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Supporting Materials

Revealing the dynamic formation mechanism of porous Mo_2C: an *in-situ* TEM study

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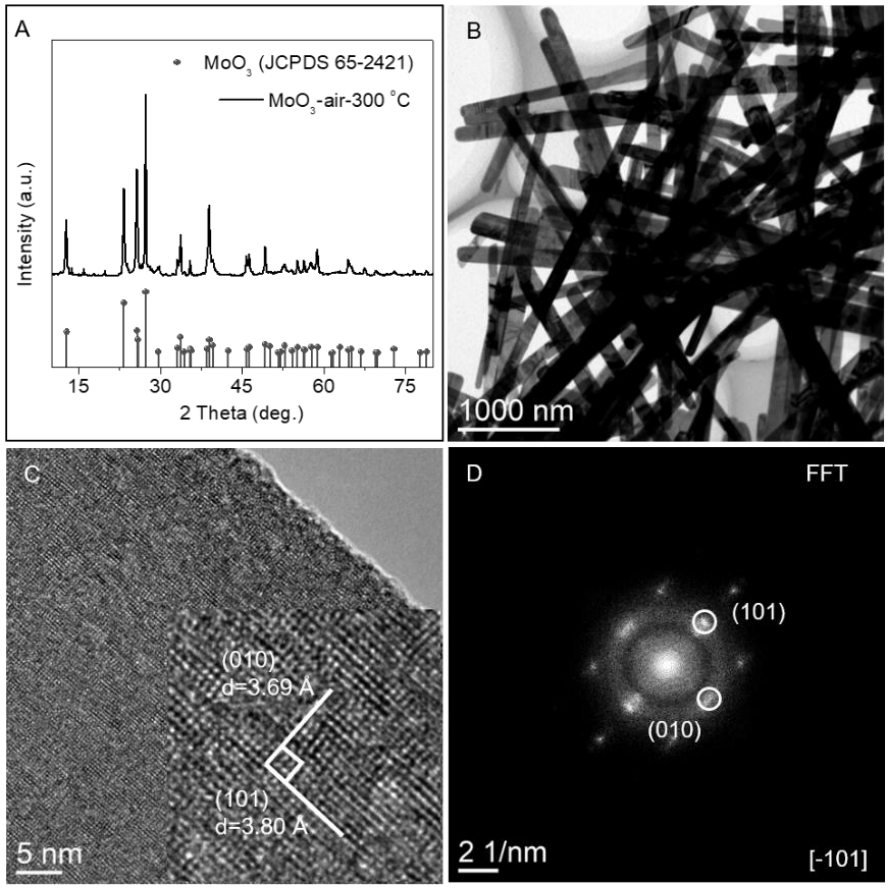
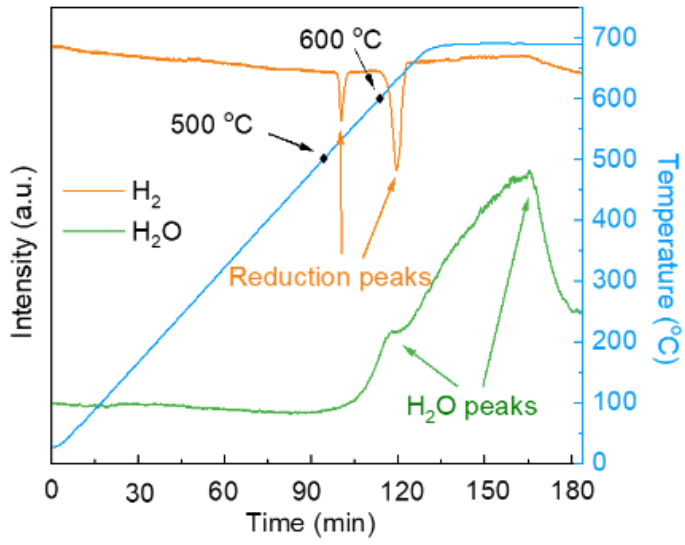
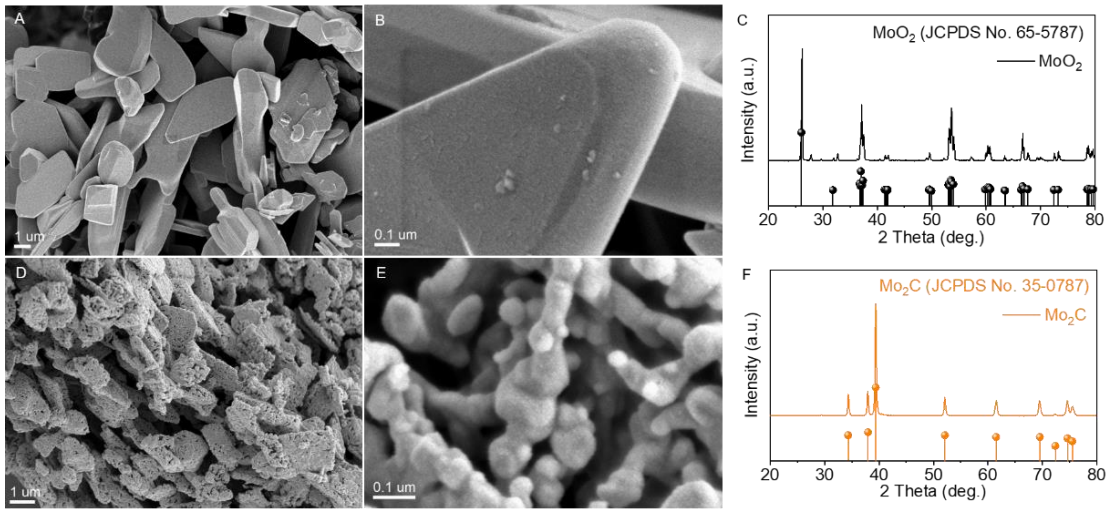


