Boosting Lewis Acidic Sites via SMSI to Enriched Oxygen Vacancy on Pt-CeO_2 Catalysts Enhancing Efficiency of CO Promoted Toluene Catalysis

Xiaoying Zhou [a], Mingyuan Zhang [a, *], Peiqi Mao [a], Jiaxuan Pang [a], Jiayi Wang [b], Liping Wang [a], Chentao Hou [a, *], Daiqi Ye [c, *]

[a] *School of Geology and Environment, Xi'an University of Science and Technology, Xi'an 710054, China.*
[b] *Non-metallic Mine Research and Design Institute Co., Ltd, Xianyang 712000, China.*
[c] *School of Environment and Energy, South China University of Technology, Guangzhou 510006, China.*
**Corresponding Author: zhangmy@xust.edu.cn (M. Zhang), houct@xust.edu.cn (C. Hou), cedqye@scut.edu.cn (Q. Ye).*

Experiment

2.2 Characterization of catalysts

In this work, the crystal structure and quality of the nanomaterials were determined using X-ray powder diffraction (XRD, D8 ADVANCE, Bruker-AXS, Germany). The specific surface area of the nanomaterials was measured using the BET method in a nitrogen atmosphere with a fully automatic surface analyzer (ASAP 2020M, Micromeritics, USA). The morphologies of different catalyst samples were observed using scanning electron microscopy (SEM, Merli, Panaco, Netherlands). The microstructure of all samples was examined using transmission electron microscopy (TEM, JEM-2010F, JEOL, Japan). H_2-temperature programmed reduction, O_2-temperature programmed desorption, and NH_3-temperature programmed desorption experiments were conducted on various catalysts using BSD-Chem C200 (Beishide Instrument Technology, Beijing). These experiments aimed to investigate the reducibility of the nanomaterials and the relationship between the oxygen species and acidic sites on the catalyst surface. The surface defect structure and oxygen vacancy content of different samples were measured using visible/UV-Raman spectroscopy with a LabRAM HR Evolution Laser (HYJ, France). In situ tracking and detection of intermediate species adsorbed on the catalyst surface during the catalytic reaction were performed using Fourier infrared spectroscopy (INVENIO-S, Bruker, Germany). The Pt content on all catalyst surfaces was quantified using an iCAP 6300 inductively coupled plasma emission spectrometer (PerkinElmer, USA). The densities of Bronsted and Lewis acids were determined by the pyridine adsorption infrared (Py-IR) method with the Nicolet-380 (Bruker tensor27) apparatus.

