Supporting Information

High-purity H\textsubscript{2} production by sorption-enhanced water gas shift on a 
K\textsubscript{2}CO\textsubscript{3}-promoted Cu/MgO-Al\textsubscript{2}O\textsubscript{3} difunctional material

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**Fig. S1.** XRD patterns of KMA-0.2-y at 2θ degrees of (a) 20-80° and (b) 40-45°.

**Fig. S2.** Pore size distribution curves of KCMA-x-y.
**Fig. S3.** CO\textsubscript{2}-TPD patterns of KCMA-0.2-y.

**Fig. S4.** FESEM images of (a) KCMA-0-9, (b) KCMA-0.1-9, (c) KCMA-0.2-9, (d) KCMA-0.3-9, (e) KCMA-0.2-15, (f) KCMA-0.2-21, (g) KCMA-0.2-9(300) and (h) KCMA-0.2-9(420) after 10 adsorption-desorption cycles.
Fig. S5. H₂-TPR profile of KCMA-0.2-9.

Fig. S6. XRD patterns of KCMA-0.2-9, KCMA-0.2-9(300) and KCMA-0.2-9(420).
Fig. S7. CO conversion and product gas composition (\(\gamma_1\), dry and N\(_2\)-free basis) over KCMA-0.2-9(420) at the first SEWGS cycle.

Fig. S8. CO\(_2\) uptake of KCMA-0.2-9 at different CO\(_2\) partial pressures.

(Note: when 1% CO\(_2\)/N\(_2\) was used as feedstock, the CO\(_2\) uptake was measured by a Vaisala GMP252 CO\(_2\) probe, as mentioned in the text. In other cases (5%, 15%, 50%, 80% and 100% of CO\(_2\)), the CO\(_2\) uptake was measured using a thermogravimetric analyzer (TGA, WRT-3P, Shanghai Precision & Scientific Instrument Co., Ltd.).)