Supporting Information

Fabrication of PdCu@SiO_2@Cu core-shell-satellite catalyst for the selective hydrogenation of acetylene

Shuang Liu, Shaobo Han, Yong Li and Wenjie Shen*

State Key Laboratory of Catalysis, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian 116023, China

* e-mail: shen98@dicp.ac.cn

Table s1. Structure of the typical core-shell-satellite architectures.

Sample	Core size (nm)	Satellite size (nm)	Shell thickness (nm)	Ref.
Ag@SiO_2@TiO_2@Au	30-60	11 × 40	10-15	1
Ag@SiO_2@CeO_2@Au	30	2-10	15-20	2
Au@SiO_2@AgPt	18 × 61	2-5	2-3	3
Ag@SiO_2@Ag	60-80	5	35-45	4
Ni@SiO_2@Ni	11.7	3-7	11.2	5
Ag@SiO_2@Pt	12/25/50/100	5	8-10	6
Au@pNIPAM@Ag	50	6/10/14/34	~140	7
Ag@RF@Ag	45	~3-8	30	8
	40	8	100	
AuAg@pNIPAM@Ag	64	15	~140	9
PdCu@SiO_2@Cu	**7**	**1.4**	**8**	**This work**

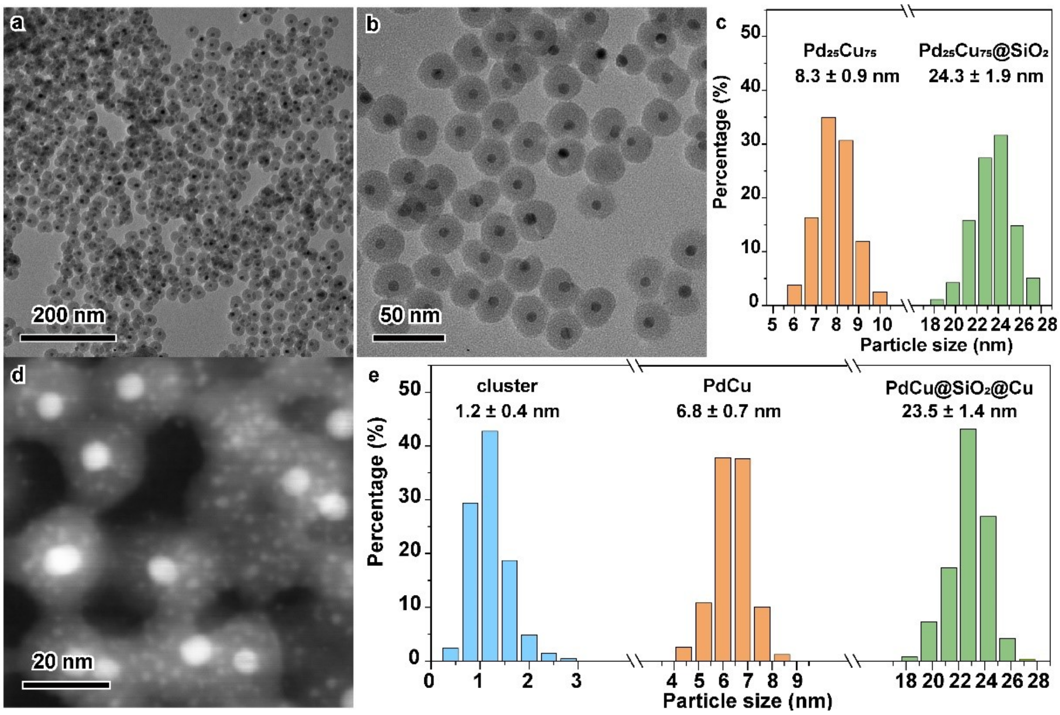

Figure s1. TEM/STEM images and particle size distributions of the as-synthesized $Pd_{25}Cu_{75}@SiO_2$ core-shell (**a-c**) and $PdCu@SiO_2@Cu$ core-shell-satellite (**d, e**) architectures.

