Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

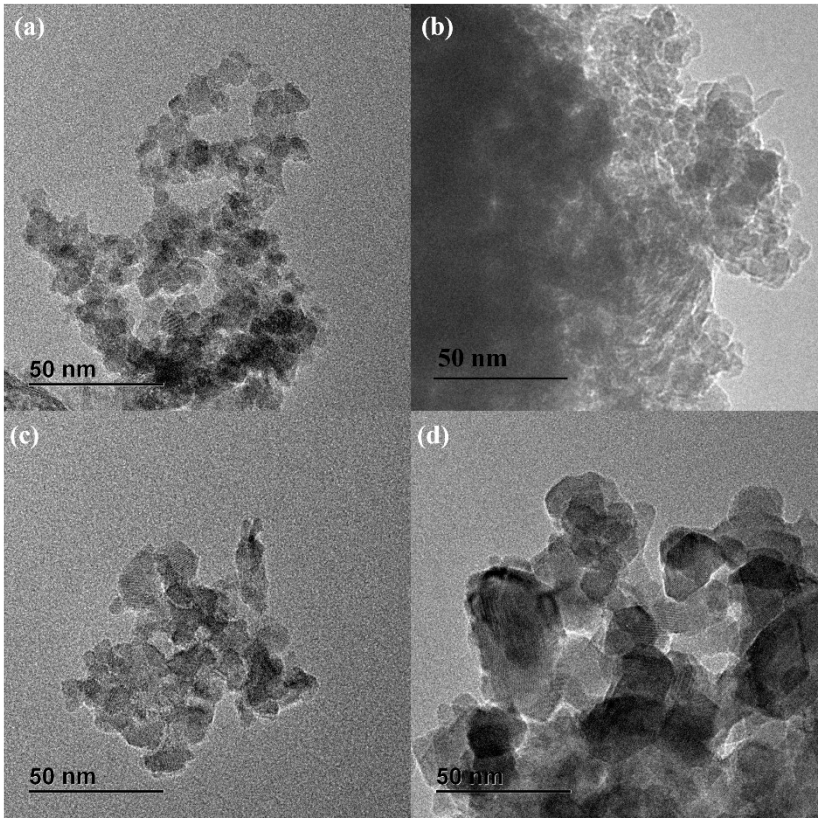

Figure S1.TEM images of $CuCoMnO_x$-200 (a), $CuCoMnO_x$-300 (b), $CuCoMnO_x$-400 (c)and $CuCoMnO_x$-500 (d).

