

Supplementary Information

Synthesis of high entropy oxides derived from metal organic frame and catalytic performance for total toluene oxidation

Abid Hussain^{a, b}, Yuhua Zheng^{a*}, Qianyu Wang^{a, c}, Yanbin Cui^{a, b*}

^a State Key Laboratory of Mesoscience and Engineering, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China.

^b Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, Beijing 100049, China.

^c State Key Laboratory of Heavy Oil Processing, China University of Petroleum, Beijing 102249, China.

Corresponding author:

*Tel: +861062621607. e-mail: ybcui@ipe.ac.cn.

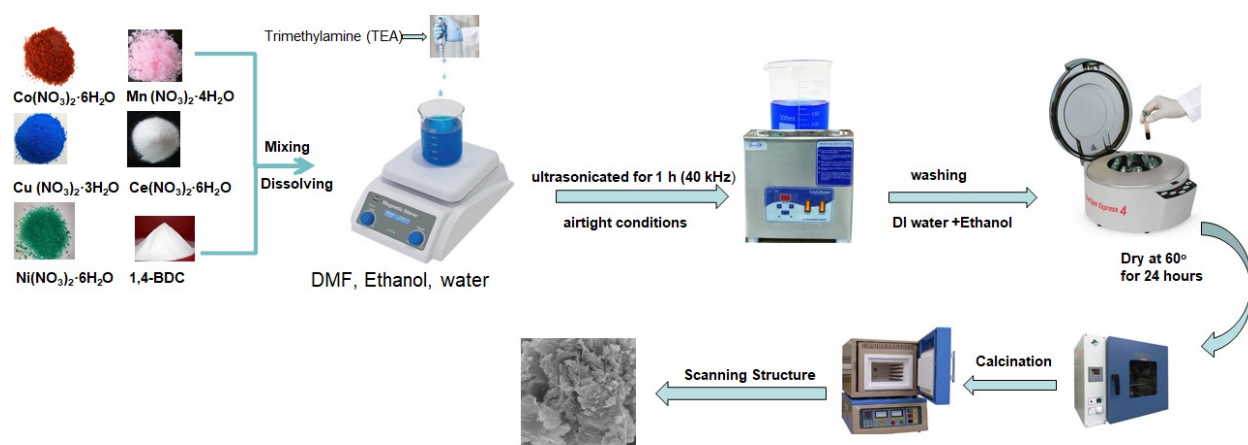


Fig. S1 Scheme for the synthesis of HEO.

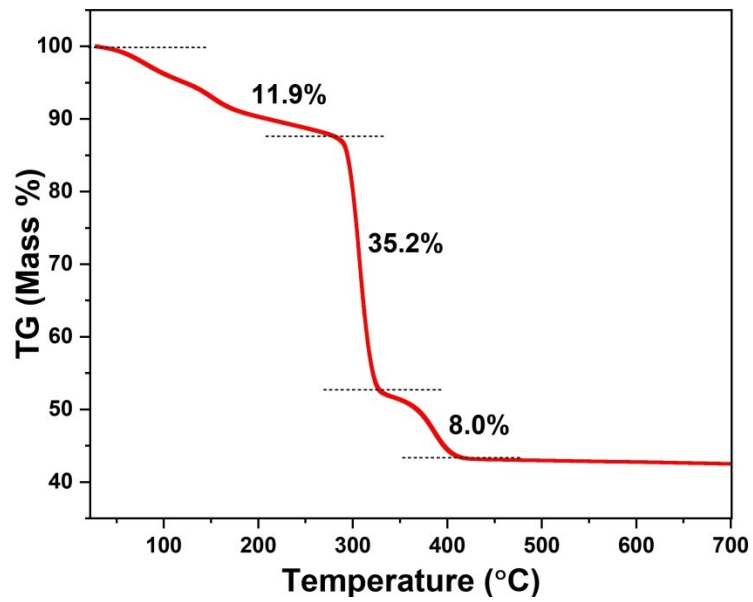


Fig. S2 TGA of HE-MOF before calcination.

