Supporting Information

Cu based mix metal oxides for efficient photothermal catalysis of water gas shift reaction

Fuli Liu,[a] Lizhu Song,[a] Shuxin Ouyang,[a,c] Hua Xu[a,b*]

[a] School of Materials Science & Engineering, Tianjin University, Tianjin 300072, China

[b] School of Chemistry and Environmental Engineering, Wuhan Institute of Technology, Wuhan 430205, China

[c] College of Chemistry, Central China Normal University, Wuhan 430079, China

* Author to whom correspondence should be addressed.

Electronic mail: XU.Hua@wit.edu.cn

Table S1 Molar mass of the metal precursors used for the prepared catalysts.

	n (mmol)			H_2 Yield
Samples	$Cu(NO_3)_2{\cdot}3H_2O$	$Zn(NO_3)_2{\cdot}6H_2O$	$Al(NO_3)_3{\cdot}9H_2O$	**(mmol)**
CuAl	2.70	0	2.70	4.19
CuZnAl	2.70	2.70	2.70	5.46
$CuZn_2Al$	2.70	5.40	2.70	6.68
$CuZn_3Al$	2.70	8.10	2.70	7.80
$CuZn_4Al$	2.70	10.80	2.70	6.42
$CuZn_5Al$	2.70	13.50	2.70	4.64
$CuZn_3Al_{0.25}$	2.70	8.10	0.68	4.97
$CuZn_3Al_{0.5}$	2.70	8.10	1.35	5.19
$CuZn_3Al_2$	2.70	8.10	5.40	3.69
$CuZn_3Al_4$	2.70	8.10	10.80	0.23
$CuZn_{0.8}Al_{0.2}$	2.70	2.16	0.54	3.32
$CuZn_{0.6}Al_{0.4}$	2.70	1.62	1.08	8.00
$CuZn_{0.5}Al_{0.5}$	2.70	1.35	1.35	4.15
$CuZn_{0.4}Al_{0.6}$	2.70	1.08	1.62	3.74
$CuZn_{0.2}Al_{0.8}$	2.70	0.54	2.16	3.52
CuZn	2.70	2.70	0	9.46

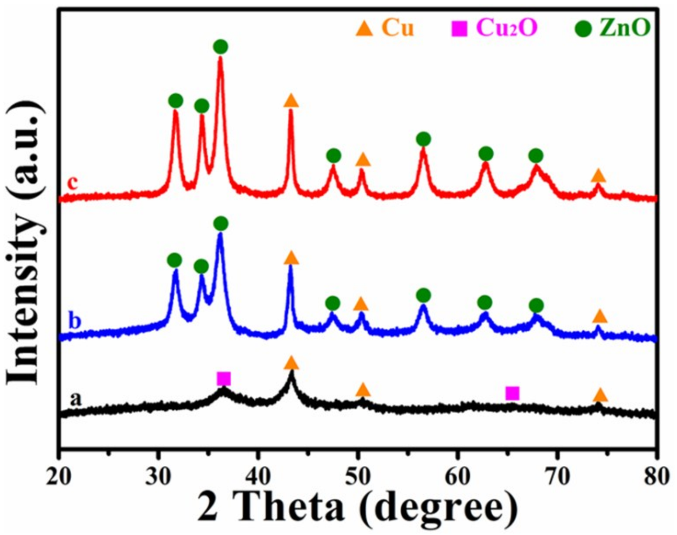

Fig. S1 XRD patterns of the Cu-based catalysts after WGS photothermal reaction. a: CuAl, b: $CuZn_{0.6}Al_{0.4}$, and c: CuZn.