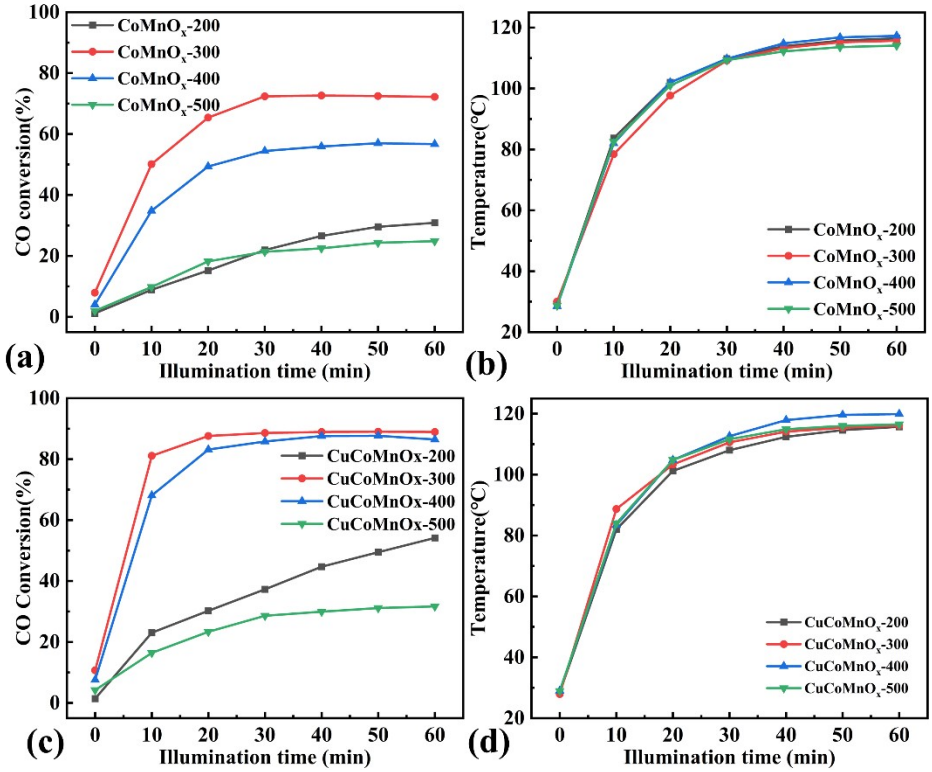

Figure S2. CO conversion (a,c) and temperature (b,d) curves of $CoMnO_x$-T and $CuCoMnO_x$-T in CO-PROX at 250 mW/cm^2.

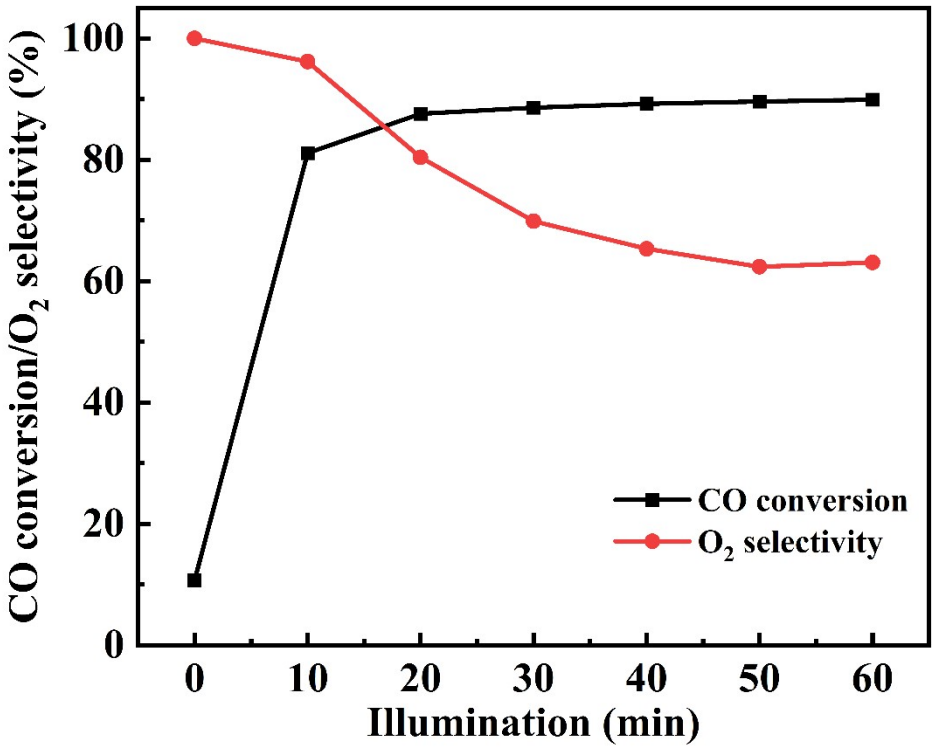

Figure S3. CO conversion and O_2 selectivity of $CuCoMnO_x$-300 for photothermal CO-PROX.

