

CuMo_xW_(1-x)O₄ Solid Solution Display Visible Light Photoreduction of CO₂ to CH₃OH Coupling With Oxidation of Amine to Imine

Chao Luo ¹, Tian Yang ³, Qianfei Huang ², Xian Liu ³, Huan Ling ¹, Yuxin Zhu ¹, Guoming Xia ¹, Wennan Zou ^{1,*} and Hongming Wang ^{1,*}

¹ Institute for Advanced Study, Nanchang University, Nanchang 330031, China; luochao@ncu.edu.cn (C.L.); huanling_ncu@126.com (H.L.); ncu_zhuyuxin@163.com (Y.Z.); gmxia_ncu@126.com (G.X.)

² School of Information Engineering, Jiangxi Modern Polytechnic College, Jiangxi 330095, China; huangqianfei1015@hotmail.com

³ College of Chemistry, Nanchang University, Nanchang 330031, Jiangxi, China; yangtian_92@163.com (T.Y.); lzhnxylx@163.com (X.L.)

* Correspondence: zouwn@ncu.edu.cn (W.Z.); hongmingwang@ncu.edu.cn (H.W.)

The standard curve method was applied to carry out the quantitative analysis using benzylamine, methanol and N-benzylidenebenzylamine as standard sample, respectively.

The conversion rate of benzylamine were obtained according to the internal standard curve:

$$m_{t0} = 1.9451 \times 10^{-4} \times A_{t0} - 0.027, \quad (1)$$

$$\text{Con.}\% = (m_0 - m_{t0})/m_0 \times 100\%, \quad (2)$$

$m_0 = 0.9813\text{mg}$, slope: 1.9451×10^{-4} , intercept: -0.027 , m_0 : the mass of benzylamine, A_{t0} : Gas chromatographic peak area of benzylamine at time t , m_{t0} : the mass of benzylamine at time t .

The yield of CH₃OH were obtained according to the formula:

$$Y_t = 0.34482 \times A_{t1} + 0.012 \quad (3)$$

A_{t1} : Gas chromatographic peak area of CH₃OH at time t , Y_t : The yield of CH₃OH at time t , units: μmol , slope: 0.34482 , intercept 0.012 .

The selectivity of N-benzylidenebenzylamine were obtained according to the formula:

$$m_{t1} = 2.4091 \times 10^{-4} \times A_{t1} - 0.016, \quad (4)$$

$$\text{Sel.}\% = m_{t1}/(m_0 - m_{t0}), \quad (5)$$

slope: 2.4091×10^{-4} , intercept: -0.016 , m_{t1} : the mass of N-Benzylidenebenzylamine at time t , A_{t1} : Gas chromatographic peak area of N-benzylidenebenzylamine at time t .

