Supporting Information

Atmospheric pressure synthesis of nano-scaled SAPO-34 catalysts for effective conversion of methanol to light olefins

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Synthesis of $Al_2MgO_8Si_2$

$Al_2MgO_8Si_2$ was pre-synthesized by the following method. $Al_2(SO_4)_3 \cdot 18H_2O$ was dispersed in stirring to the solution of Na_2SiO_3 under 85°C. After cooling down to room temperature, MgO, $NaAlO_2$ and NaOH solution were added into the above solution in turn. The mixture was filtered after 1 hour of the reaction, washed three times with deionized water to remove sodium ions and dried overnight to obtain $Al_2MgO_8Si_2$.

Synthesis of SAPO-34 zeolite without MgO

SAPO-34 zeolite without MgO was prepared also under atmospheric pressure. A certain amount of silica resource and aluminum resource was added to TEAOH solution and stirred at room temperature for 2 h. Subsequently, the desired amount of H_3PO_4, SAPO-34 seeds and deionized water were added in turn and stirred for 6 h. The synthesis gel with a molar composition of 1.0 Al_2O_3 : 0.5 SiO_2 : 1.0 P_2O_5 : 1.0 TEAOH : 50 H_2O was heated to 90°C and kept for 12 h to remove the solvent before it was crushed and sifed to 20-40 mesh. The obtained particles were transferred into a quartz tube and crystallized at 200°C for 24 h in presence of steam under atmospheric pressure. After calcination at 600 °C for 5 h, the aimed sample was obtained.

Synthesis of SAPO-34 zeolite with MgO

For comparasion, SAPO-34 zeolite with MgO was prepared also under atmospheric pressure. A certain amount of silica resource, aluminum resource and MgO was added to TEAOH solution and stirred at room temperature for 2 h. Then desired amount of H_3PO_4, SAPO-34 seeds and deionized water were added in turn and stirred for 6 h. The synthesis gel with a molar composition of 1.0 Al_2O_3 : 0.5 SiO_2 : 1.0 P_2O_5 : 1.0 TEAOH : 50 H_2O was heated to 90°C and kept for 12 h to remove the solvent before it was crushed and sifed to 20-40 mesh. The obtained particles were transferred into a quartz tube and crystallized at 200 °C for 24 h in presence of steam under atmospheric pressure. After calcination at 600°C for 5 h, SAPO-34 containing MgO was obtained.

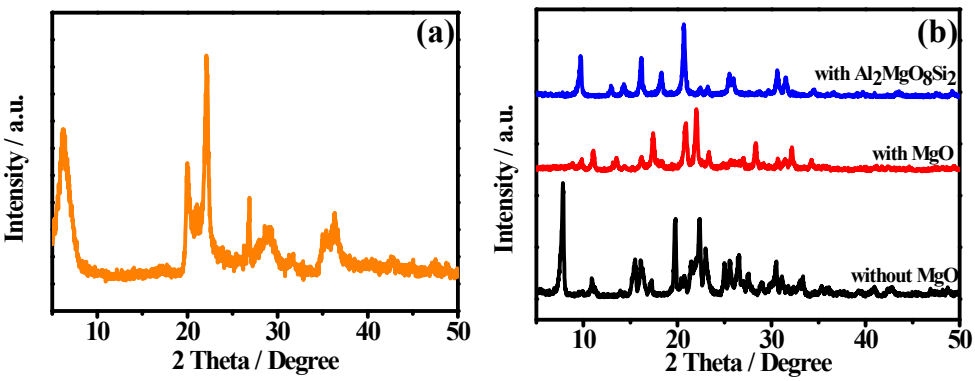

Fig. S1 XRD patterns of $Al_2MgO_8Si_2$ (a), and SAPO-34 synthesized without MgO, with MgO and with $Al_2MgO_8Si_2$ (b).

