Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Synthesis of tri-level hierarchical SAPO-34 zeolite with intracrystalline micro-meso-macroporosity showing superior MTO performance

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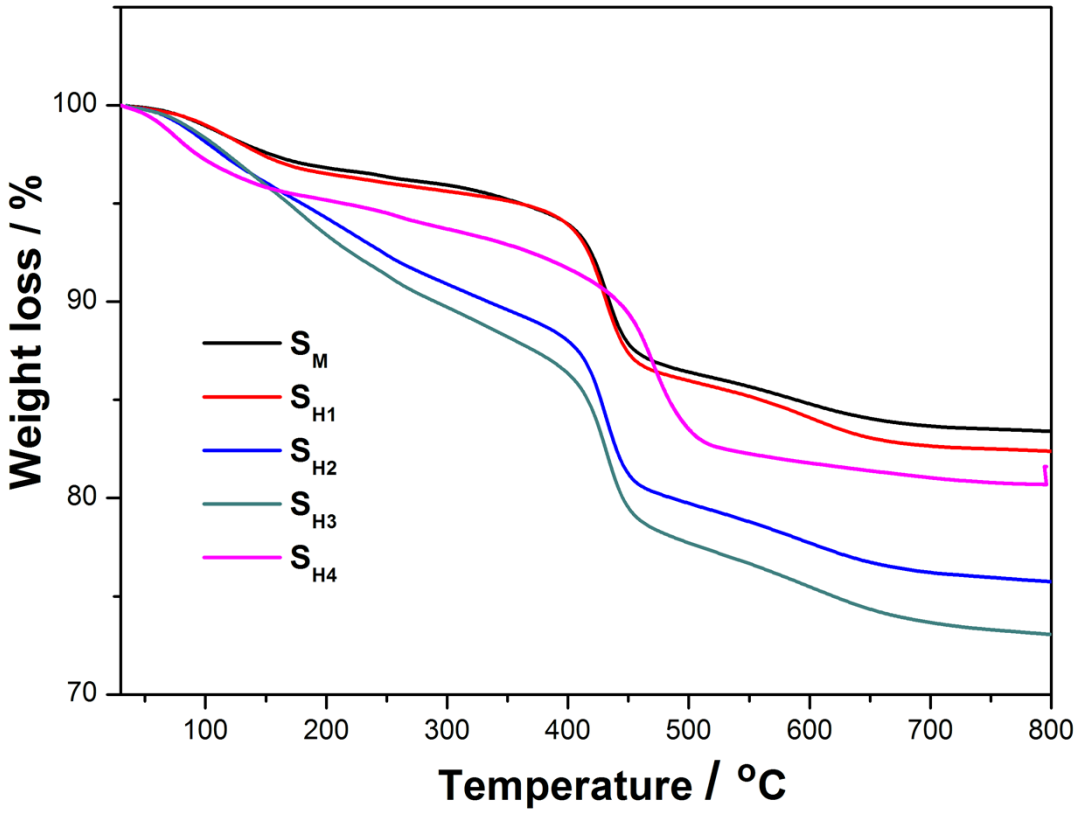

Figure S1 The TG curves of conventional microporous SAPO-34 (S_M) and hierarchically porous SAPO-34 (S_{H1}, S_{H2}, S_{H3}, and S_{H4}) catalysts.