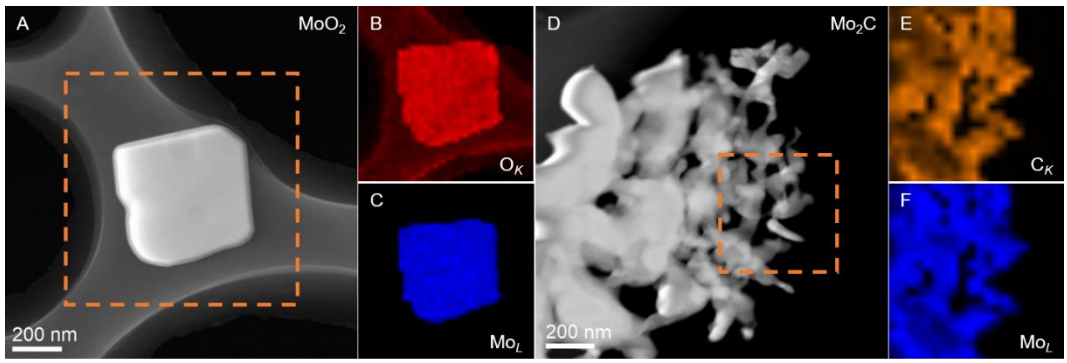
Supplementary Figure 1. Typical XRD pattern (A), low-magnification TEM (B), HRTEM (C) images of MoO_3 nanobelts after calcination in air, and the local FFT (D) of the enlarge part in (C).



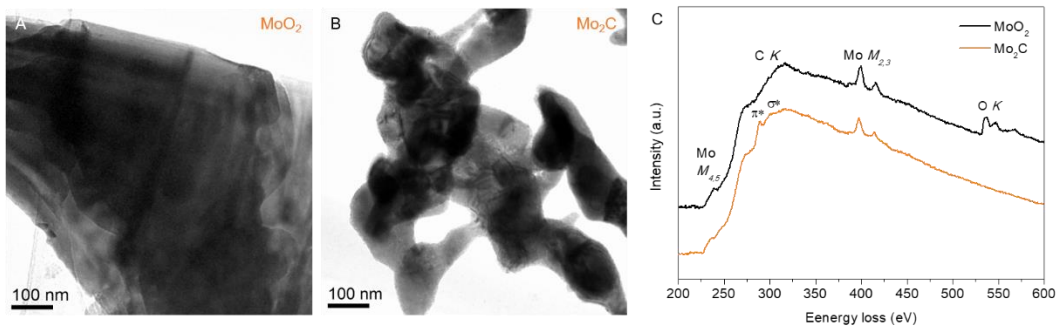
Supplementary Figure 2. TPSR profiles of the carbonization process under 20 vol.% CH_4/H_2 atmosphere.