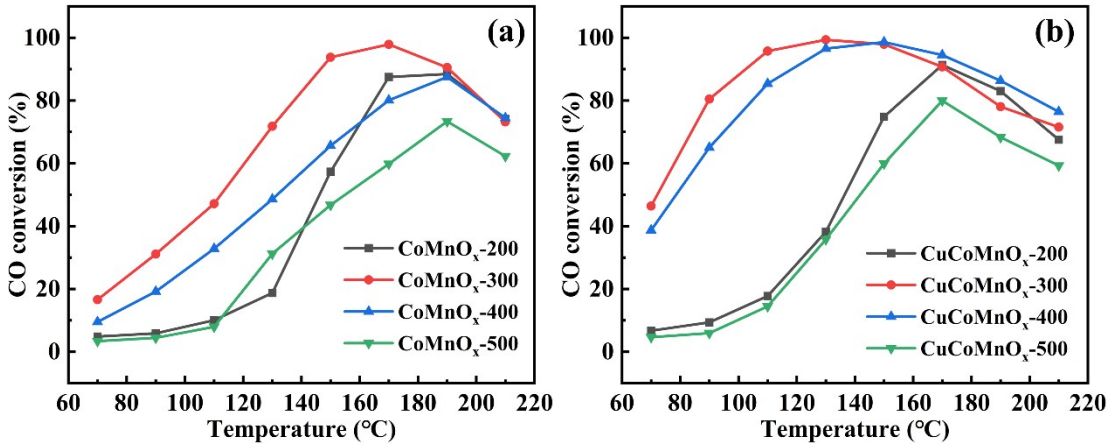

Figure S4. CO conversion of thermal catalysis over $CoMnO_x$-T (a) and $CuCoMnO_x$-T (b).

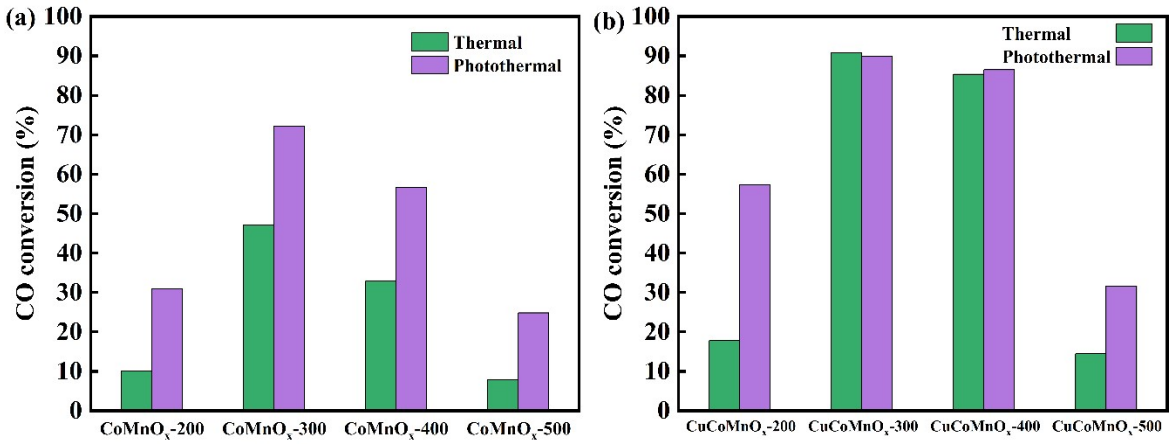

Figure S5. comparation of CO conversion of the $CoMnO_x$ and $CuCoMnO_x$ catalysts for thermal and photothermal CO-PROX.