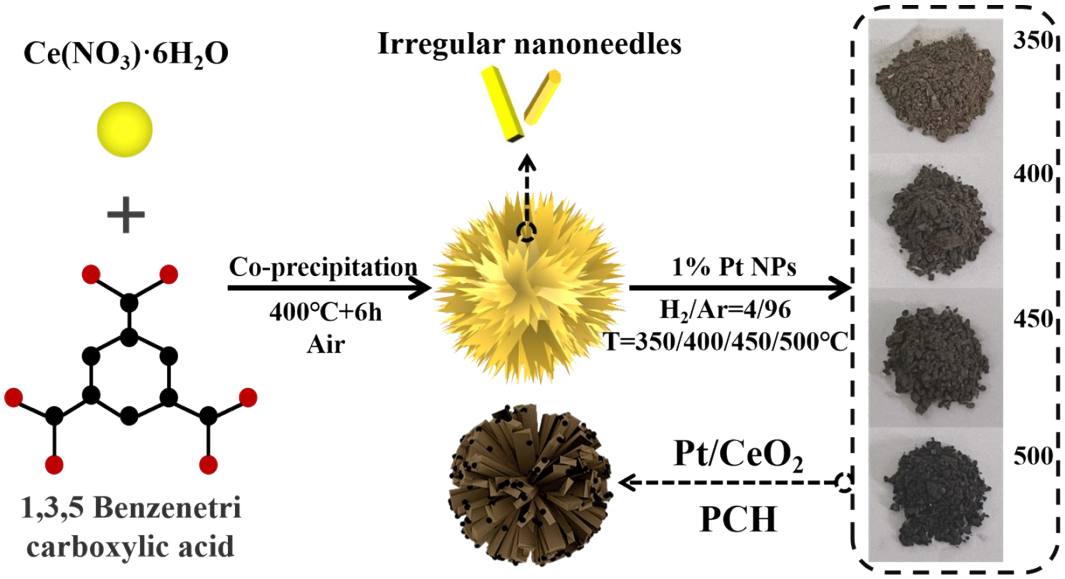


Fig. S1. Schematic diagram of preparation of PCH catalytics.

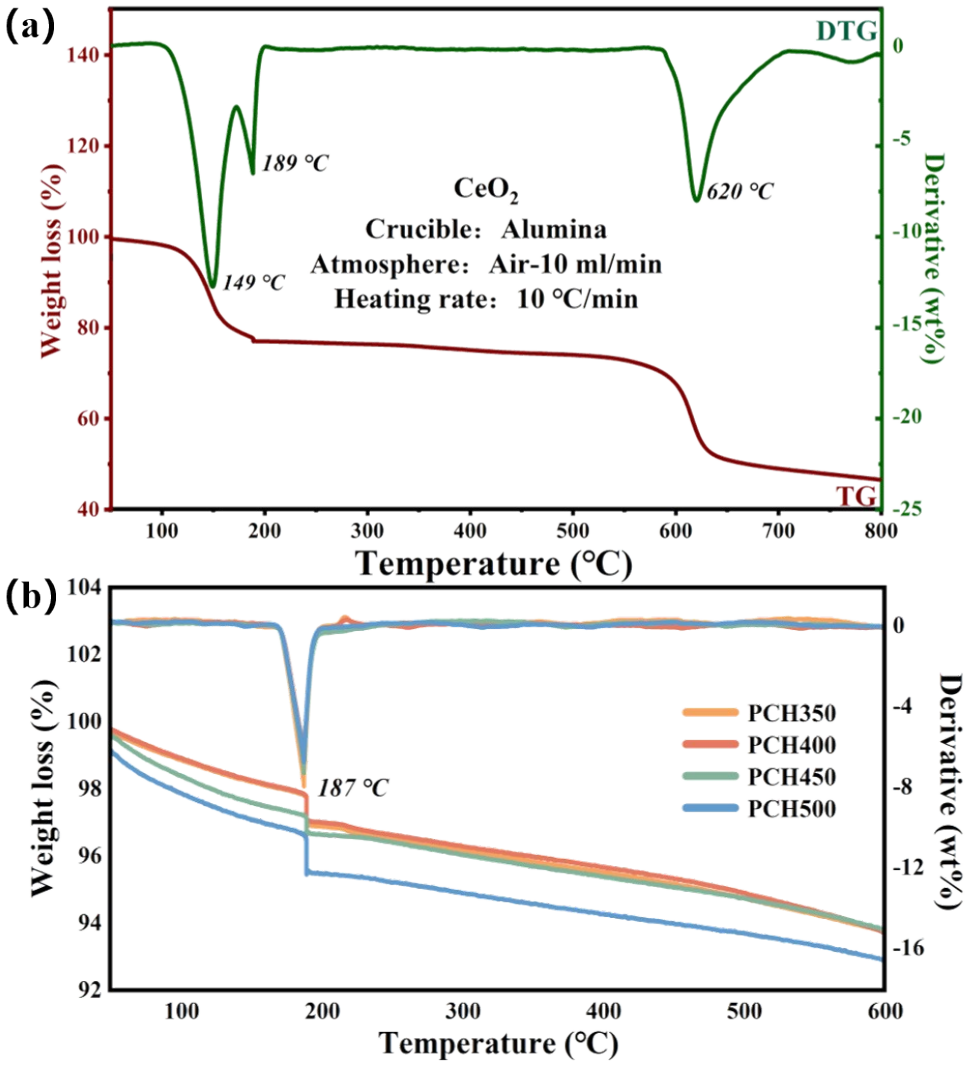


Fig. S2. Curves of TGA over (a) CeO_2; (b) PCH catalytics.

