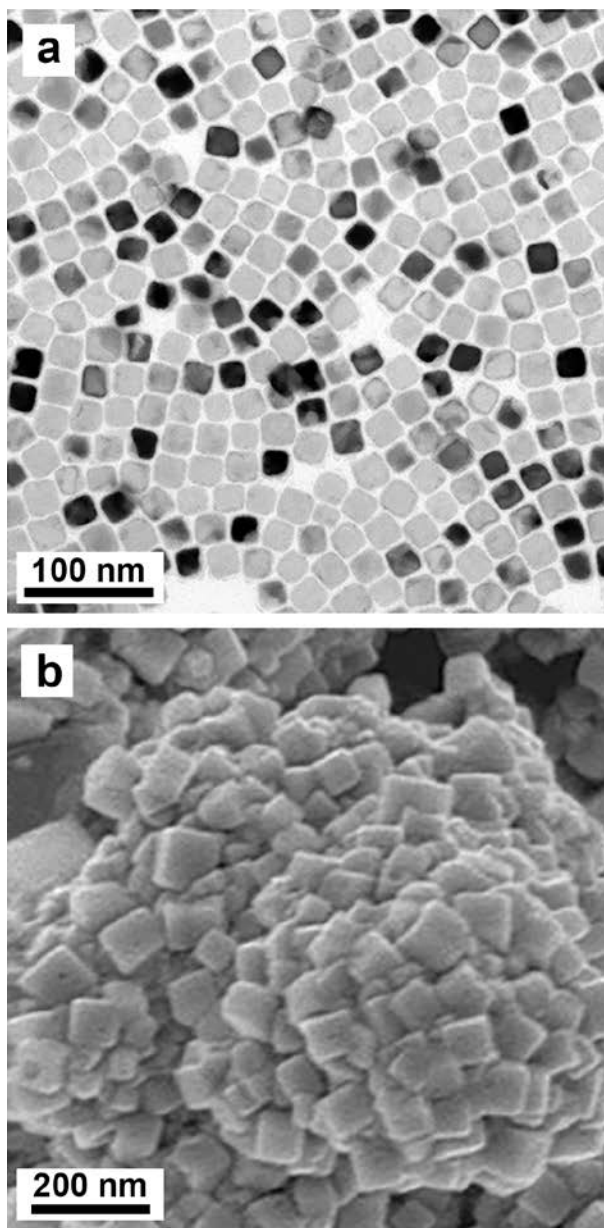


Figure S1. (a) TEM image of Cu nanocubes with an average size of 24 ± 1.5 nm. In a typical protocol, CuBr and TOPO were dissolved in oleylamine and the reaction solution was heated at 210 °C for 1 h. (b) SEM image of Cu nanocubes with sizes in a range of 30-100 nm synthesized from electropolishing. (a) Reprinted with permission from ref. S1. Copyright 2014 American Chemical Society. (b) Reprinted with permission from ref. S2. Copyright 2016 Wiley-VCH.

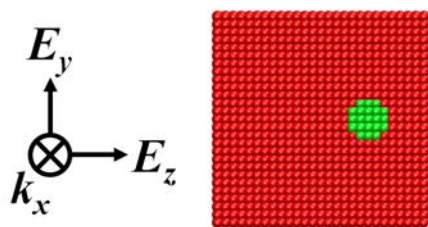


Figure S2. The k -vector and E -field of the incident light with respect to the orientation of an individual nanocube used for the DDA calculation.

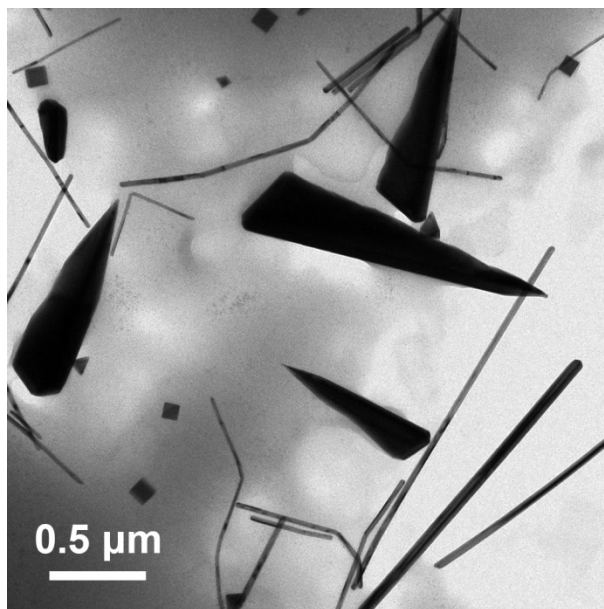


Figure S3. TEM image of the solid products that were obtained during a standard synthesis in the absence of Au seeds. The products contained Cu nanocubes, nanowires, and microstructures with a tapered dimension.

