

**Preparation of Ni based mesoporous Al<sub>2</sub>O<sub>3</sub> catalyst with enhanced CO<sub>2</sub>  
methanation performance**

Jianghui Lin<sup>1†</sup>, Caiping Ma<sup>2,3†</sup>, Luo Jing<sup>4</sup>, Xianghui Kong<sup>1</sup>, Yanfei Xu<sup>1</sup>, Guangyuan Ma<sup>1</sup>, Jie Wang<sup>1</sup>, Chenghua Zhang<sup>5\*</sup>, Zhengfeng Li<sup>1</sup>, Mingyue Ding<sup>1,6\*</sup>

*<sup>1</sup>School of Power and Mechanical Engineering, Hubei International Scientific and Technological Cooperation Base of Sustainable Resource and Energy, Wuhan University, Wuhan 430072, China*

*<sup>2</sup>State Key Laboratory of Coal Conversion, Institute of Coal Chemistry, Chinese Academy of Sciences, Taiyuan 030001, China*

*<sup>3</sup>University of Chinese Academy of Sciences, Beijing 100049, China*

*<sup>4</sup>Xiamen Tobacco Industrial CO., LTD, Xiamen 361022, China*

*<sup>5</sup>Synfuels China Co. Ltd., Beijing 101407, China*

*<sup>6</sup>Key Laboratory of Advanced Energy Materials Chemistry (Ministry of Education), Nankai University, Tianjin 300071, China*

†These authors contributed equally to this work.

\*Corresponding author

E-mail address: [dingmy@whu.edu.cn](mailto:dingmy@whu.edu.cn) (Mingyue Ding); [zhangchh@sxicc.ac.cn](mailto:zhangchh@sxicc.ac.cn)

(Chenghua Zhang).

---

---

**Table 1s** Comparison of catalysts with different pore sizes

Catalysts	$S_{\text{BET}}^{\text{a}}$ ( $\text{m}^2 \cdot \text{g}^{-1}$ )	$D_{\text{p}}^{\text{b}}$ (nm)	$\text{CO}_2^{\text{c}}$ con. (%)	$\text{CH}_4^{\text{c}}$ sel. (%)	Ref
25Ni/MA	237.0	3.1	77.2	99.9	This paper
25Ni/CA	166.2	4.7	72.6	99.5	This paper
25Ni/ $\text{Al}_2\text{O}_3$	188.3	8.1	73.0	99.0	1

a Surface area of the support.

b Pore diameter of the support.

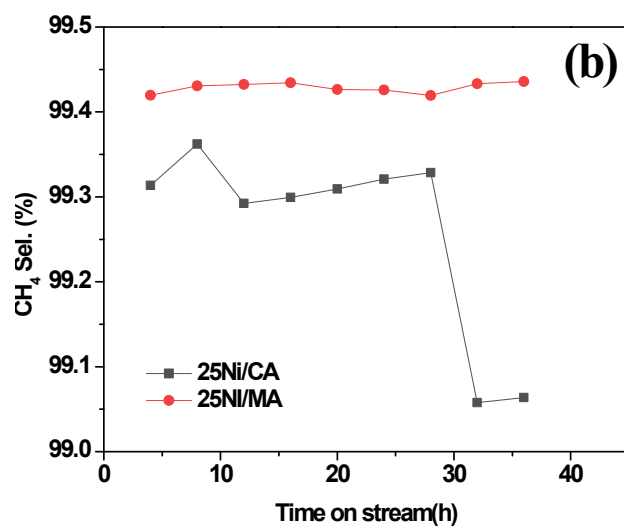
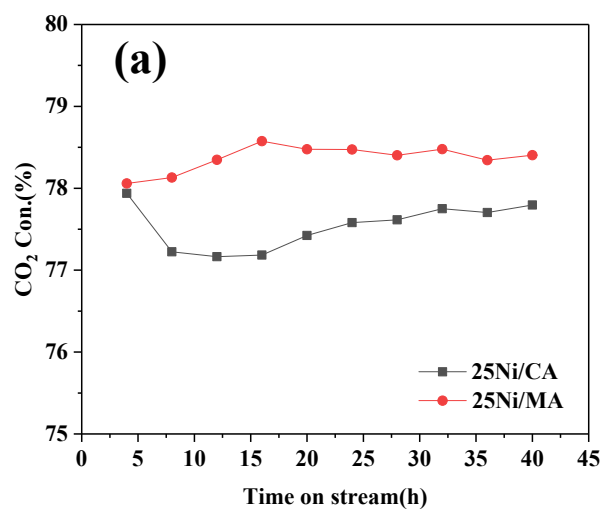
c The reaction temperature is 350-360 °C.

