Electronic Supplementary Material (ESI) for Catalysis Science & Technology.

Supporting Information

Stable Ni Nanocrystals on Porous Single-Crystalline MgO particles for Enhanced Dry Reforming Activity and Durability of CH_4/CO_2

Suning Zhang, [ab] Fangyuan Cheng*[abc] and Kui Xie*[abc]

[a] *College of Chemistry, Fuzhou University, Fuzhou 350108, Fujian, China.*

[b] *Key Laboratory of Design & Assembly of Functional Nanostructures, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou 350002, China.*

[c] *Fujian Science & Technology Innovation Laboratory for Optoelectronic Information of China, Fuzhou, Fujian 350108, China.*

** Corresponding author: cfy@fjirsm.ac.cn (F. Cheng), kxie@fjirsm.ac.cn (K. Xie).*

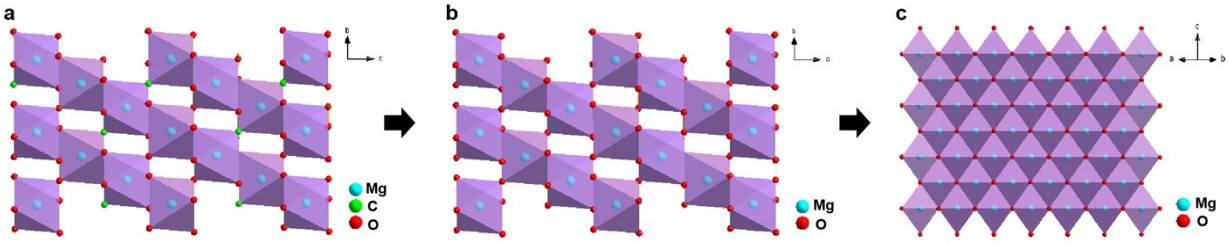

Figure S1. (**a-c**) The growth diagram from SC $MgCO_3$ particles to PSC MgO particles using the lattice reconstruction strategy.

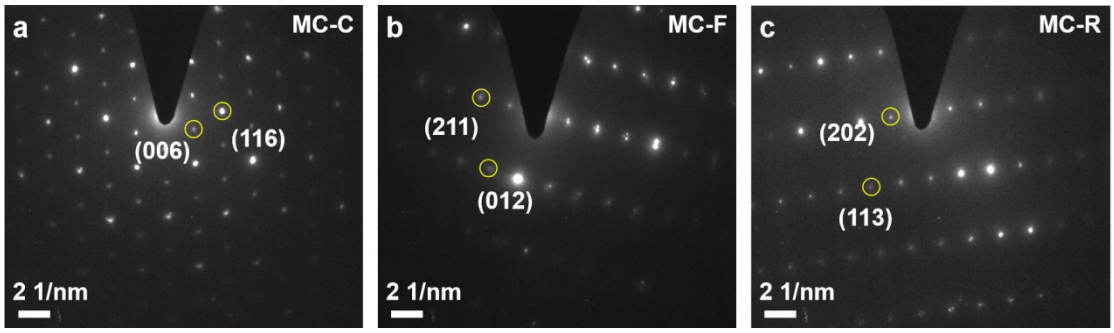

Figure S2. (**a-c**) SAED patterns of MC-C, MC-F and MC-R.

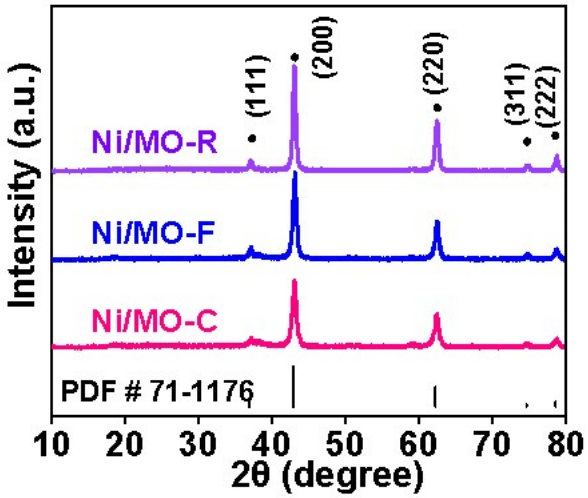

Figure S3. XRD patterns of PSC Ni/MgO particles.

