

Supplementary Information for

Yttrium oxide modified Cu/ZnO/Al₂O₃ catalysts via hydrotalcite-like precursors for the CO₂ hydrogenation reaction to methanol

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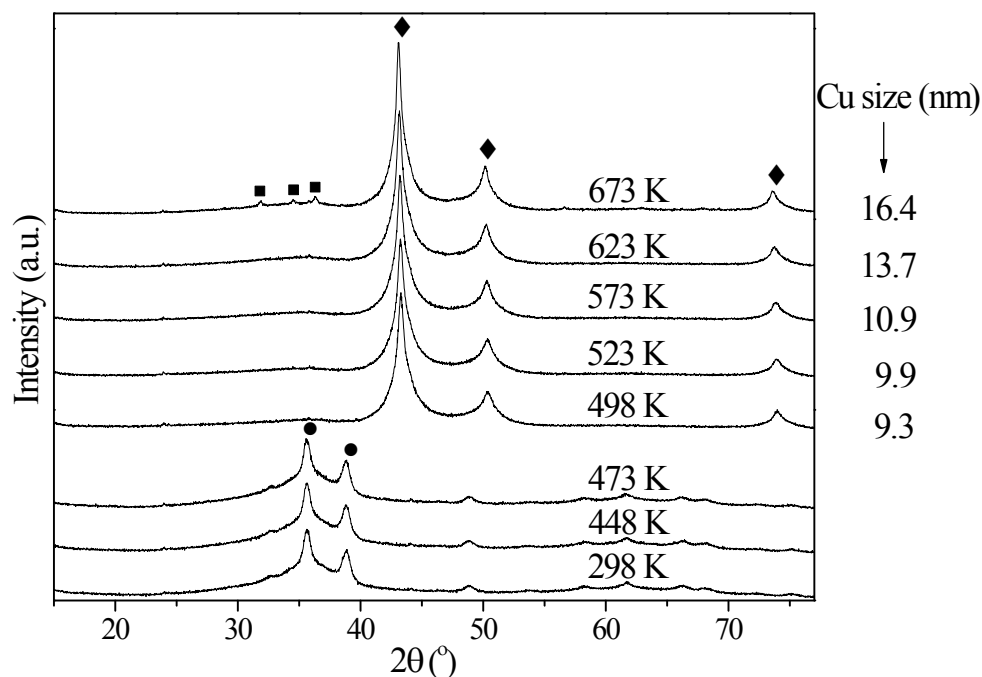


Fig. S1 *In situ* XRD patterns collected during the reduction process of CHT-Y0 in 5% H₂/He from 298 to 673 K. (●) CuO; (◆)Cu; (■) ZnO.

