Supplementary Information (SI) for Journal of Materials Chemistry A.


# Supporting Information

## Cerium-optimized high-entropy spinel oxide for efficient and anti-interference removal of VOC from complex flue gas

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**Preparation of MnCeOx Catalyst:** The MnCeOx catalyst was synthesized following a previously reported method [1]. An equimolar amount (10 mmol) of ($Mn(NO_3)_2$ and $Ce(NO_3)_3 \cdot 6H_2O$ were dissolved in 100 mL of deionized water. Then, 60 mmol of citric acid was gradually added to the solution, which was stirred at 80 °C for 7 h. The resulting suspension was then dried at 110 °C for 12 h, followed by calcination at 600 °C for 5 h in air. The synthesized catalyst is denoted as MnCeOx.

Reference：

[1] Yu Dai, Xingyi Wang, Qiguang Dai, Dao Li. Applied Catalysis B: Environmental, 2012, 111, 141-149.

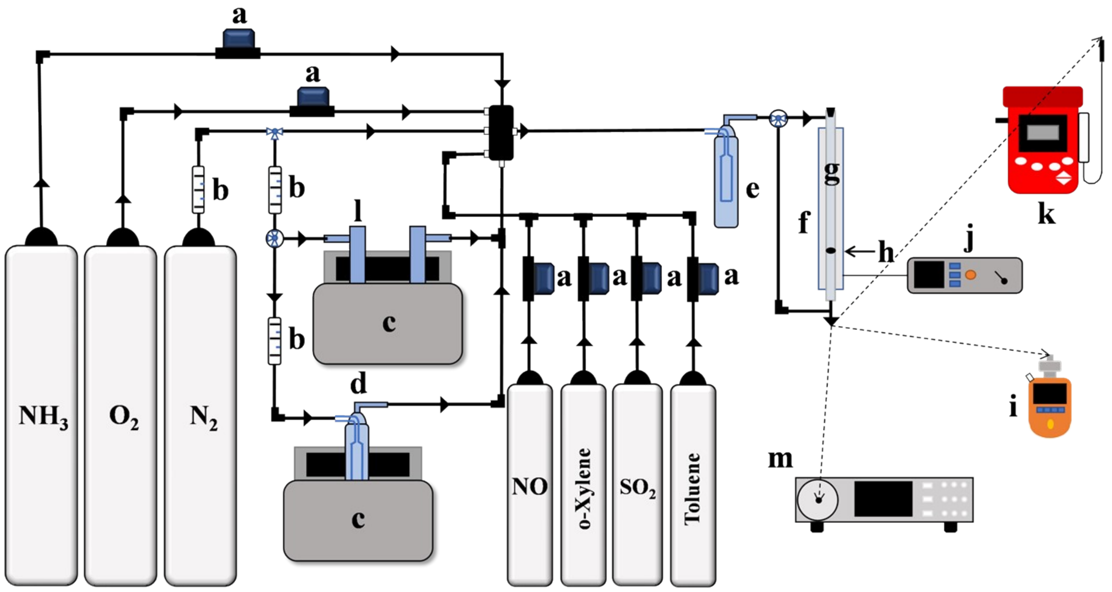



Figure S1. Schematic diagram of the experimental apparatus. Components (a: mass flow meter; b: volume flow meter; c: thermostatic bath; d: cleaning bottle for water vapor generation; e: cleaning bottle for gas mixing; f: heating device; g: quartz reactor; h: catalyst; i: gas detector; j: temperature controller; k: flue gas analyzer; l: Mercury generator; m: mercury analyzer)

