Electronic Supplementary Information (ESI)

Synthesis of anatase-free nano-sized hierarchical TS-1 zeolite and its excellent catalytic performance in alkenes epoxidation

Tianjun Zhang,[a] Xiaoxin Chen,[a] Guangrui Chen,[a] Mengyang Chen,[a] Risheng Bai,[a] Mingjun Jia[c] and Jihong Yu*[ab]

a State Key Laboratory of Inorganic Synthesis and Preparative Chemistry, College of Chemistry, Jilin University, Changchun 130012, P. R. China.

b International Center of Future Science, Jilin University, 2699 Qianjin Street, Changchun 130012, P. R. China.

c Key Laboratory of Surface and Interface Chemistry of Jilin Province, College of Chemistry, Jilin University, Changchun 130012, P. R. China.

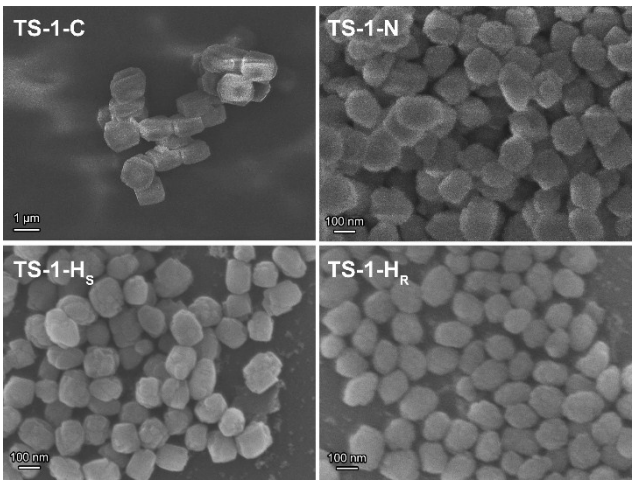

Fig. S1 SEM images of microporous TS-1 (TS-1-C and TS-1-N) and nano-sized hierarchical TS-1 (TS-1-H_S and TS-1-H_R).

Table S1 textural properties of TS-1-H_R and TS-1-H_S synthesized with different addition amount of Triton X-100.

samples	S_{BET} (m^2/g)[a]	S_{micro} (m^2/g)[b]	S_{ext} (m^2/g)[b]	V_{micro} (cm^3/g)[b]	V_{meso} (cm^3/g)[c]
TS-1-H_S-A	406	296	110	0.15	0.29
TS-1-H_S-B	414	292	122	0.14	0.30
TS-1-H_S-C	430	260	170	0.12	0.38
TS-1-H_R-A	414	300	114	0.15	0.30
TS-1-H_R-B	429	295	134	0.14	0.32
TS-1-H_R-C	455	289	166	0.14	0.38

A, B, C refer to Triton X-100 to SiO_2 molar ratio of 0.102, 0.204 and 0.408, respectively. a. S_{BET} (total surface area) calculated using the BET method; b. S_{micro} (micropore area), S_{ext} (external surface area) and V_{micro} (micropore volume) calculated using the t-plot method; c. V_{meso} (mesopore volume) calculated using the BJH method (from adsorption).

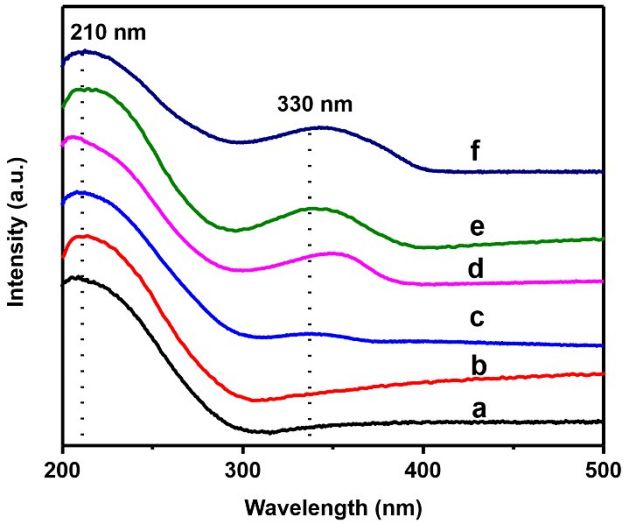

Fig. S2 UV/Vis spectra of TS-1-H_R (a, b, c) and TS-1-H_S (d, e, f) synthesized with Triton X-100 to SiO_2 molar ratio of 0.102, 0.204 and 0.408, respectively.