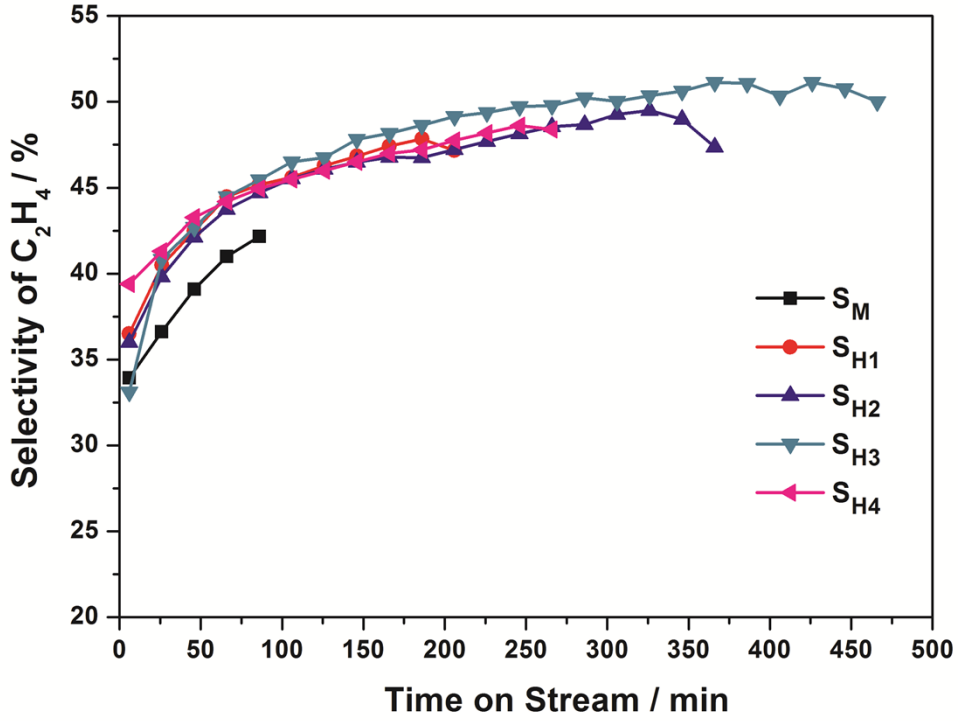

Figure S2 Selectivity of ethylene versus time-on-stream over conventional microporous SAPO-34 (S_M) and hierarchically porous SAPO-34 (S_{H1}, S_{H2}, S_{H3}, and S_{H4}) catalysts in MTO reaction. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

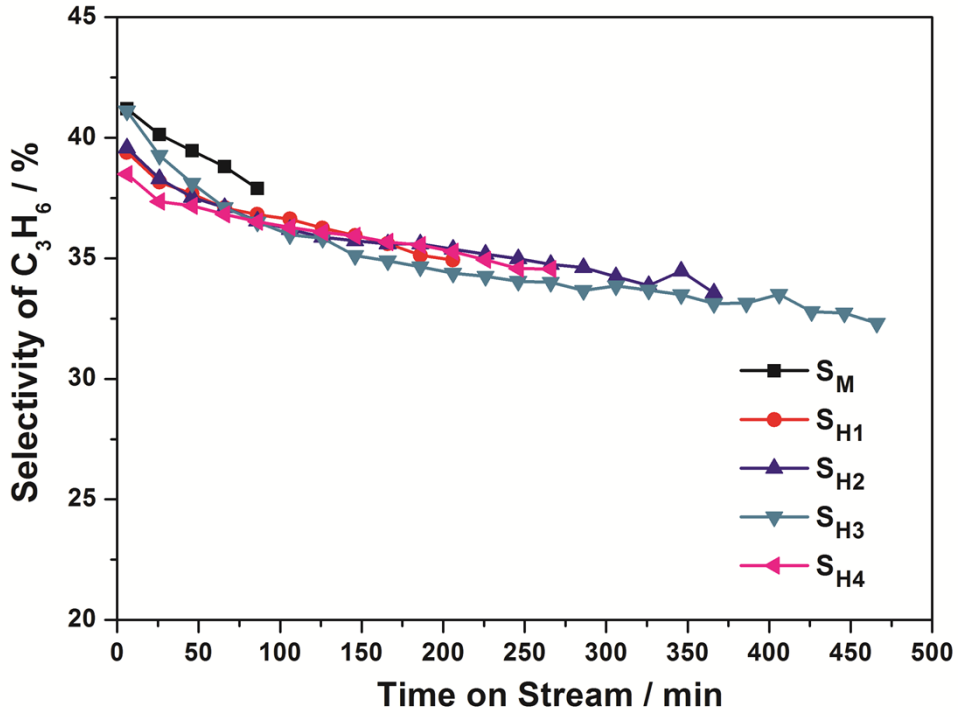

Figure S3 Selectivity of propylene versus time-on-stream over conventional microporous SAPO-34 (S_M) and hierarchically porous SAPO-34 (S_{H1}, S_{H2}, S_{H3}, and S_{H4}) catalysts in MTO reaction. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