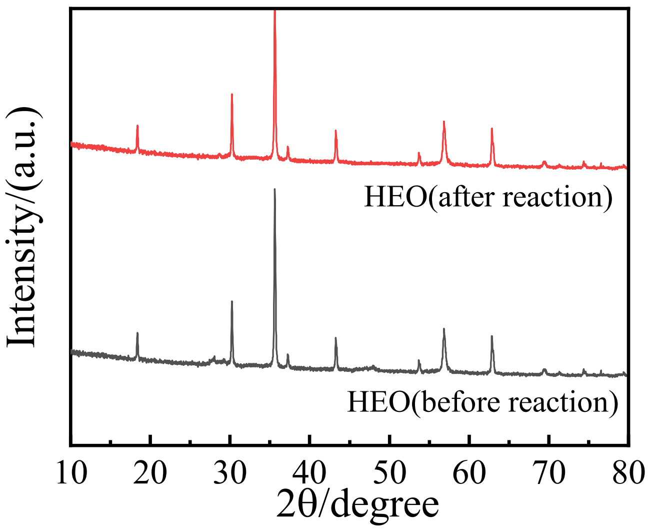



Figure S2. XRD patterns of the fresh HEO and spent HEO after reaction at 450 °C

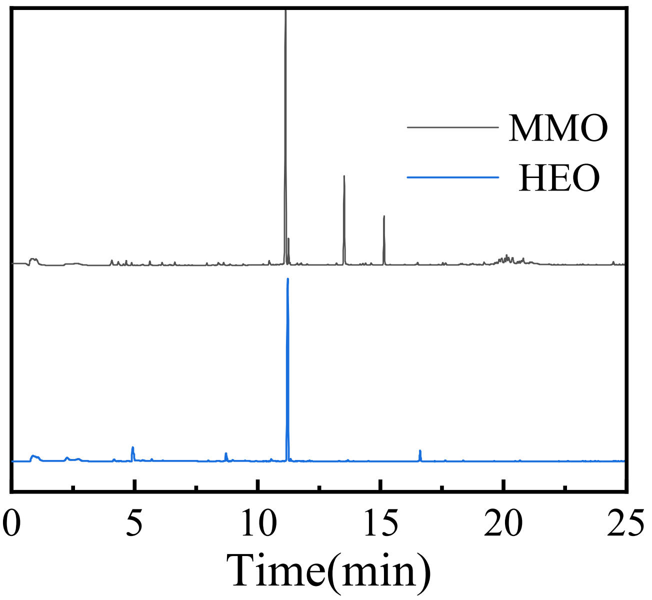



Figure S3. GC-MS spectra analysis of enriched tail gas after o-xylene oxidized by HEO and MMO.