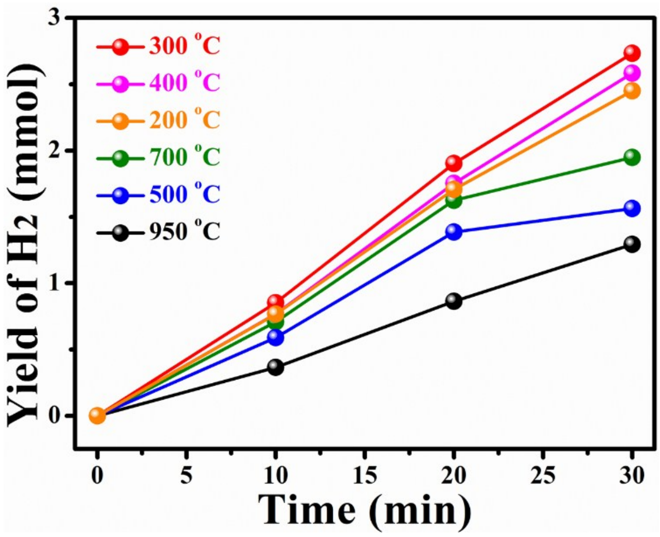

Fig. S2 Curves of H_2 evolution as a function of $CuAl_{0.5}$ catalyst prepared via calcination at various temperature (200-950 ^{o}C).

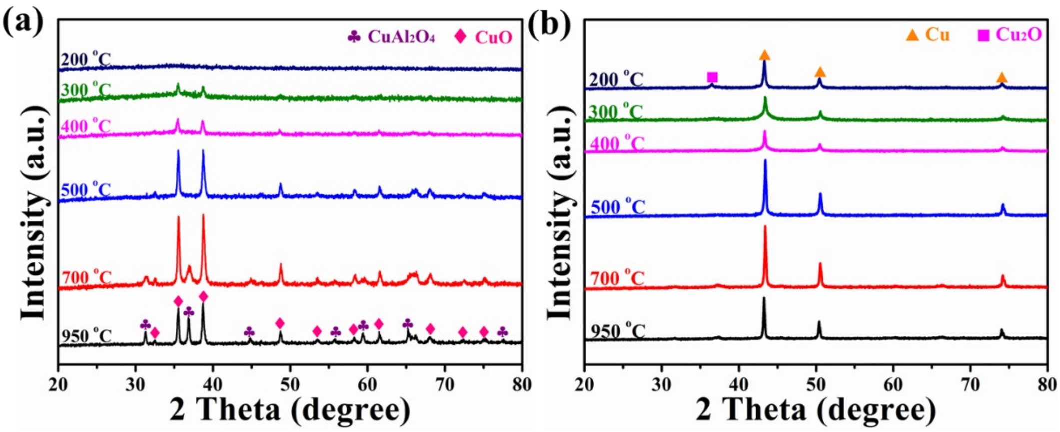

Fig. S3 XRD patterns of $CuAl_{0.5}$ catalyst prepared via calcination at various temperatures, before (a) and after WGS reaction (b).

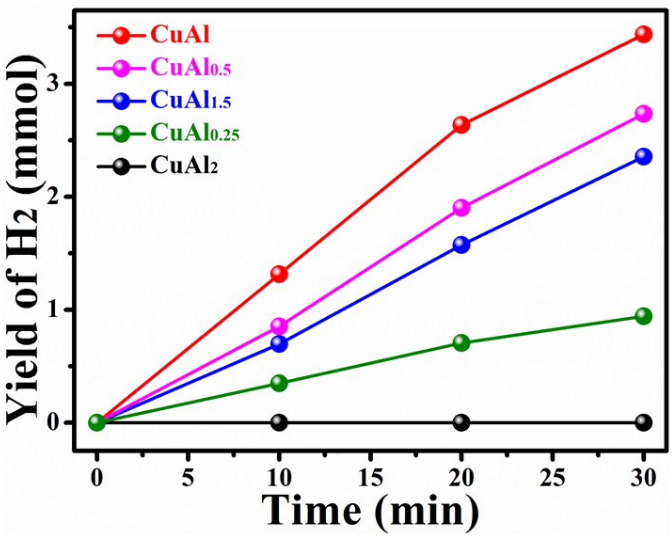

Fig. S4 Curves of H_2 evolution as a function of CuAl catalyst prepared with a various molar ratio between Cu and Al.