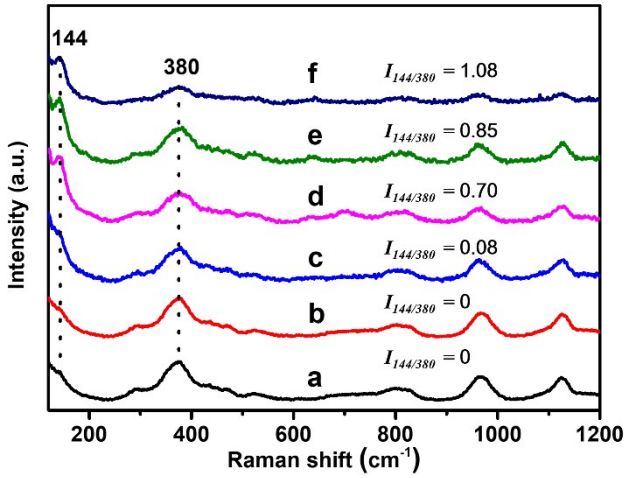

Fig. S3 UV-Raman spectra of TS-1-H_R (a, b, c) and TS-1-H_S (d, e, f) synthesized with Triton X-100 to SiO_2 molar ratio of 0.102, 0.204 and 0.408, respectively. $\boldsymbol{I}_{144/380}$ is used to estimate the content of anatase TiO_2. The wavelength of the excitation light is 320 nm.

Table S2 Epoxidation of various alkenes over different TS-1 samples

	allyl chloride		1-heptene		cyclopentene	
	Conv. (%)	Sel. (%)	Conv. (%)	Sel. (%)	Conv. (%)	Sel. (%)
TS-1-C	27.7	100	12.2	99.5	23.8	100
TS-1-N	66.9	96.1	30.3	98.1	33.7	99.0
TS-1-H_S	63.7	94.3	36.1	98.4	40.2	97.7
TS-1-H_R	70.6	96.9	51.3	99.1	50.3	98.5

Reaction conditions: cat., 50 mg; alkenes, 10 mmol; H_2O_2 (30 wt%), 10 mmol; CH_3OH, 10 mL; temp., 333 K; time, 2 h.

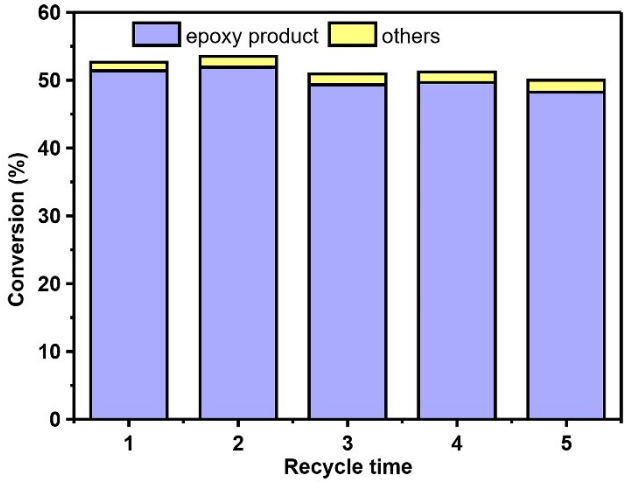

Fig. S4 Recycling tests of TS-1-H_R as catalyst for epoxidation of 1-hexene Reaction conditions: cat., 50 mg; 1-hexene, 10 mmol; H_2O_2 (30 wt%), 10 mmol; CH_3OH, 10 mL; temp., 333 K; time, 2 h.

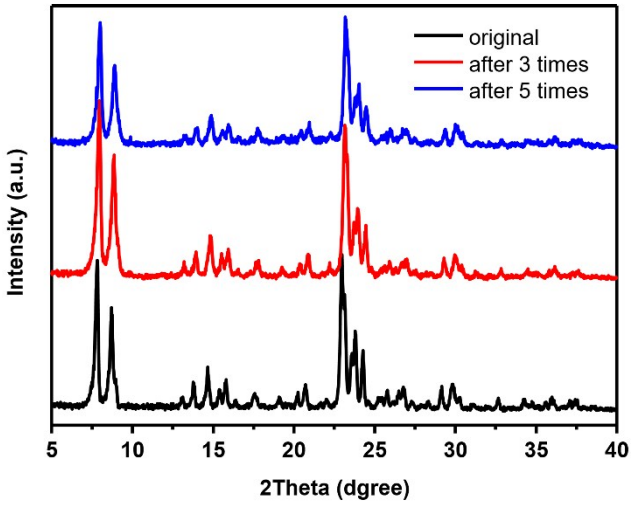

Fig. S5 XRD patterns of TS-1-H_R in recycling test

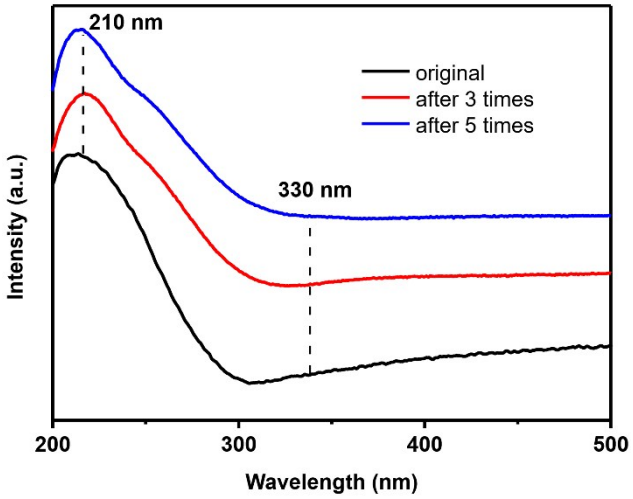

Fig. S6 UV/Vis spectra of TS-1-H_R in recycling test