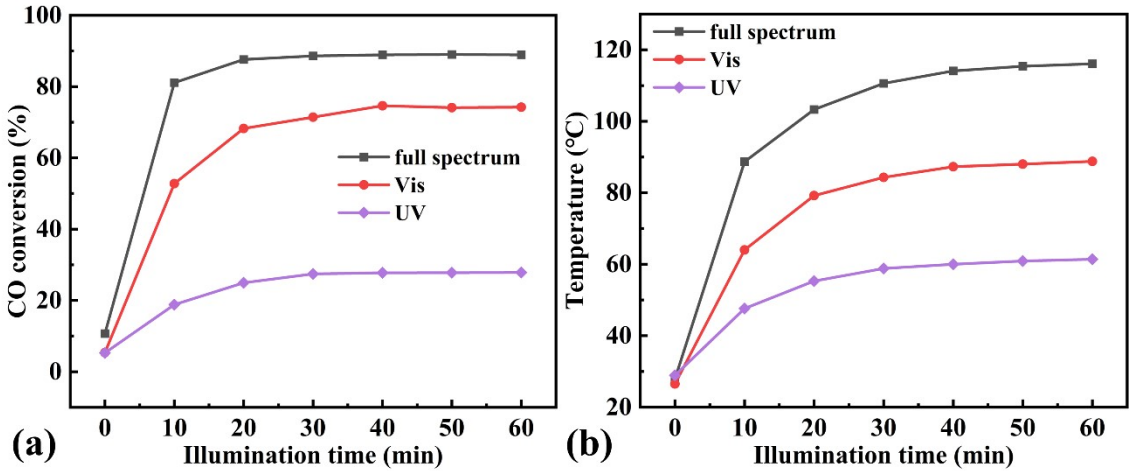

Figure S6. CO conversion and temperature curve of $CuCoMnO_x$-300 in CO-PROX at 250mW/cm^2 illuminated under different optical composition.

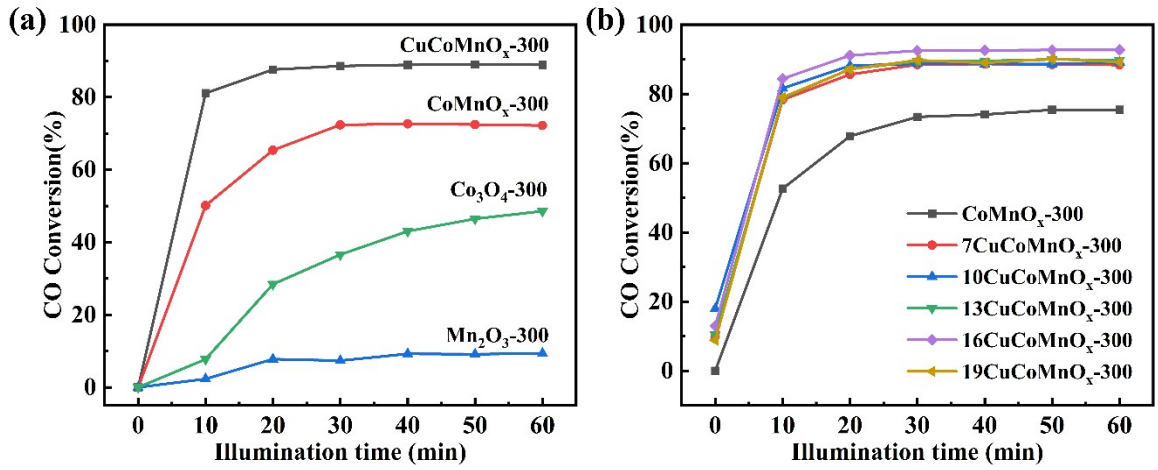

Figure S7. CO conversions of pure Co_3O_4 and Mn_2O_3, binery $CoMnO_x$ and ternary $CuCoMnO_x$ calcined at 300 °C (a) and CO conversions of $CuCoMnO_x$-300 with different copper amount in photothermal CO-PROX at 250mW/cm^2.

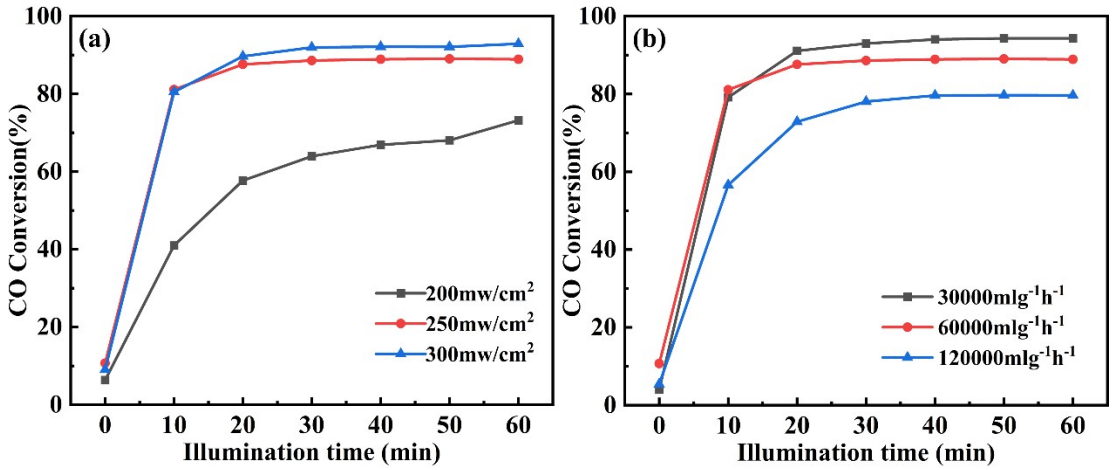

Figure S8. CO conversion of $CuCoMnO_x$-300 in CO-PROX at different illumination power densities (a) and at different weight hourly space velocity (b) at 250 mW/cm^2 (b).