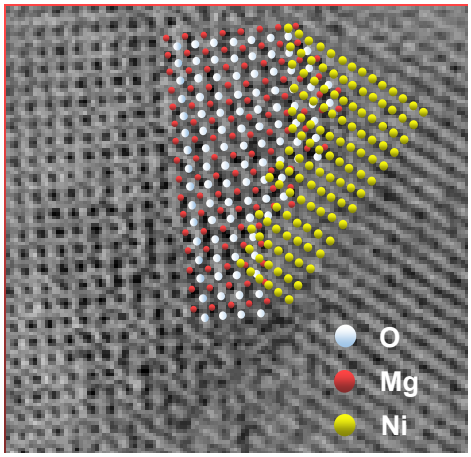

Figure S4. HR-TEM image of PSC Ni/MgO with well-defined interface structure.

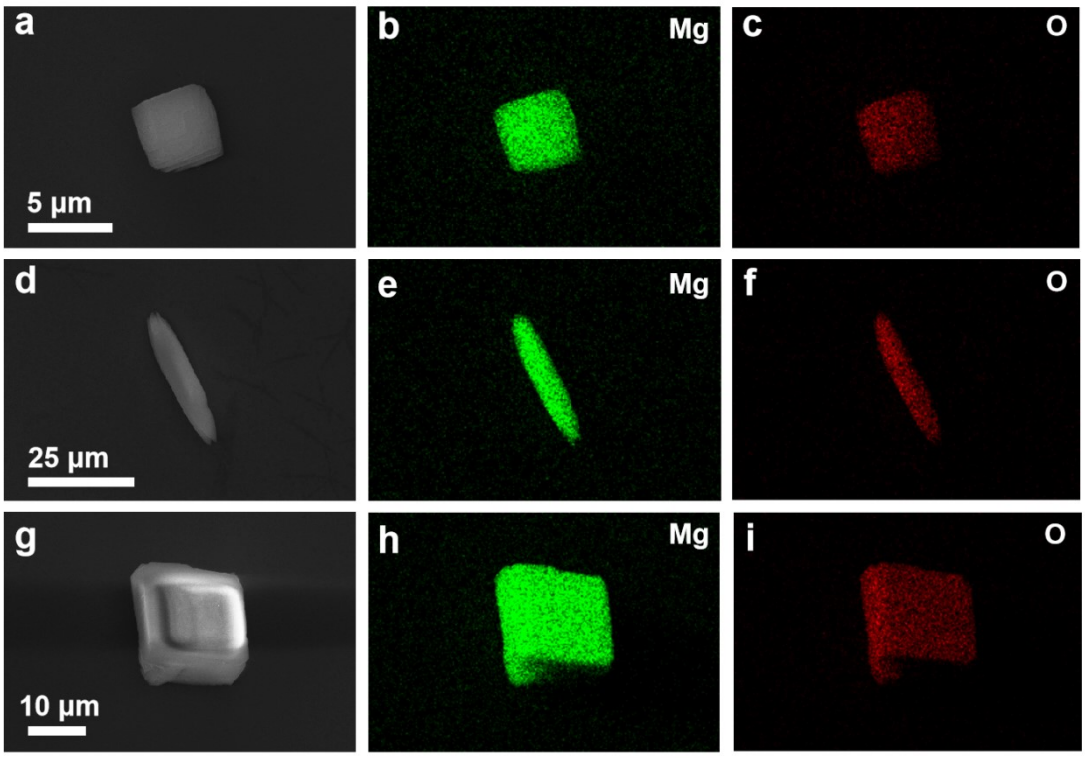

Figure S5. (**a-i**) Element mappings of PSC MgO particles.