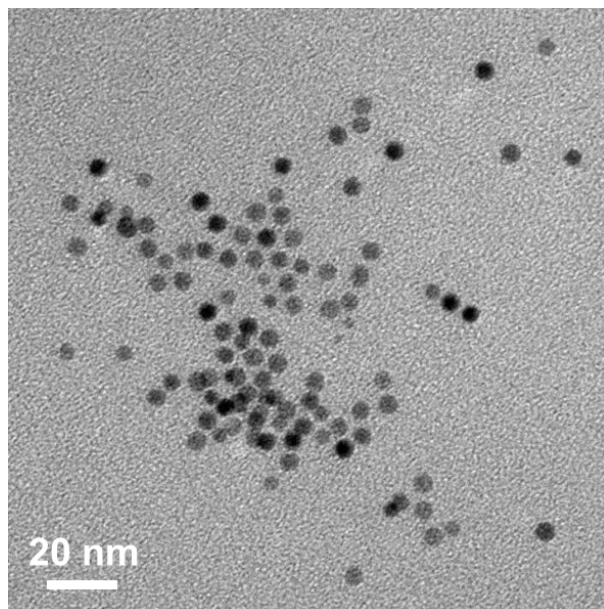


Figure S4. A typical TEM image of the 5-nm Au spheres that served as seeds for the growth of Cu nanocubes.

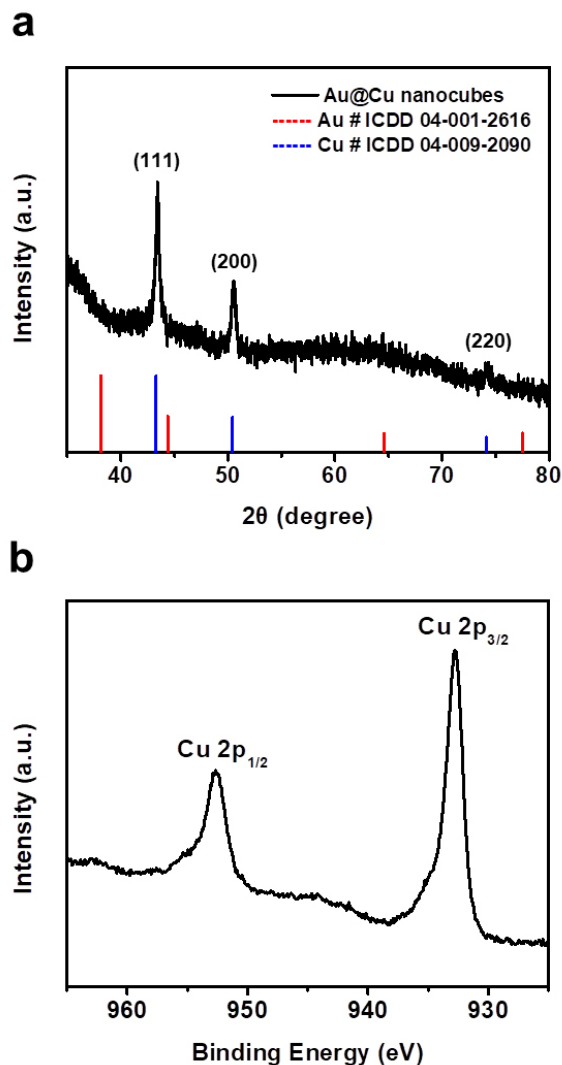


Figure S5. (a) Powder XRD pattern and (b) XPS spectrum of the Au@Cu nanocubes prepared using the standard protocol. Because the Au@Cu nanocubes were small in size, they tended to be randomly oriented when deposited on the substrate and, in this case, the (100) planes were not well aligned with the X-ray beam. Thus, in the XRD pattern, the (200) diffraction peak was weaker than the (111) diffraction peak.

