

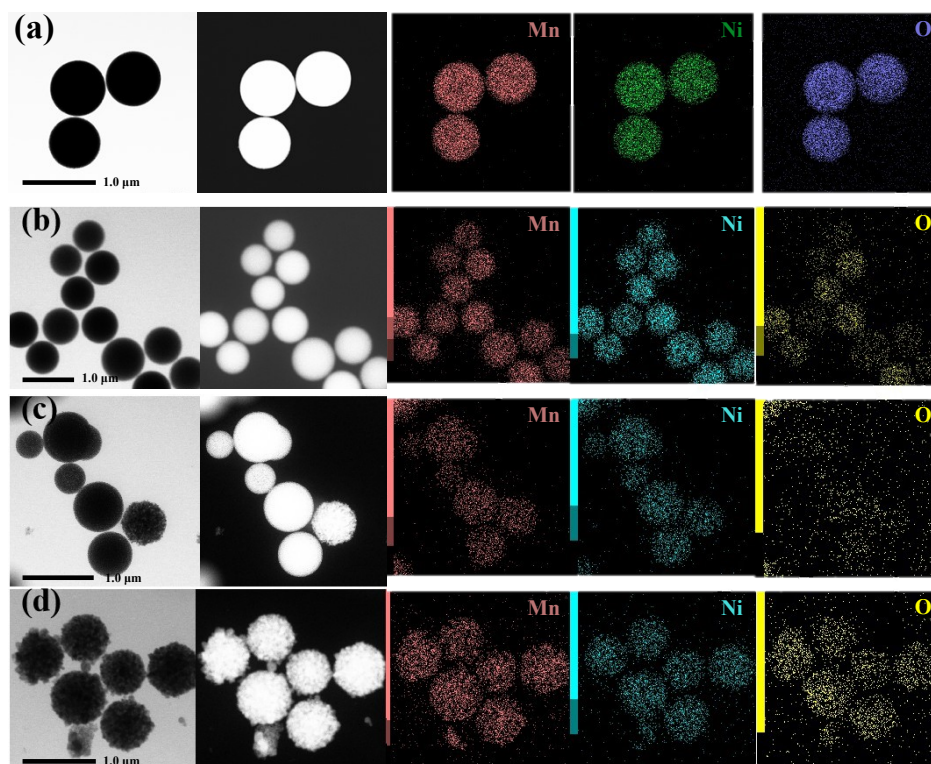
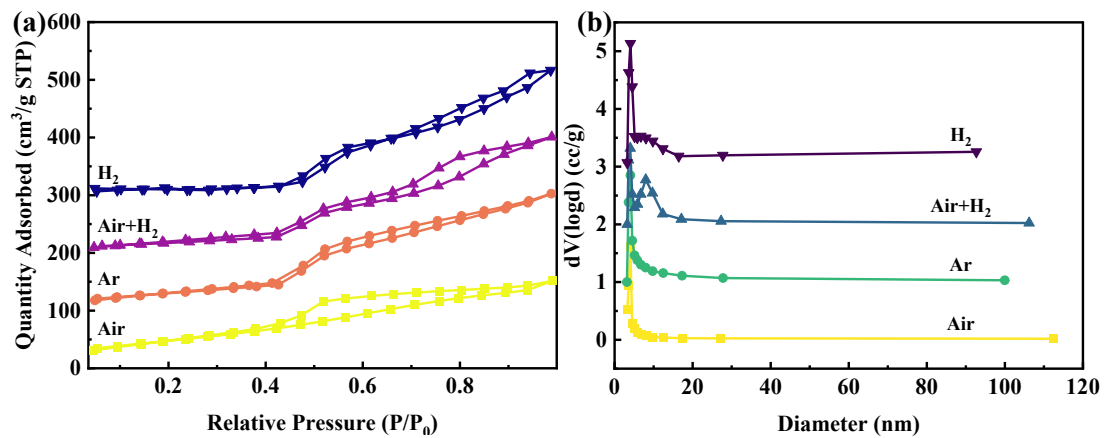


Fig. S1 TEM images and EDS mapping of catalysts after calcination in different atmospheres: (a) NMO-Air, (b) NMO-Ar, (c) NMO-Air+H₂, and (d) NMO-H₂.