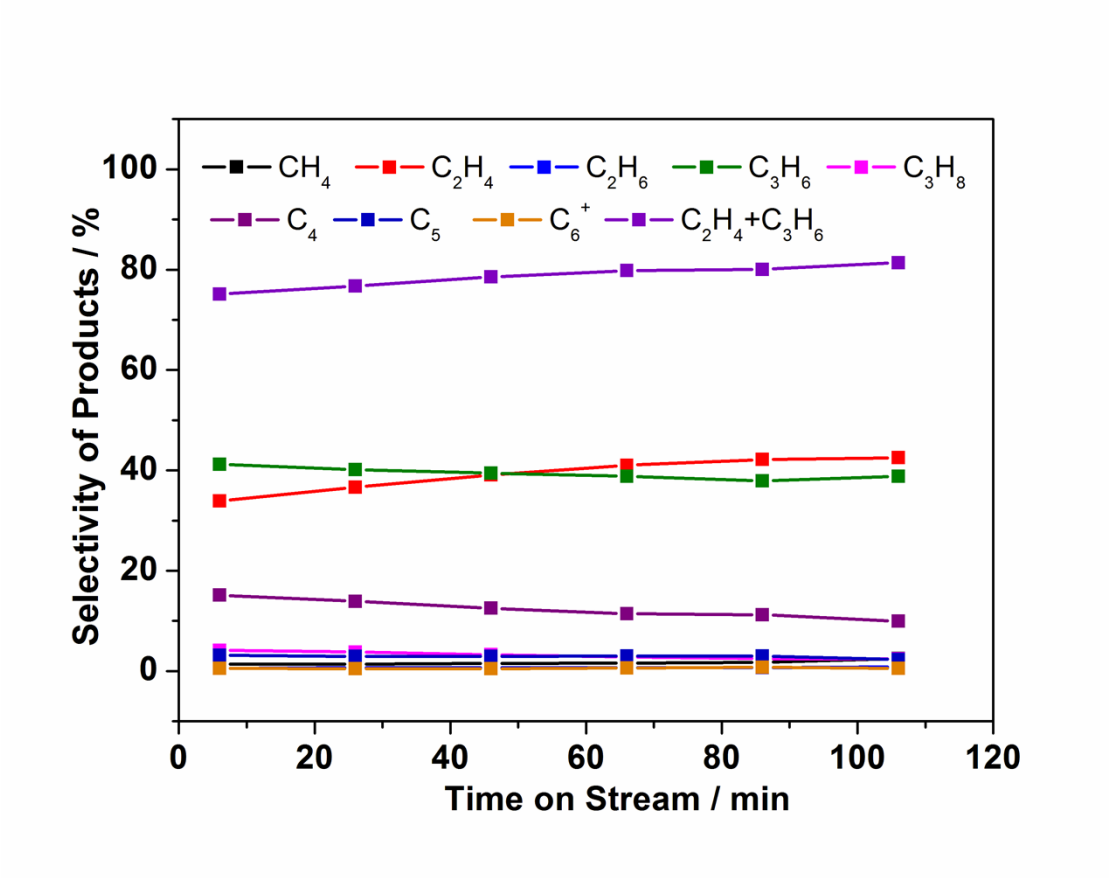

Figure S4 Products distribution of conventional microporous SAPO-34 catalyst (S_M) in MTO reaction. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

