

Supporting information

For

**Synthesis of SAPO-34 zeolite for improved MTO performance:
Tuning crystal size and insight into formation mechanism**

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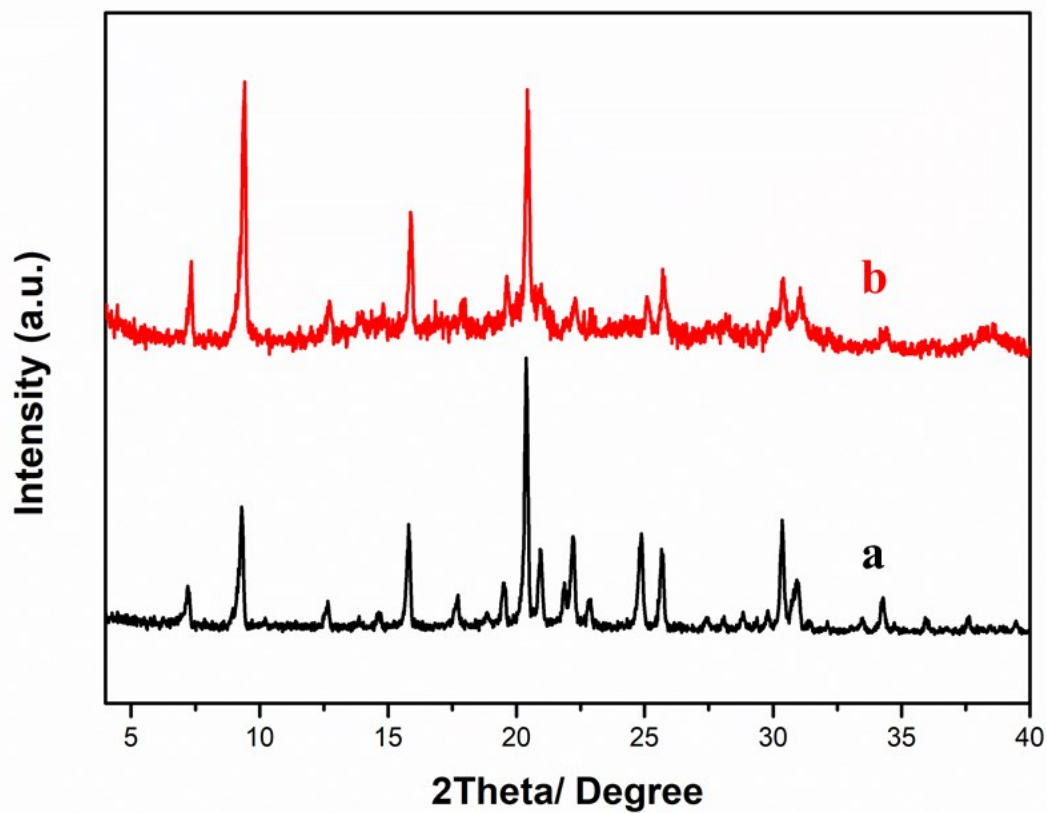


Fig. S1 XRD patterns of samples synthesized in concentrated gel system $1\text{Al}_2\text{O}_3:1\text{P}_2\text{O}_5:0.4\text{SiO}_2:3\text{TEA}:0.008\text{PEG}:x\text{H}_2\text{O}$ when (a) $x=25$ and (b) $x=20$.