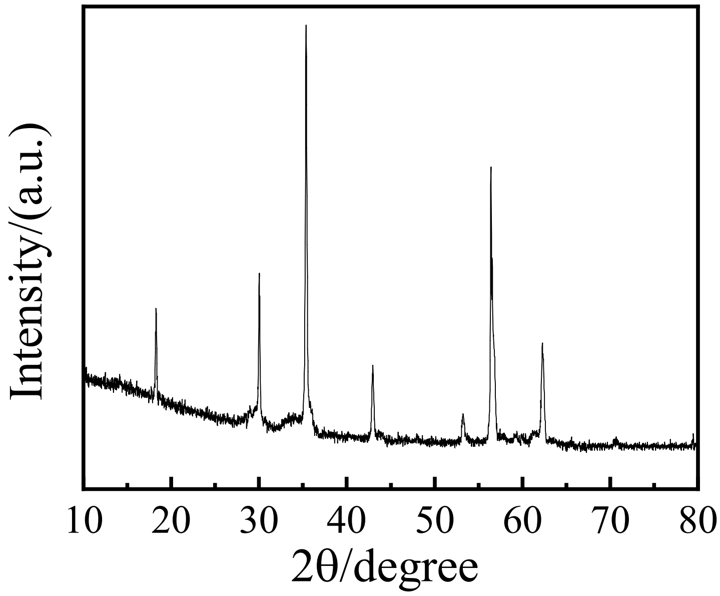



Figure S4. XRD patterns of the Al-HEO

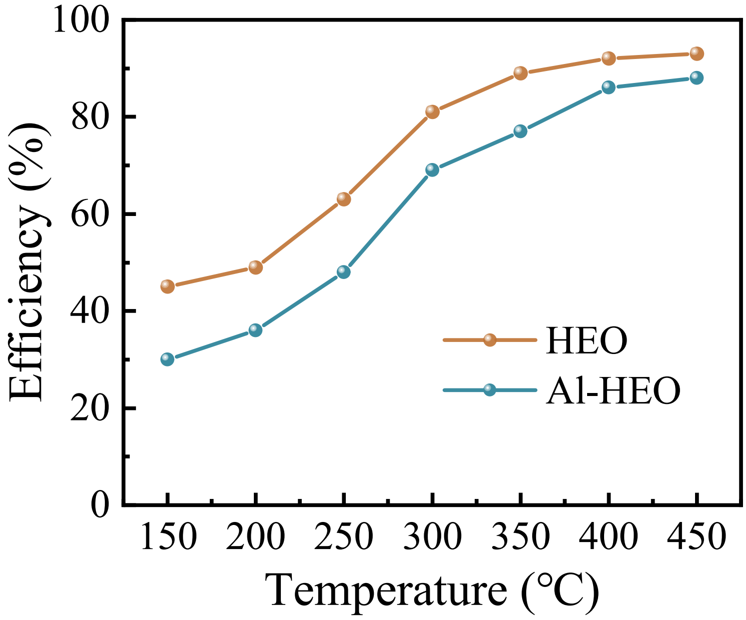



Figure S5. O-xylene removal efficiency of HEO and Al-HEO

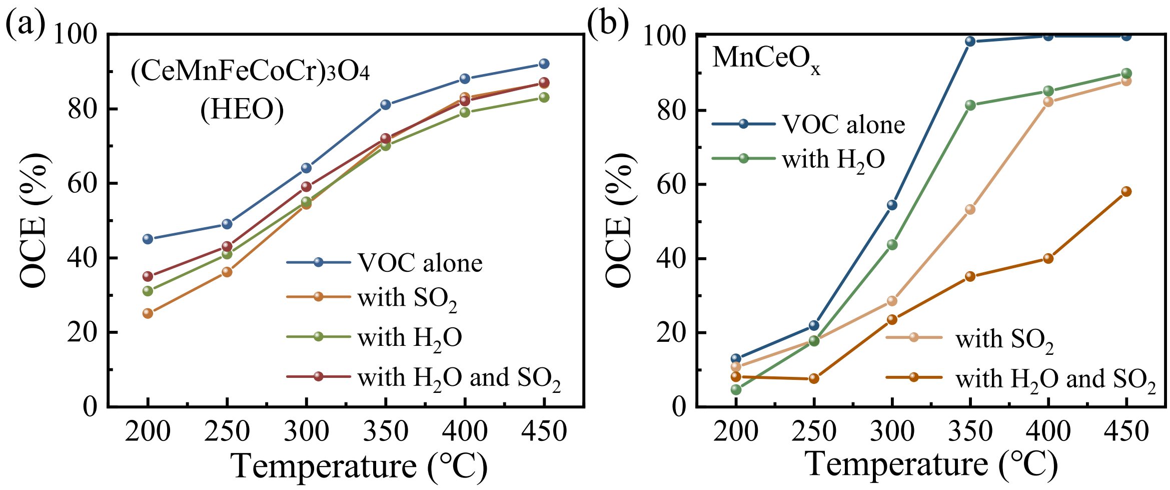



Figure S6. Comparison of catalytic oxidation activity between HEO (a) and conventional MnCeOx catalyst (b) for o-xylene degradation

