

## Supporting Information

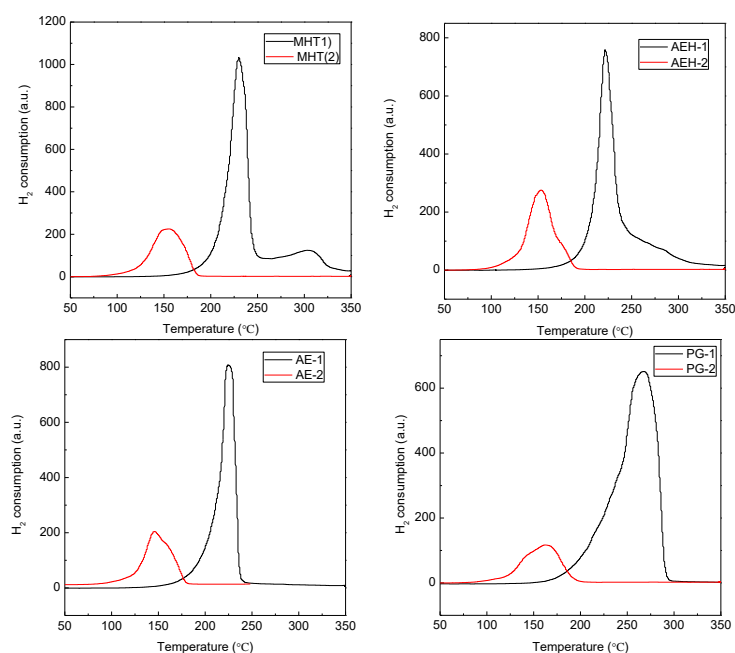
For

**Efficient synthesis of methanol and ethylene glycol via the hydrogenation of CO<sub>2</sub>-  
derived ethylene carbonate on Cu/SiO<sub>2</sub> catalysts with balanced Cu<sup>+</sup>-Cu<sup>0</sup> sites**

Tongyang Song,<sup>a</sup> Wei Chen,<sup>a</sup> Yuanyuan Qi,<sup>a</sup> Jiqing Lu,<sup>b</sup> Peng Wu,<sup>a</sup> Xiaohong Li<sup>a,\*</sup>

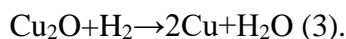
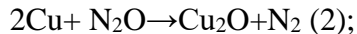
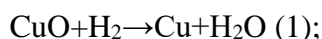
*<sup>a</sup> Shanghai Key Laboratory of Green Chemistry and Chemical Processes, School of  
Chemistry and Molecular Engineering, East China Normal University, 3663 North  
Zhongshan Rd., Shanghai 200062, PR China*

*<sup>b</sup> Key Laboratory of the Ministry of Education for Advanced Catalysis Materials,  
Institute of Physical Chemistry, Zhejiang Normal University, Jinhua 321004, China*