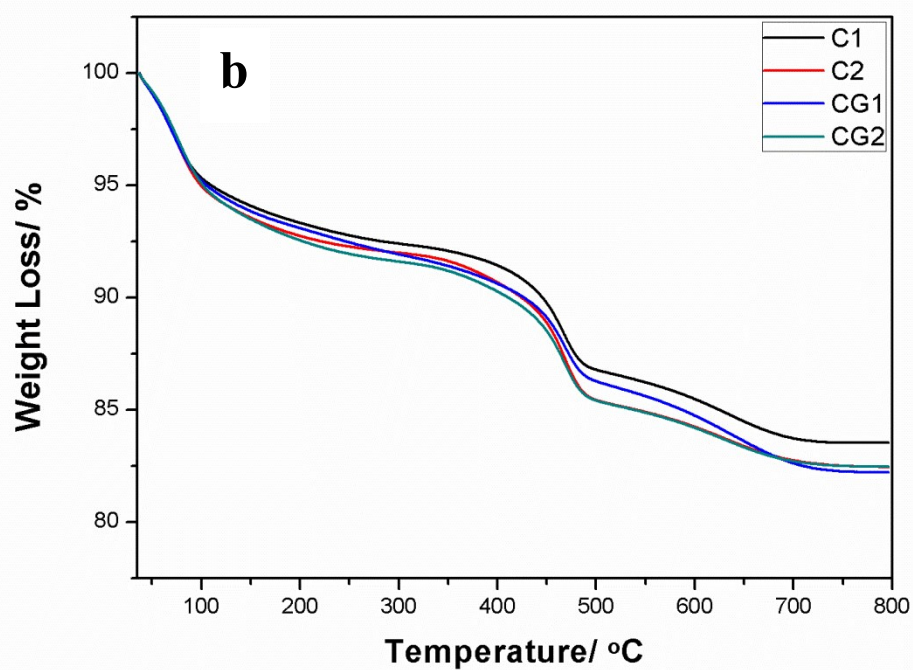
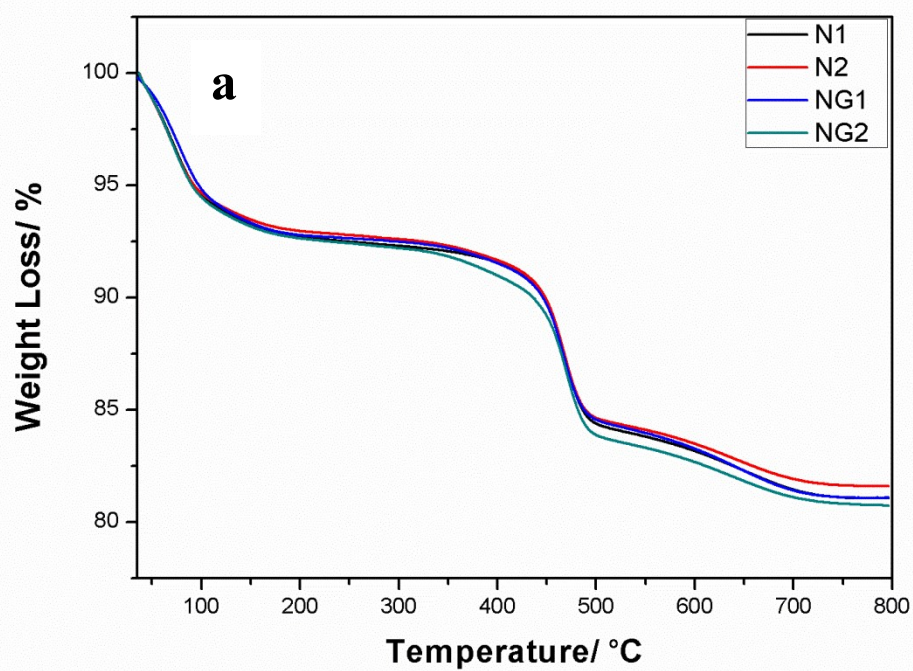


Fig. S2 TG curves of the samples synthesized in normal gel system (a) and concentrated gel system (b).