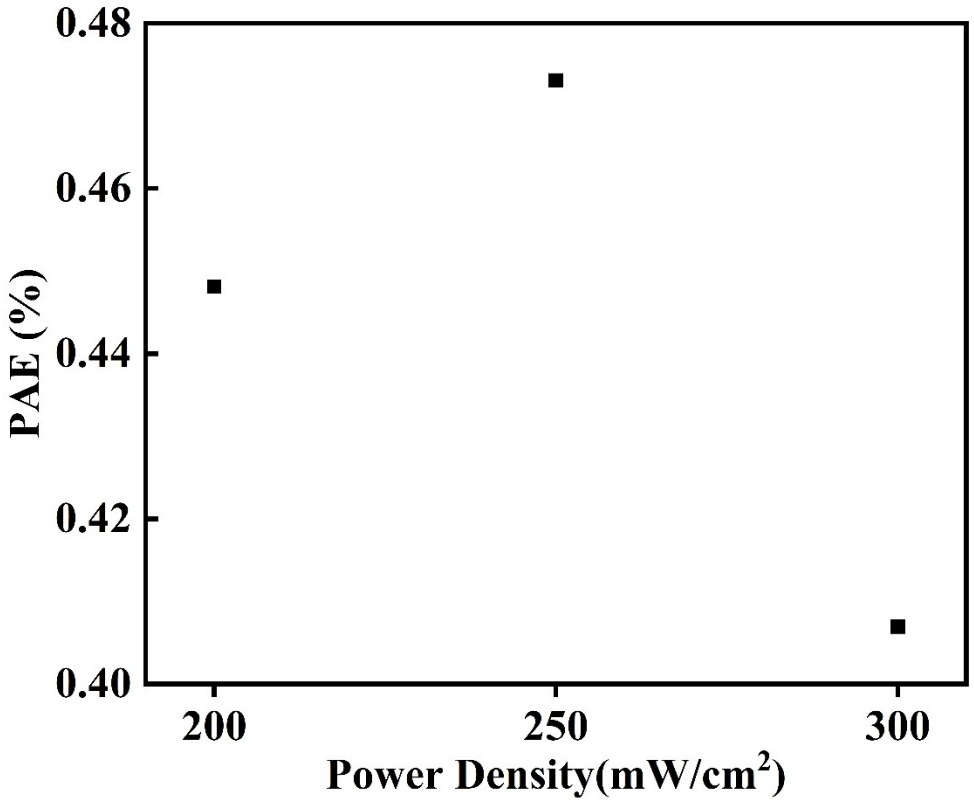

Figure S9. PAE values of $CuCoMnO_x$-300 catalyst under different illumination densities.