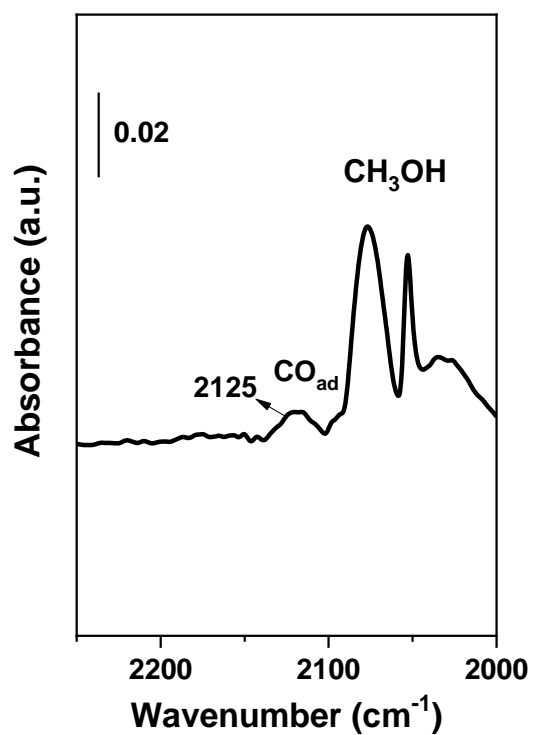


**Fig. S1** N<sub>2</sub>O titration profiles of various Cu/SiO<sub>2</sub> catalysts.

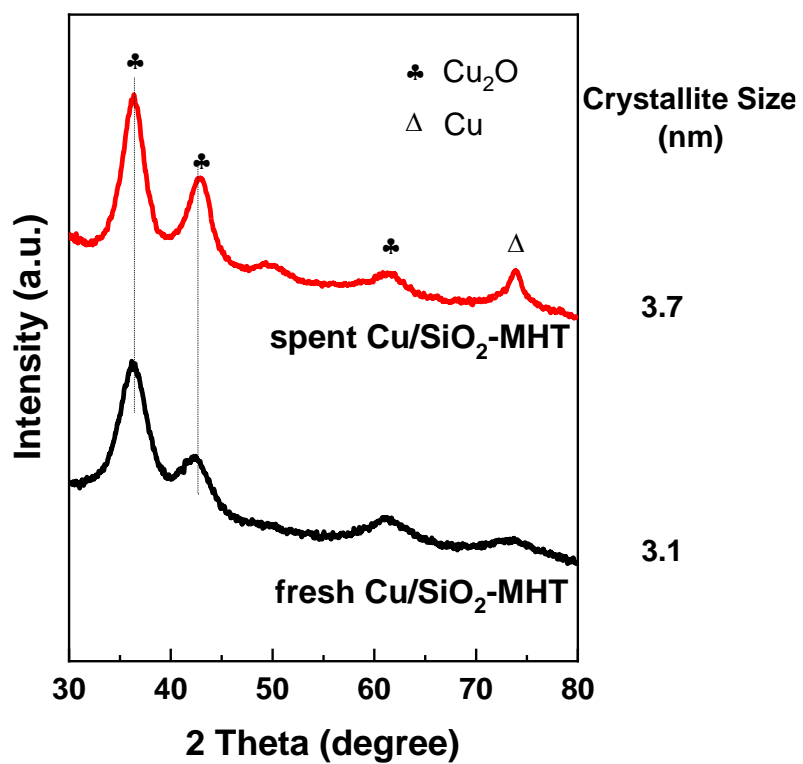
The N<sub>2</sub>O titration process includes the following steps [1-3]:



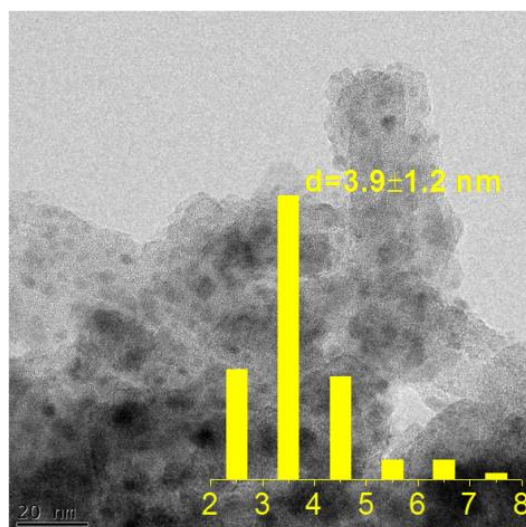
According to the XRD results, the as-calcined Cu/SiO<sub>2</sub>-MHT, Cu/SiO<sub>2</sub>-AEH and Cu/SiO<sub>2</sub>-AE catalysts mainly showed the characteristic diffractions of copper phyllosilicate and no obvious CuO diffraction was observed. After reduction, the three Cu/SiO<sub>2</sub> catalysts (MHT, AEH and AE) contained Cu<sub>2</sub>O species and a little Cu<sup>0</sup> species. As well known, the Cu<sup>+</sup> from reduction of copper phyllosilicate is very stable, and it is difficult to be further reduced to Cu<sup>0</sup>. If we use N<sub>2</sub>O titration to calculate the Cu dispersion, the hydrogen consumption for the three Cu/SiO<sub>2</sub> catalysts (MHT, AEH and AE) catalysts will decrease a lot in the first step, resulting in Cu dispersion increased unreasonably. Hence, the Cu dispersion calculated by N<sub>2</sub>O titration only represents the dispersion of a small amount of copper on Cu/SiO<sub>2</sub> catalysts (MHT, AEH and AE) catalysts. On the contrary, as-calcined Cu/SiO<sub>2</sub>-PG contained large amount of CuO. The Cu dispersion from the N<sub>2</sub>O titration is in good agreement with that from the XRD and TEM results. Therefore, we adopted the Cu dispersion from TEM results to calculate the TOF values.