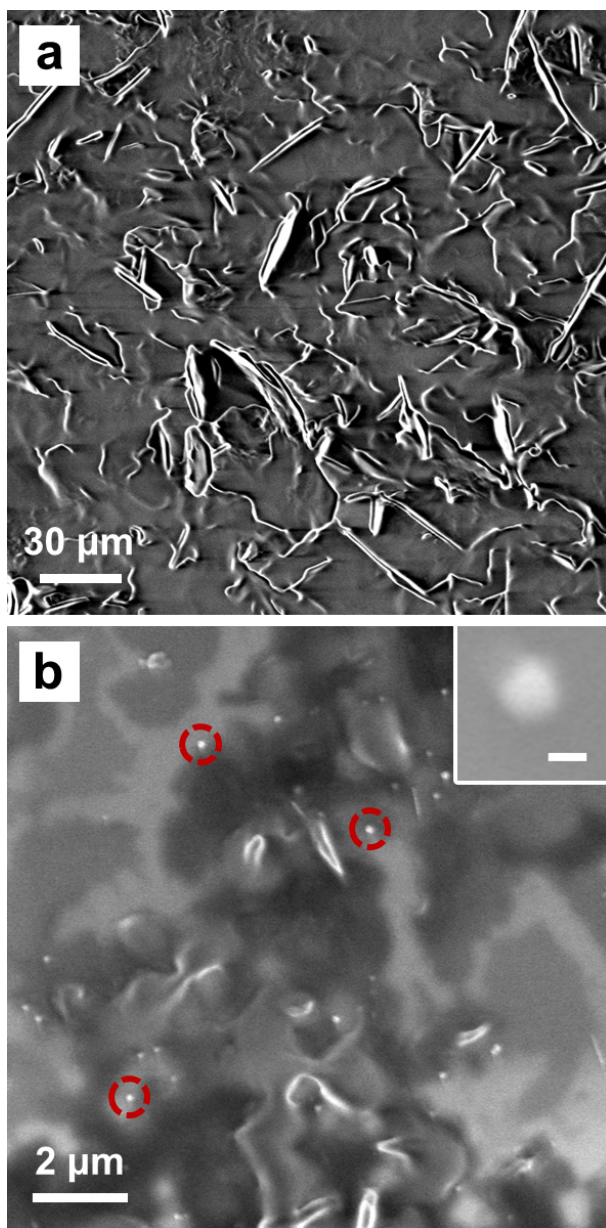


Figure S6. SEM images (at two different magnifications) of the solid product obtained at $t = 10$ min into a standard synthesis. The lamellar sheets are mainly composed of Cu(II)-HDA complexes. The particles circled in red correspond to the Au@Cu nanocrystals. The inset shows a magnified SEM image of the Au@Cu nanocrystal (scale bar: 20 nm).

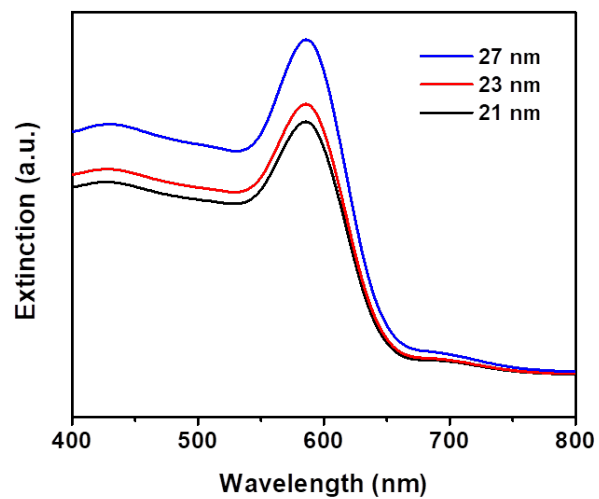


Figure S7. Extinction spectra calculated using the DDA method for the Au@Cu nanocubes with different edge lengths.