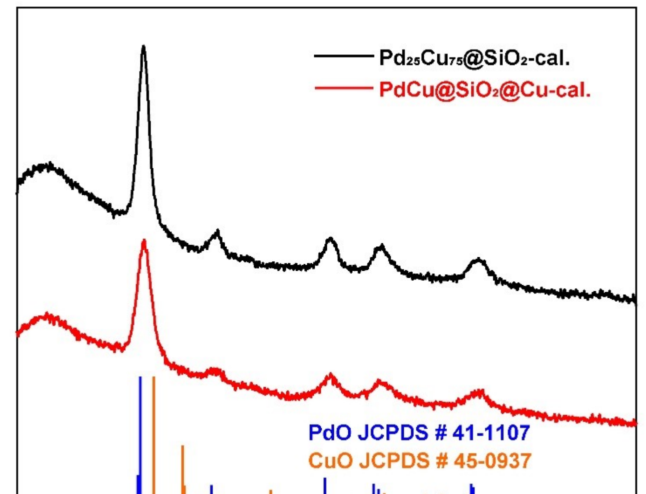

Figure s2. XRD patterns of the as-calcined $Pd_{25}Cu_{75}@SiO_2$ and $PdCu@SiO_2@Cu$ samples.

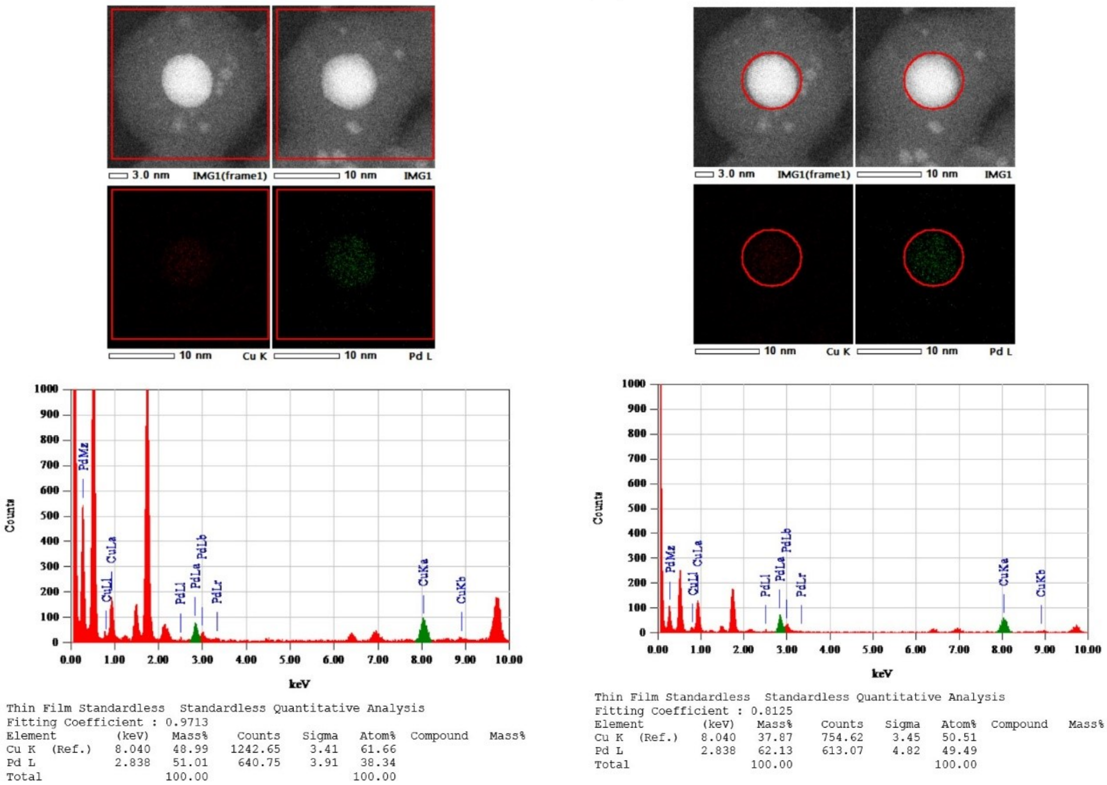

Figure s3. Semi-quantitative analysis of the core-shell-satellite catalyst by EDS.

