

Room-temperature synthesis of mesoporous CuO nanostructure and its catalytic activity for cyclohexene oxidation

Xinxin Sang, Jianling Zhang*, Tianbin Wu, Bingxing Zhang, Xue Ma, Li Peng, Buxing Han, Xincheng Kang, Chengcheng Liu, Guanying Yang

Beijing National Laboratory for Molecular Sciences, CAS Key Laboratory of Colloid and Interface and Thermodynamics, Institute of Chemistry, Chinese Academy of Sciences.

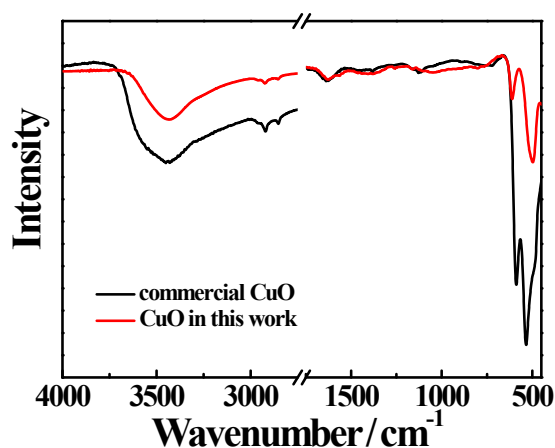


Fig. S1 FT-IR spectrum of (a) CuO synthesized in TEA and (b) commercial CuO. CuO obtained in this work presents the same FT-IR spectrum as commercial CuO. The bands in the infrared spectrum at below 700 cm⁻¹ are due to Cu-O vibrations. The peak at 3500 cm⁻¹ indicates that there are still traces of hydroxyl groups due to the surface adsorption. No peaks of TAE were observed.

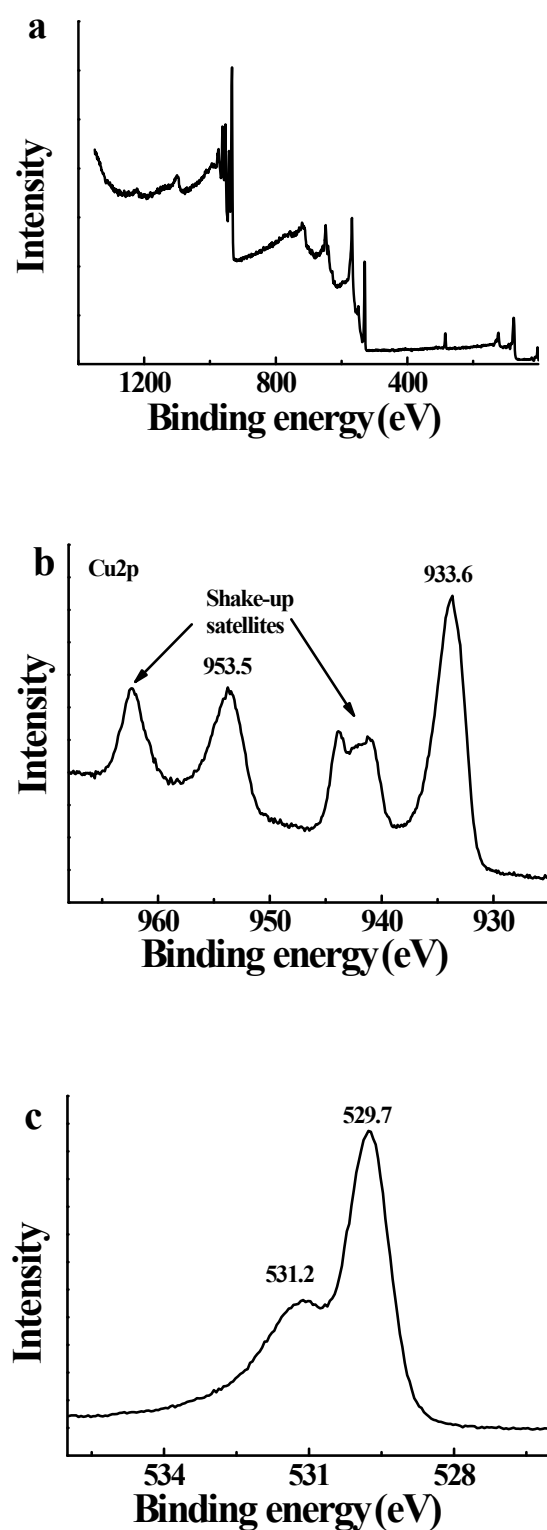
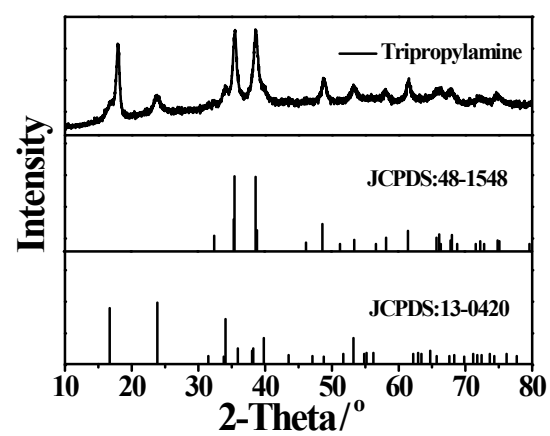
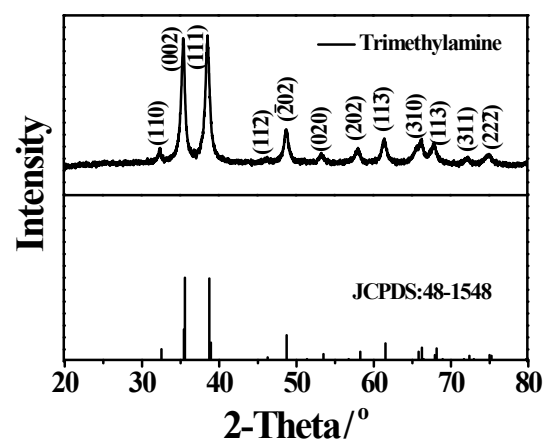


