L-Lysine derived fabrication of Cu@Ni core-satellite nanoassemblies as efficient non-Pt catalysts for methanol oxidation reaction

Anzhou Yang [a,b], *Qiuzi Huang* [b], *Ziqi Wei* [b], *Zehan Yu* [b], *Meifeng Cui* [b], *Wu Lei* [a,*], *Yawen Tang* [b,*], *and Xiaoyu Qiu* [b,*]

[a] School of Chemical Engineering, Nanjing University of Science and Technology, Nanjing 210094, P. R. China

[b] Jiangsu Key Laboratory of New Power Batteries, Jiangsu Collaborative Innovation Center of Biomedical Functional Materials, School of Chemistry and Materials Science, Nanjing Normal University, Nanjing 210023, P. R. China

* Correspondence author:

E-mail: leiwuhao@njust.edu.cn (W. Lei).

tangyawen@njnu.edu.cn (Y. Tang).

07255@njnu.edu.cn (X. Qiu).

Figures

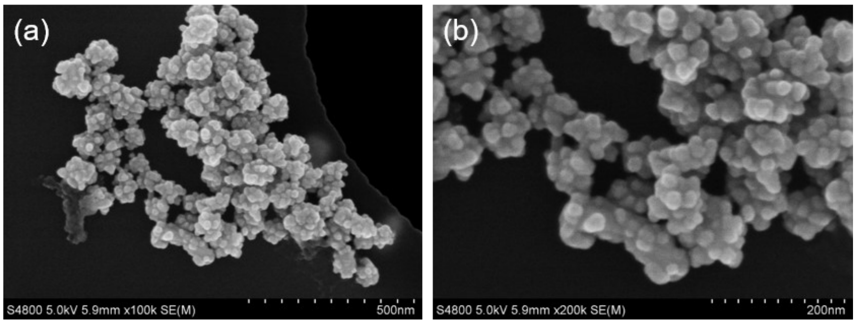

Figure S1. SEM images of Cu@Ni CS-NAs.

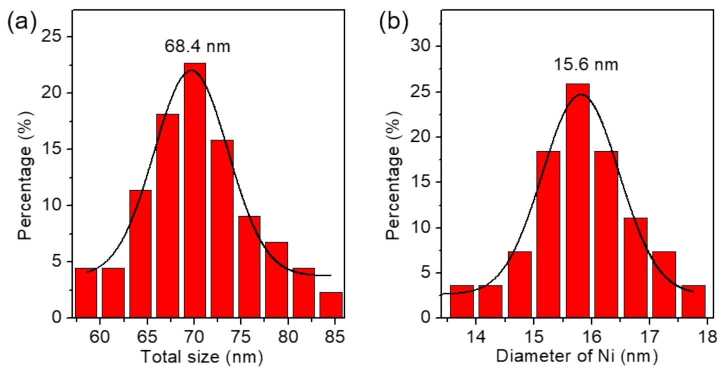

Figure S2. Particle size distribution diagram of (a) total size and (b) surface satellites for Cu@Ni CS-NAs.

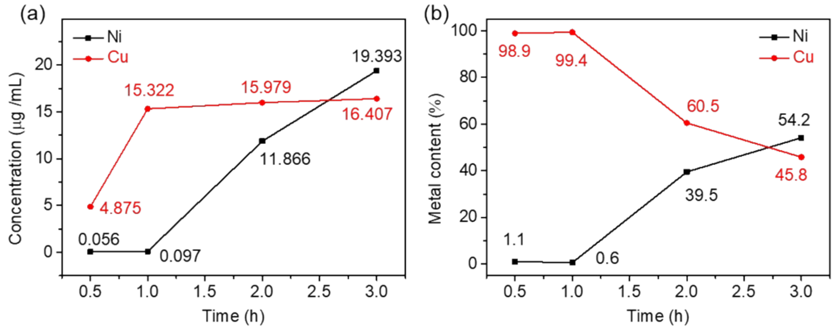

Figure S3. (a) ICP-MS analysis of the products reacted for 0.5 h, 1 h, 2 h, and 3 h, respectively. The as-collected products were dissolved in 20 mL aqua regia and then diluted by deionized water with ratio of 1:6. (b) Metal content analysis.