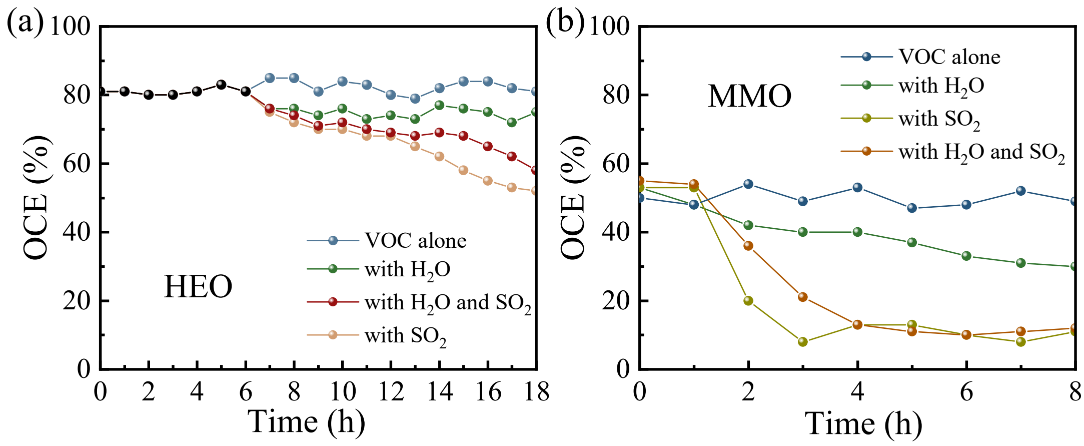



Fig. S7 Long-term stability of (a) HEO and (b) MnCeOx for o-xylene oxidation

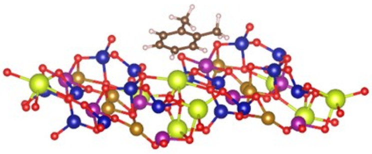
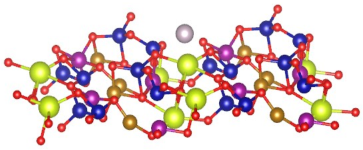
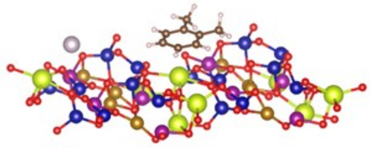
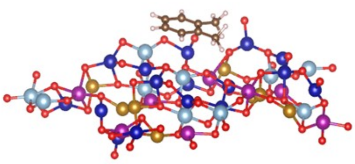
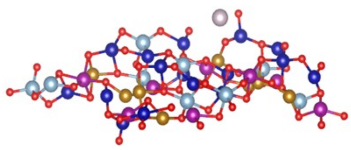
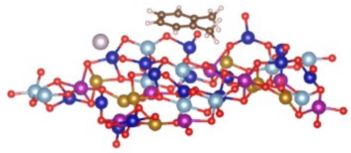
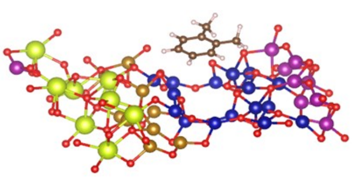
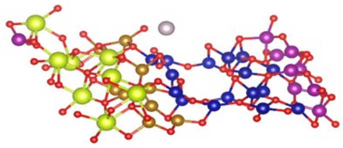
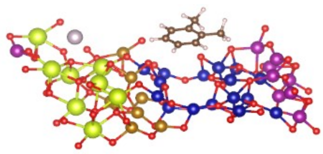
Table S1. Surface area, pore size and pore volume of HEO and MMO catalysts

| Catalyst | Surface area($m^2/g$) | Pore volume($cm^3/g$) | Pore size(nm) |
|---|---|---|---|
| HEO | 1.73 | 0.017 | 9.09 |
| MMO | 39.72 | 0.061 | 4.16 |

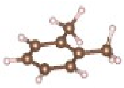
Table S2. Elemental percentage of ICP, XPS as well as EDS tests for HEO and MMO

| Characterization | Samples | Composition (at%) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mn | Co | Cr | Fe | Ce | Mn：Co：Cr：Fe：Ce |
| ICP | HEO | 20.4 | 20.2 | 20.0 | 20.6 | 18.8 | 1.02：1.01：1.00：1.03：0.94 |
| | MMO | 20.6 | 20.5 | 19.5 | 20.3 | 19.1 | 1.03：1.02：0.98：1.01：0.96 |
| XPS | HEO | 23.0 | 17.1 | 16.9 | 25.2 | 17.8 | 1.15：0.86：0.85：1.26：0.89 |
| | MMO | 10.9 | 14.4 | 26.0 | 41.3 | 7.4 | 0.55：0.72：1.30：2.06：0.37 |
| EDS | HEO | 20.8 | 20.2 | 19.8 | 19.7 | 19.5 | 1.04：1.01：0.99：0.98：0.97 |
| | MMO | 26.4 | 15.6 | 22.5 | 25.0 | 10.6 | 1.32：0.78：1.13：1.25：0.53 |

Table S3. Optimized adsorption configurations for pollutants

| Catalysts | Adsorption model [a] (O-xylene) | Adsorption model ($Hg^0$) | Adsorption model (O-xylene+$Hg^0$) |
|---|---|---|---|
| HEO $(CeMnFeCoCr)_3O_4$ |  |  |  |
| Al-HEO $(AlMnFeCoCr)_3O_4$ |  |  |  |
| MMO $CeMnFeCoCrO_x$ |  |  |  |

[a] o-xylene, $Hg^0$ are located at the optimized stable adsorption sites;

 $Hg^0$  O-xylene

Purple, Mn; dark blue, Cr; green, Fe; blue, Co; brown, Ce; light blue, Al; red, O.