

Supporting Information for

## Highly Efficient Oxidation of Ethyl Lactate to Ethyl Pyruvate Catalysed by TS-1 Under Mild Conditions

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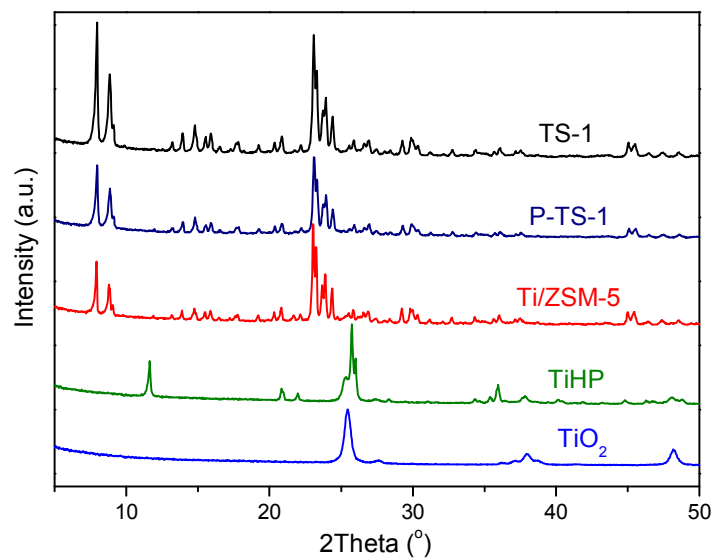
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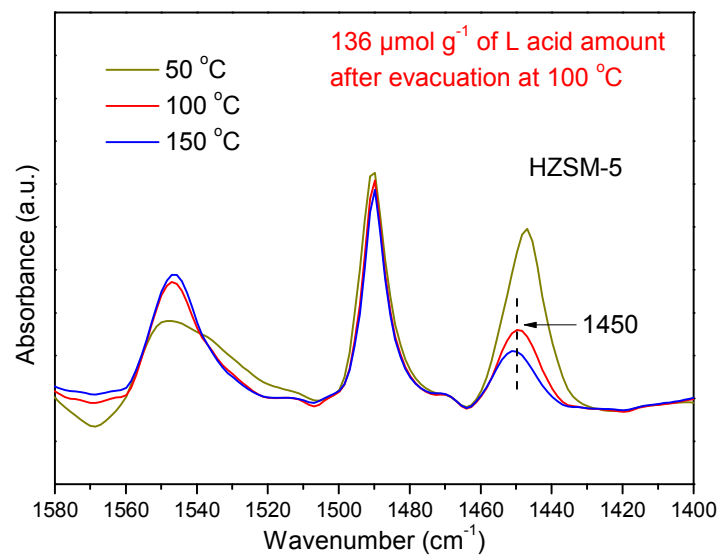
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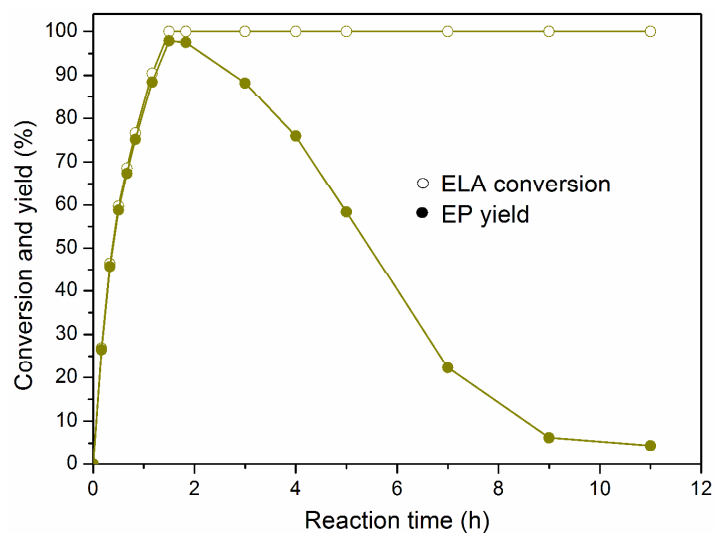
E-mail addresses: [zhoulipeng@zzu.edu.cn](mailto:zhoulipeng@zzu.edu.cn)



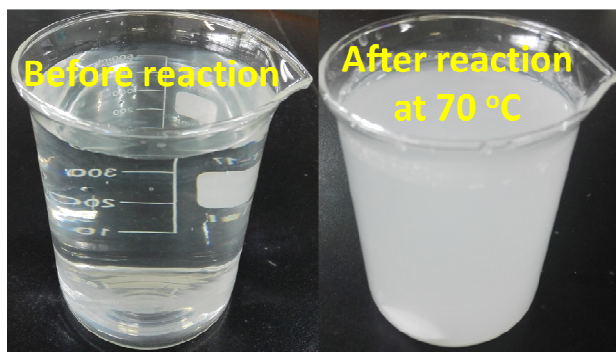
**Figure S1.** XRD patterns of  $\text{TiO}_2$ , TS-1, Ti/ZSM-5, TiHP and P-TS-1.