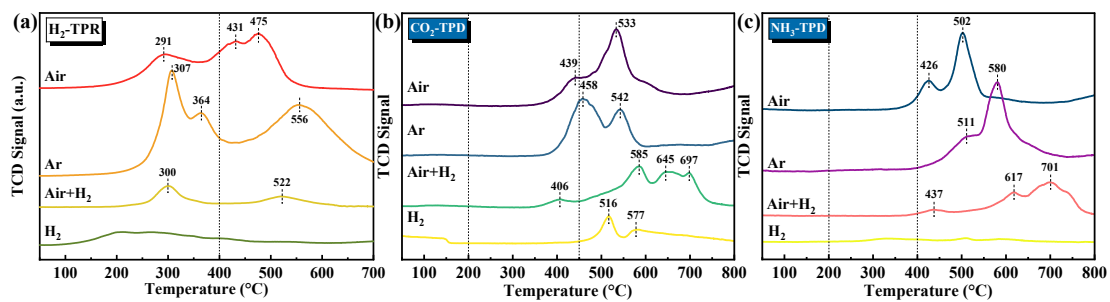
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6 **Fig. S2** (a) The N₂ adsorption-desorption isotherms and (b) pore diameter distribution

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curves.

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10 **Fig. S3** (a) H₂-TPR, (b) CO₂-TPD, and (c) NH₃-TPD of catalysts after calcination in

11 different atmospheres.

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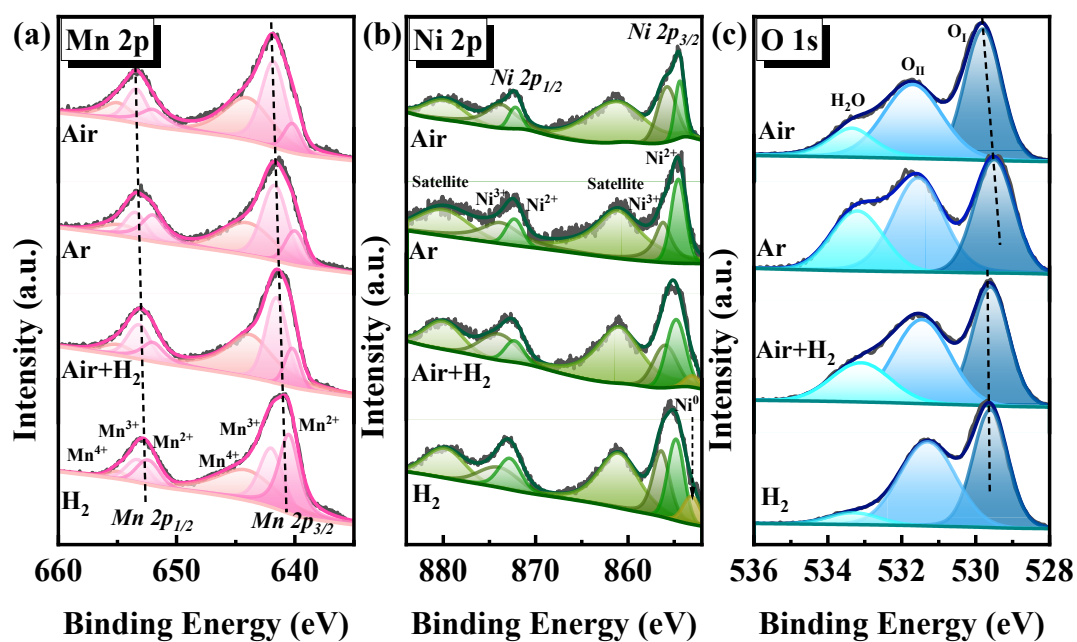


Fig. S4 XPS spectra of as-prepared catalysts: (a) Mn 2p, (b) Ni 2p, and (c) O 1 s.