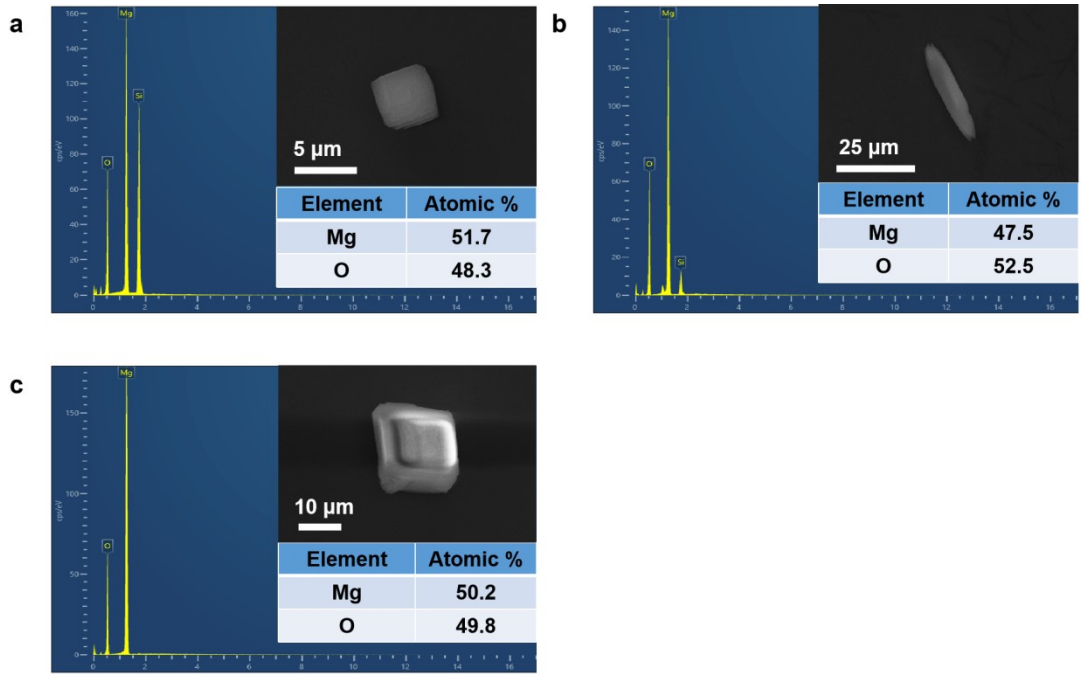

Figure S6. (a-c) EDS test of PSC MgO particles with different morphology.

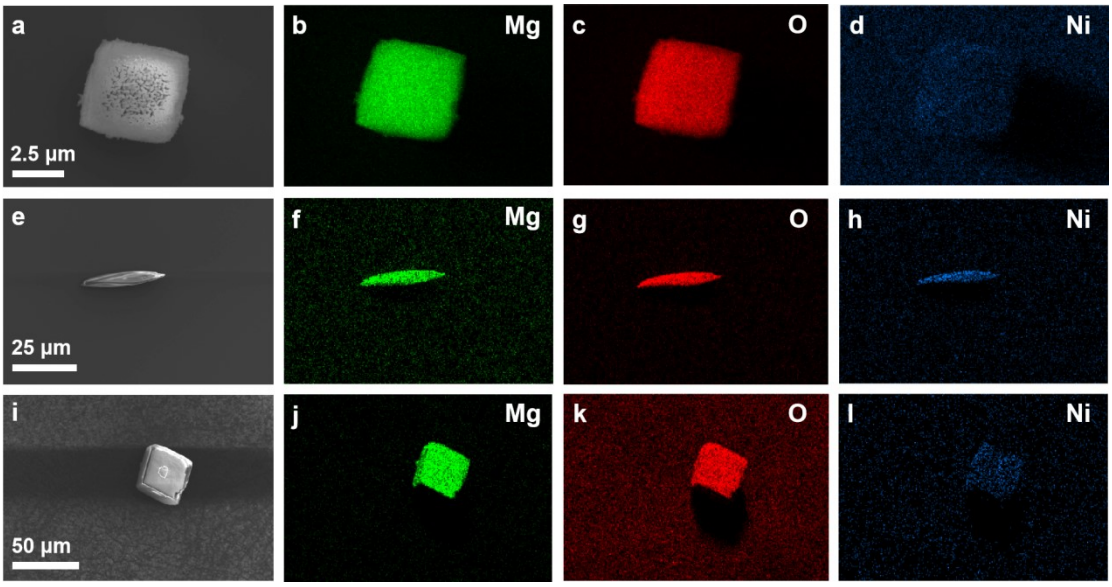

Figure S7. (**a-l**) Element mappings of PSC Ni/MgO particles.