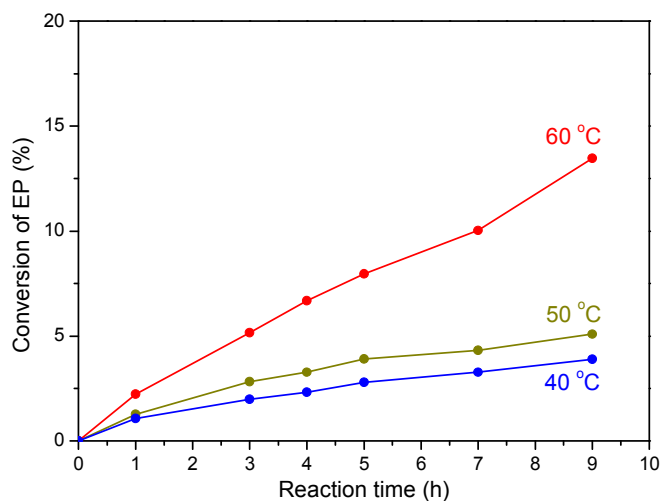
**Figure S2.** FTIR spectra of H-ZSM-5 after pyridine adsorption and evacuation at 50, 100, and 150 °C for 30 min.



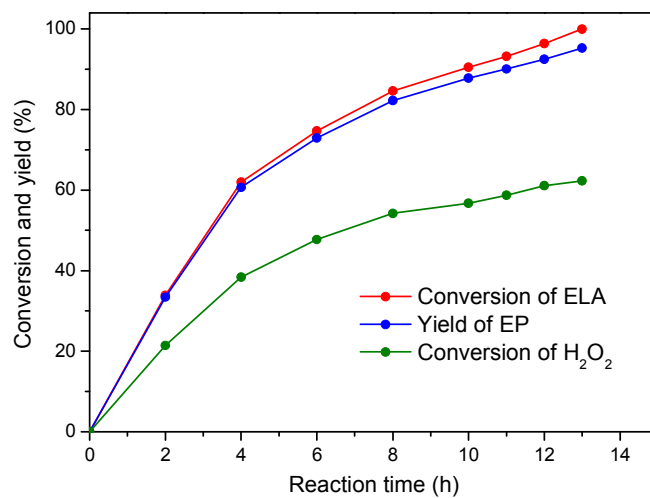
**Figure S3.** Time course of conversion of ELA over TS-1 at 70 °C. Reaction conditions: 10 mL of ELA, 25 mL of 30% H<sub>2</sub>O<sub>2</sub> (molar ratio of H<sub>2</sub>O<sub>2</sub> to ELA = 2.80), 300 mg of TS-1.



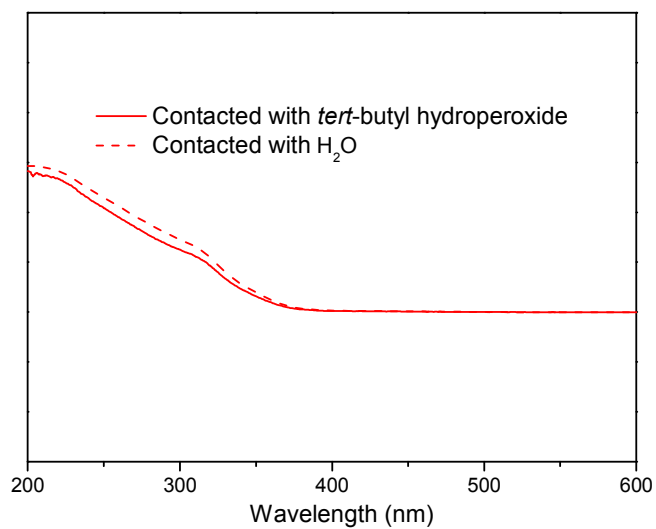
**Figure S4.** Observation of CO<sub>2</sub> in decomposition of EP: clear Ca(OH)<sub>2</sub> aqueous solution before reaction and formation of CaCO<sub>3</sub> solid after reaction at 70 °C for 11 h.