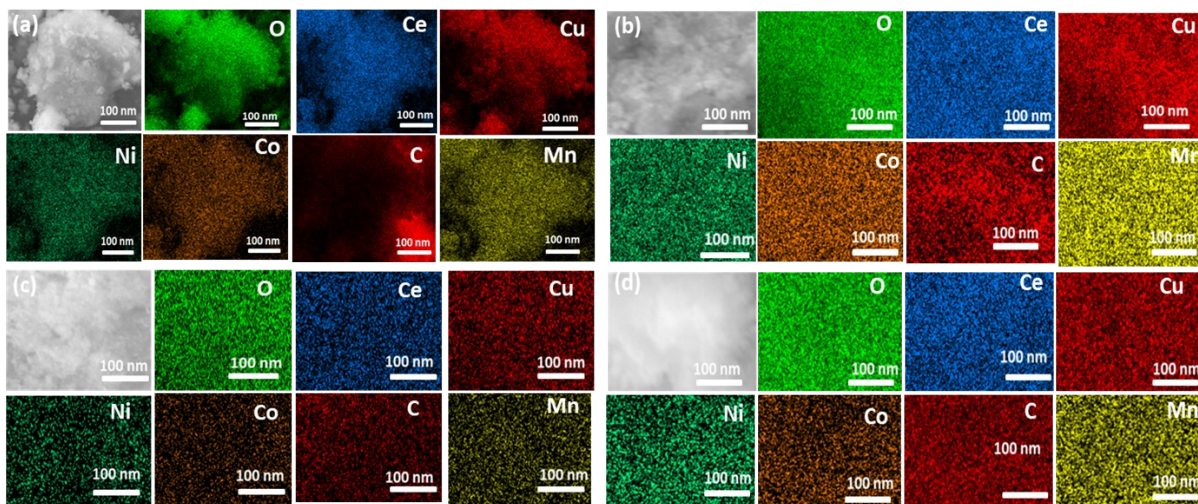


Fig. S3. EDS images of (a) Ce-HEO-300, (b) Ce-HEO-400, (c) Ce-HEO-500 and (d) Ce-HEO-700.

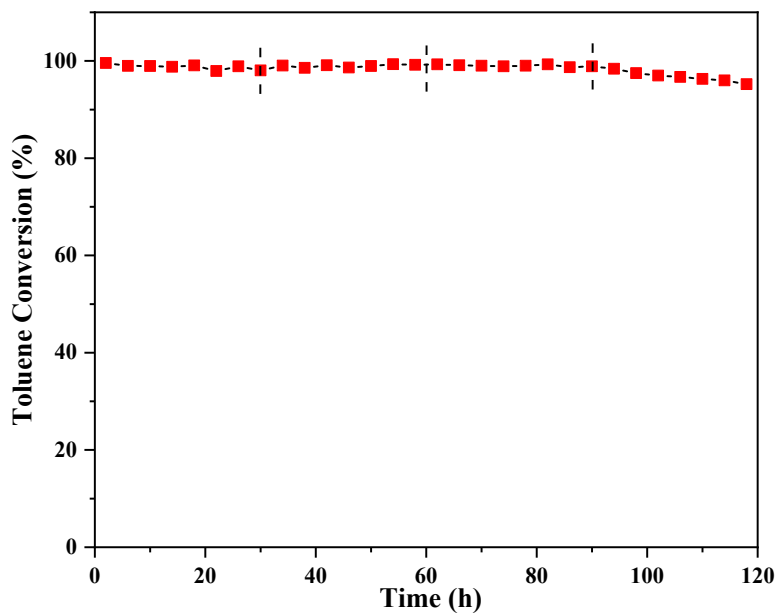


Fig. S4 Catalytic stability of Ce-HEO-700 for toluene oxidation at 330 °C.

Table S1 Specific surface area and average pore diameter of the catalysts.

Sample	Ce-HEO-300	Ce-HEO-400	Ce-HEO-500	Ce-HEO-700
Specific surface area (m ² /g)	136.18	152.96	66.33	15.83
Average Pore diameter (nm)	12.62	13.06	22.47	32.05

Table S2 Comparison of toluene conversion for the catalysts

Temp (°C)	Ce-HEO-300	Ce-HEO-400	Fe-HEO-400	La-HEO-400	Ce-HEO-500	Ce-HEO-700
T ₅₀	265	180	245	250	225	225
T ₉₀	300	255	280	300	270	270

Table S3 Catalytic oxidation of toluene over different HEO catalysts.

Catalyst	GHSV (h ⁻¹)	Toluene (ppm)	T50 (°C)	T90 (°C)	Ref.
Ce-HEO-500	60000	1000	283	312	1
0.5%Au/Ce-HEO-500	60000	1000	230	245	
HEO-400	60000	800	232	274	2
HEO-500	60000	800	239	288	
HEO-600	60000	800	246	254	
HEO-700	60000	800	300	344	
HEO-800	60000	800	407	486	
Ce-HEO-300	60000	1000	265	300	This work
Ce-HEO-400	60000	1000	180	255	
Ce-HEO-500	60000	1000	225	270	
Ce-HEO-700	60000	1000	225	270	
Fe-HEO-400	60000	1000	245	280	
HEO-400	60000	1000	250	300	

References:

- 1 J. Zhou, Y. Zheng, G. Zhang, X. Zeng, G. Xu, Y. Cui, Environ. Technol., 2023, **23**, 3016-3028.
- 2 T. Xue, Y. Wang, L. Yang, Z. Li, Y. Gao, Q. Wang, Catalysts., 2023, **13**, 119-131.