---

**Table 2s** Comparison of as-prepared catalyst and other typical catalysts for CO<sub>2</sub>

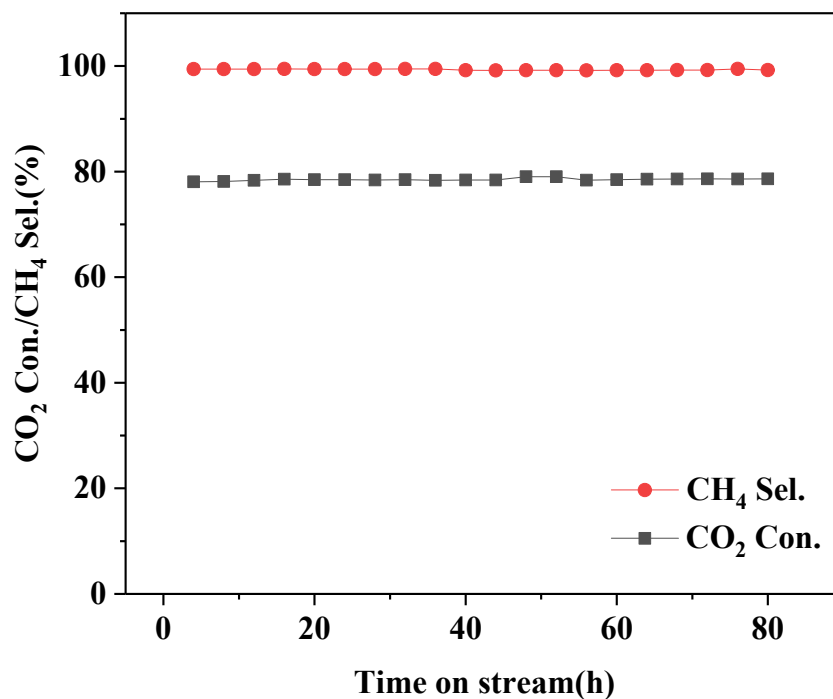
methanation

Catalysts	T/°C	P/atm	CO <sub>2</sub> con./%	CH <sub>4</sub> sel./%	Ref.
Ni/CA	380	1.0	73.6	99.4	This paper
Ni/MA	360	1.0	77.2	99.9	This paper
Ni/Al <sub>2</sub> O <sub>3</sub>	400	—	70.5	69.5	2
Ni/SiO <sub>2</sub>	400	—	67.5	65.5	2
Ni/TiO <sub>2</sub>	450	1.0	64.0	97.5	3
Ni/MgO	450	1.0	60.0	96.5	3
Ni/CeO <sub>2</sub> -ZrO <sub>2</sub>	350	1.0	67.9	98.4	4



**Fig. 1s** Deactivation test of the 25Ni/CA and 25Ni/MA catalyst at 400 °C, GHSV =

6000 ml·g<sup>-1</sup>·h<sup>-1</sup>, H<sub>2</sub>/CO<sub>2</sub> = 4, 1 atm.



**Fig. 2s** Reusability test of the 25Ni/MA catalyst at 400 °C, GHSV = 6000 ml·g<sup>-1</sup>·h<sup>-1</sup>,  
H<sub>2</sub>/CO<sub>2</sub> = 4, 1atm.

## References

- 1 S. Rahmani, M. Rezaei and F. Meshkani, *J. Ind. Eng. Chem.*, 2014, **20**, 1346-1352.
- 2 X. Guo, A. Traitangwong, M. Hu, C. Zuo, V. Meeyoo, Z. Peng and C. Li, *Energy and Fuels*, 2018, **32**, 3681-3689.
- 3 S. Tada, T. Shimizu, H. Kameyama, T. Haneda and R. Kikuchi, *Int. J. Hydrogen Energy*, 2012, **37**, 5527-5531.
- 4 P. A. U. Aldana, F. Ocampo, K. Kobl, B. Louis, F. Thibault-Starzyk, M. Daturi, P. Bazin, S. Thomas and A. C. Roger, *Catal. Today*, 2013, **215**, 201-207.