

Supporting Information

Rapid synthesis of Cu₂O hollow spheres at low temperature and its catalytic performance for the decomposition of ammonium perchlorate

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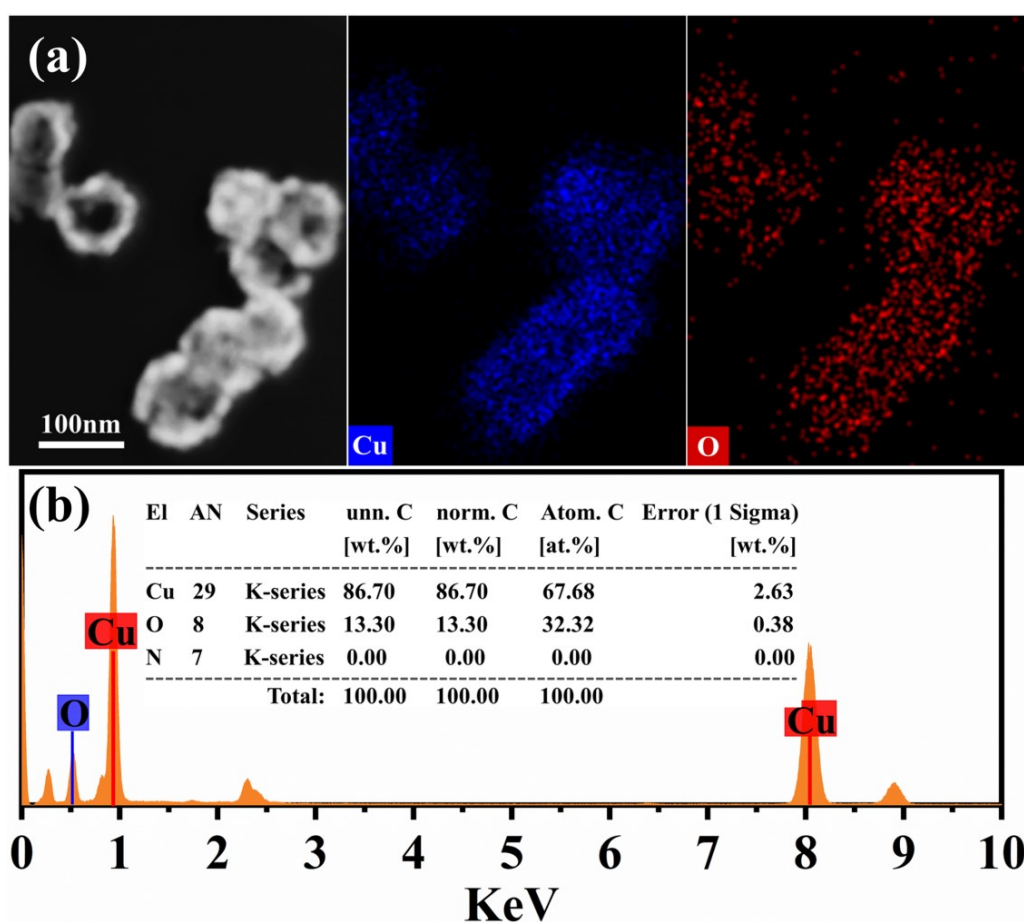


Fig. S1 (a) Element analysis of EDX mapping for Cu₂O hollow spheres and (b) corresponding EDX point scan.