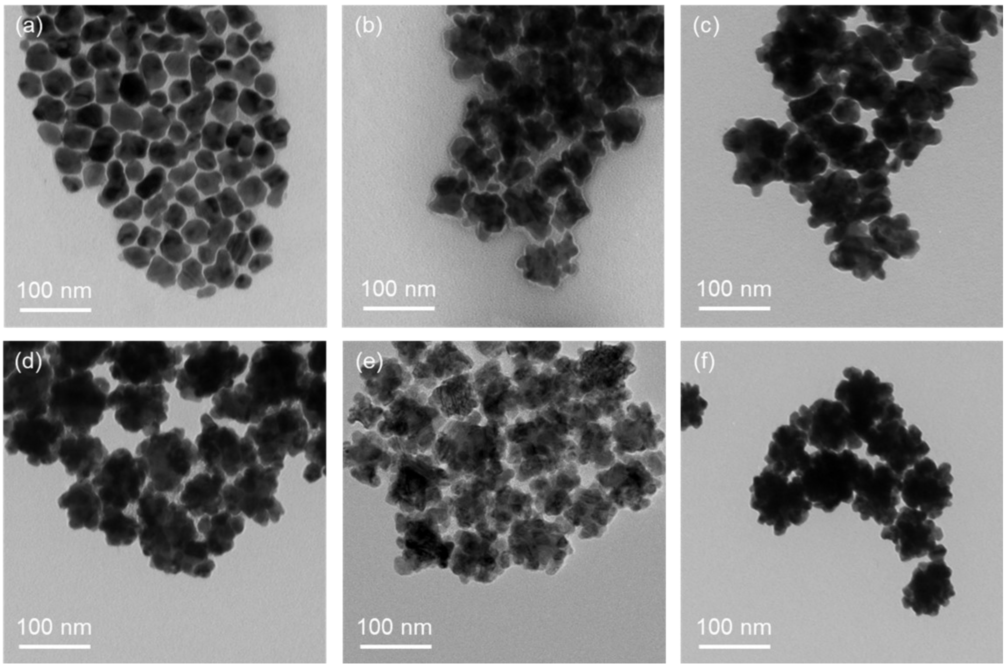

Figure S4. Representative TEM images of products using different dosage of L-lysine. (a) 0 mg, (b) 10 mg, (c) 20 mg, (d) 30 mg, (e) 40 mg, and (f) 50 mg L-lysine.

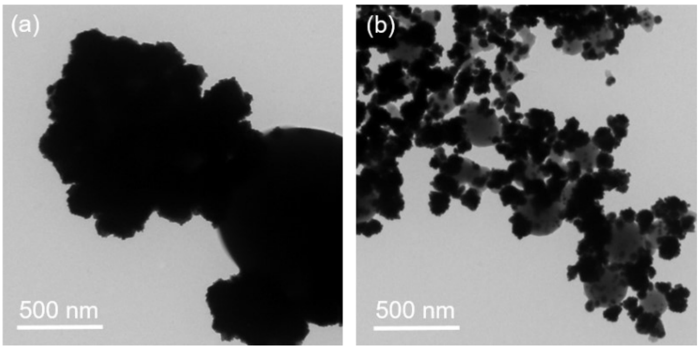

Figure S5. TEM images of the products prepared in the absence of (a) TEG and (b) OAm, respectively.

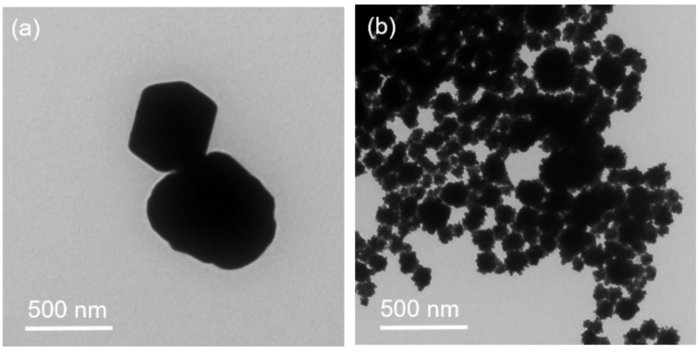

Figure S6. TEM images of (a) pure Cu nanopolyhedrons, and (b) pure Ni nanoparticles.