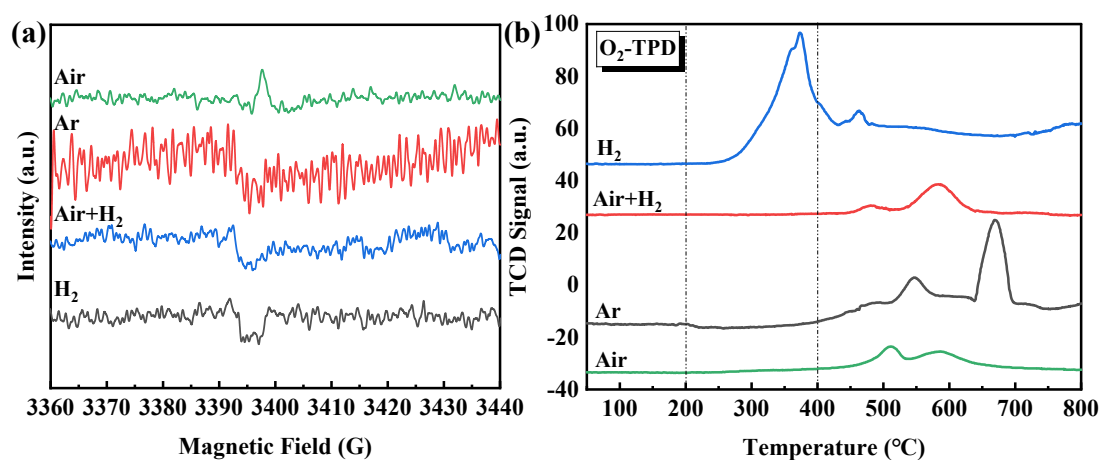
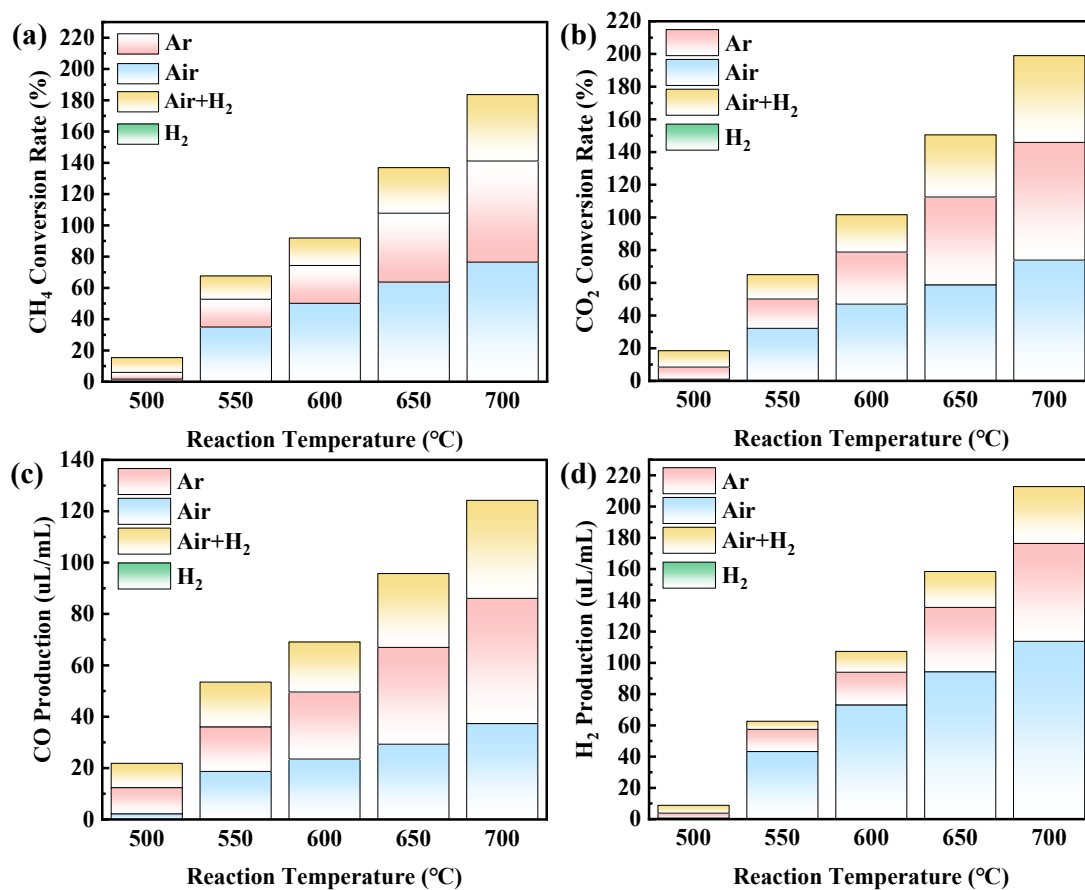


Fig. S5 The (a) low-temperature EPR and (b) O₂-TPD of materials.