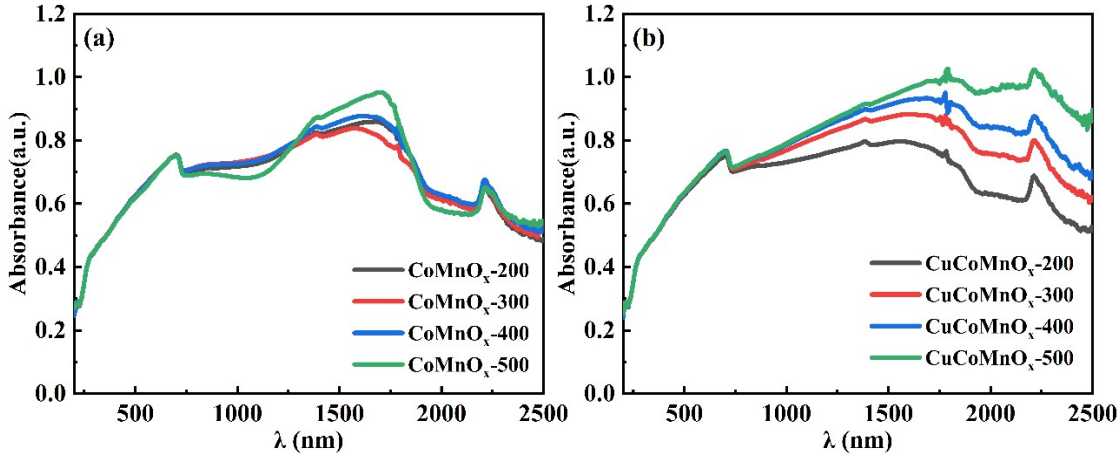

Figure S10. UV-Vis-IR absorption spectrums of (a) $CoMnO_x$-T, (b) $CuCoMnO_x$-T.

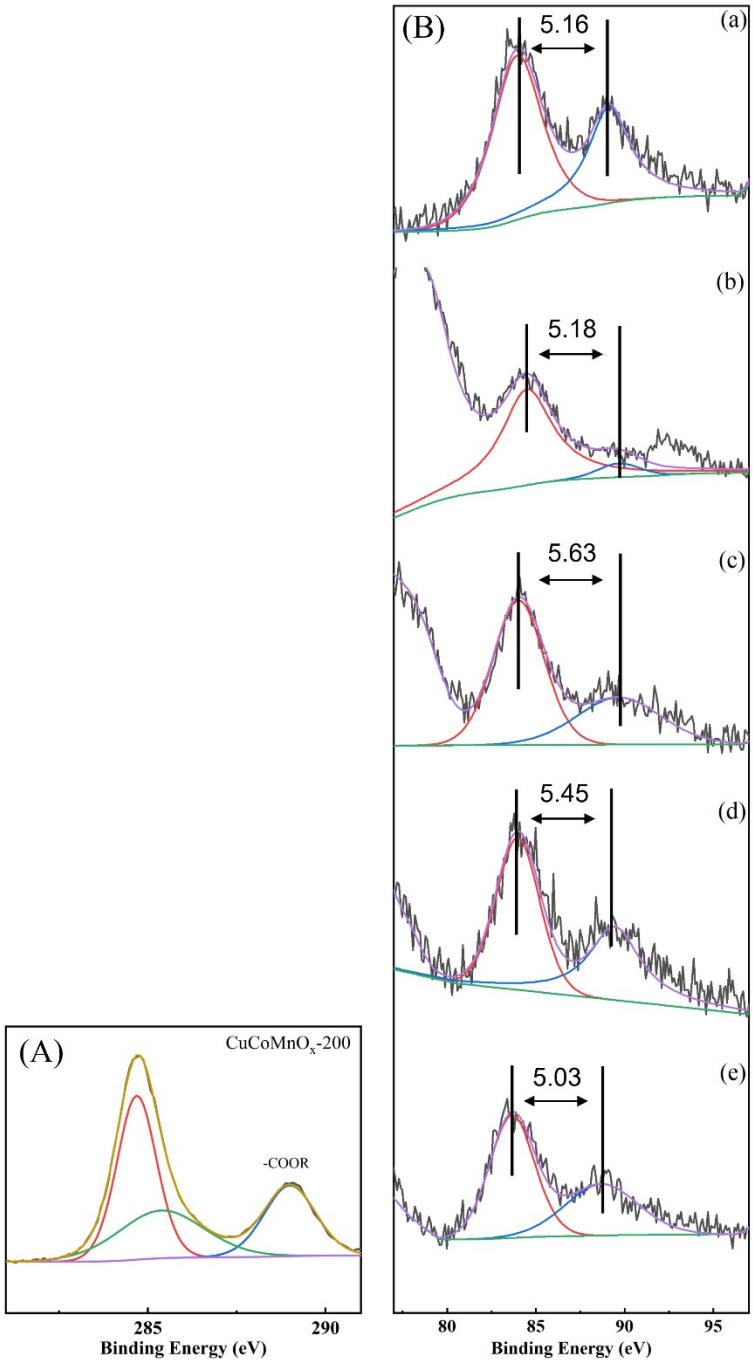

Figure S11. XPS spectra of C 1s (A) and Mn 3s (B) of $CoMnO_x$-300 (a), $CuCoMnO_x$-200 (b), $CuCoMnO_x$-300 (c) , $CuCoMnO_x$-400 (d) and $CuCoMnO_x$-500 (e).