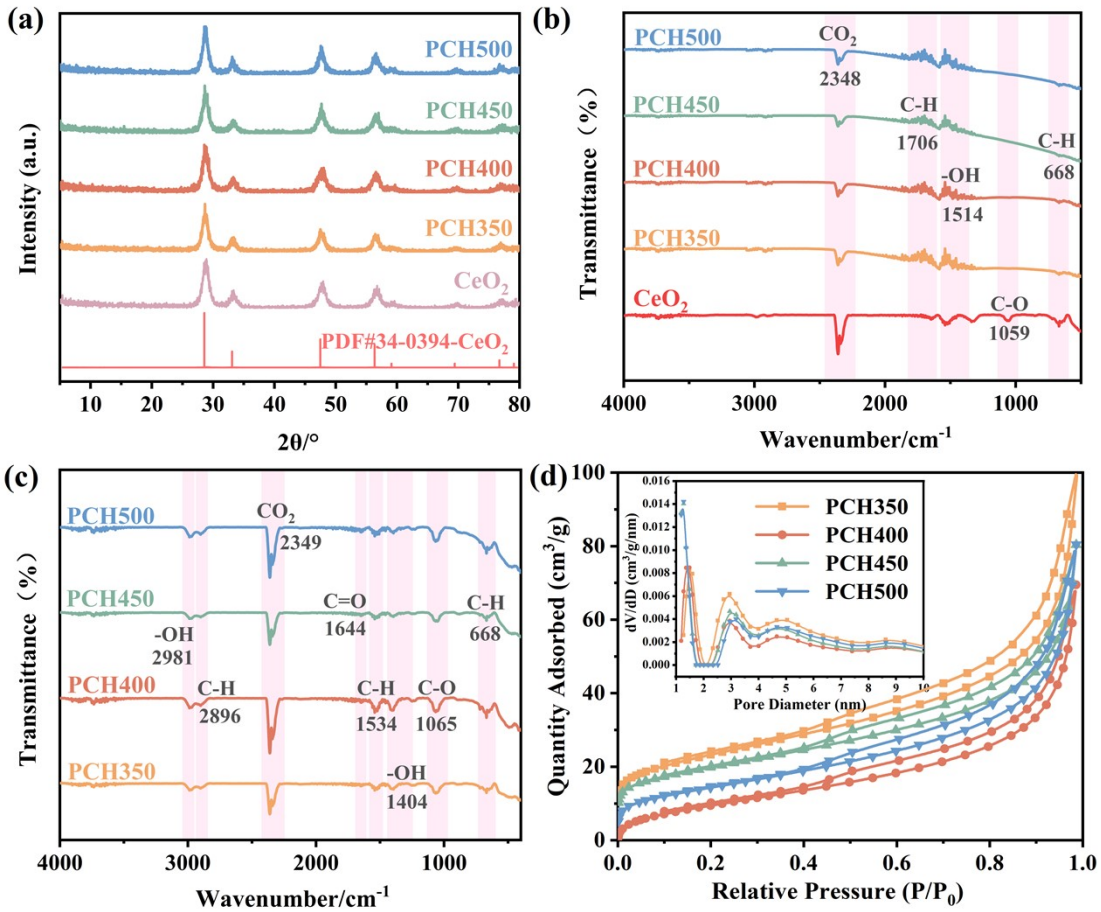


Fig. S3. (a) XRD patterns of PCH catalysts after reaction; FT-IR spectra of (b) Before reaction, (c) After reaction on PCH catalysts; (d) BET of PCH catalysts.