Fig. S2 XPS study of CuO synthesized in TEA: (a) A wide-range of XPS spectra (b) Cu₂p spectra (c) O1s spectra. The survey spectra (Fig. S2a) indicates that there is no amine left on the surface of CuO nanocrystals because the characteristic N1s

peaks do not appear in the range of 394-410 eV. In Fig. S2b, the peaks located at 933.6 eV and 953.5 eV can be assigned to $\text{Cu}2p_{3/2}$ and $\text{Cu}2p_{1/2}$ of CuO, respectively. The Cu2p spectrum contains a characteristic (for the Cu^{2+} state) “shake-up” satellite. In Fig. S2c, the peak at 529.7 eV corresponds to O^{2-} in CuO. The O1s spectrum contains a small shoulder on the side with binding energy 531.2 eV, which can be attributed to the weakly charged oxygen species from air. The Cu2p and O1s spectra presented in Fig. S2 are typical for CuO samples and agree well with the literature data.¹



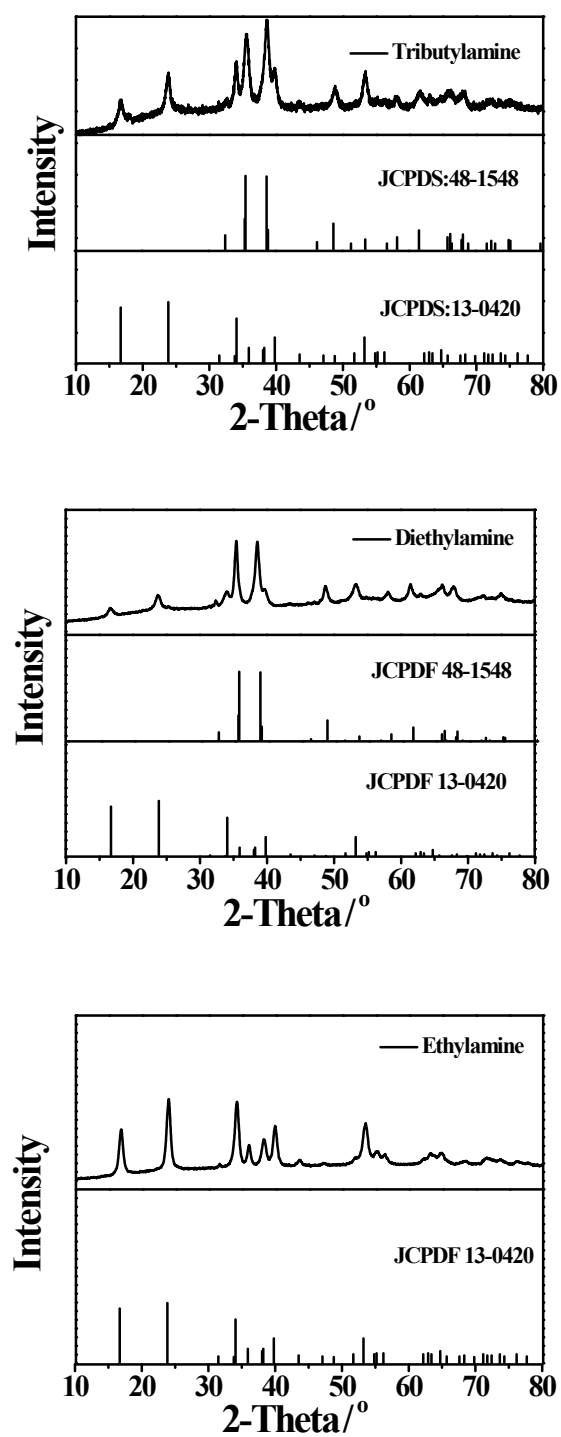


Fig. S3 XRD patterns of the samples synthesized in different amine solution.

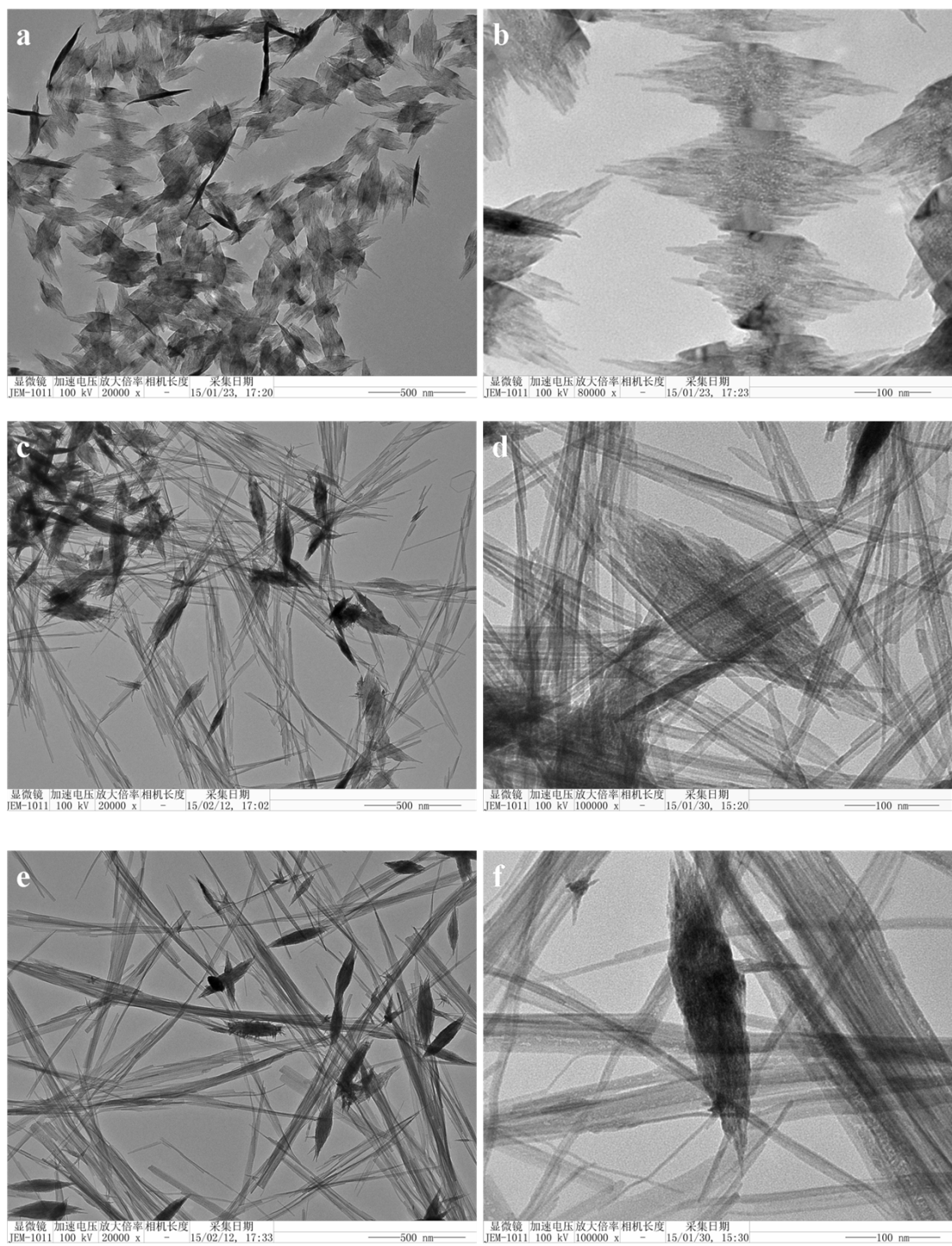


Fig. S4 TEM images of the samples synthesized in TMA (a, b), TPA (c, d), TBA (e, f) solution.