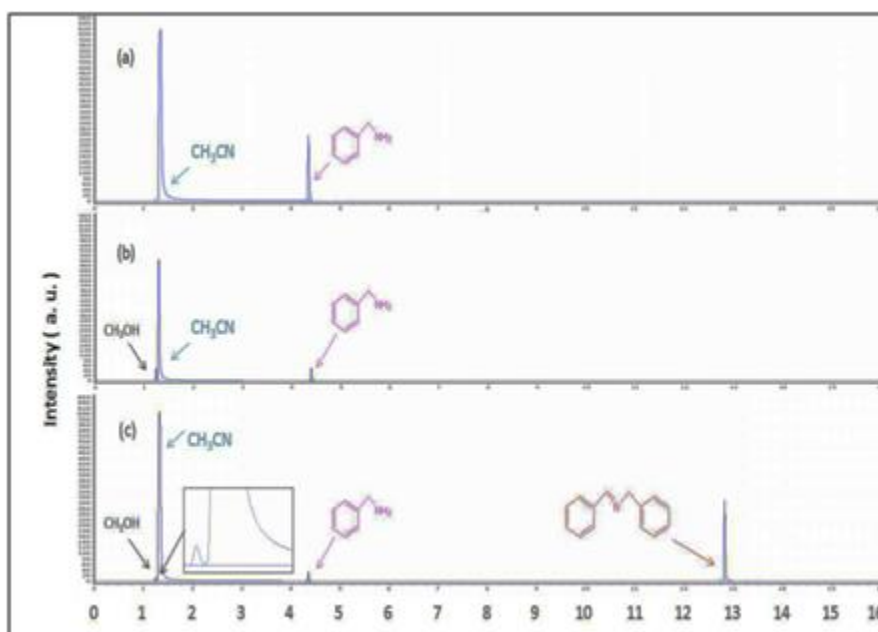


Figure S1. GC chromatograms of (a) before irradiation and (b) the stand CH_3OH and benzylamine in CH_3CN and (c) product (CH_3OH) after irradiation for 10 hours with the partial enlarged drawing.

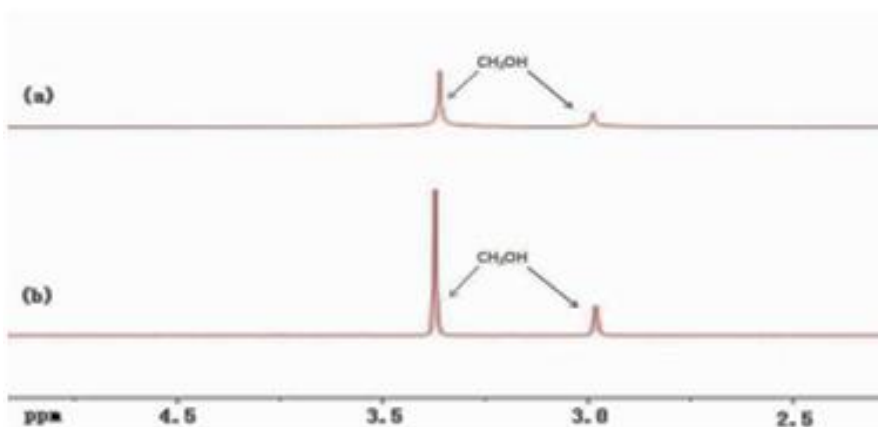


Figure S2. The ^1H NMR spectra of (a) the product (CH_3OH) photocatalyzed by $\text{CuW}_{0.7}\text{Mo}_{0.3}\text{O}_4$ ($x = 0.7$) after reaction for 10 hours and (b) the stand CH_3OH .

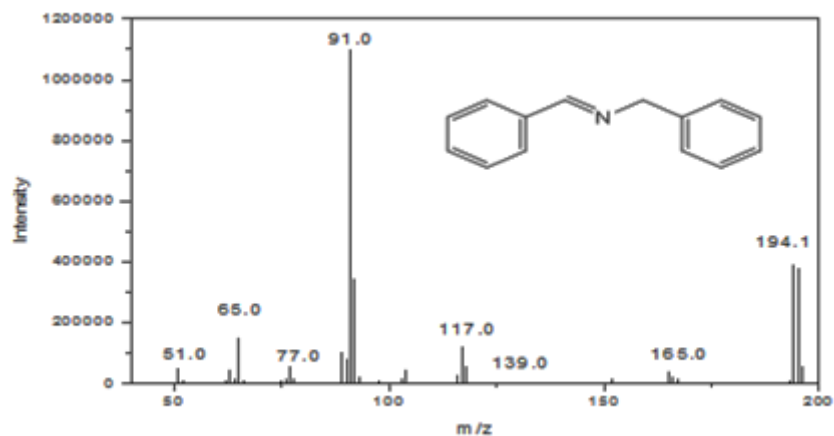


Figure S3. the MS of Products photocatalyzed by $\text{CuW}_{0.7}\text{Mo}_{0.3}\text{O}_4$ ($x = 0.7$) after irradiation for 10 hours.