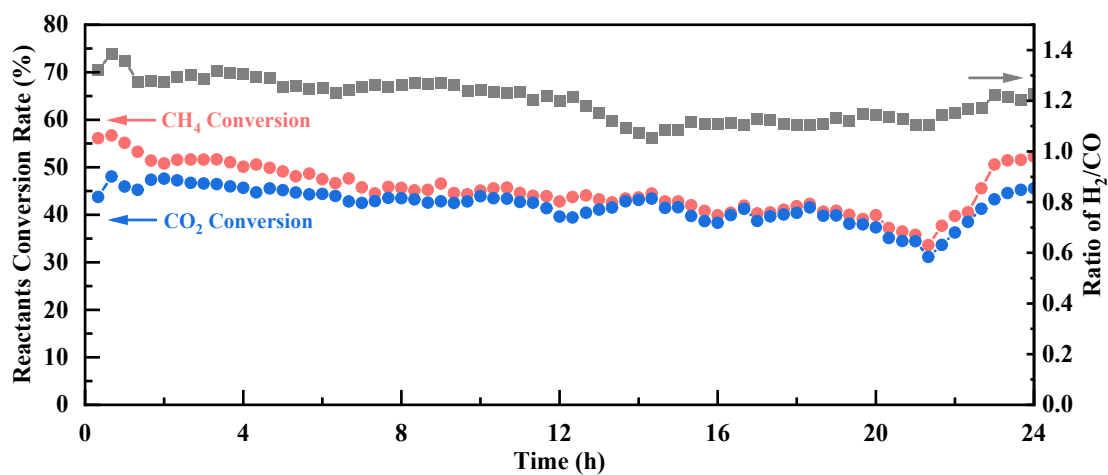
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20 **Fig. S6** The DRM activity: (a) CH₄ conversion rate, (b) CO₂ conversion rate, (c) CO

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production, and (d) H₂ production.

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24 **Fig. S7** the DRM reaction stability of NMO-Air under 600 °C for 24 h. Flow rate: 30

25 30 mL min⁻¹ (CH₄/CO₂/Ar=1/1/3), catalyst quality: 50 mg.

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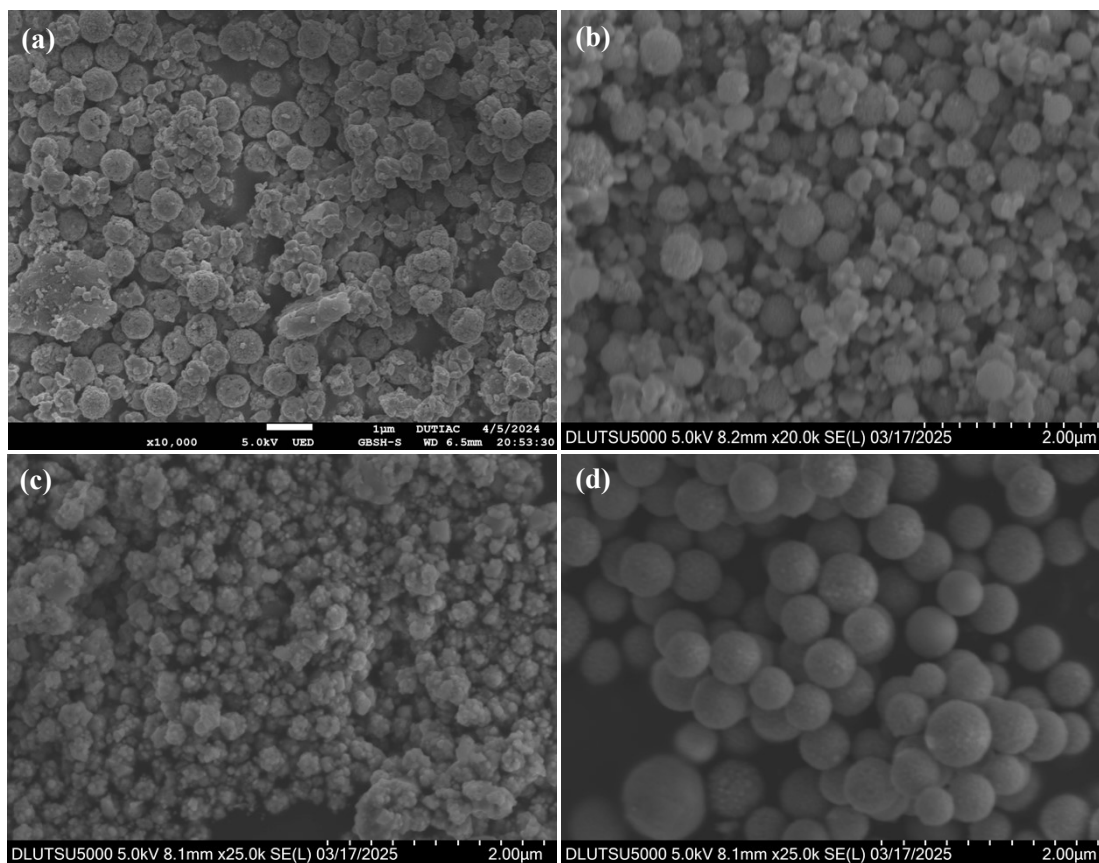


Fig. S8 The SEM images after reaction: (a) NMO-Air, (b) NMO-Ar, (c) NMO-Air+H₂, and (d) NMO-H₂.