Electronic Supplementary Material (ESI) for Catalysis Science & Technology.
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Dehydrogenation of Propane over PtSnAl/SBA-15 Catalysts: Al-addition Effect and Coke Formation Analysis

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Supplementary Information

Table of content:

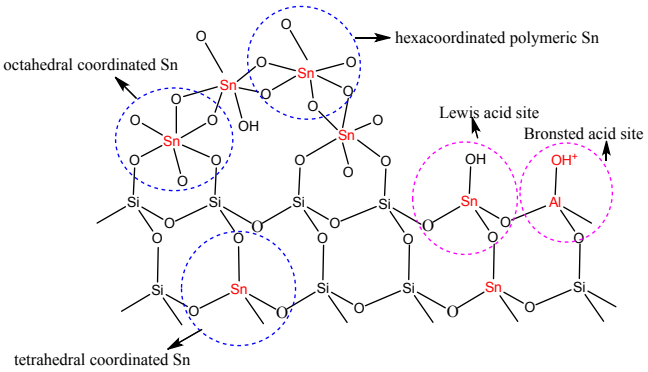

Fig. S1 The suggested model of the coordination states of Sn and acidity of PtSnAl/SBA-15 system.

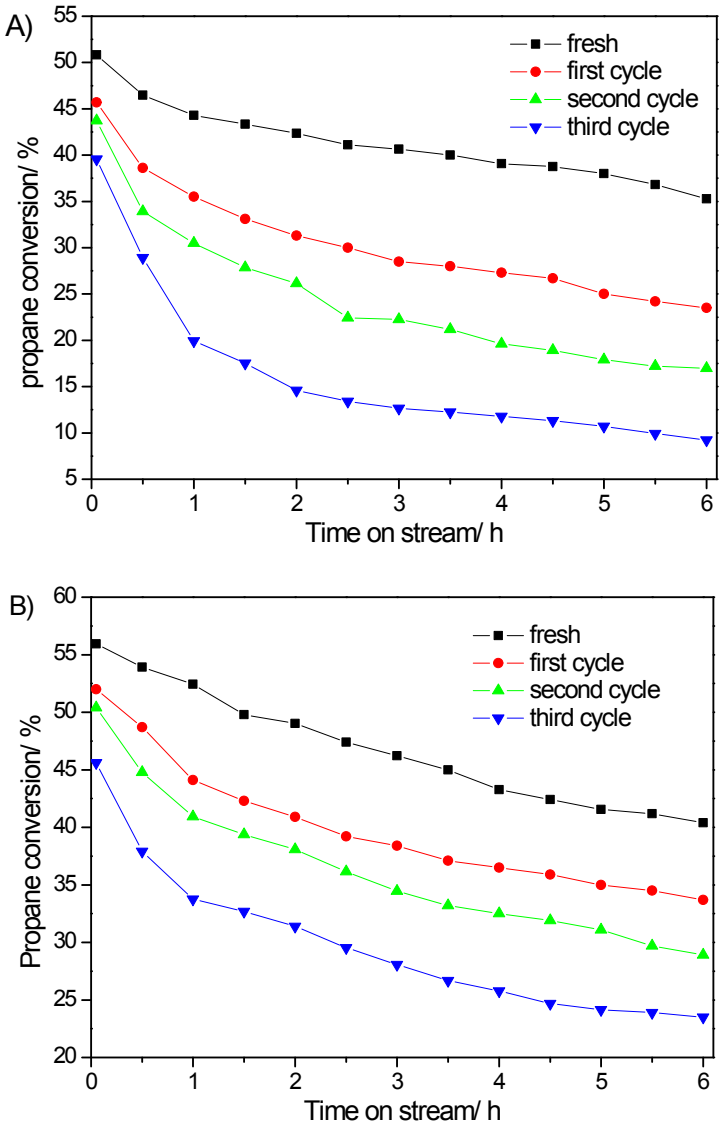

Fig. S2 The performance comparison of (A) $PtSnAl_0$/SBA-15 and (B) $PtSnAl_{0.2}$/SBA-15 catalysts for propane dehydrogenation. Regeneration conditions: catalyst regeneration was performed by oxidative treatment using 10% O_2/Ar (50 ml/min) for 4h at 500 ^oC. And then the catalyst was reduced in 10% H_2/Ar (50 ml/min) for 4h at 500 ^oC.