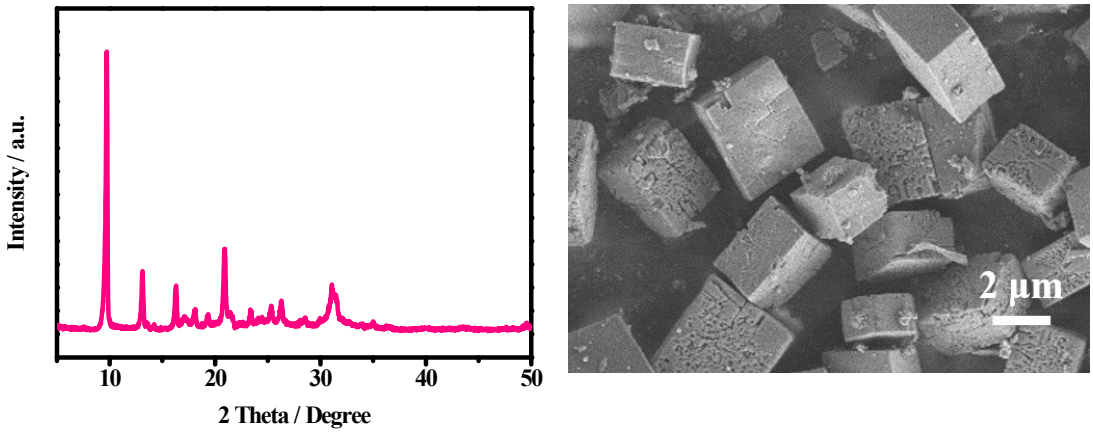

Fig. S2 XRD pattern and SEM image of SP34-CS.

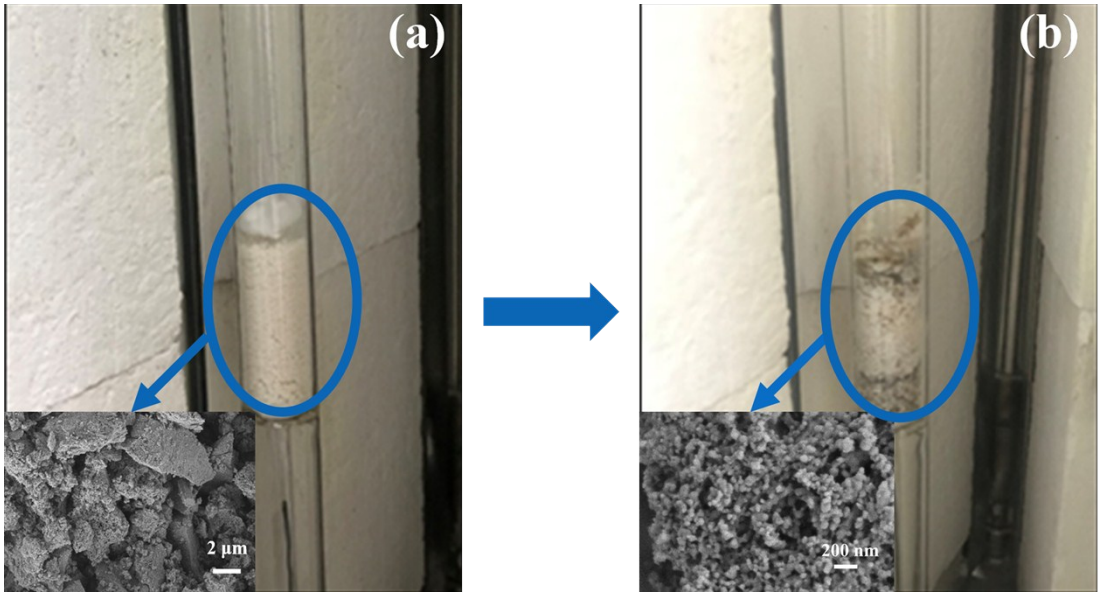

Fig. S3 Photographs and SEM images of dried gels before (a) and after (b) crystallization.