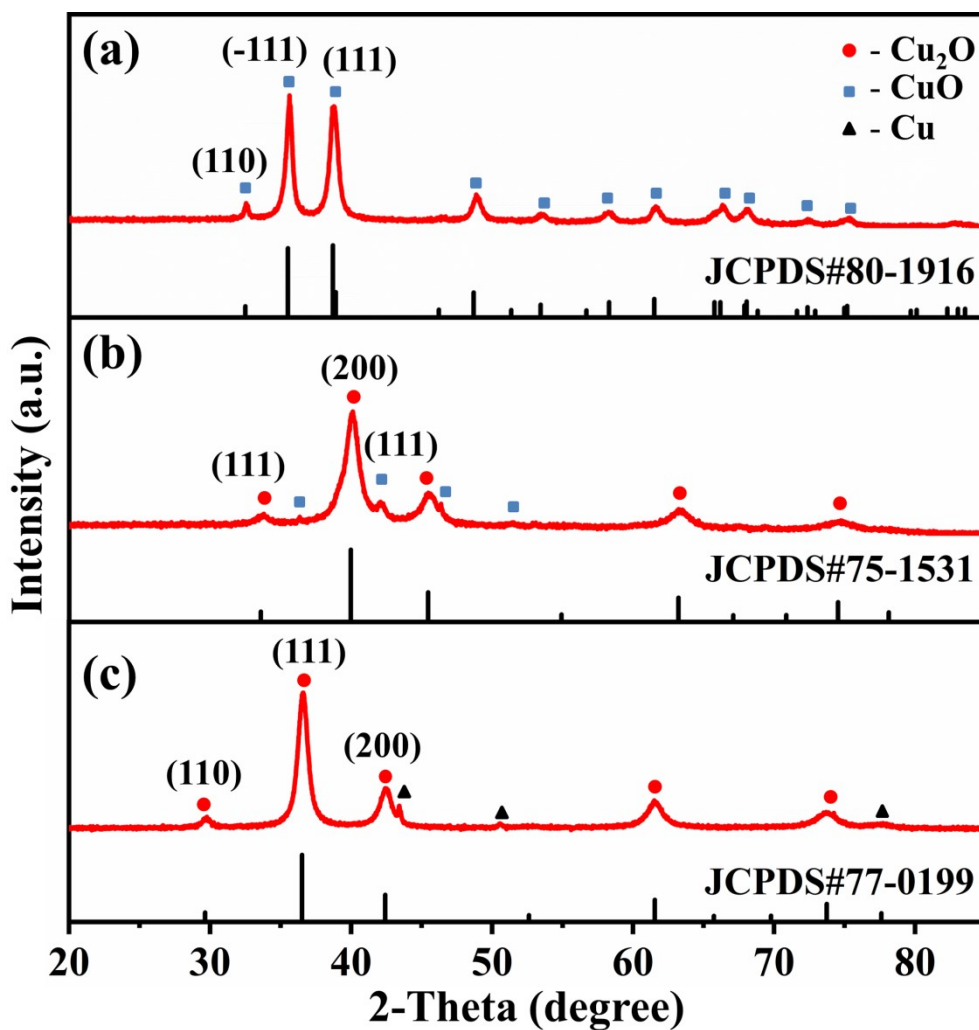


Fig. S2 XRD patterns of products in different reaction stages: (a) reacted for 5 min after addition of NaOH; (b) reacted for 1 min after addition of AA; (c) reacted for 60 min after addition of AA.

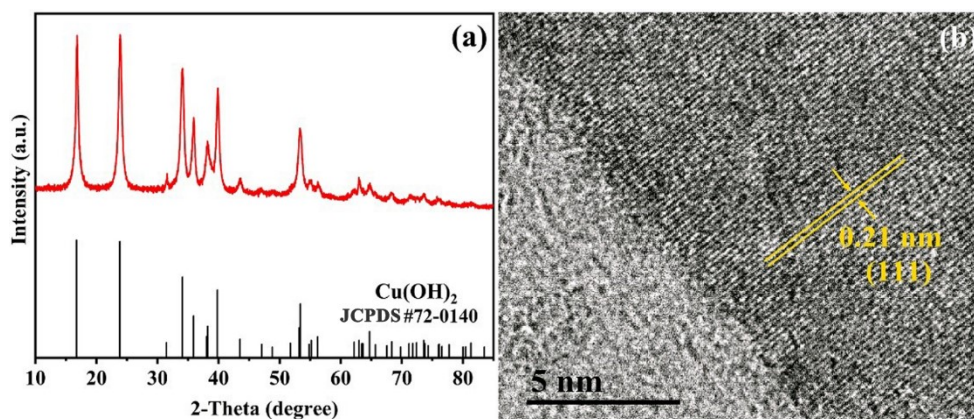


Fig. S3 (a) XRD pattern of product after adding NaOH and (b) HRTEM image of CuO nanosheet (after adding NaOH for 5 min).