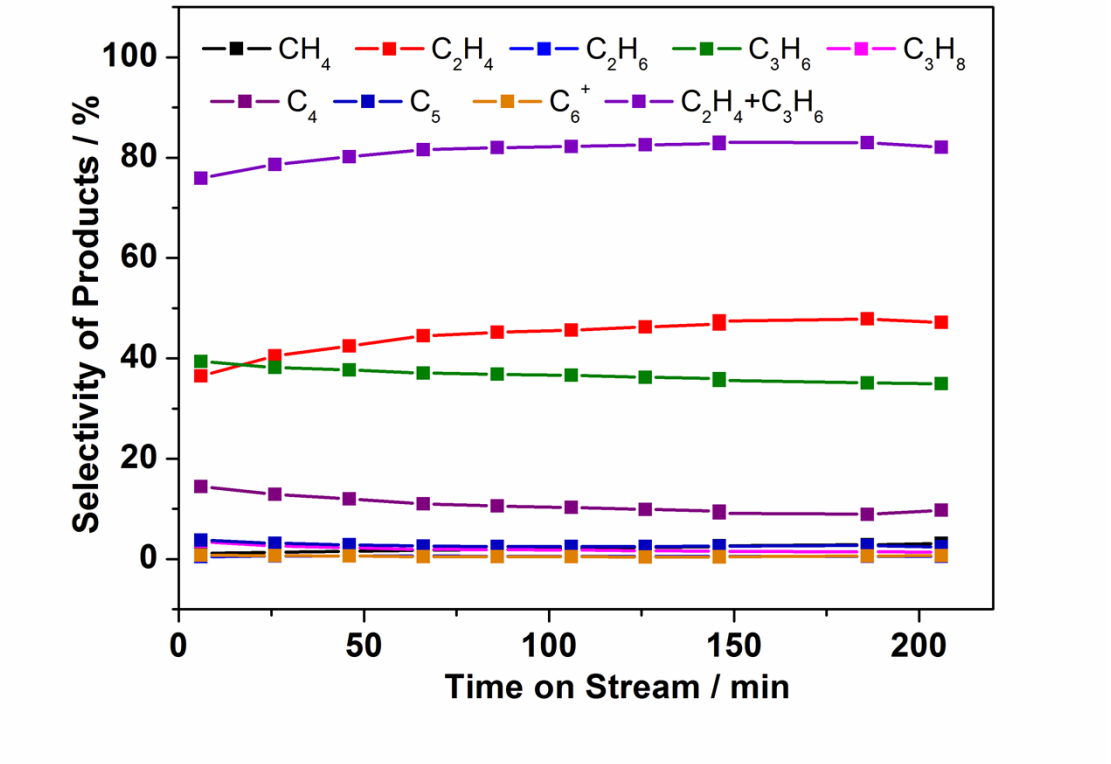

Figure S5 Products distribution of hierarchically porous SAPO-34 catalyst (S_{H1}) in MTO reaction. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