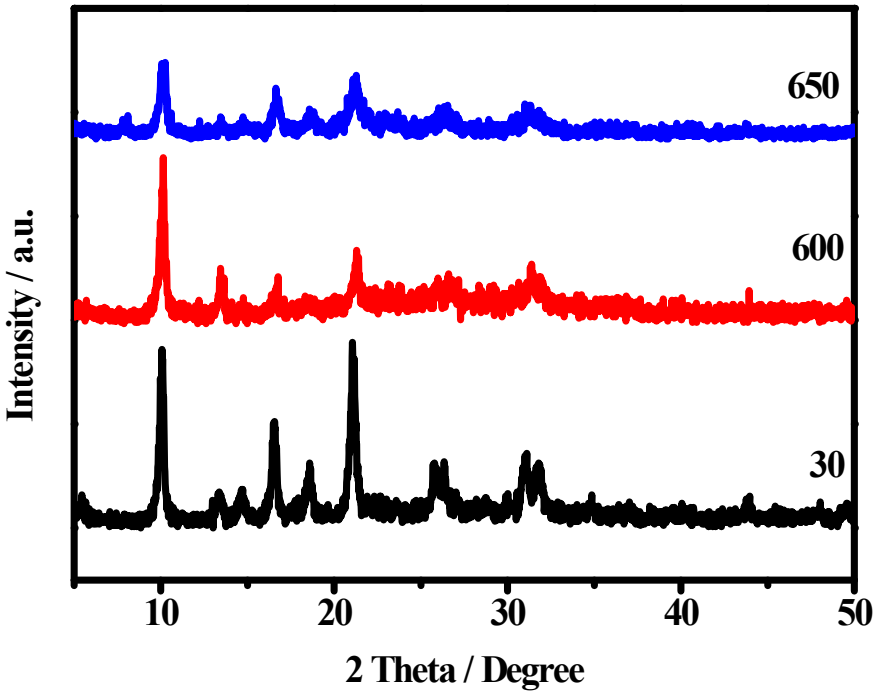

Fig. S4 XRD pattern of SP34-AS-3 before and after hydrothermally treated at 600 and 650 °C for 2 h .

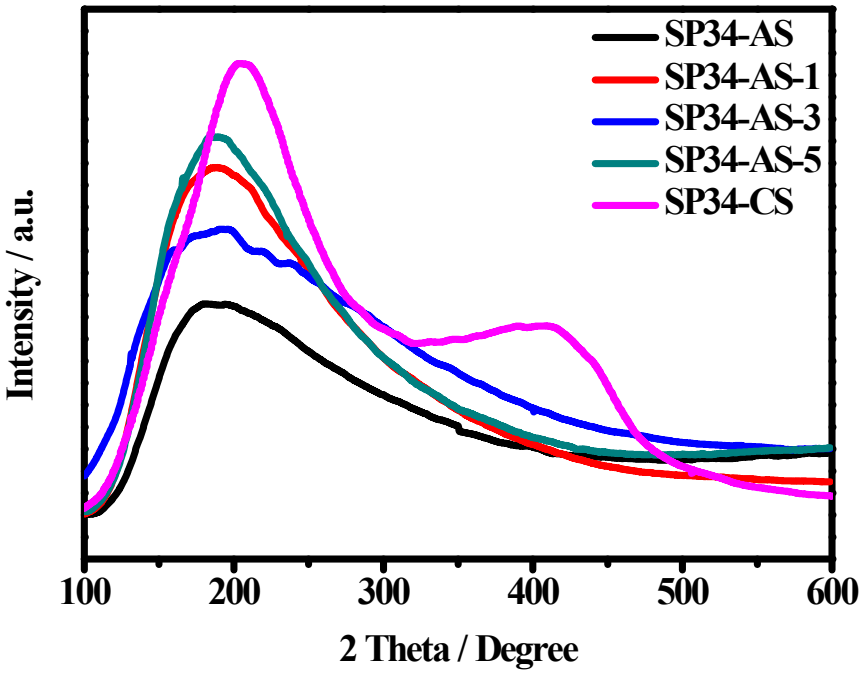

Fig. S5 NH_3-TPD profiles of SP34-AS, SP34-AS-1, SP34-AS-3, SP34-AS-5 and SP34-CS.