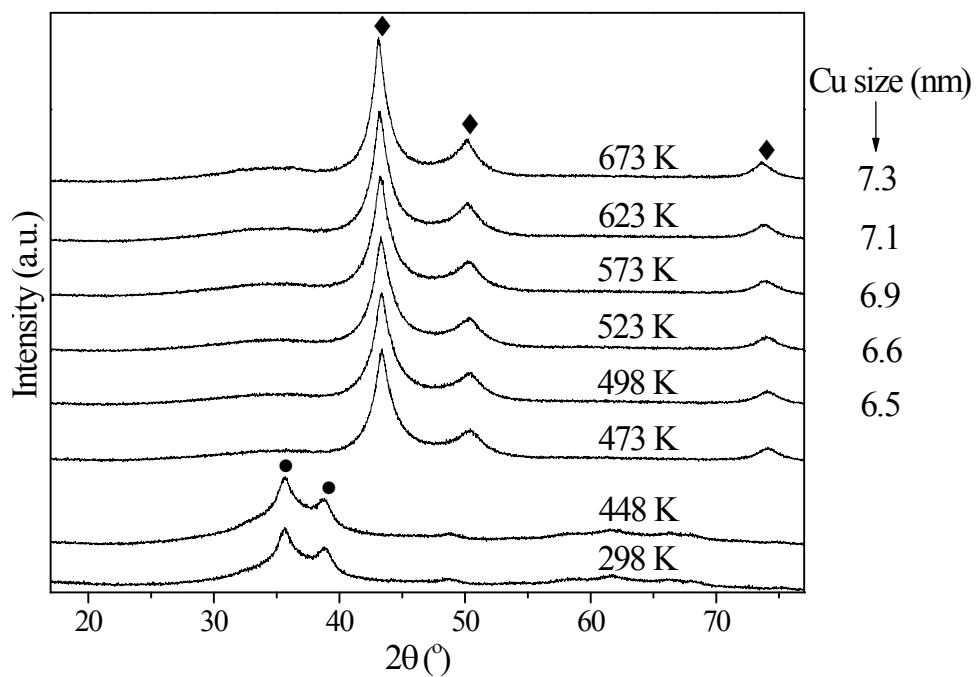


Fig. S2 *In situ* XRD patterns collected during the reduction process of CHT-Y0.1 in 5% H_2/He from 298 to 673 K. (●) CuO; (◆)Cu.

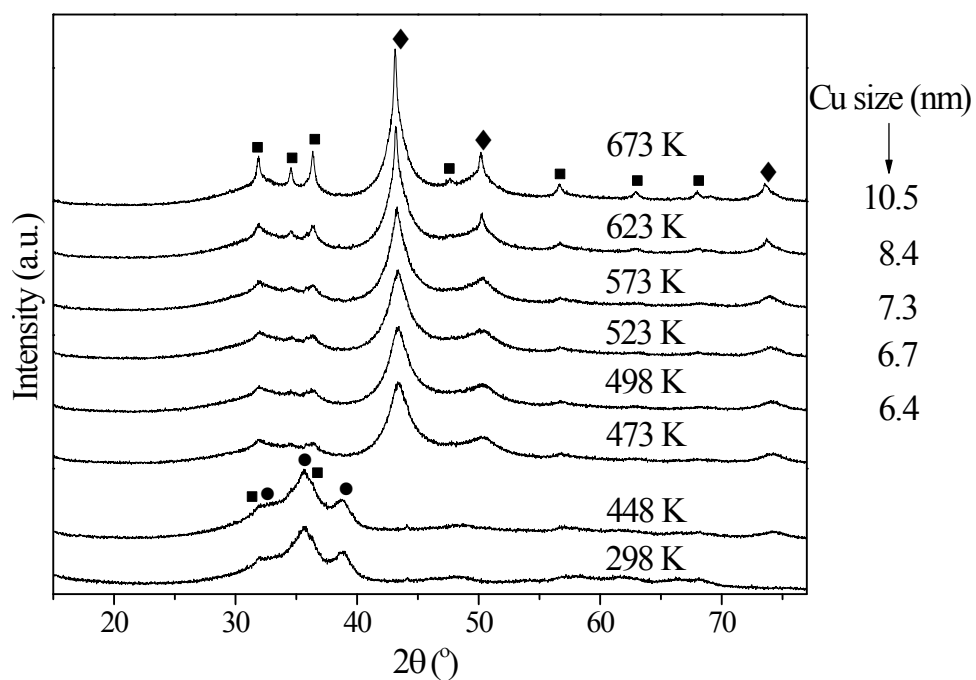


Fig. S3 *In situ* XRD patterns collected during the reduction process of CHT-Y0.5 in 5% H_2/He from 298 to 673 K. (●) CuO; (◆)Cu; (■) ZnO.