.

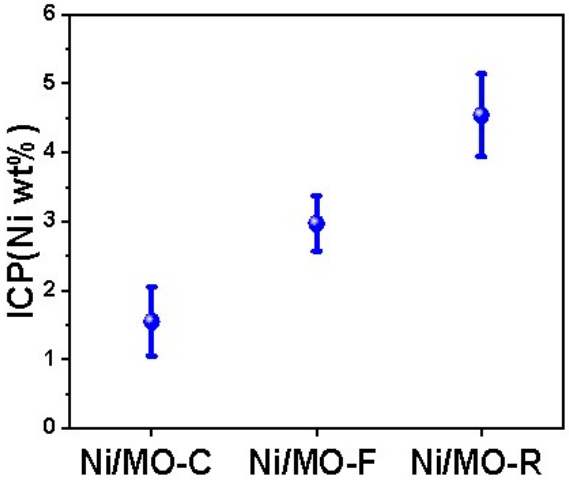

Figure S8. PSC Ni/MgO load with different SC Ni nanoparticle contents.

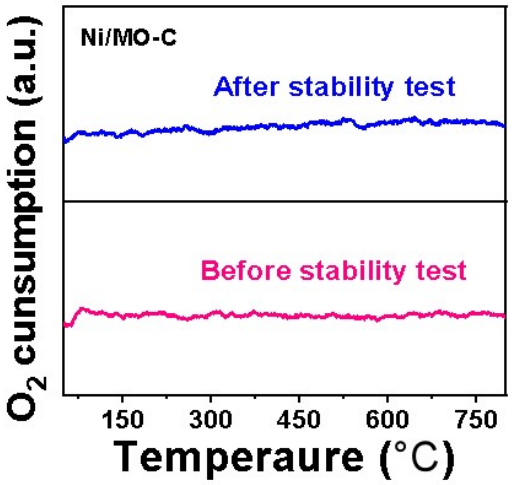

Figure S9. The TPO profiles of PSC Ni/MgO before and after 150 hours of DRM long-term testing at 700 °C.