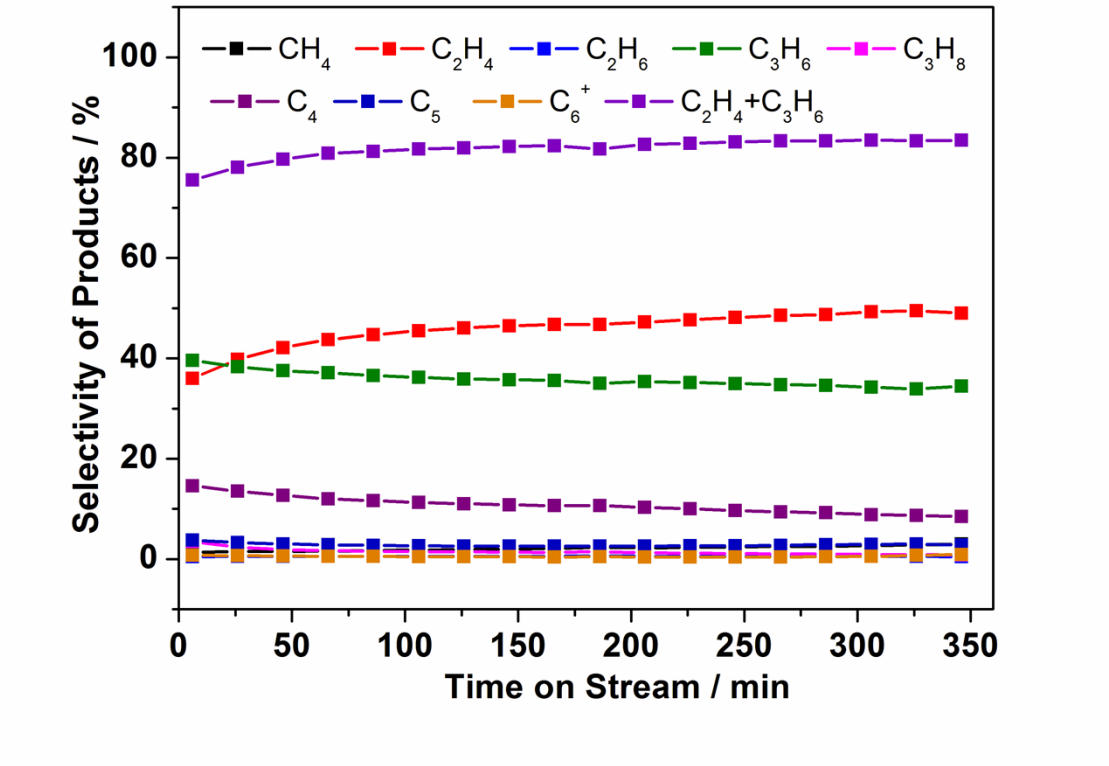

Figure S6 Products distribution of hierarchically porous SAPO-34 catalyst (S_{H2}) in MTO reaction. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