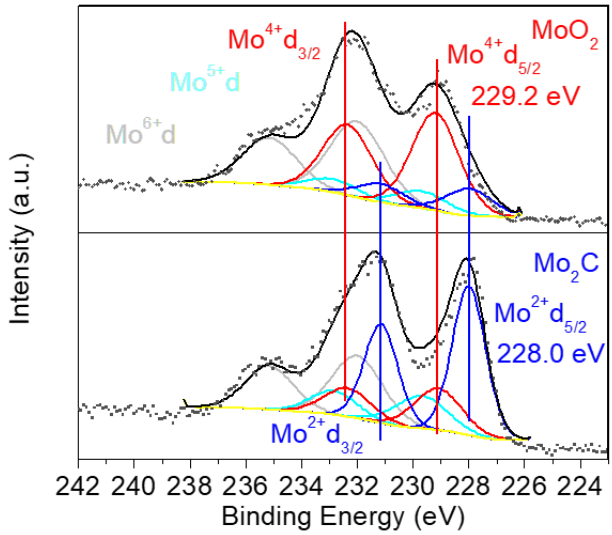
Supplementary Figure 3. SEM images and XRD patterns of MoO_2 (A-C) and Mo_2C (D-F) samples, respectively.



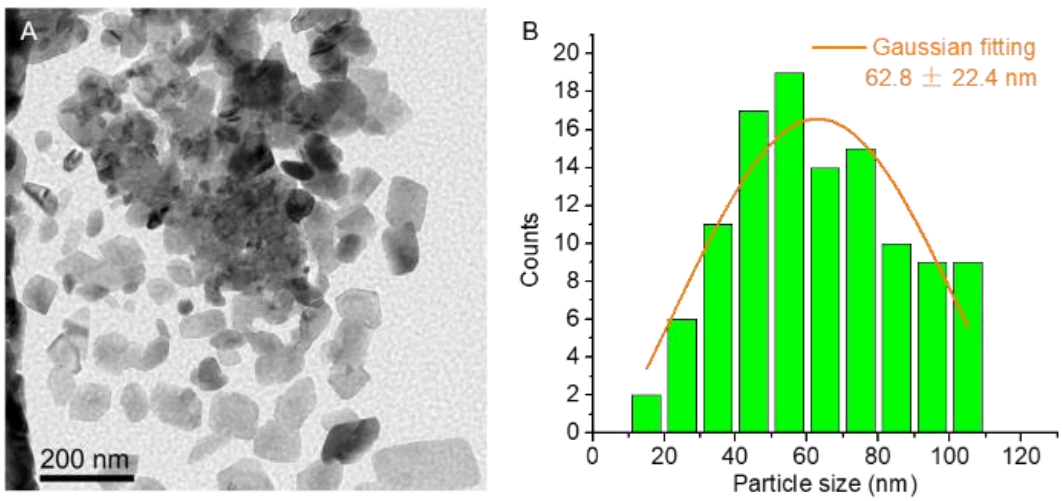
Supplementary Figure 4. STEM images and EDX elemental maps of MoO_2 (A-C) and Mo_2C (D-F) samples, respectively.