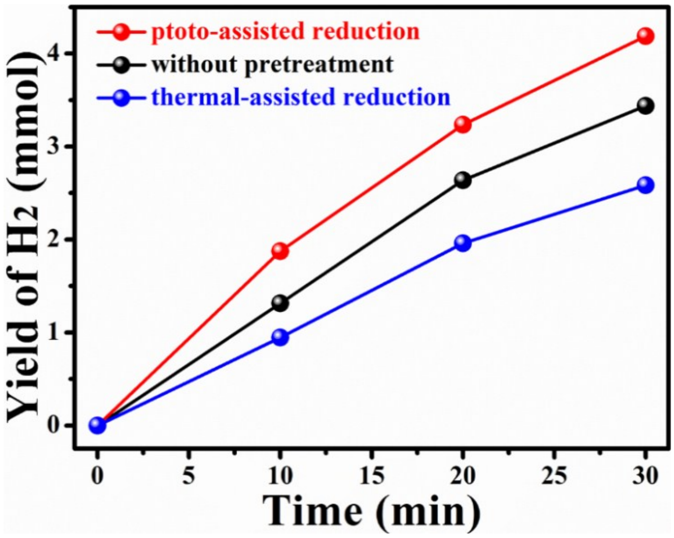

Fig. S5 Curves of H_2 evolution as a function of CuAl catalyst pretreated via either photo-assisted reduction or thermal-assisted reduction.

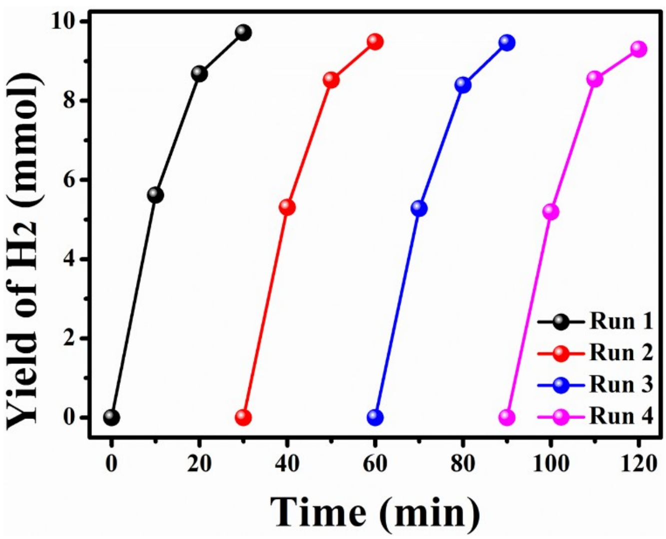

Fig. S6 Stability test of WGS reaction over the CuZn catalyst (30 min for each cycle).

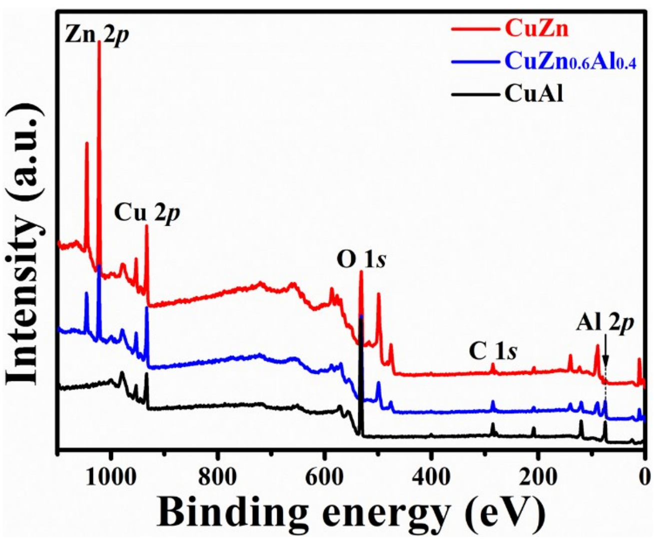

Fig. S7 Survey XPS spectra of CuAl, $CuZn_{0.6}Al_{0.4}$ and CuZn catalysts.