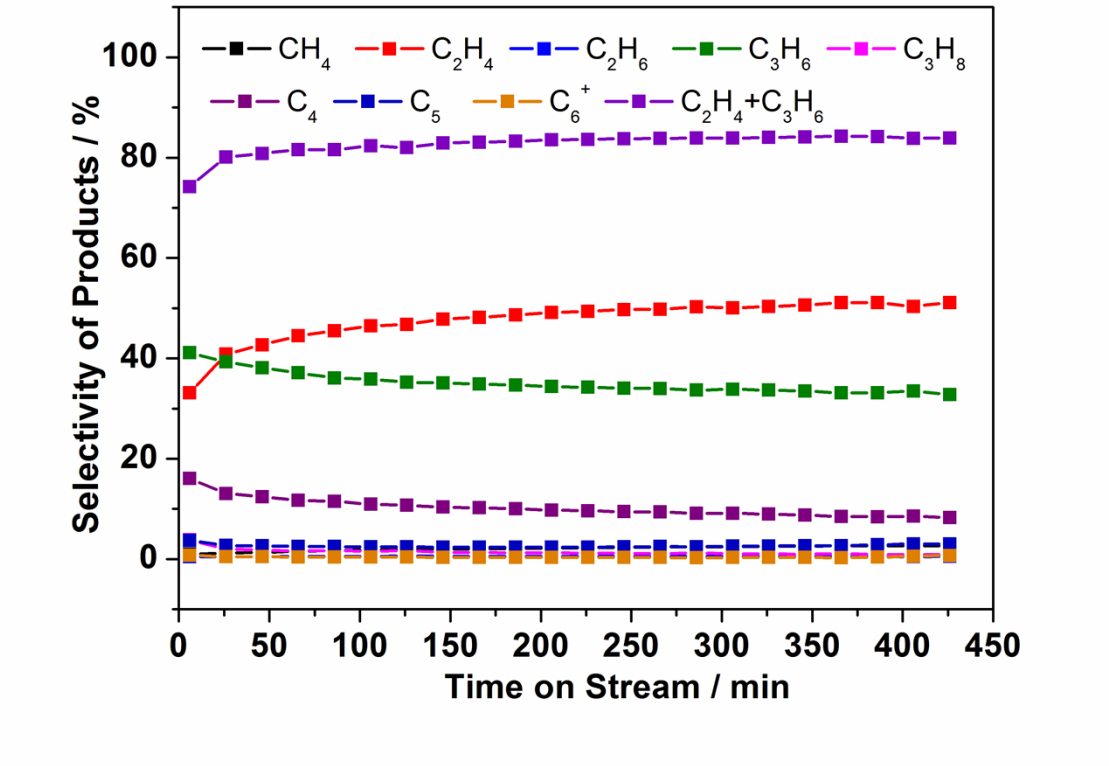

Figure S7 Products distribution of hierarchically porous SAPO-34 catalyst (S_{H3}) in MTO reaction. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

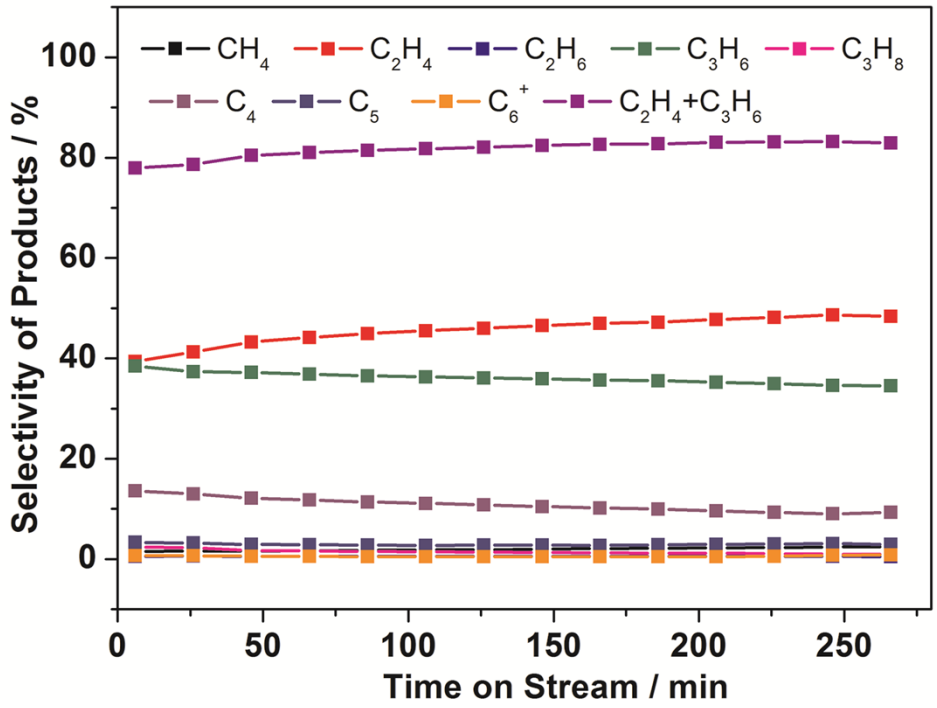

Figure S8 Products distribution of hierarchically porous SAPO-34 catalyst (S_{H4}) in MTO reaction. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