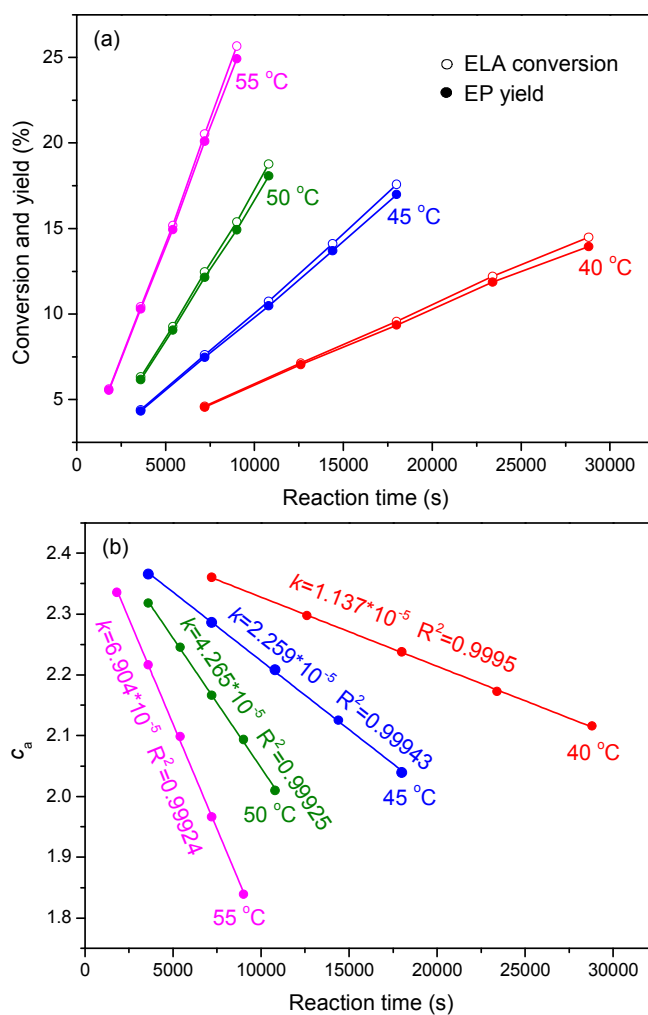
**Figure S5.** Time course of EP decomposition over TS-1 at different temperature. Reaction conditions: 10 mL of EP, 25 mL of 30%  $\text{H}_2\text{O}_2$  (molar ratio of  $\text{H}_2\text{O}_2$  to ELA = 2.8), 300 mg of catalyst.

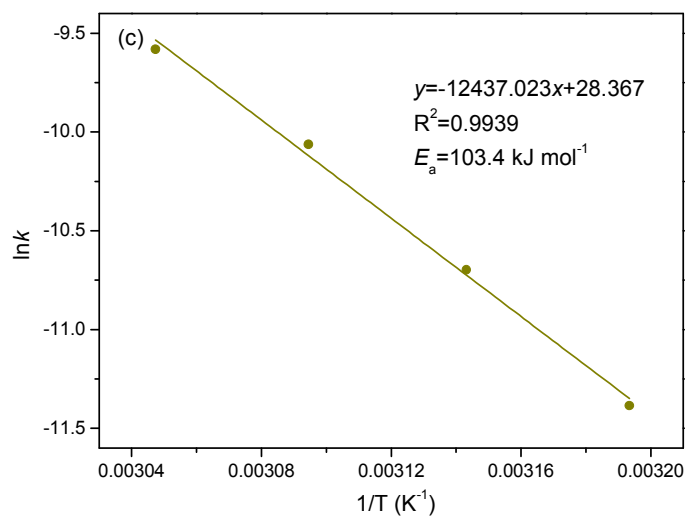


**Figure S6.** Conversion of  $\text{H}_2\text{O}_2$  in the oxidation of ELA to EP over TS-1. Reaction conditions: 10 mL of ELA, 15 mL of 30%  $\text{H}_2\text{O}_2$  (molar ratio of  $\text{H}_2\text{O}_2$  to ELA = 1.68), 300 mg of catalyst, 50 °C.