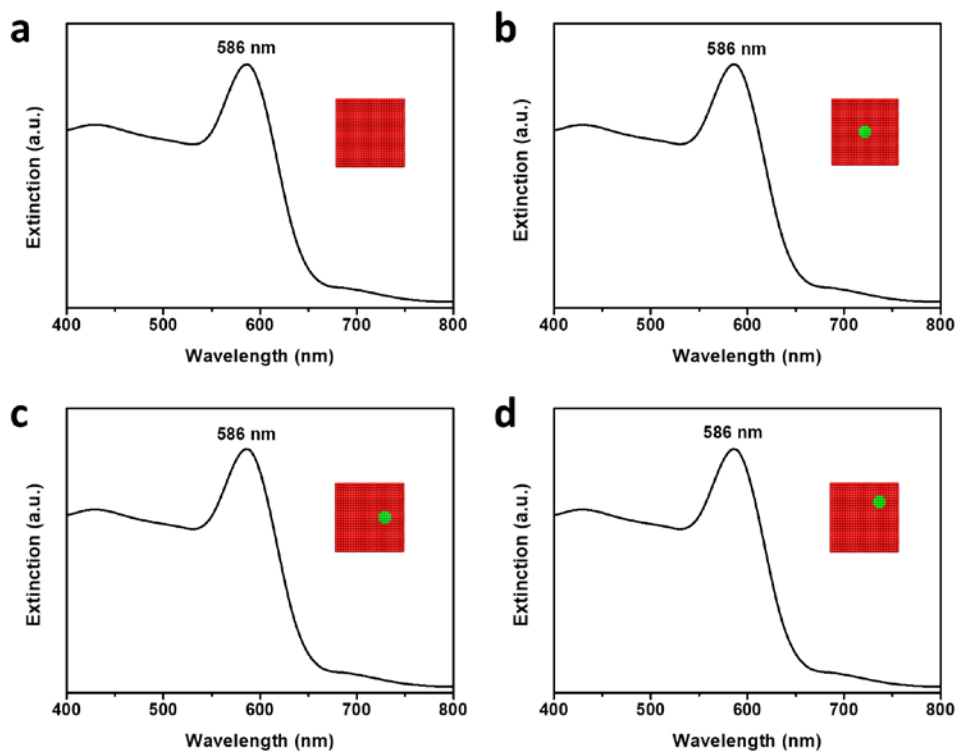


Figure S8. Comparison of the simulated extinction spectra for: (A) Cu cube; (B) Au@Cu nanocube with the Au seed located at the center; (C) Au@Cu nanocube with the Au seed located near one of the edges; (D) Au@Cu nanocube with the Au seed located at one of the corners. The Cu cube and Au seed are 27 nm in edge length and 5 nm in diameter, respectively.

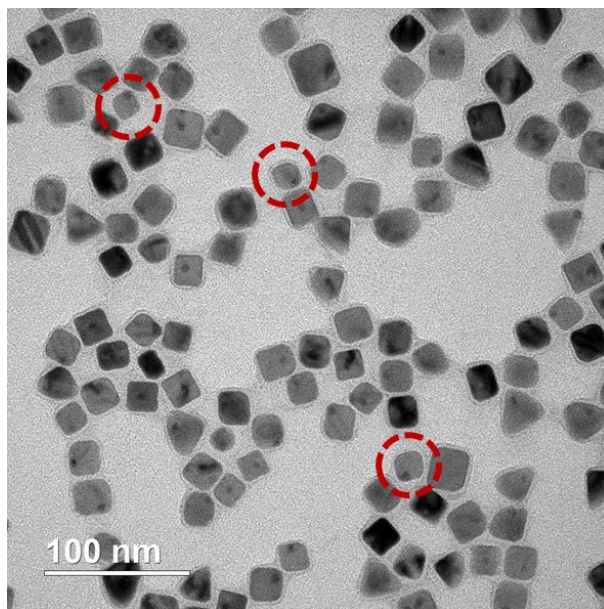


Figure S9. TEM image of the Au@Cu nanocubes obtained using the standard protocol and 1.0 mL of Au seed suspension (0.0262 mg/mL). The sample was collected at a speed of 30,130g. Some nanocrystals with small sizes ranging from 12–18 nm are marked with red circles.

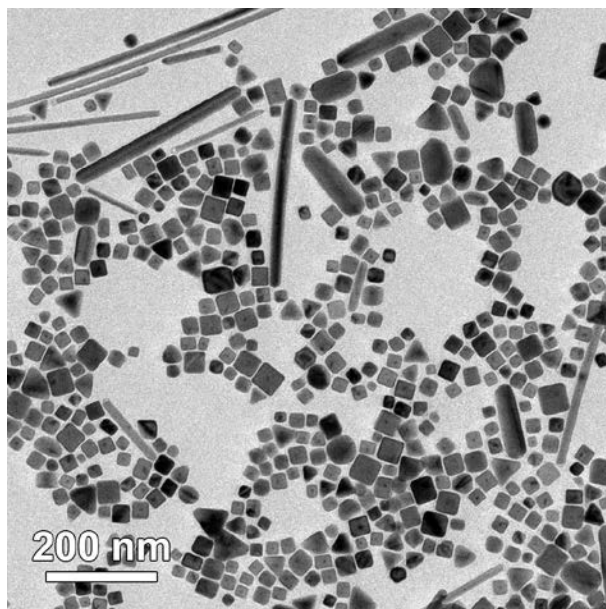


Figure S10. TEM image (at a relatively low magnification and thus large view) of the Au@Cu core-shell nanocrystals prepared using the standard protocol except for the use of 13.1 mg of CuCl_2 .

References

- S1. Guo, H.; Chen, Y.; Cortie, M. B.; Liu, X.; Xie, Q.; Wang, X.; Peng, D. L. Shape-Selective Formation of Monodisperse Copper Nanospheres and Nanocubes via Disproportionation Reaction Route and Their Optical Properties. *J. Phys. Chem. C* **2014**, *118*, 9801–9808.
- S2. Roberts, F. S.; Kuhl, K. P.; Nilsson, A. Electroreduction of Carbon Monoxide over a Copper Nanocube Catalyst: Surface Structure and pH Dependence on Selectivity. *ChemCatChem*. **2016**, *8*, 1119–1124.