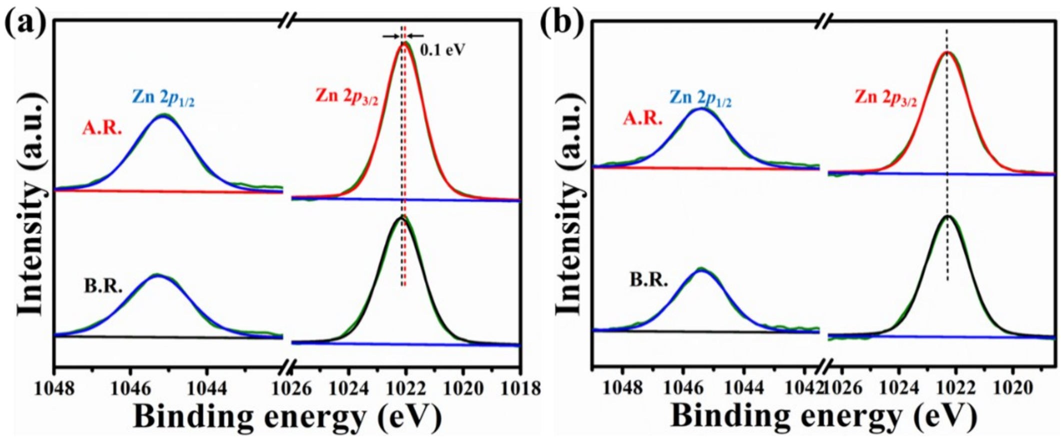

Fig. S8 Zn 2*p* XPS spectra of CuZn (a) and $CuZn_{0.6}Al_{0.4}$ (b) catalysts before and after WGS reaction. (B.R.: before reaction, A.R.: after reaction.)

Table S2 Binding energy of Zn 2*p* XPS of CuZn and $CuZn_{0.6}Al_{0.4}$ catalysts before and after WGS reaction.

	Zn $2p_{3/2}$ B.R. (eV)	Zn $2p_{3/2}$ A.R. (eV)	Zn $2p_{1/2}$ B.R. (eV)	Zn $2p_{1/2}$ A.R. (eV)
$CuZn_{0.6}Al_{0.4}$	1022.3	1022.3	1045.4	1045.4
CuZn	1022.1	1022.0	1045.2	1045.1

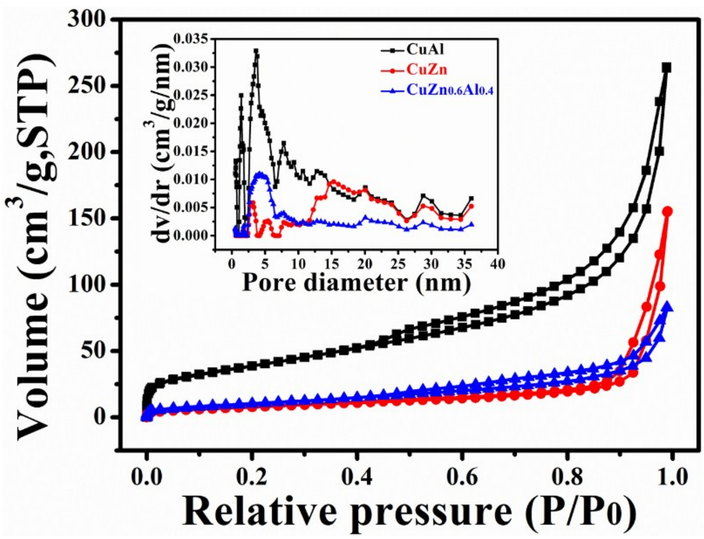

Fig. S9 Nitrogen adsorption-desorption isotherms and pore-size distribution curves (inset) of CuAl, $CuZn_{0.6}Al_{0.4}$ and CuZn catalysts.