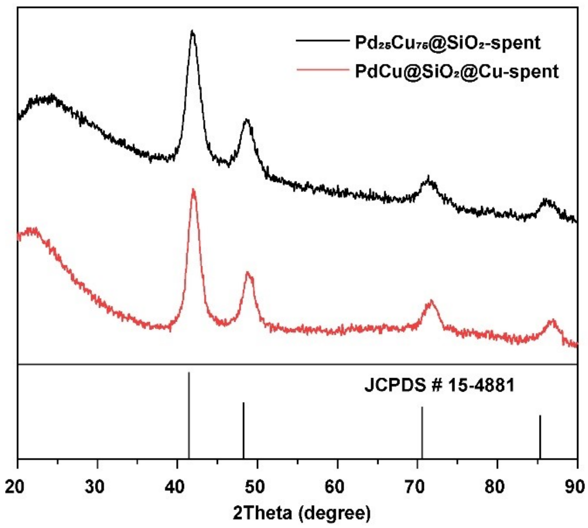

Figure s4. XRD patterns of the spent catalysts.

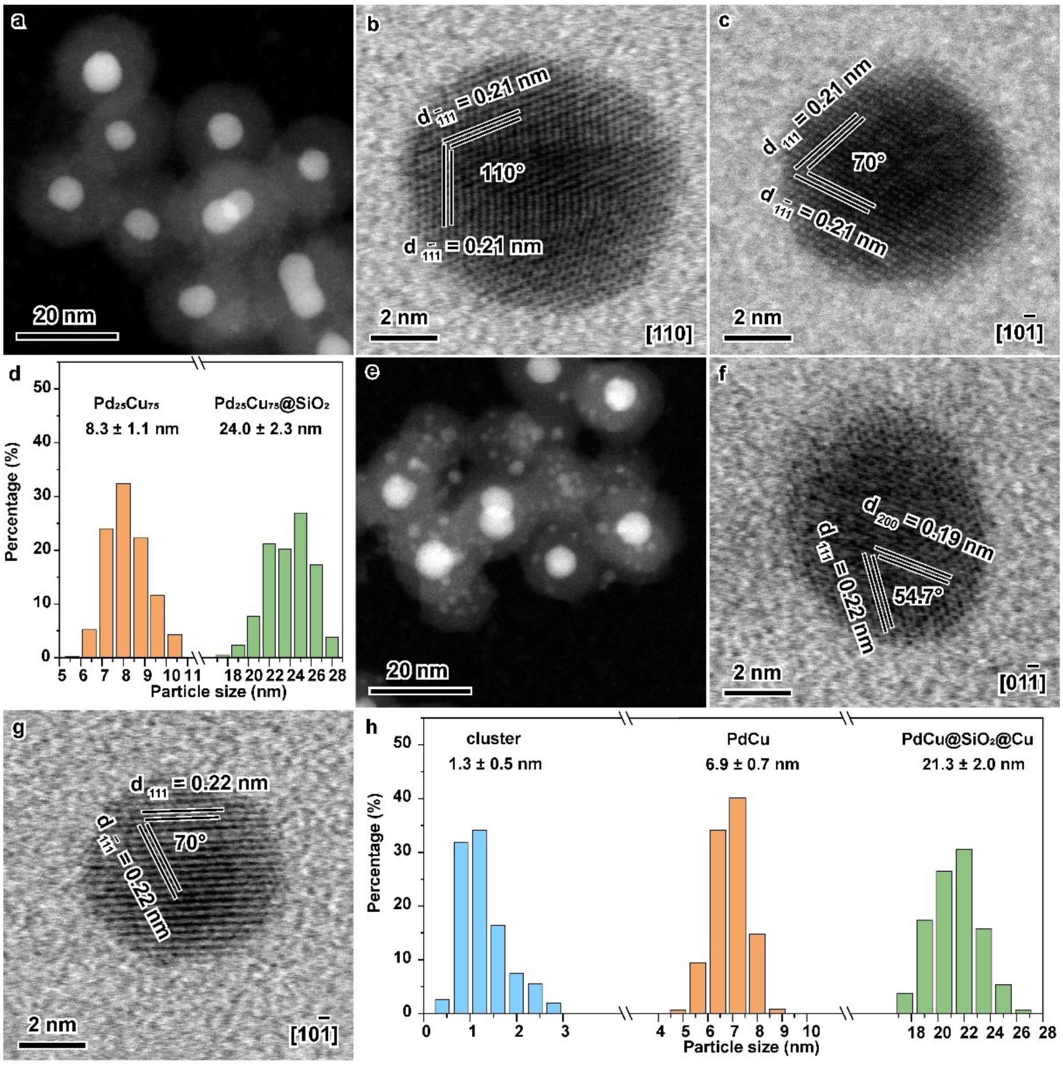

Figure s5. HRTEM/STEM images and particle size distributions of the spent $Pd_{25}Cu_{75}@SiO_2$ core-shell (**a-d**) and $PdCu@SiO_2@Cu$ core-shell-satellite (**e-h**) catalysts.

Table s2. Acetylene hydrogenation over Pd and PdCu catalysts.

Catalyst (wt.)	Temp. (K)	Feed gas (vol.%)	Conv. (%)	Ethylene Sel. (%)	Ref.
0.11%Pd_1/ND@G	453	1%C_2H_2/10%H_2/20%C_2H_4/He	100	>90	10
1.8%Pd_1/C_3N_4	388	0.5%C_2H_2/1%H_2/20%C_2H_4/Ar	100	83	11
1.0%Pd/ZnO	423	2% C_2H_2/20%H_2/He	100	91	12