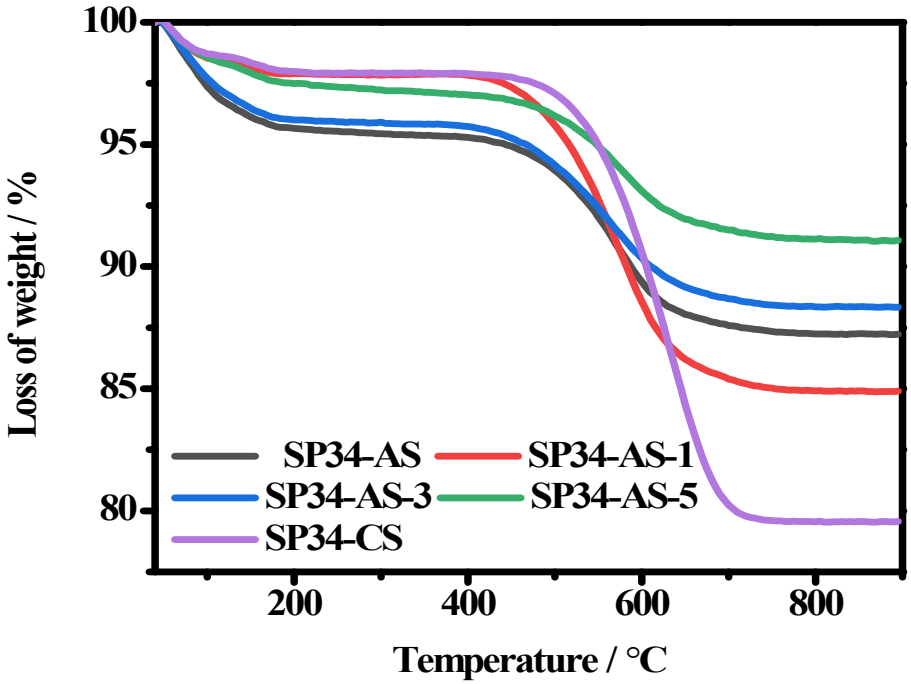

Fig. S6 TG curves of SP34-AS, SP34-AS-1, SP34-AS-3, SP34-AS-5 and SP34-CS.

Table S1 The acid site density of prepared samples

Sample	SP34-AS	SP34-AS-1	SP34-AS-3	SP34-AS-5	SP34-CS
Acid site density (mmol/g)	0.23	0.33	0.28	0.34	0.43

Table S2 Product selectivity (%) of MTO reaction over various catalysts.

Catalysts	Lifetime /min[a]	C_1	$C_2^=$	C_2	$C_3^=$	C_3	C_4	$C_4^=$	$C_2^=+C_3^=$	$C_2^=\sim C_4^=$	Carbon balance
SP34-CS	450	1.64	23.51	1.73	34.31	14.05	4.48	13.55	57.82	71.37	98%
SP34-AS	120	1.44	28.61	0.35	39.80	4.67	4.45	14.50	68.41	82.91	95%
SP34-AS-1	240	1.34	27.24	0.73	40.71	4.34	4.75	14.56	67.95	82.51	97%
SP34-AS-3	330	1.58	31.03	0.56	39.61	4.13	4.33	12.96	70.64	83.60	98%
SP34-AS-5	60	1.01	27.07	0.39	40.09	3.94	5.10	15.97	67.16	83.13	94%

Reaction conditions : WHSV = 0.5 h^{-1}, T = 400°C, catalyst weight = 1.0 g and 1 atm.

[a] Catalyst lifetime is defined as the reaction duration with methanol conversion higher than 95%.

Table S3 Variation of coke formation in methanol conversion over SAPO-34.

Samples	SP34-AS	SP34-AS-1	SP34-AS-3	SP34-AS-5	SP34-CS
coke (%, g/gcat)	8.05	12.93	7.38	5.91	18.34
TOS (min)	120	240	330	60	450
R_{coke} (mg/min)	0.67	0.54	0.22	0.99	0.41
P_{coke} (g/gMeOH)	0.08	0.06	0.03	0.12	0.05

R_{coke} (mg/min) = Coke amount (mg) / reaction time (min),

P_{coke} (g/g) = Coke amount (g) / methanol feedstock (g).