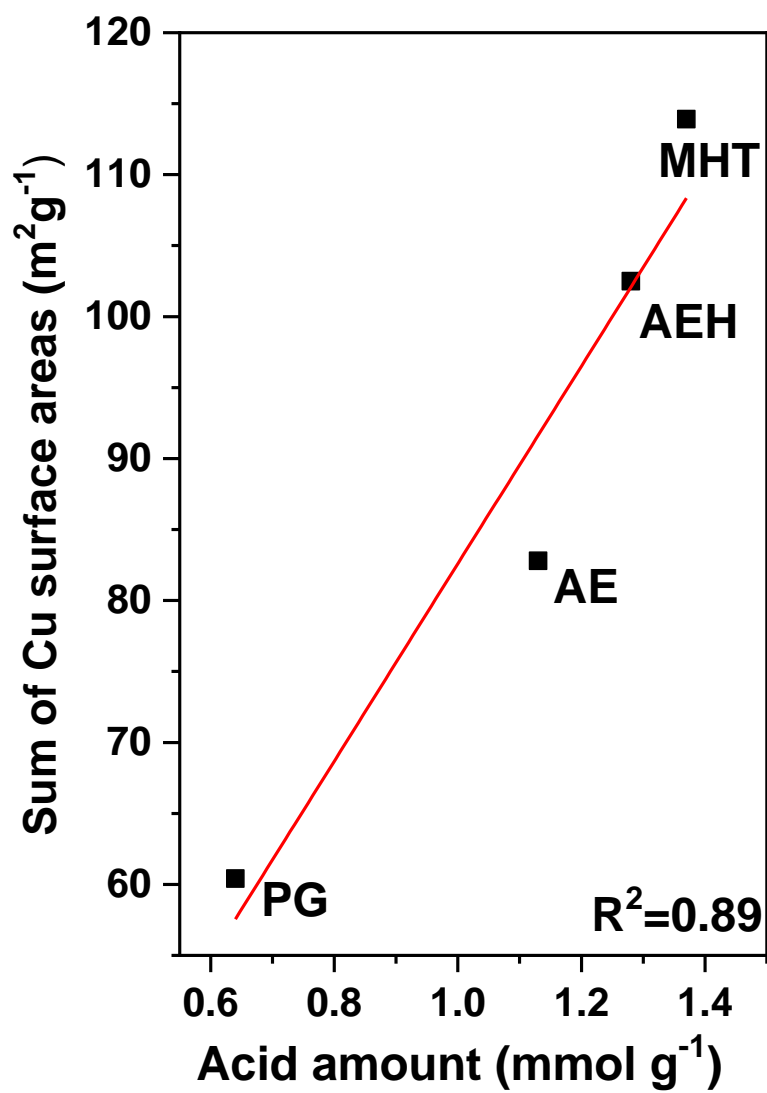
**Fig. S2** *In situ* FTIR spectra of MeOH adsorbed on the Cu/SiO<sub>2</sub>-MHT catalyst at 180 °C. Besides the IR bands of the gaseous MeOH, one band centered at about 2125 cm<sup>-1</sup> was also detected, which is assigned to Cu<sup>+</sup>-CO.



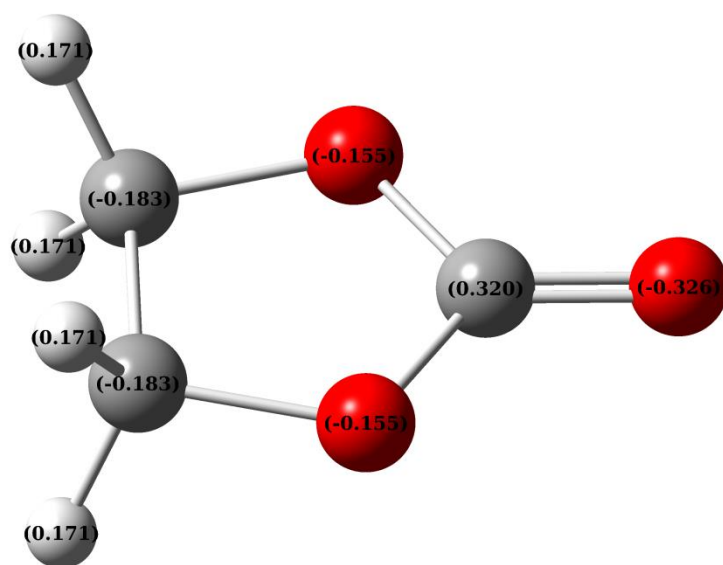
**Fig. S3** XRD patterns of the fresh and the spent Cu/SiO<sub>2</sub>-MHT catalyst after 10 cycles.



**Fig. S4** TEM image of the spent Cu/SiO<sub>2</sub>-MHT catalyst after 10 cycles.



**Fig. S5** The correlation of acid amount and the sum copper surface areas for Cu-based catalysts.



**Fig. S6** Charge distribution of EC molecule calculated by DFT.

## References

- [1] C. Van Der Grift, A. Wielers, B. Jogh, J. Van Beunum, M. De Boer, M. Versluijs-Helder, J. Geus, *J. Catal.*, 1991, 131, 178-189.
- [2] C. Zhang, L. Wang, J. Liu, Y. Yang, P. He, Y. Cao, J. Chen, H. Li, *ChemCatChem*, 2018, 10, 4617-4628.
- [3] F. Deng, N. Li, S. Tang, C. Liu, H. Yue, B. Liang, *Chem. Eng. J.*, 2018, 334, 1943-1953.