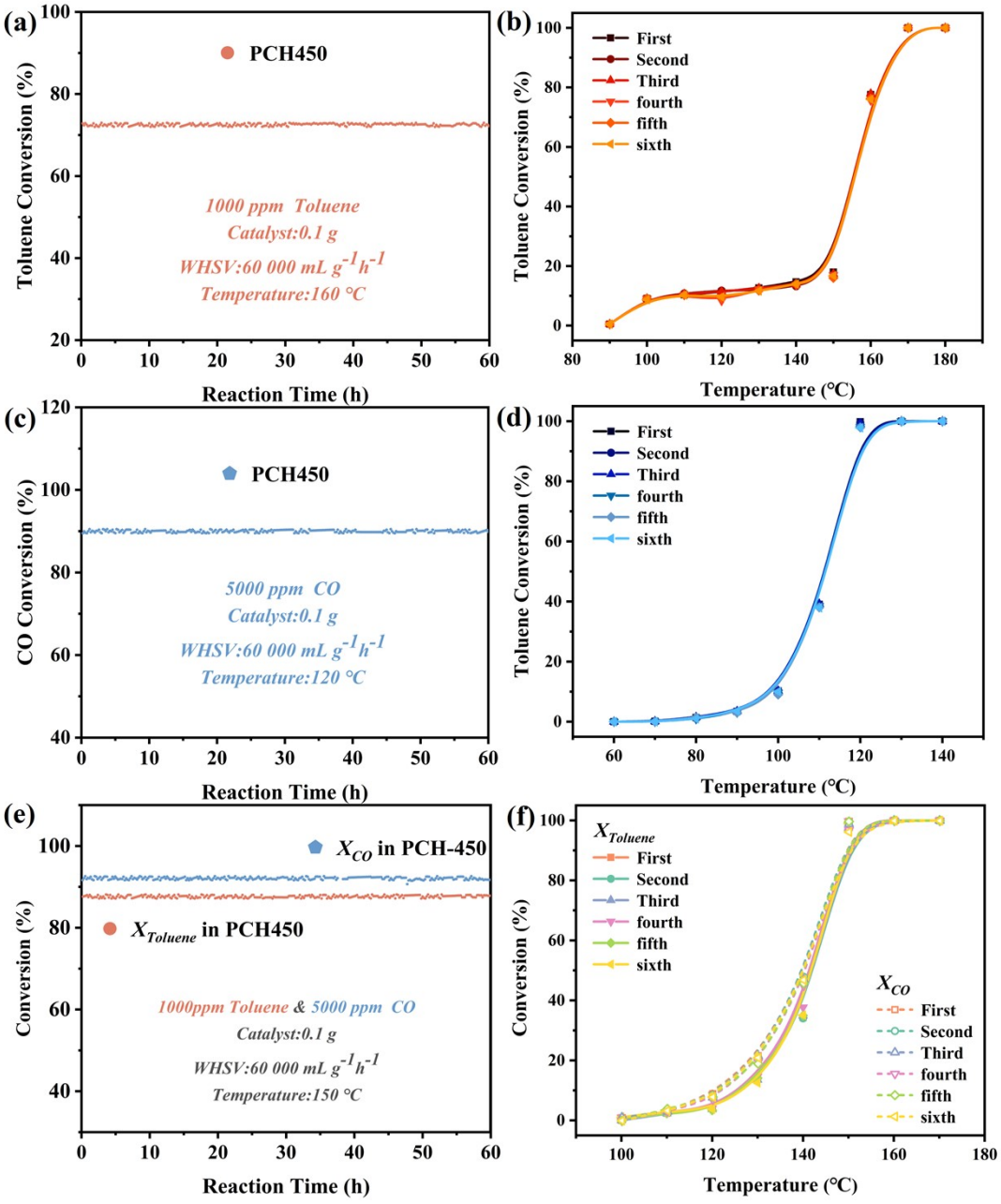
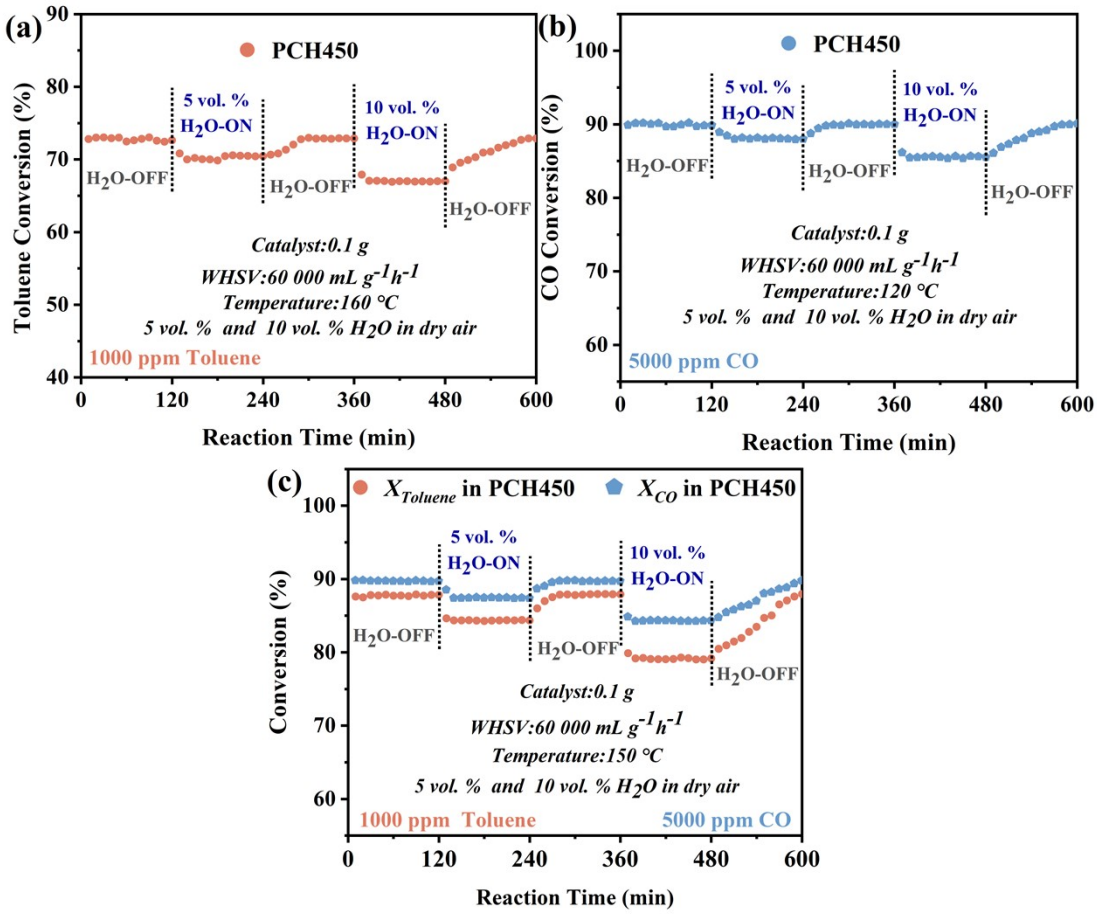


Fig. S4. Tests of durability for (a) Toluene, (c) CO, and (e) Toluene + CO conversion on PCH450 catalyst. Tests of multiple cyclicity for (a) Toluene, (c) CO, and (e) Toluene + CO conversion on PCH450 catalyst.



1

2 **Fig. S5.**Tests of resistance to water vapor interference for (b) Toluene, (d) CO, and (f) Toluene +
3 CO conversion on PCH450 catalyst.