0.043%Pd_1/MPNC	383	0.5%C_2H_2/5%H_2/50%C_2H_4/He	85	83	13
2.0%Pd/$MgAl_2O_4$	363	0.5%/5%H_2/50%C_2H_4/He	100	15	14
1.29%PdCu/TiO_2	373	1.5%C_2H_2/1.7%H_2/C_2H_4	98	78	15
0.05%$Pd_{0.006}$Cu/SiO_2	443	1%C_2H_2/20%H_2/20%C_2H_4/He	100	85	16
1.0%PdCu/Al_2O_3	363	0.5%C_2H_2/3%/H_2/Ar	100	95.2	17
0.2%Pd_1/Cu(111)	393	1%C_2H_2/20%H_2/20%C_2H_4/N_2	100	85	18
0.058%$PdCu_{40}$/SiO_2	433	1%C_2H_2/20%H_2/20%C_2H_4/He	100	85	19
$PdCu_{15}$@C	393	0.5%C_2H_2/10%H_2/N_2	100	91	20
0.09%Pd_1Cu_1/ND@G	383	1%C_2H_2/10%H_2/20%C_2H_4/He	100	92	21
9.5 wt.%PdCu@SiO_2@Cu	**373**	**1 vol.% C_2H_2, 2 vol.% H_2, He**	**72**	**89**	**This work**