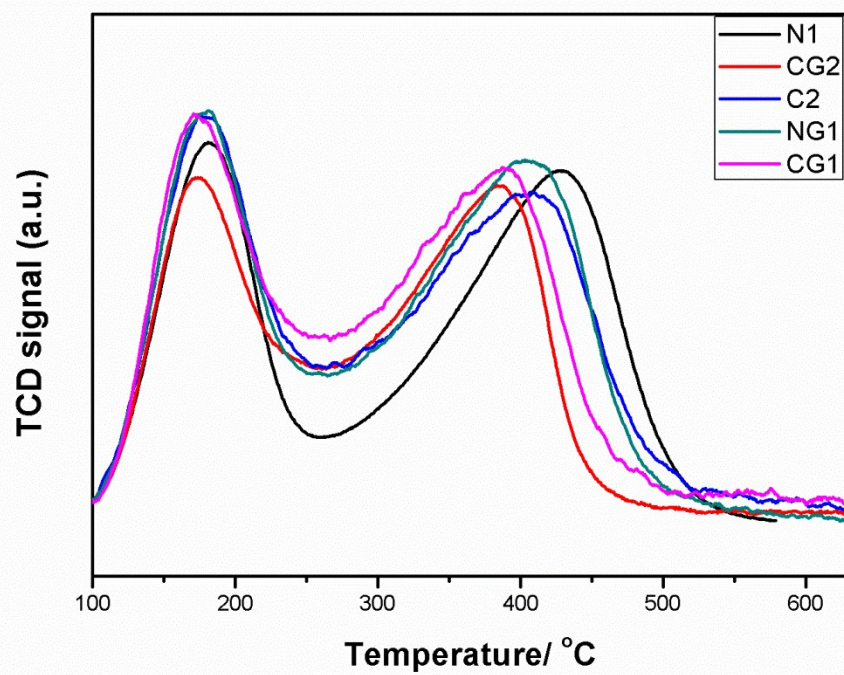


Fig. S3 NH₃-TPD curves of N1, CG2, C2, NG1 and CG1 samples.

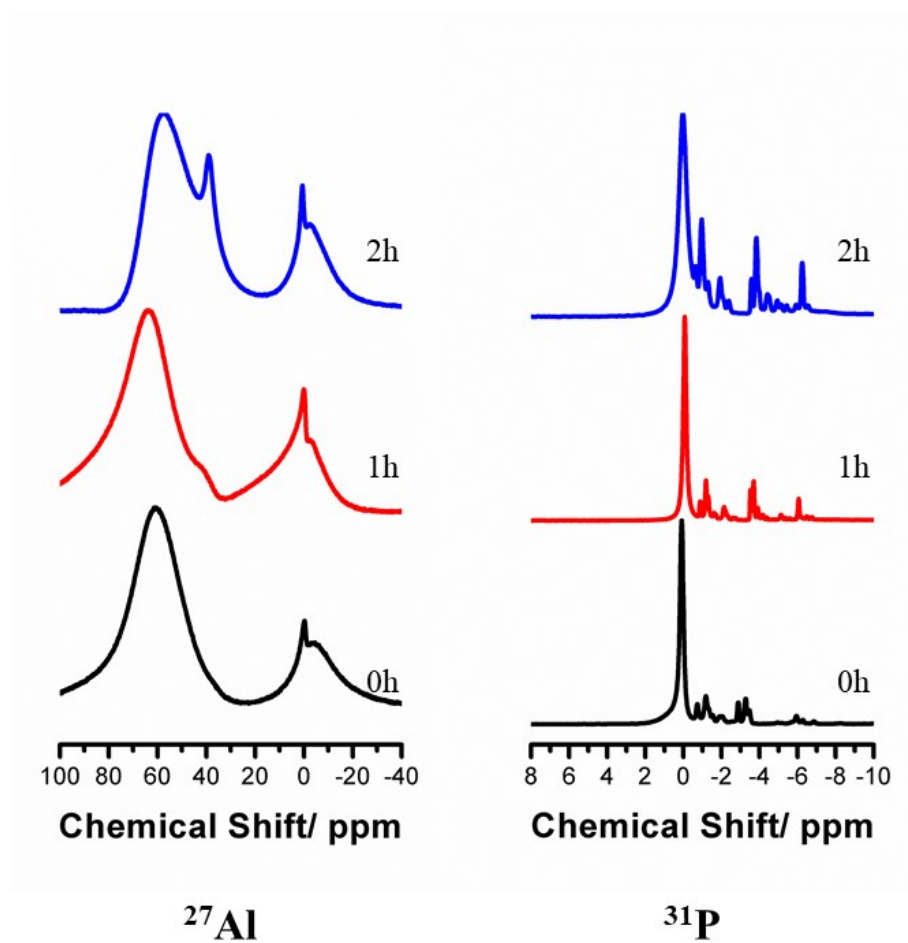


Fig. S4 Liquid NMR of ^{27}Al and ^{31}P of N_2 .