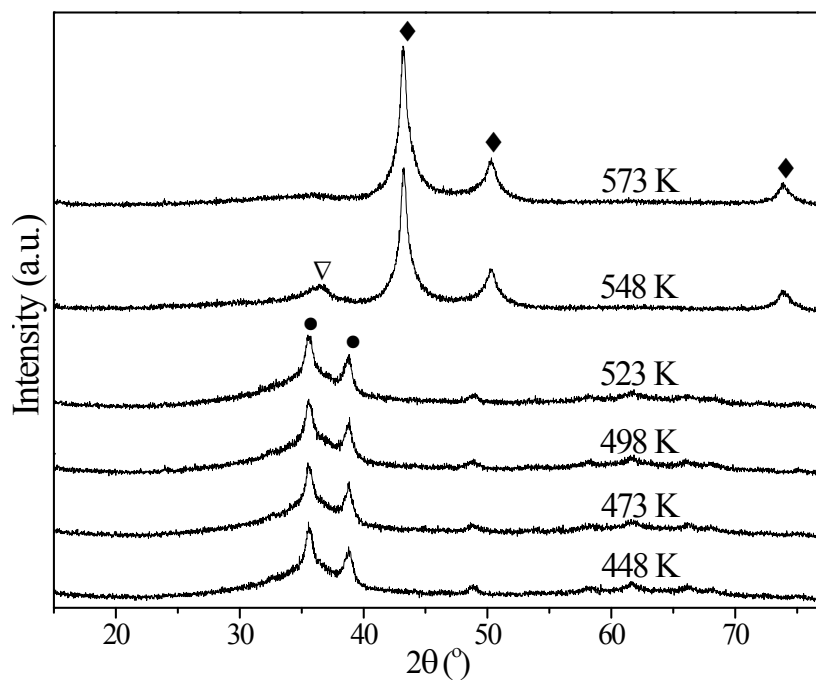


Fig. S4 Phase evolution of CHT-Y0 sample recorded by *in situ* XRD during the heating of CHT-Y0.5 in 5% H₂/He from 448 to 573 K at a heating rate of 5 K min⁻¹.

(●) CuO; (▽) Cu₂O; (◆)Cu.

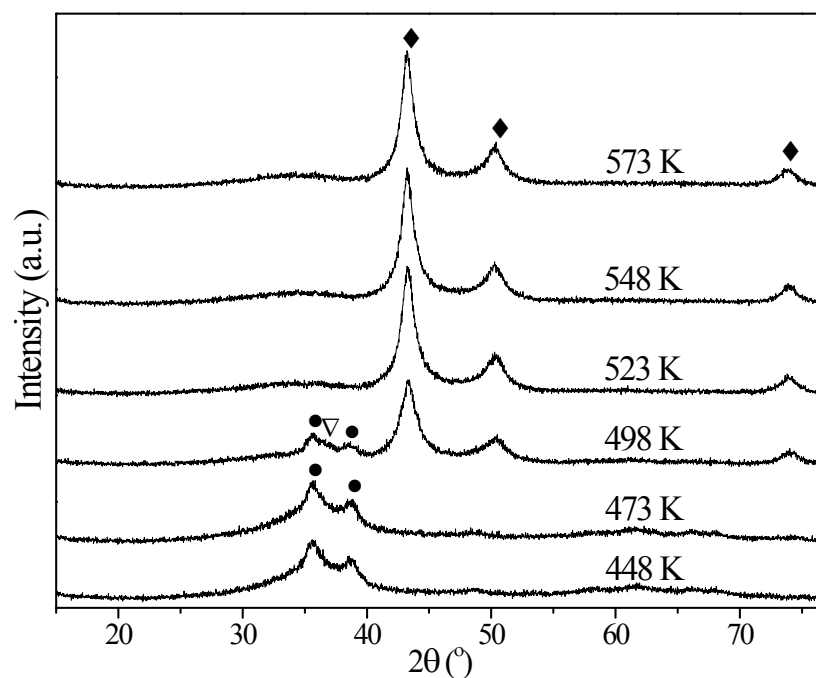


Fig. S5 Phase evolution of CHT-Y0.1 sample recorded by *in situ* XRD during the heating of CHT-Y0.5 in 5% H₂/He from 448 to 573 K at a heating rate of 5 K min⁻¹.

(●) CuO; (▽) Cu₂O; (◆)Cu.