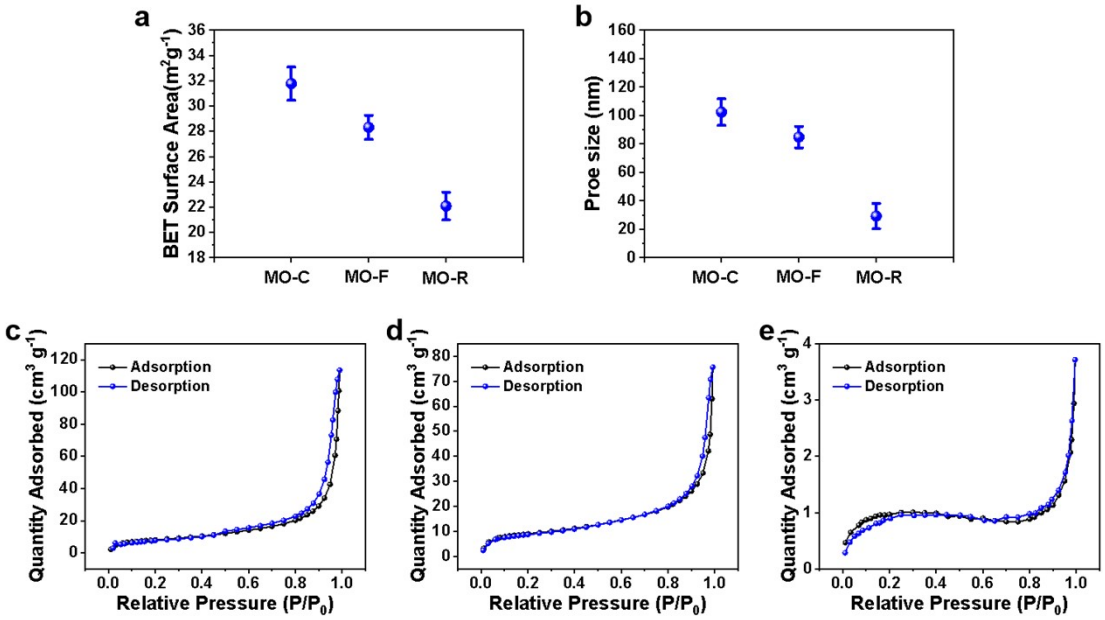

Figure S10. (a-b) BET surface area and BJH average pore size of PSC MgO with different morphologies. **(c-e)** N_2 adsorption-desorption isotherms of MO-C, MO-F, MO-R.

Table S1. The comparison of the performance of dry reforming of CO_2/CH_4 under typical operation conditions.

Catalyst	Gas composition	WHSV ($L \cdot g_{cat}^{-1} h^{-1}$)	Temperature	test time	CH_4 Conversion	CO_2 Conversion	H_2/CO radio	Ref
$Ni/SiO_2@Al_2O_3$	$CH_4/CO_2/N_2$= 1:1:0.2	12	800 °C	100h	62.8%	82.3%	0.82	[1]
Ni/MgO-SiO_2	CH_4/CO_2/Ar= 1:1:1	18	700 °C	50h	88%	92%	0.75	[2]
NiMo/MgO	CH_4/CO_2/Ar= 1:1:8	60	800 °C	850h	100%	100%	1	[3]
$Ni_3GaC_{0.25}$	$CH_4/CO_2/N_2$= 1:1:1	54	600 °C	72h	48%	52%	-	[4]
Ni/MgO	CH_4/CO_2/Ar= 1:1:2	80	800 °C	40h	72%	-	0.84	[5]
Ni/MgO-ZrO_2	CH_4/CO_2=1:1.2	60	800 °C	50h	90.5%	-	1.6	[6]
Ni/MgO (M-1)	CH_4/CO_2/Ar= 1:1:8	24	700 °C	150h	≥95%	≥96%	0.99	This work
Ni/MgO (M-2)	CH_4/CO_2/Ar= 1:1:8	24	700 °C	150h	≥90%	≥92%	0.96	This work
Ni/MgO (M-3)	CH_4/CO_2/Ar= 1:1:8	24	700 °C	150h	≥81%	≥89%	0.92	This work

References

[1]. J. W. Han, J. S. Park, M. S. Choi and H. Lee, Applied Catalysis B: Environmental, 2017, 203, 625-632.

[2]. Q. Zhang, X. Feng, J. Liu, L. Zhao, X. Song, P. Zhang and L. Gao, International Journal of Hydrogen Energy, 2018, 43, 11056-11068.

[3]. Y. Song, E. Ozdemir, S. Ramesh, A. Adishev, S. Subramanian, A. Harale, M. Albuali, B. A. Fadhel, A. Jamal and D. Moon, Science, 2020, 367, 777-781.

[4]. K. Y. Kim, J. H. Lee, H. Lee, W. Y. Noh, E. H. Kim, E. C. Ra, S. K. Kim, K. An and J. S. Lee, ACS Catalysis, 2021, 11, 11091-11102.

[5]. Y. Fu, W. Kong, B. Pan, C. Yuan, S. Li, H. Zhu and J. Zhang, Journal of the Energy Institute, 2022, 105, 214-220.

[6]. B.-J. Kim, H.-R. Park, Y.-L. Lee, S.-Y. Ahn, K.-J. Kim, G.-R. Hong and H.-S. Roh, Journal of CO_2 Utilization, 2023, 68.