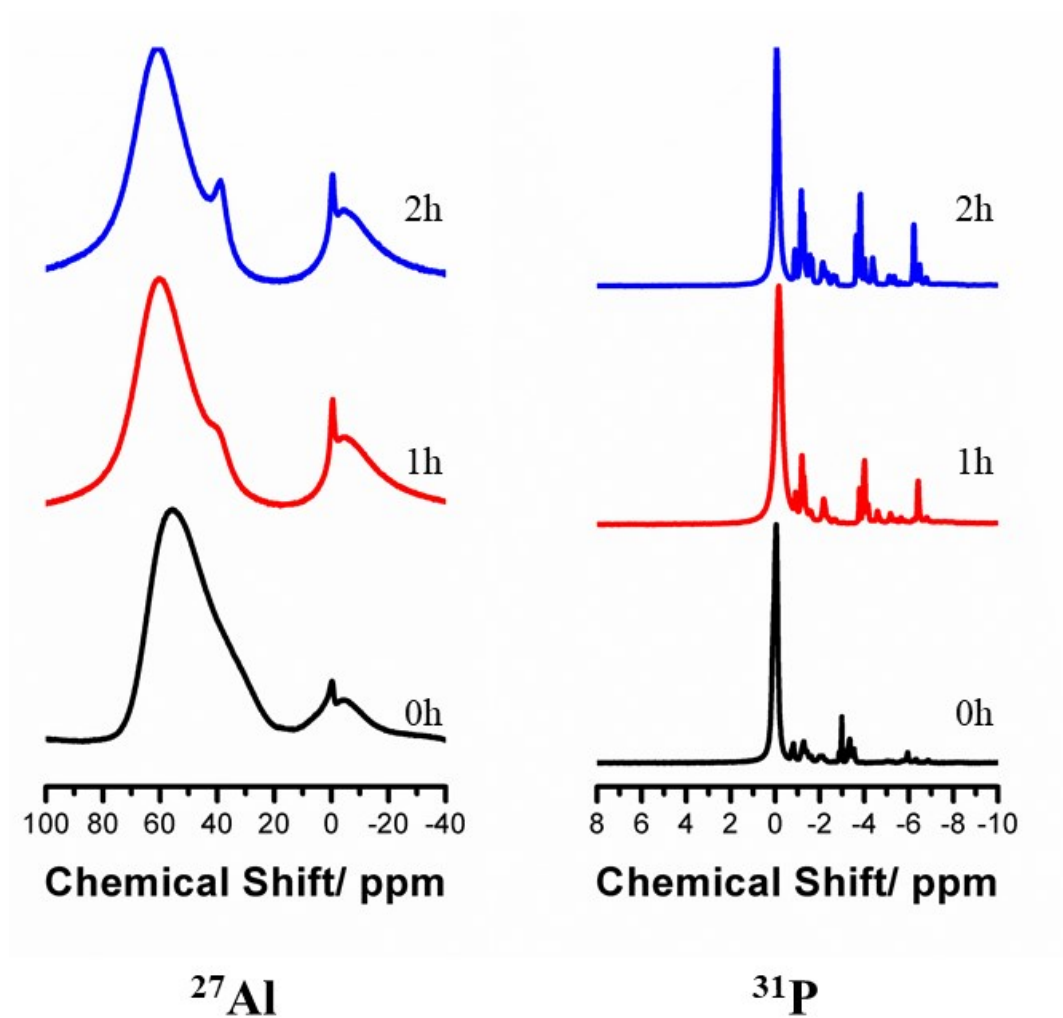


Fig. S5 Liquid NMR of ^{27}Al and ^{31}P of NG1.

