



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Heating or Cooling: Temperature Effects on the Synthesis of Atomically Precise Gold Nanoclusters (Article)

Chen, T., Yao, Q., Yuan, X., Nasaruddin, R.R., Xie, J.  

Department of Chemical and Biomolecular Engineering, National University of Singapore, 4 Engineering Drive 4, Singapore, 117585, Singapore

Abstract

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Developing an efficient, well-controlled synthesis strategy for gold nanoclusters (Au NCs) is crucial for delivering their expected applications in many fields; and such development requires fundamental understandings on the synthetic chemistry. The synthesis of Au NCs typically consists of a pair of reversible reactions: a fast reduction-growth reaction and a slow size-focusing reaction. Here we demonstrate that the above two reactions can be well-balanced while accelerated in a heated synthesis protocol, thus providing an efficient and scalable synthesis method to obtain thermodynamically favorable Au₂₅(SR)₁₈ NCs (SR denotes thiolate ligand) with high yield (>95% on gold atom basis) and fast kinetics. By investigating the Au NC formation behavior at different temperature, we identified the endothermic nature of the reductive formation of Au₂₅(SR)₁₈ NCs from Au(I)-thiolate complex precursors. More interestingly, if overheated, after the formation of Au₂₅(SR)₁₈, there exists an irreversible first-order reaction, which could transform Au₂₅(SR)₁₈ into Au NCs of mixed sizes. As a result, 40 °C is identified as the optimal temperature to synthesize Au₂₅(SR)₁₈ in aqueous solution, as the half-life of the transformation reaction (67.8 h) is much longer than the time needed to obtain high yield Au₂₅(SR)₁₈. The detailed understandings on the temperature effects of Au NC synthesis would facilitate the development of efficient synthesis strategies for atomically precise Au NCs with predesigned size, composition and structure. © 2016 American Chemical Society.

SciVal Topic Prominence

Topic: Nanoclusters | Gold | fluorescent gold

Prominence percentile: 99.923 

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Indexed keywords

Engineering controlled terms: Gold Nanoclusters Planning Solutions Temperature

Engineering uncontrolled terms: Complex precursors Controlled synthesis Efficient synthesis First order reactions Optimal temperature Reversible reaction Synthetic chemistry Transformation Reactions

Engineering main heading: Chelation

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Chen, T. , Yao, Q. , Nasaruddin, R.R.
(2019) *Angewandte Chemie - International Edition*

Deepening the understanding of thiolate-protected metal clusters using high-performance liquid chromatography

Niihori, Y. , Yoshida, K. , Hossain, S.
(2019) *Bulletin of the Chemical Society of Japan*

Synthesis of Water-Soluble [Au₂₅(SR)... a Stoichiometric Amount of NaBH₄

Chen, T. , Fung, V. , Yao, Q.
(2018) *Journal of the American Chemical Society*

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References (61)

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- 1 Dreaden, E.C., Alkilany, A.M., Huang, X., Murphy, C.J., El-Sayed, M.A.
The golden age: Gold nanoparticles for biomedicine
(2012) *Chemical Society Reviews*, 41 (7), pp. 2740-2779. Cited 1624 times.
doi: 10.1039/c1cs15237h
[View at Publisher](#)

- 2 Abadeer, N.S., Murphy, C.J.
Recent Progress in Cancer Thermal Therapy Using Gold Nanoparticles
(2016) *Journal of Physical Chemistry C*, 120 (9), pp. 4691-4716. Cited 278 times.
<http://pubs.acs.org.ezproxy.um.edu.my/journal/jpccck>
doi: 10.1021/acs.jpcc.5b11232
[View at Publisher](#)

- 3 Yang, L., Shang, L., Nienhaus, G.U.
Mechanistic aspects of fluorescent gold nanocluster internalization by live HeLa cells
(2013) *Nanoscale*, 5 (4), pp. 1537-1543. Cited 71 times.
doi: 10.1039/c2nr33147k
[View at Publisher](#)

- 4 Song, X.-R., Goswami, N., Yang, H.-H., Xie, J.
Functionalization of metal nanoclusters for biomedical applications
(2016) *Analyst*, 141 (11), pp. 3126-3140. Cited 131 times.
<http://pubs.rsc.org.ezproxy.um.edu.my/en/journals/journal/an>
doi: 10.1039/c6an00773b
[View at Publisher](#)

The Innermost Three Gold Atoms Are Indispensable to Maintain the Structure of the Au₁₈(SR)₁₄ Cluster

Yu, Y. , Yao, Q. , Chen, T.
(2016) *Journal of Physical Chemistry C*

Carbon Monoxide: A Mild and Efficient Reducing Agent towards Atomically Precise Gold Nanoclusters

Chen, T. , Xie, J.
(2016) *Chemical Record*

Enhancing stability through ligand-shell engineering: A case study with Au₂₅(SR)₁₈nanoclusters

Yuan, X. , Goswami, N. , Mathews, I.
(2015) *Nano Research*

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