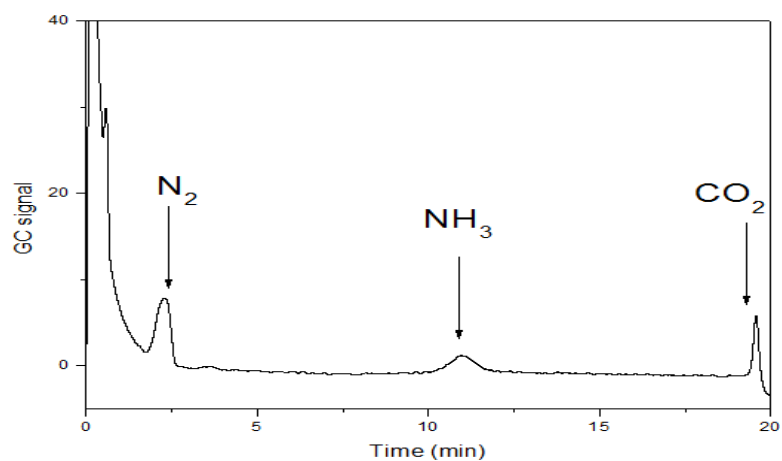
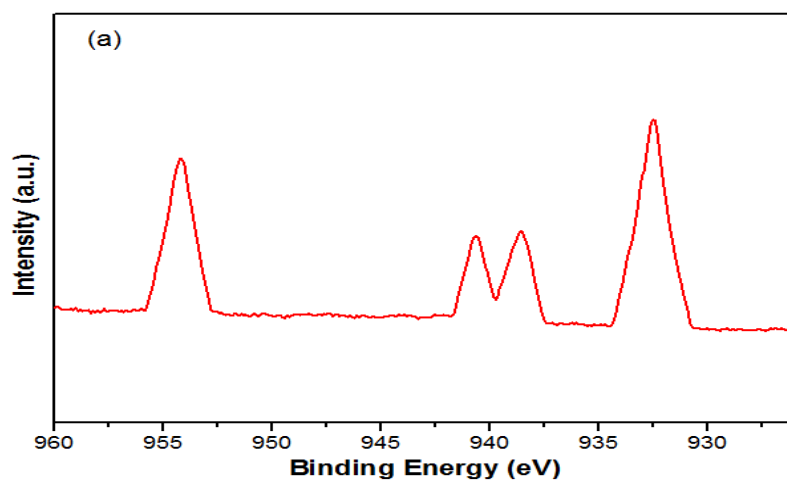


Figure S4. GC chromatograms of gas phase products after irradiation for 10 hours.



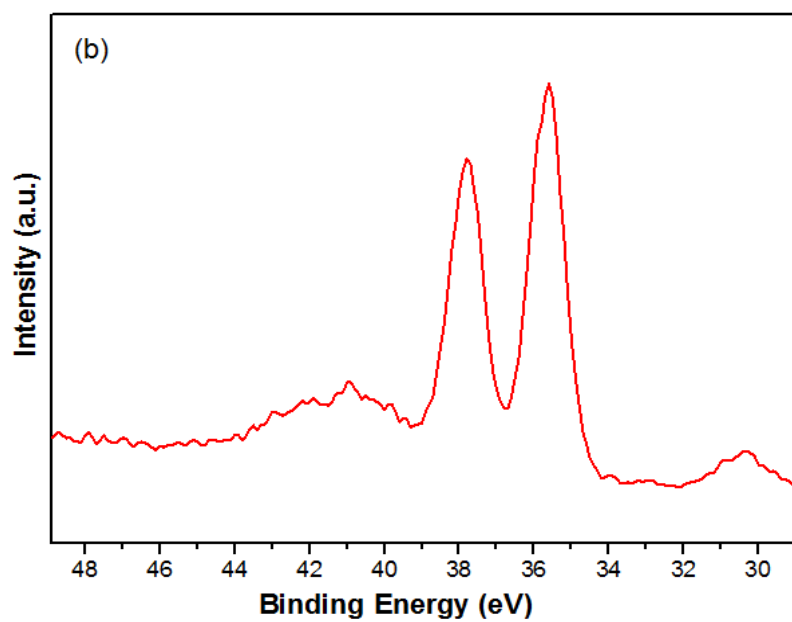


Figure S5. XPS spectra of (a) Cu_{2p} and (b) W_{4f} of photocatalysts.