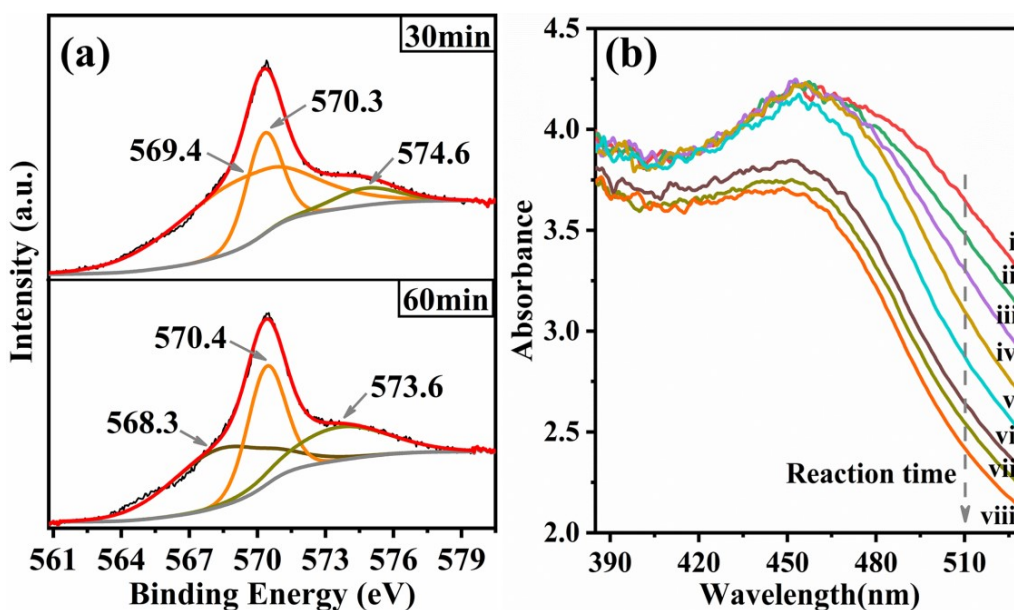


Fig. S4 (a) Peak fitting of the Cu LMM spectrum for the sample measured at 30 and 60 min of reaction; (b) UV-Vis spectra of Cu_2O products under different reaction times: i) 1min, ii) 5 min, iii) 10 min, iv) 20 min, v) 30 min, vi) 40 min, vii) 50 min, viii) 60 min.

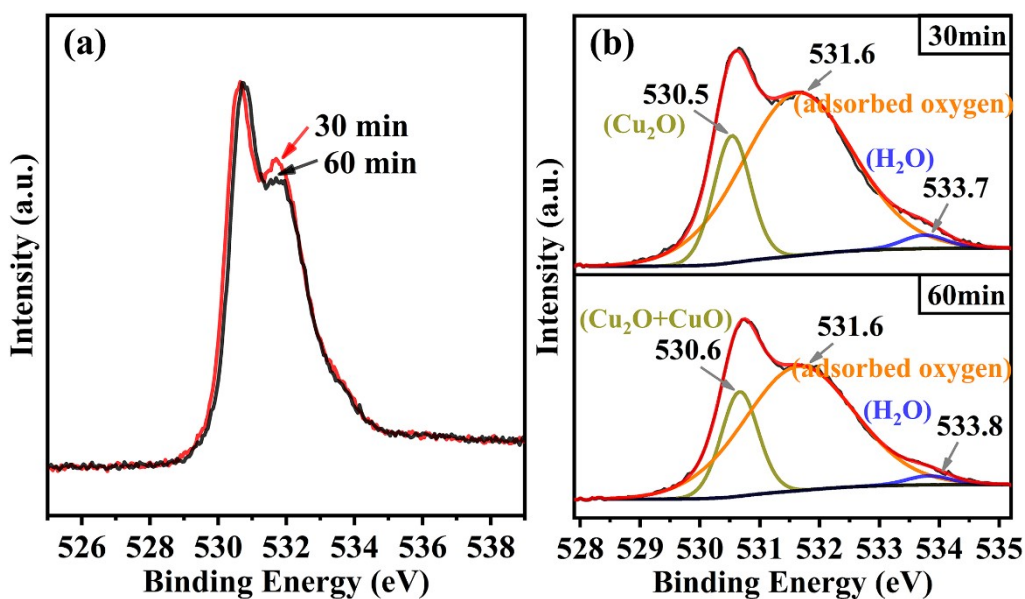


Fig. S5 (a) $\text{O}1s$ XPS core-level spectra and (b) peak fitting of the $\text{O}1s$ spectrum for the sample measured at 30 min and 60 min of reaction.