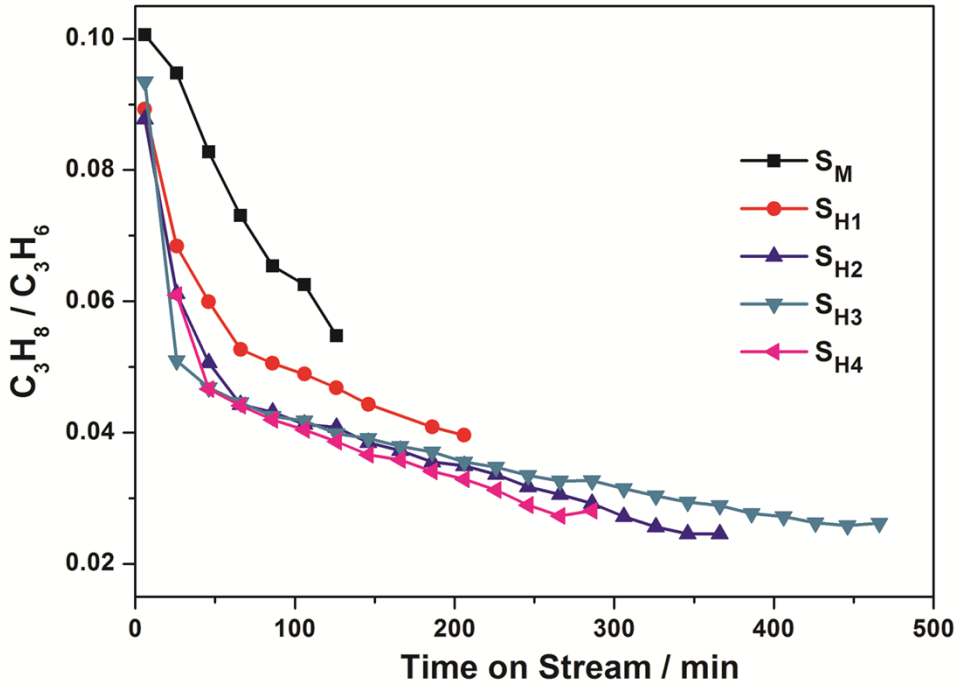

Figure S9 Hydrogen transfer index (HTI, C_3H_8/C_3H_6) values of methanol conversion over conventional microporous SAPO-34 (S_M) and hierarchically porous SAPO-34 (S_{H1}, S_{H2}, S_{H3}, and S_{H4}) catalysts. Experimental conditions: WHSV = 4 h^{-1}, T = 723 K, catalyst weight = 300 mg.

Table S1 MTO results on conventional microporous SAPO-34 (S_M) and hierarchically porous SAPO-34 (S_{H1}, S_{H2}, S_{H3}, and S_{H4}) catalysts.

Samples	TOS (min)	Selectivity（%）							
		CH_4	C_2H_4	C_2H_6	C_3H_6	C_3H_8	C_4	C_5^+	$C_2^=+C_3^=$
S_M	6	1.4	33.9	0.5	41.2	4.2	15.1	3.7	75.1
	66*	1.6	41.0	0.7	38.8	2.8	11.4	3.7	79.8
S_{H1}	6	1.2	36.5	0.5	39.4	3.5	14.4	4.5	75.6
	186*	2.8	47.8	0.6	35.1	1.4	8.9	4.8	82.9
S_{H2}	6	1.3	36.0	0.5	39.6	3.5	14.6	5.1	75.6
	306*	2.7	49.3	0.5	34.2	0.9	8.9	3.5	83.5
S_{H3}	6	1.0	33.1	0.5	41.1	3.8	16.0	4.5	74.2
	386*	2.7	51.1	0.5	33.1	0.9	8.4	3.3	84.2
S_{H4}	6	1.5	39.4	0.5	38.5	2.4	13.6	4.1	77.9
	226*	2.3	48.2	0.5	34.9	1.1	9.3	3.7	83.1

Reaction conditions: WHSV = 4 h^{-1}, T =723K, catalyst weight = 300 mg.

* Lifetime: the reaction duration with > 99.9% methanol conversion.

Table S2 The variations of coke formation in methanol conversion over conventional microporous SAPO-34 (S_M) and hierarchically porous SAPO-34 ($S_{H1,}$ S_{H2}, S_{H3}, and S_{H4}) catalysts.

Catalysts	S_M	S_{H1}	S_{H2}	S_{H3}	S_{H4}
Coke (%, g/gcat)	16.95	22.39	23.06	23.07	21.18
TOS (min)	126	246	366	486	286
R_{coke} (mg/min) (1)	0.403	0.273	0.189	0.142	0.222
P_{coke} (g/gMeOH) (2)	0.020	0.014	0.009	0.007	0.011

(1) R_{coke}(mg/min) = coke amount (mg) / reaction time (min);

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