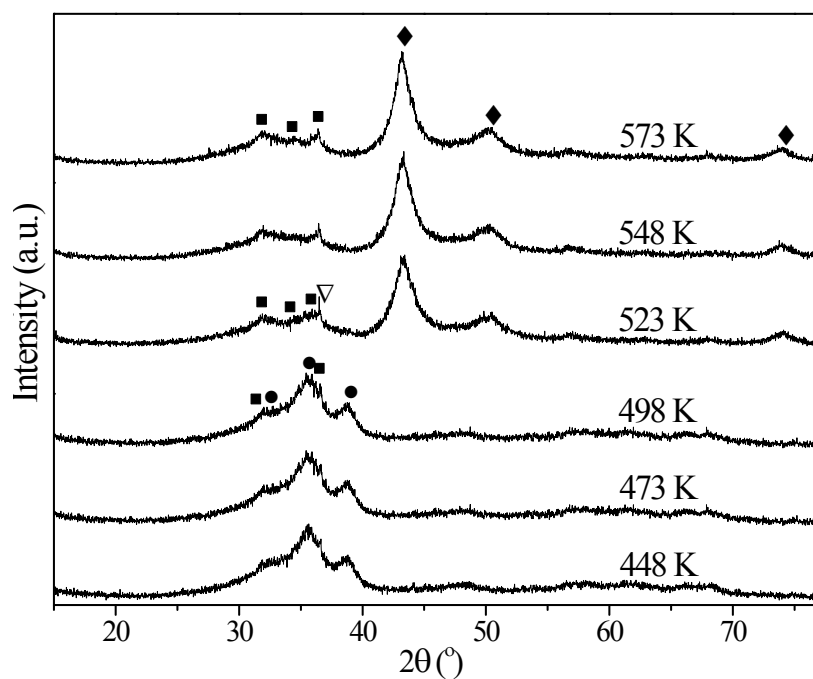


Fig. S6 Phase evolution of CHT-Y0.5 sample recorded by *in situ* XRD during the heating of CHT-Y0.5 in 5% H₂/He from 448 to 573 K at a heating rate of 5 K min⁻¹.

(●) CuO; (▽) Cu₂O; (◆)Cu; (■) ZnO.

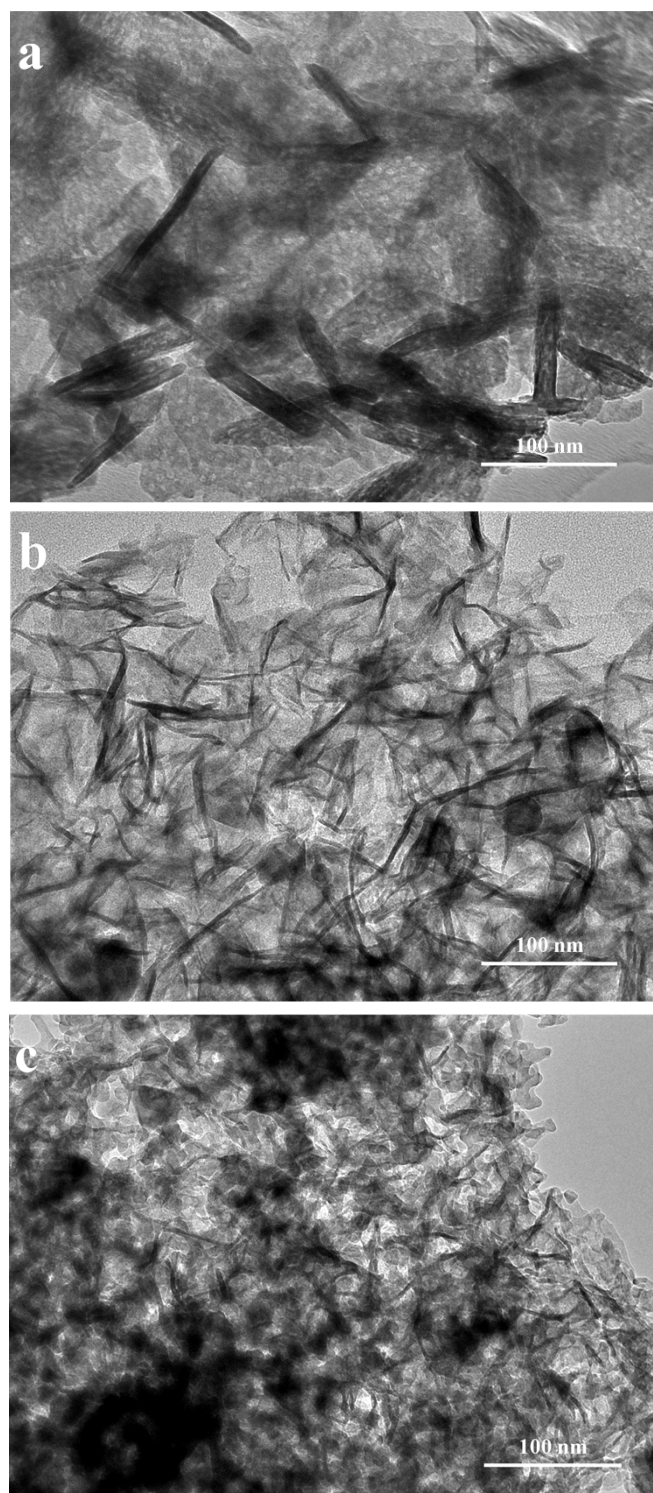


Fig. S7 TEM images of calcined (a) CHT-Y0, (b) CHT-Y0.1 and (c) CHT-Y0.5 samples at 773 K for 4 h.