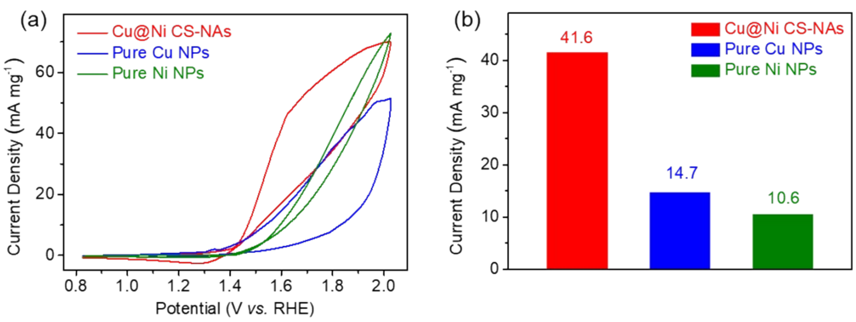

Figure S7. (a) CV curves of the catalysts in 1.0 M KOH + 0.5 M CH_3OH solution at a scan rate of 50 mV s^{-1}. (b) Contrast histogram of mass activity at 1.6 V

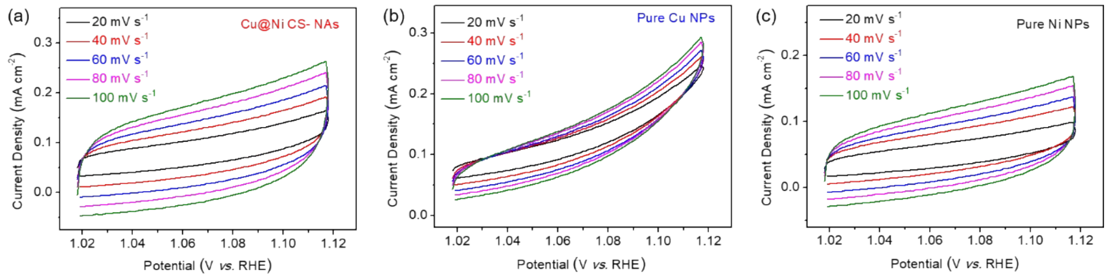

Figure S8. CV curves in the double layer region at different scan rates for (a) Cu@Ni CS-NAs, (b) pure Cu NPs and (c) pure Ni NPs.

Table S1 Comparison of the MOR performance of Cu@Ni CS-NAs with previously reported efficient catalysts in alkaline medium.

Number	Catalyst	Specific activity (mA cm^{-2})	Applied potential	Electrolyte	Ref
1	Cu@Ni CS-NAs	29.6	1.60 V @RHE	1.0 M KOH + 0.5 M CH_3OH	This work
2	Ni-beta-SDS/GC	21	0.77 V @Hg/HgO	0.1 M NaOH + 0.1 M CH_3OH	*J. Mater. Chem. A*, **2015**, *3*, 5811-5814
3	NiO/Ni@CNTs	4.5	0.58 V @Hg/HgO	1.0 M KOH + 1.0 M CH_3OH	*J. Mater. Chem. A*, **2017**, *5*, 9946-9951
4	Ni_2Sn_1	10.8	0.49 V @Hg/HgO	0.5 M KOH + 0.5 M CH_3OH	*Appl. Catal. B: Environ.* **2018**, *234*, 10-18
5	Urchin-like $Ni_1Co_2O_4$	13.5	0.6 V @Ag/AgCl	0.1 M KOH + 0.5 M CH_3OH	*Nanoscale*, **2014**, *6*, 9665-9672
6	$Ni_{60}Nb_{40}$ nanoglass	9.3	0.8 V @Ag/AgCl	0.1 M NaOH + 4.0 M CH_3OH	*ACS Appl. Nano Mater.* **2020**, *3*, 7252-7259
7	$La_{1.4}Sr_{0.6}NiO_{4+\delta}$	3.34	1.59 V @RHE	0.5 M NaOH + 1.5 M CH_3OH	*ACS Appl. Energy Mater.* **2022**, *5*, 503-515
8	CuS	7.7	0.7 V @Ag/AgCl	0.1 M NaOH + 0.5 M CH_3OH	*J. Mater. Chem. A*, **2016**, *4*, 12253-12262
9	$NiCo_2O_4$-rGO	16.6	1.66 V @SHE	1.0 M KOH + 0.5 M CH_3OH	*Electrochim. Acta*, **2016**, *213*, 717-729
10	Ni-MOF/$Ni(OH)_2$ heterocomposite	24.6	0.85 V @Hg/HgO	0.1 M KOH + 1.0 M CH_3OH	*ACS Appl. Mater. Interfaces*, **2021**, *13*, 26472-26481
11	Mn doped $Ni(OH)_2$	16.7	1.55 V @RHE	1.0 M KOH + 0.5 M CH_3OH	*Nano Energy*, **2019**, *55*, 37-41