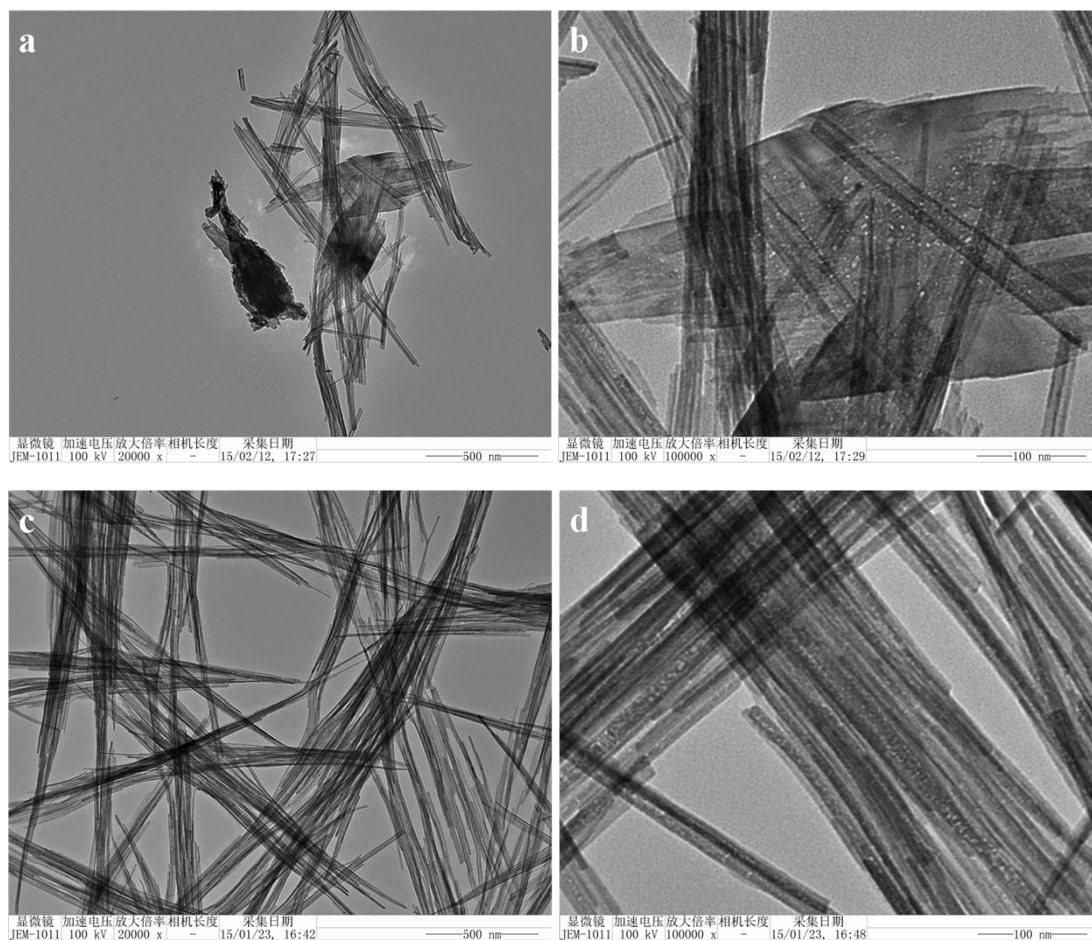


Fig. S5 TEM images of the samples synthesized in DEA (a, b) and EA (c, d).