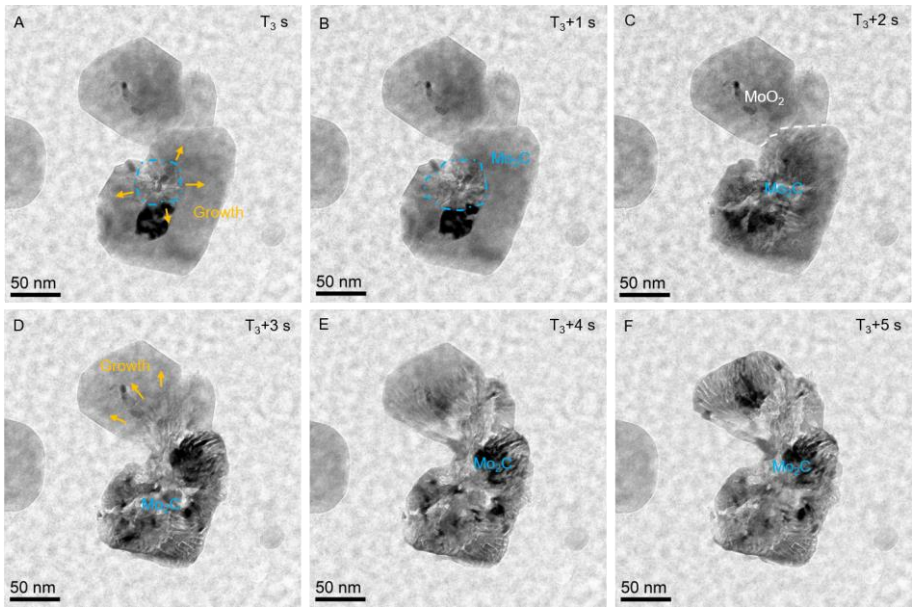
Supplementary Figure 5. TEM images of MoO_2 (A) and Mo_2C (B). (C) EEL spectra of MoO_2 and Mo_2C samples.



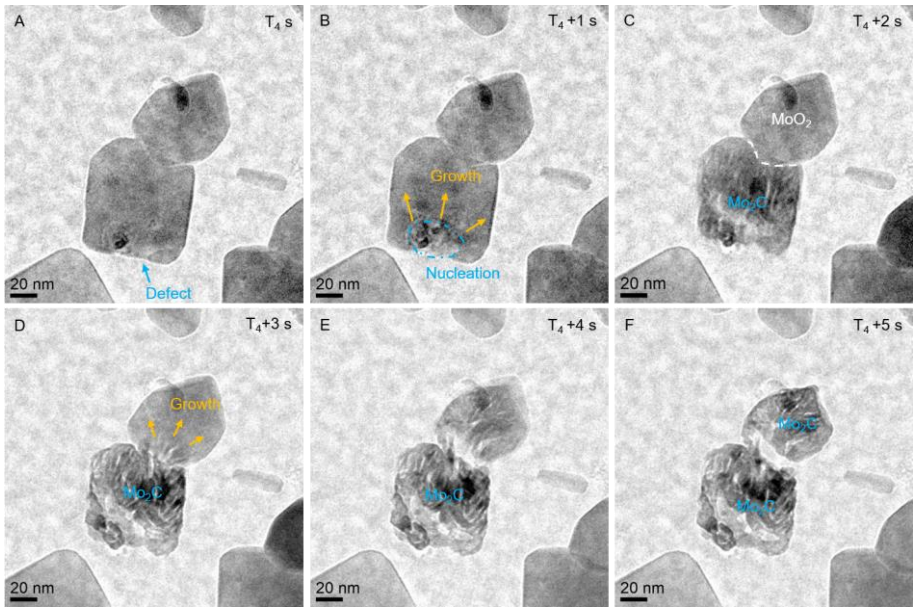
Supplementary Figure 6. Mo 3d XPS spectra of MoO_2 and Mo_2C samples.



Supplementary Figure 7. *In-situ* TEM image (A) of MoO_2 and the corresponding PSD histogram (B) under 20 vol.% CH_4/H_2 atmosphere at 600 °C.