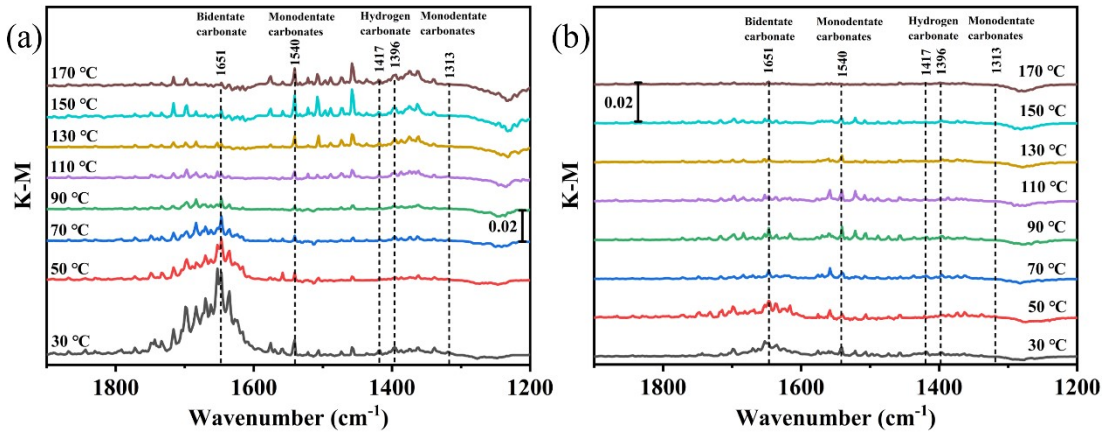

Figure S12. DRIFTS spectra (1900-1200 cm^{-1}) of $CoMnO_x$-300 (a) and $CuCoMnO_x$-300 (b) under the reaction stream at different temperature.

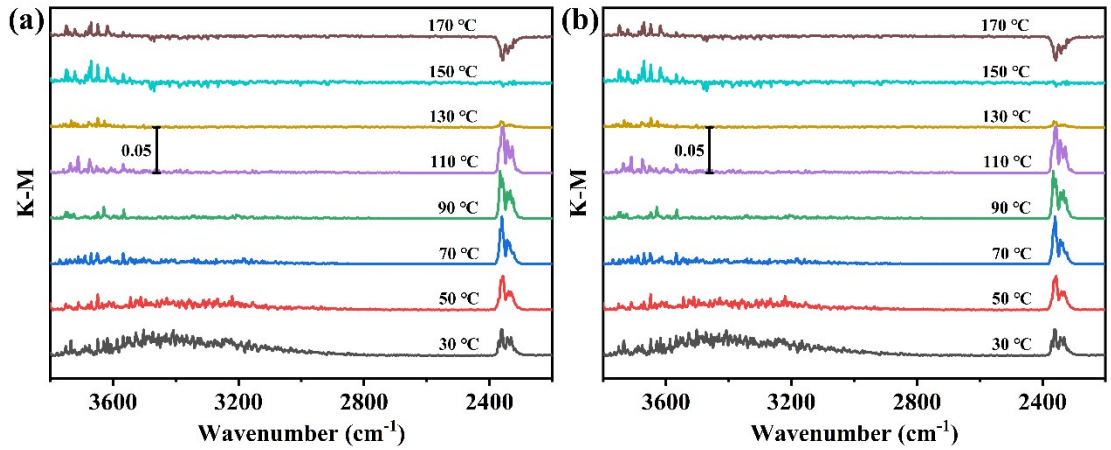

Figure S13. DRIFTS spectra (3800-2200 cm^{-1}) of $CoMnO_x$-300 (a) and $CuCoMnO_x$-300 (b).