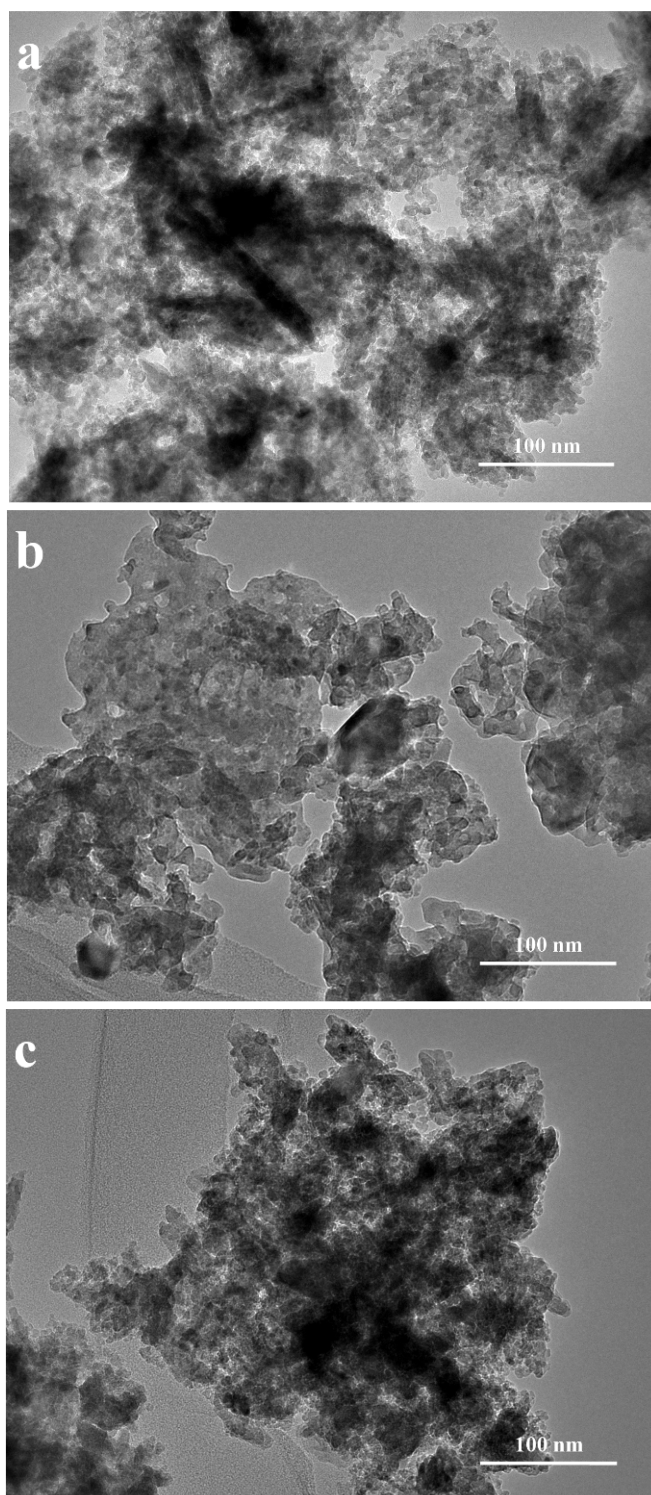


Fig. S8 TEM images of spent (a) CHT-Y0, (b) CHT-Y0.1 and (c) CHT-Y0.5 catalysts after 500 h.