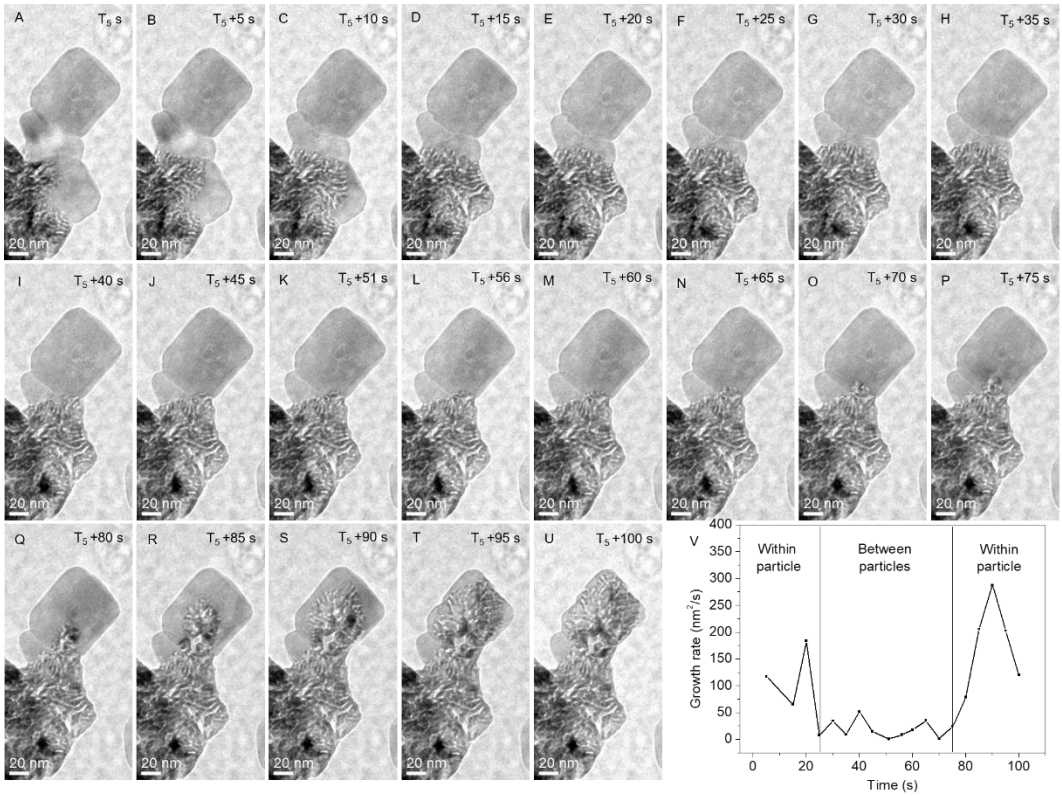


Supplementary Figure 8. *In-situ* TEM images of the structural evolution of adjacent MoO_2 NPs to Mo_2C nanocrystals under 20 vol.% CH_4/H_2 atmosphere at 700 °C.