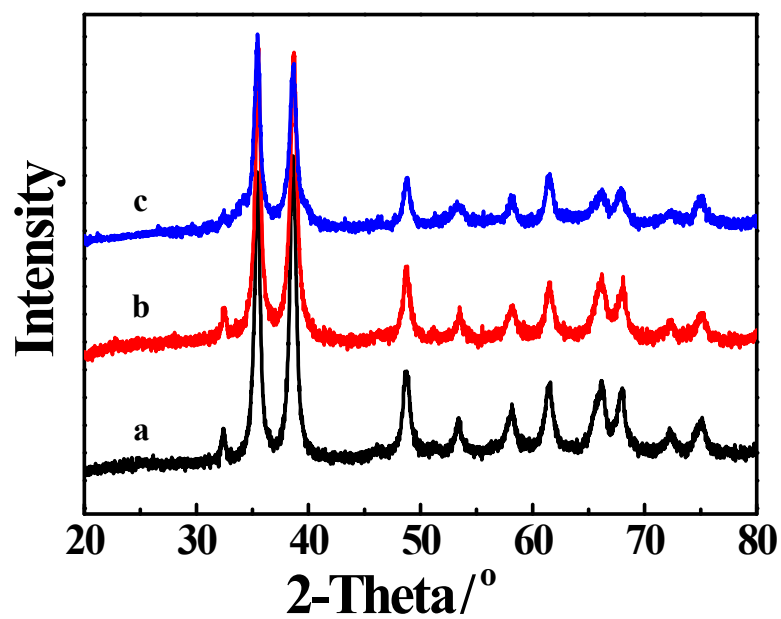


Fig. S6 XRD patterns of the CuO synthesized from $\text{Cu}(\text{NO}_3)_2$ (a), CuSO_4 (b) and CuCl_2 (c) in TEA aqueous solution.

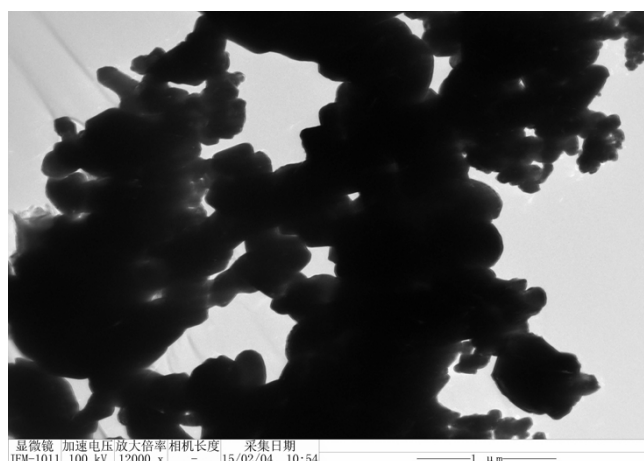


Fig. S7 TEM image of commercial CuO.

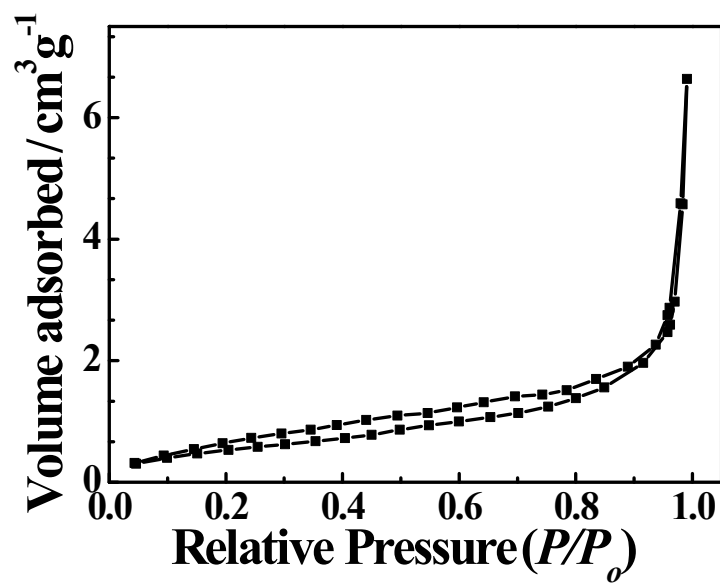


Fig. S8 N_2 adsorption-desorption isotherm of commercial CuO.

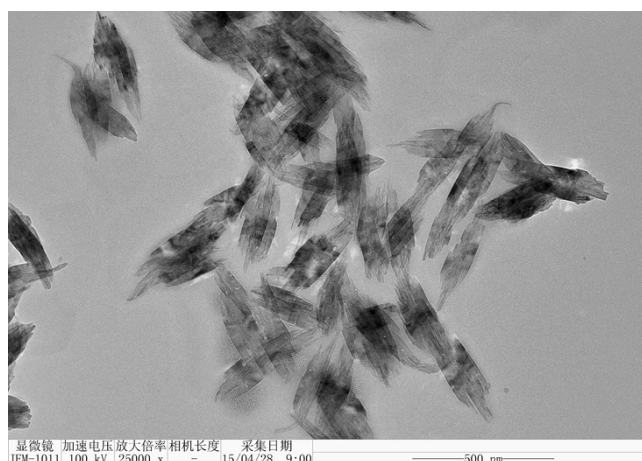


Fig. S9 TEM image of the CuO reused four times.

References

1. H. Cao, H. F. Jiang, X. S. Zhou, C. R. Qi, Y. G. Lin, J. Y. Wu and Q. M. Liang, *Green Chem.*, 2012, **14**, 2710.