The results of FT-IR

FT-IR spectra of PtSnAl/SBA-15 catalysts are shown in Fig. 8. The band at 3420 cm^{-1} can be assigned to the hydrogen-bonded Si–OH because of terminal Si–OH of Q_2 and adjacent Q_3.[1] And the band at 1640 cm^{-1} and 1080 cm^{-1} corresponds to the O–H bending of adsorbed water and the Si–O asymmetrical stretching of Si–O–Si, respectively. The band at 808 cm^{-1} is assigned to symmetric stretching vibration Si–O–Si of tetrahedral SiO_4, while the band at 457 cm^{-1} is attributed to the Si–O–Si bending mode.[2] Shah et al.[3] have reported that the band at 960 cm^{-1} in Sn-SBA-15 should correspond to a vibration mode of SiO_4 perturbed by a neighboring SnO_2 or Sn=O (OH) group due to the presence of an adjacent $Si–O^{\delta-}•••Sn^{\delta+}$. The presence of this band in PtSnAl/SBA-15 samples is generally attributed to the formation of Si–O–M (Si–O–Sn or Si–O–Al) linkages in metallosilicates, which is consistent with the result of UV-Vis characterization.

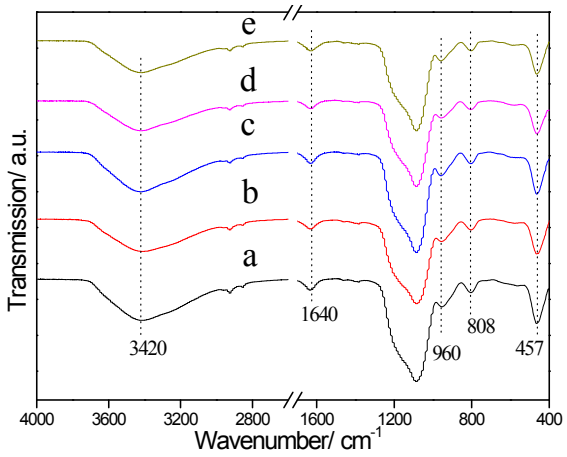

Fig. S3 FT-IR spectra of PtSnAl/SBA-15 catalysts: (a) $PtSnAl_0$/SBA-15, (b) $PtSnAl_{0.1}$/SBA-15, (c) $PtSnAl_{0.2}$/SBA-15, (d) $PtSnAl_{0.3}$/SBA-15, (e) $PtSnAl_{0.4}$/SBA-15.

Table S1. A comparison of catalytic performance over different catalysts for propane dehydrogenation to produce propene

Catalysts	C_3H_8 in fed/%	Reaction temperature/°C	C_3H_8 Conversion /%	C_3H_6 Selectivity/%	References
Pt-Sn/ Ce-γ-Al_2O_3	14	576	43.8	92.5	4
Pt–Sn/ θ-Al_2O_3	63	620	40	93	5
Pt-Sn/ SAPO-34	80	585	23	94	6
PtSn/ZnO/ $MgAl_2O_4$	50	530	39.9	98.4	7
Cr_2O_3/Al_2O_3	20	600	26	70	8
CrO_x/ Al_2O_3	10	550	37	88	9
Al-ZSM-5	16	530	19	19	10
Fe-ZSM-5	16	530	16	7.2	10
Cr-SBA-15	10	580	18	81	11
PtSnAl/ SBA-15	17	590	56	98	This work

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