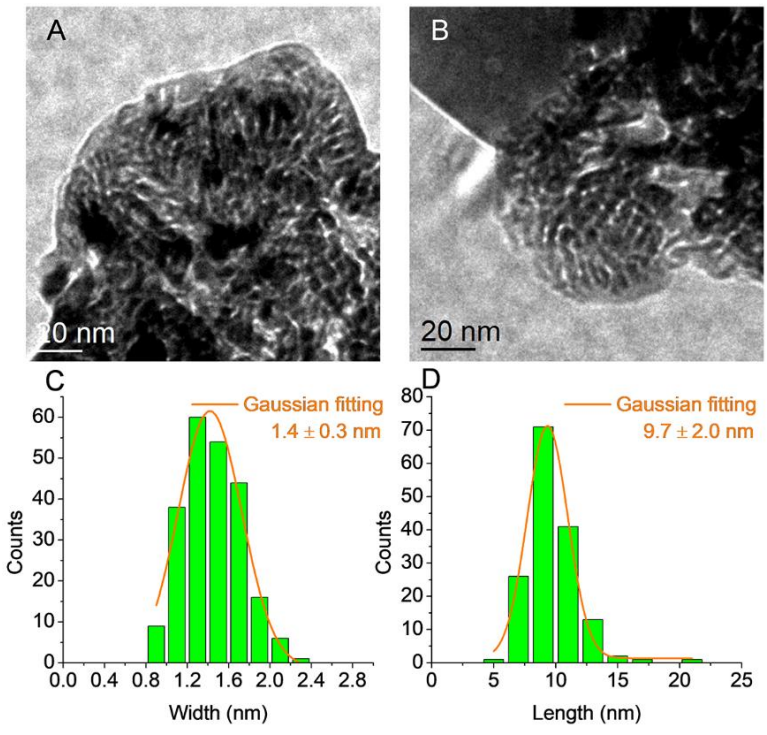


Supplementary Figure 9. *In-situ* TEM images of the structural evolution of adjacent MoO_2 NPs to Mo_2C nanocrystals under 20 vol.% CH_4/H_2 atmosphere at 700 °C.

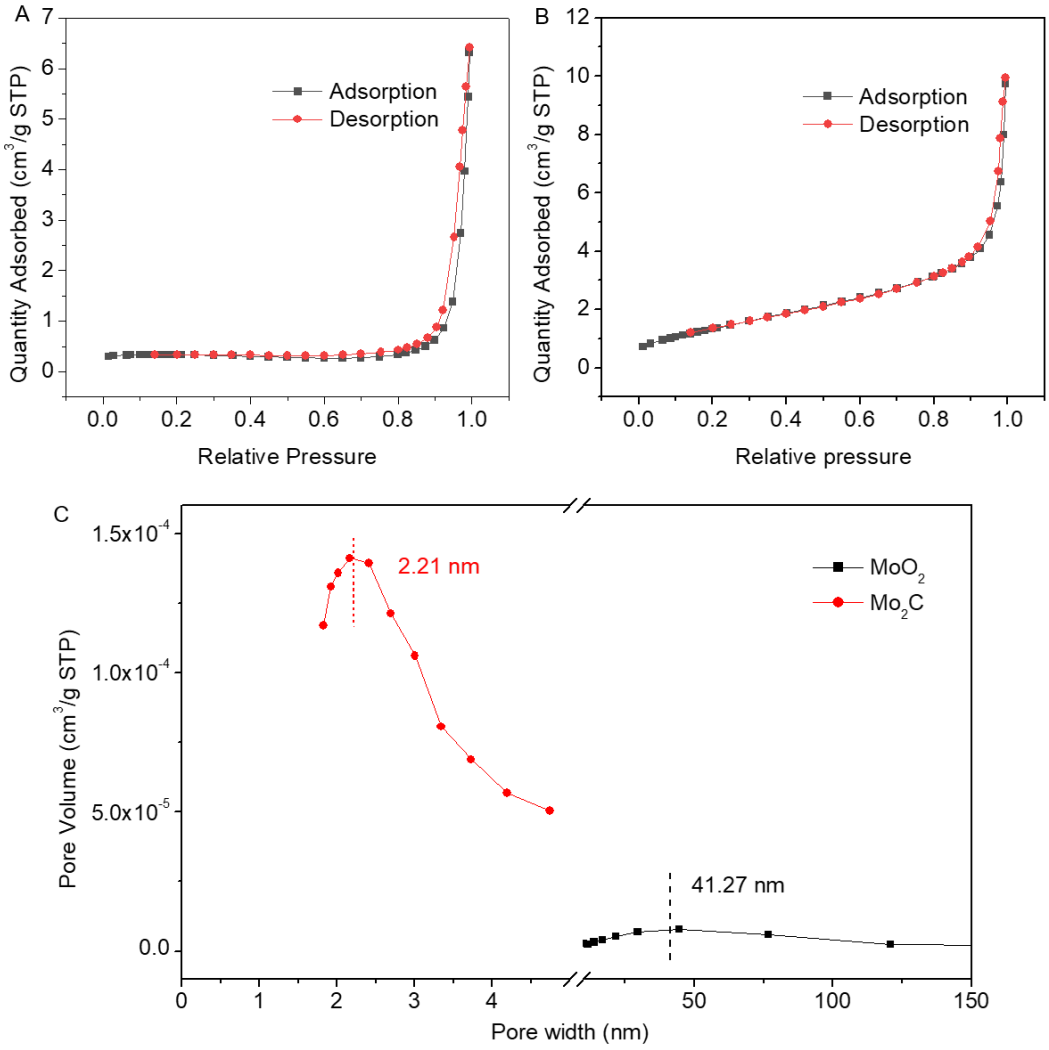
Supplementary Figure 10. *In-situ* TEM images regarding the growth process on Mo_2C within and between MoO_2 NPs under 20 vol.% CH_4/H_2 atmosphere at 700 °C.



