1. Characterization of the catalysts

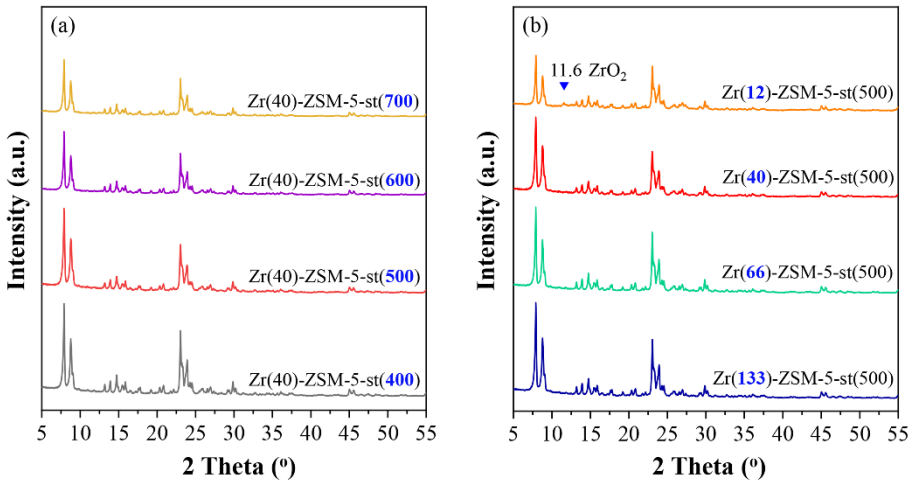

Figure S1. XRD patterns of Zr(40)-ZSM-5-st treated at 400-700℃(a) and Zr-ZSM-5-st(500) with Si/Zr mole ratio of 12-133(b).

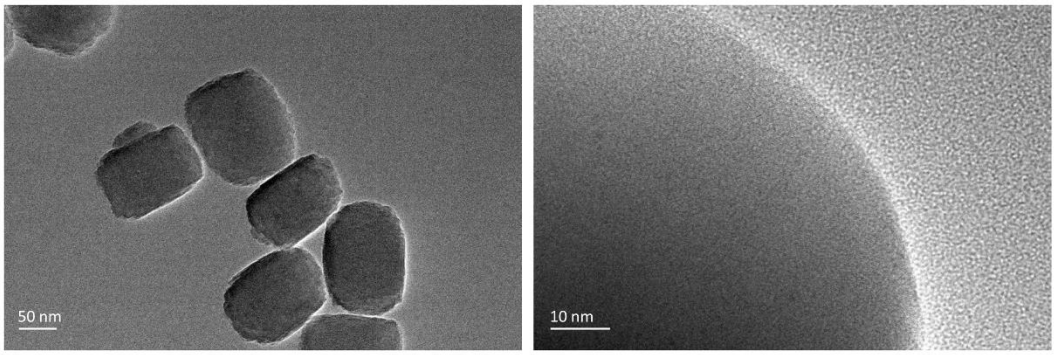

Figure S2. TEM images of ZSM-5 zeolite.

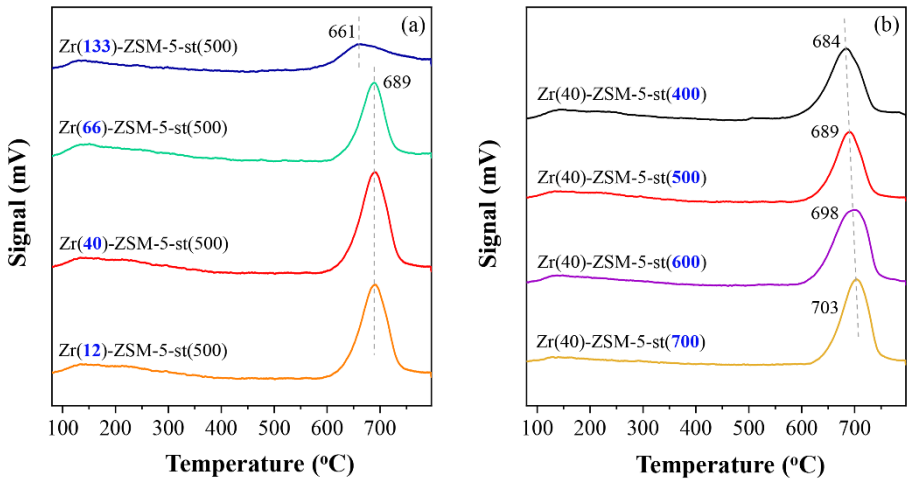

Figure S3. NH3-TPD spectra of Zr(40)-ZSM-5-st treated at 400-700℃(a) and Zr-ZSM-5-st(500) with Si/Zr mole ratio of 12-133(b).

Table S1. Surface area and pore volume distribution of ZSM-5, Zr-ZSM-5 and a series of Zr-ZSM-5-st catalysts.

Sample	S_{BET}[a] (m^2/g)	V_{total}[b] (cm^3/g)	V_{micro}[c] (cm^3/g)	V_{meso}[d] (cm^3/g)
ZSM-5	325.923	0.326	0.120	0.206
Zr(40[d])-ZSM-5	325.329	0.324	0.117	0.207
Zr(40)-ZSM-5-st(400[e])	339.067	0.337	0.094	0.243
Zr(40)-ZSM-5-st(500)	383.716	0.370	0.085	0.285
Zr(40)-ZSM-5-st(600)	353.321	0.338	0.072	0.266
Zr(40)-ZSM-5-st(700)	325.208	0.304	0.061	0.243

[a]S_{BET} is estimated by the BET method.

[b]V_{total} (total volume) is calculated by the BJH adsorption method.

[c]V_{micro} (micropore volume) is calculated by t-plot method.

[d]V_{meso} (mesopore volume) = V_{total} - V_{micro}.