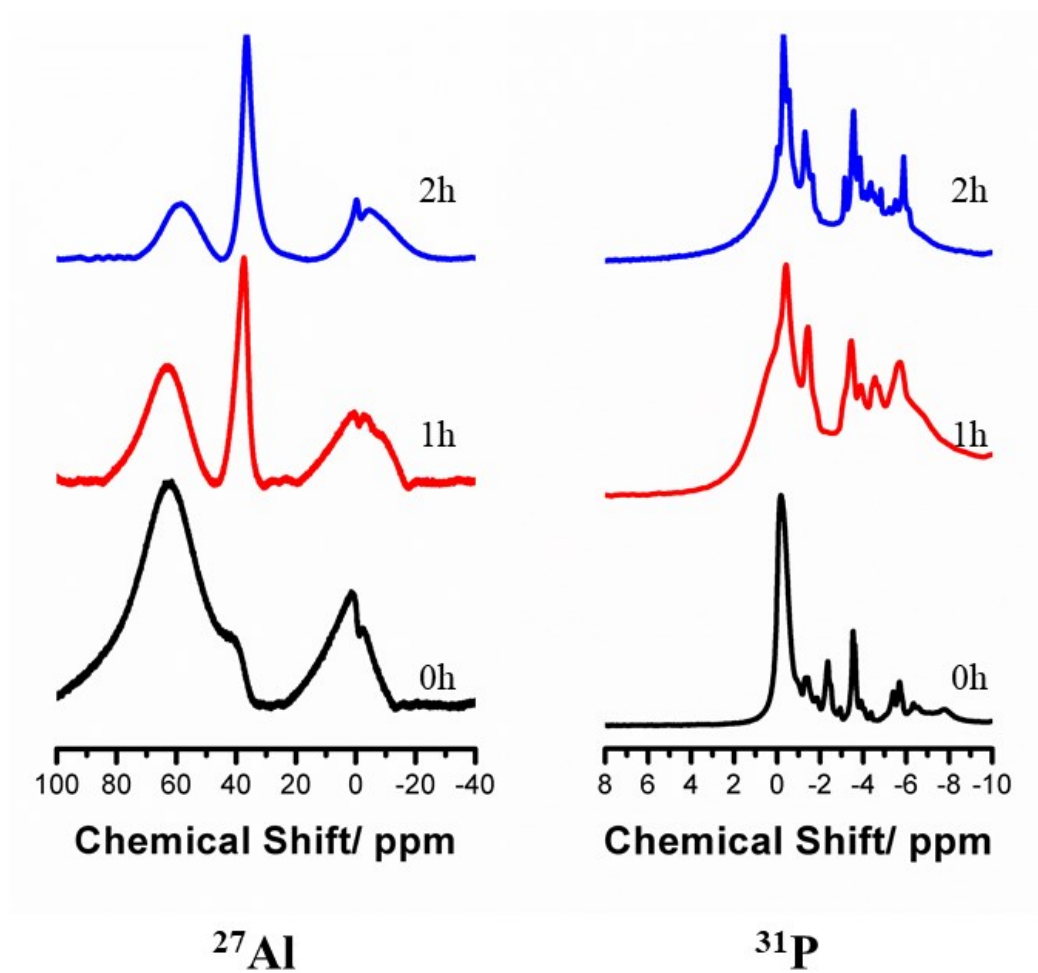


Fig. S6 Liquid NMR of ^{27}Al and ^{31}P of C1.

Table S1 Topological structure, relative crystallinity and elemental analysis of as-synthesized SAPO-34 samples.

Samples	Topological structure	Relative crystallinity/%	Si/Al ratio*
N1	CHA	77.1	0.183
N2	CHA	95.9	0.178
NG1	CHA	74.2	0.203
NG2	CHA	84.6	0.200
C1	CHA	79.4	0.175
C2	CHA	100	0.156
CG1	CHA	77.2	0.170
CG2	CHA	89.5	0.154

*Elemental analysis by ICP

Table S2 Textural properties of the conventional micropores of five samples: N1, C2, CG2, NG1 and CG1.

Sample names	$S_{\text{BET}}(\text{m}^2/\text{g})^{\text{a}}$	$S_{\text{micro}}(\text{m}^2/\text{g})^{\text{b}}$	$S_{\text{ext}}(\text{m}^2/\text{g})^{\text{b}}$	$V_{\text{micro}}(\text{cm}^3/\text{g})^{\text{b}}$	$V_{\text{meso}}(\text{cm}^3/\text{g})^{\text{c}}$
N1	694.1	682.5	11.5	0.25	0.01
C2	644.2	620.1	24.1	0.22	0.05
CG2	674.9	660.7	14.2	0.25	0.01
NG1	663.9	637.1	26.8	0.26	0.03
CG1	621.6	595.7	25.9	0.22	0.03

a. S_{BET} (total surface area) is calculated by BET formula, the data from $0.05 < P/P_0 < 0.30$. b. S_{micro} (micropore surface area), S_{ext} (external surface area) and V_{micro} (micropore volume) are calculated by t-plot method. c. V_{meso} (mesopore volume) is calculated by BJH method.

Table S3 MTO performance of five samples: N1, C2, CG2, NG1 and CG1.

Sample names	TOS (min)	Selectivity(%)		
		C ₂ H ₄	C ₃ H ₆	C ₂ H ₄ +C ₃ H ₆
CG2	326	32.6	45.6	78.2
C2	46	29.5	40.3	69.8
N1	46	32.8	42.2	75.0
NG1	166	35.1	43.7	78.8
CG1	126	34.1	43.1	77.2

Reaction condition: WHSV = 2 h⁻¹, T = 400 °C

Catalysis lifetime: The conversion of methanol is more than 99%