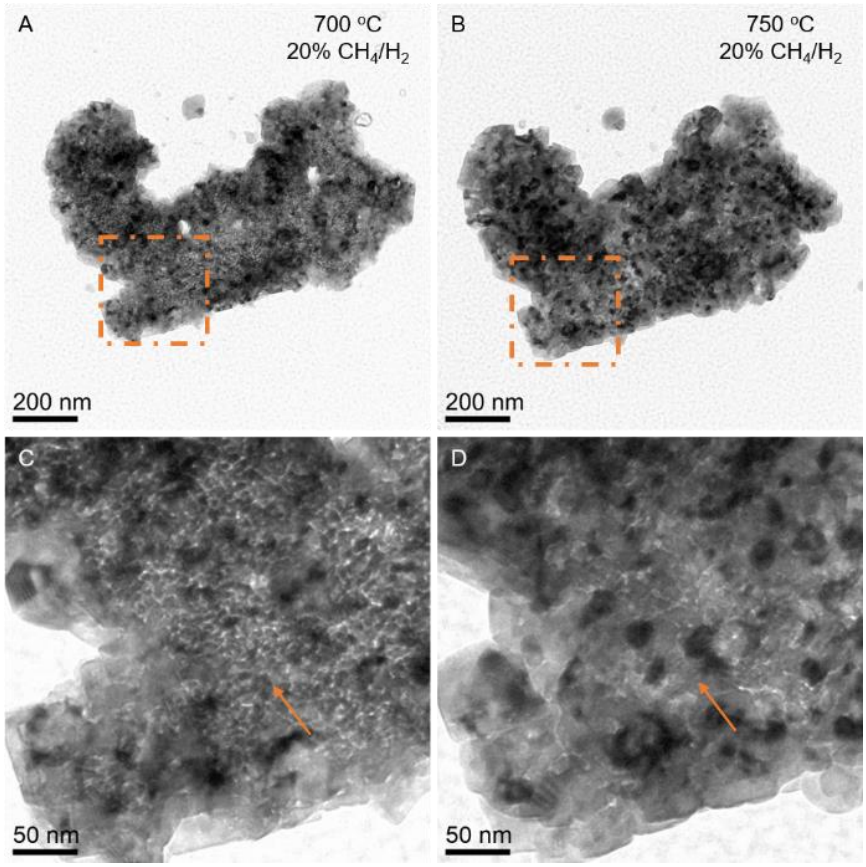
Supplementary Figure 11. *In-situ* TEM images regarding the growth rate on Mo_2C within and between MoO_2 NPs under 20 vol.% CH_4/H_2 atmosphere at 700 °C.



Supplementary Figure 12. *In-situ* TEM images (A, B) and statistical analysis of pore width (C) and length (D) of Mo_2C.



Supplementary Figure 13. N_2 adsorption/desorption isotherms of MoO_2 (A) and Mo_2C (B) samples. (C) The pore size distributions of MoO_2 and Mo_2C samples.



Supplementary Figure 14. *In-situ* TEM images of Mo_2C sample under 20 vol.% CH_4/H_2 atmosphere at 700 °C (A) and 750 °C (B). (C, D) Enlarged TEM images from the dashed boxes in (A) and (B).