Tab. S1 Comparison of endothermic and exothermic peak areas in the DSC curve.

Entry	pure AP			AP+Cu ₂ O nanocages		
	EndP	ExoP		EndP	ExoP	
Start(°C)	242.2	272.3	416.4	243.2	256.3	290.1
End(°C)	251.8	319.4	437.5	255.1	282.6	321.9
Height(mW/mg)	0.6498	0.3419	0.5064	0.8517	1.163	1.515
Area(J/g)	57.37	247.6		63.6	603.1	

EndP: Endothermic peak; ExoP: Exothermic peak.

Tab. S2 Comparison of DSC data of Cu₂O and other catalysts in AP thermal decomposition.

Nanocatalyst	M (%)	dT/dt °C/min	LTD AP	LTD AP+Cat.	HTD AP	HTD AP+Cat.	Ref.
CeO ₂	4	5	301.9	289.5	428.5	378.1	[1]
α-Fe ₂ O ₃	2	10	313.2	297.5	437.4	386.8	[2]
CuO	5	10	293.4	271.5	435.2	353.8	[3]
CuO/MoS ₂	5	10	293.4	296.8	435.2	323.5	[4]
LaMnO ₃	5	10	295.8	290.3	416.0	331.8	[5]
Cu ₂ O	2	5	295.9	268.8	431.9	324.9	[6]

Tab. S3 Comparison of DSC data of Cu₂O with different morphologies in AP thermal decomposition. M=2%.

Cu ₂ O topography	dT/dt °C/min	LTD AP	LTD AP+Cat.	HTD AP	HTD AP+Cat.	Ref.
12-pods			295.7		343.2	
8-pods			284.1		345.1	
cube		304.5	281.0	421.8	348.2	[7]
hexapod	3		280.9		350.2	
cone hole-cube			276.9		337.8	
flower-like		297.0	274.8	410.5	343.7	[8]
octahedron	10	298.5	296.8	420.6	356.4	[9]
tetrahedron			278.7		336.7	
tetrahedral cage	5	295.9	268.8	431.9	324.9	[6]
hollow sphere			264.3		306.9	Our work

References

- 1 J. Shi, H. Wang, Y. Liu, X. Ren, H. Sun and B. Lv, *Inorg. Chem. Front.*, 2019, 6, 1735-1743.

- 2 S. b. Cao, X. G. Han, L. L. Zhang, J. X. Wang, Y. Luo, H. K. Zou and J. F. Chen, *Powder Technol.*, 2019, 353, 444-449.
- 3 Y. Hu, S. Yang, B. Tao, X. Liu, K. Lin, Y. Yang, R. Fan, D. Xia and D. Hao, *Vacuum*, 2019, 159, 105-111.
- 4 Y. Hu, Y. Yang, R. Fan, K. Lin, D. Hao, D. Xia and P. Wang, *Appl. Organomet. Chem.*, 2019, 33, e5060.
- 5 Y. Hu, B. Tao, F. Shang, M. Zhou, D. Hao, R. Fan, D. Xia, Y. Yang, A. Pang and K. Lin, *Appl. Surf. Sci.*, 2020, 513, 145849.
- 6 T.T. Lv, H.X. Wang, X.B. Ren, L.C. Wang, R.M. Ding, J.P. Cao and B.L. Lv, *CrystEngComm*, 2020, 22, 8214-8220.
- 7 X. L. Luo, M. J. Wang, D. S. Yang, J. Yang and Y. S. Chen, *J. Ind. Eng. Chem.*, 2015, 32, 313-318.
- 8 X. L. Luo, M. J. Wang, L. Yun, J. Yang and Y. S. Chen, *J. Phys. Chem. Solids*, 2016, 90, 1-6.
- 9 X. Wang, C. Liu, B. Zheng, Y. Jiang, L. Zhang, Z. Xie and L. Zheng, *J. Mater. Chem. A*, 2013, 1, 282-287.