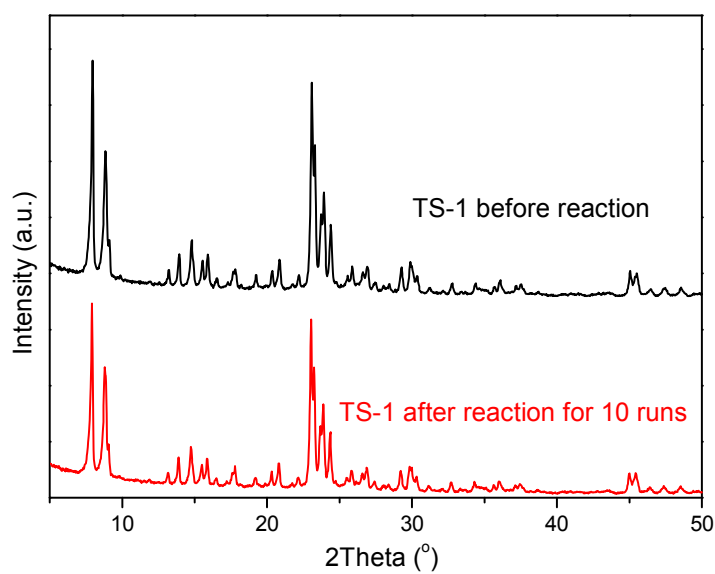


**Figure S7.** UV-vis spectra of TS-1 interacted with H<sub>2</sub>O or *tert*-butyl hydroperoxide aqueous solution.

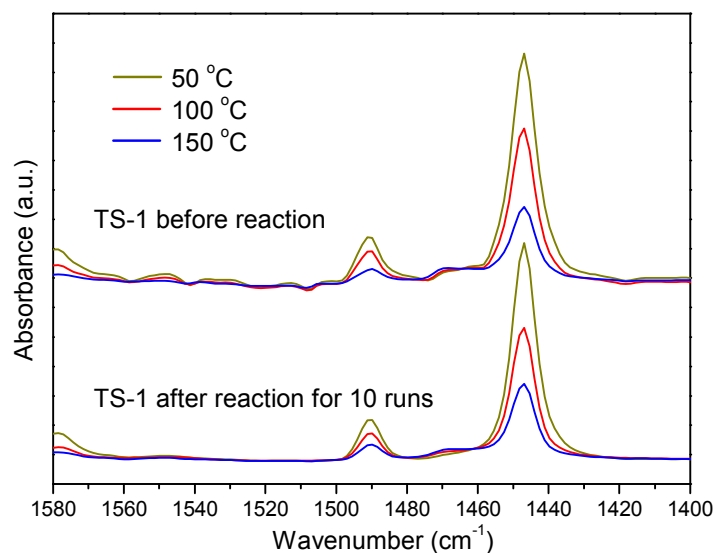




**Figure S8.** Time courses (a), zero-order rate constants (b) and Arrhenius plot (c) for the conversion of ELA over TS-1. Reaction conditions: 10 mL of ELA, 25 mL of 30%  $\text{H}_2\text{O}_2$ , 100 mg of TS-1.



**Figure S9.** XRD patterns of TS-1 after reaction for 10 runs.



**Figure S10.** FTIR spectra of the fresh TS-1 and the used TS-1 after pyridine adsorption and evacuation at 50, 100 and 150 °C for 30 min.

**Table S1. Catalytic Performance of TS-1 on Conversion of ELA to EP.<sup>a</sup>**

entry	additive	oxidant	conversion of ELA (%)	yield of EP (%)
1	Hydroquinone (0.2 g)	H <sub>2</sub> O <sub>2</sub>	100	97.5
2	No additive	H <sub>2</sub> O <sub>2</sub>	100	97.2
3	No additive	<i>tert</i> -Butyl hydroperoxide	17.3	0
4 <sup>b</sup>	No additive	H <sub>2</sub> O <sub>2</sub>	13.9	11.5

<sup>a</sup> Reaction conditions: 10 mL of ELA, 25 mL of 30% oxidant, 0.3 g of TS-1, 50 °C, 11 h.

<sup>b</sup> TS-1 was treated by Na<sub>2</sub>CO<sub>3</sub> aqueous (0.5 mol L<sup>-1</sup>) with liquid/solid = 50 mL g<sup>-1</sup> at 25 °C for 24 h.

**Table S2. Textural Parameters of the TS-1 before and after reaction**

sample	$S_{\text{BET}}$ ( $\text{m}^2 \text{g}^{-1}$ )	total pore volume ( $\text{mL g}^{-1}$ )	$S_{\text{External}}^a$ ( $\text{m}^2 \text{g}^{-1}$ )	mesopore volume <sup>a</sup> ( $\text{mL g}^{-1}$ )
TS-1 before reaction	380	0.27	45	0.10
TS-1 after reaction for 10 runs	374	0.30	68	0.14

<sup>a</sup>  $S_{\text{External}} = S_{\text{BET}} - S_{\text{Micropore}}$ ; mesopore volume = total pore volume – micropore volume, where the micropore surface area and volume were determined by the  $t$ -plot method at a relative pressure of 0.05-0.70.