Reference

1. M. Liu, X. Jin, S. Li, J.-B. Billeau, T. Peng, H. Li, L. Zhao, Z. Zhang, J. P. Claverie, L. Razzari and J. Zhang, *ACS Appl. Mater. Interfaces*, 2021, **13**, 34714–34723.
2. J. Gu, H. Liu, T. Peng, S. Li, L. Xu, J. Zhang and L. Zhang, *ACS Appl. Nano Mater.*, 2022, **5**, 4972–4982.
3. H. Jia, L. Qiu and J. Wang, *RSC Adv.*, 2015, **5**, 40316–40323.
4. Y. Mao, W. Jiang, S. Wang, M. Liu, S. Xuan, X. Gong and K. C.-F. Leung, *J. Alloys Compd.*, 2016, **680**, 406–414.
5. Z. Li, L. Mo, Y. Kathiraser and S. Kawi, *ACS Catal.*, 2014, **4**, 1526–1536.
6. K. Li, N. J. Hogan, M. J. Kale, N. J. Halas, P. Nordlander and P. Christopher, *Nano Lett.*, 2017, **17**, 3710–3717.
7. C. Alarcón-Fernández, M. Doña, A. Tapia-Fernández, G. Villaverde, M. R. Lopez-Ramirez, J. M. López-Romero and R. Contreras-Caceres, *ACS Appl. Nano Mater.*, 2020, **3**, 8247–8256.
8. P. Yang, Y. Xu, L. Chen, X. Wang, B. Mao, Z. Me, S. Wang, F. Bao and Q. Zhang, *Nano Lett.*, 2015, **15**, 8397–8401.
9. L. Tzounis, M. Doña, J. M. Lopez-Romero, A. Fery and R. Contreras-Caceres, *ACS Appl. Mater. Interfaces*, 2019, **11**, 29360–29372.

10. F. Huang, Y. Deng, Y. Chen, X. Cai, M. Peng, Z. Jia, P. Ren, D. Xiao, X. Wen, N. Wang, H. Liu and D. Ma, *J. Am. Chem. Soc.*, 2018, **140**, 13142–13146.
11. X. Huang, Y. Xia, Y. Cao, X. Zheng, H. Pan, J. Zhu, C. Ma, H. Wang, J. Li, R. You, S. Wei, W. Huang and J. Lu, *Nano Res.*, 2017, **10**, 1302–1312.
12. H. Zhou, X. Yang, L. Li, X. Liu, Y. Huang, X. Pan, A. Wang, J. Li and T. Zhang, *ACS Catal.*, 2016, **6**, 1054–1061.
13. Q. Feng, S. Zhao, Q. Xu, W. Chen, S. Tian, Y. Wang, W. Yan, J. Luo, D. Wang and Y. Li, *Adv. Mater.*, 2019, **31**, 1901024.
14. Q. Feng, S. Zhao, Y. Wang, J. Dong, W. Chen, D. He, D. Wang, J. Yang, Y. Zhu, H. Zhu, L. Gu, Z. Li, Y. Liu, R. Yu, J. Li and Y. Li, *J. Am. Chem. Soc.,* 2017, **139**, 7294–7301.
15. B. Pongthawornsakun, N. Wimonsupakit and J. Panpranot, *J. Chem. Sci.*, 2017, **129**, 1721–1734.
16. G. X. Pei, X. Y. Liu, X. Yang, L. Zhang, A. Wang, L. Li, H. Wang, X. Wang and T. Zhang, *ACS Catal.*, 2017, **7**, 1491–1500.
17. Q. Gao, Z. Yan, W. Zhang, H. S. Pillai, B. Yao, W. Zang, Y. Liu, X. Han, B. Min, H. Zhou, L. Ma, B. Anaclet, S. Zhang, H. Xin, Q. He and H. Zhu, *J. Am. Chem. Soc.*, 2023, **145**, 19961–19968.
18. L. Jiang, K. Liu, S. -F. Hung, L. Zhou, R. Qin, Q. Zhang, P. Liu, L. Gu, H. Chen, G. Fu and N. Zheng, *Nat. Nanotechnol.*, 2020, **15**, 848–853.
19. G. Pei, X. Liu, M. Chai, A. Wang and T. Zhang, *Chin. J. Catal.*, 2017, **38**, 1540–1548.
20. C. Lu, S. Zhou, W. Zhou, C. Zhou, Q. Li, A. Zeng, A. Wang, L. Tan and L. Dong, *Chem. Eng. J.*, 2023, **464**, 142609 .
21. F. Huang, M. Peng, Y. Chen, X. Cai, X. Qin, N. Wang, D. Xiao, L. Jin, G. Wang, X.-D. Wen, H. Liu and D. Ma, *J. Am. Chem. Soc.*, 2022, **144**, 18485–18493.