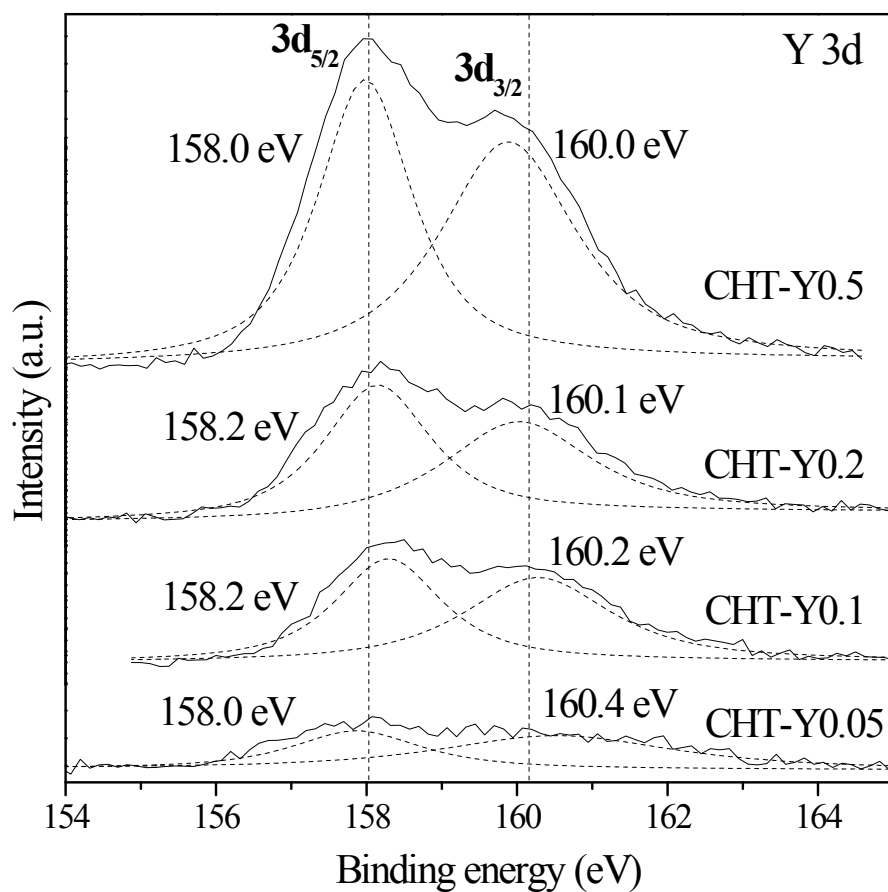


Fig. S9 XPS spectra of Y 3d core-level for the reduced CHT-Y_x catalysts.

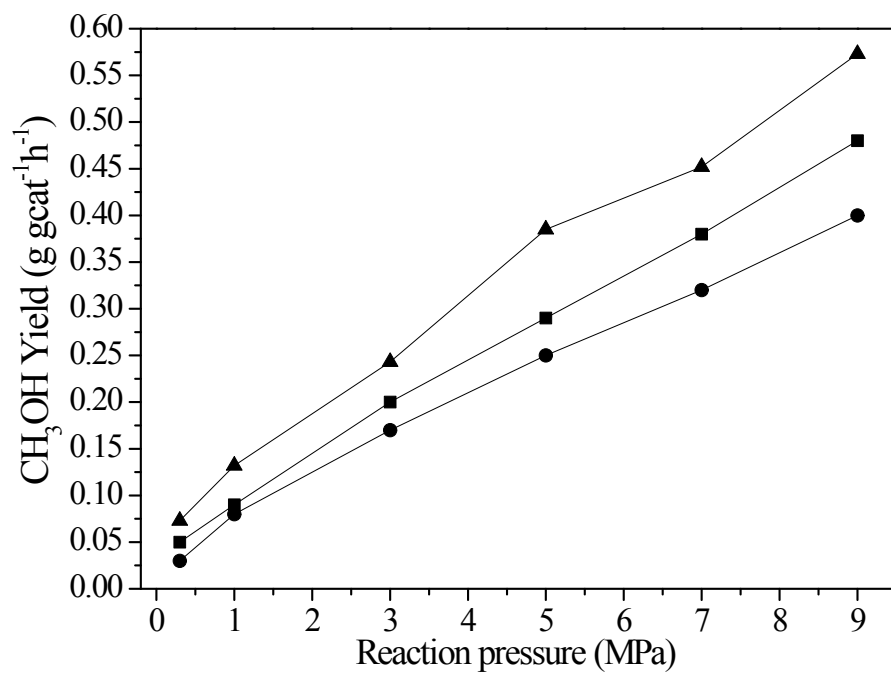


Fig. S10 Effect of reaction pressure on the yield of methanol over (circles) CHT-Y0, (triangles) CHT-Y0.1 and (rectangles) CHT-Y0.5 catalysts. Reaction conditions: T = 503 K, GHSV = 10,000 mL gcat⁻¹ h⁻¹, H₂/CO₂/N₂ = 73/24/3 (molar ratio).