

## Al-modified mesoporous silica for efficient conversion of methanol to dimethyl ether

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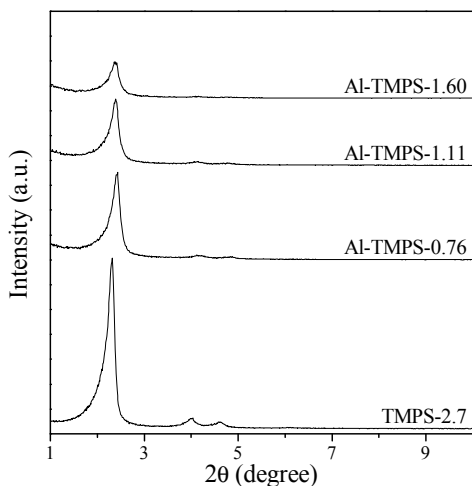
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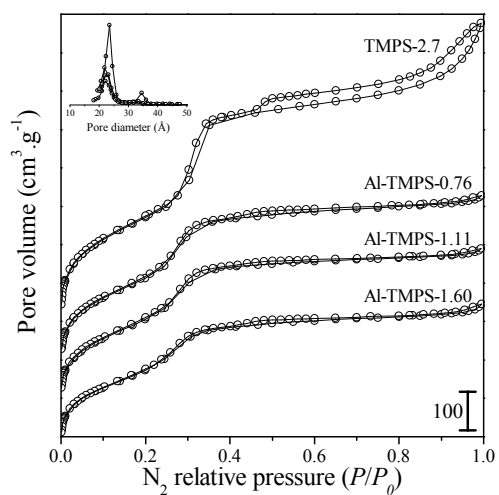
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### I) Supplementary data for X-ray diffraction



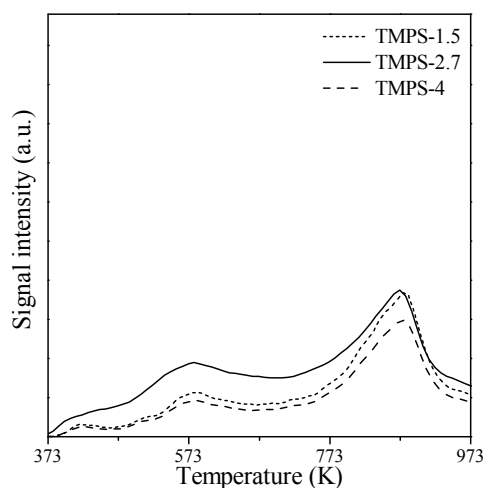
**Fig. S1** X-ray diffractograms obtained for the Al-TMPS solids.

## II) Supplementary data for N<sub>2</sub> physisorption



**Fig. S2** Nitrogen physisorption isotherms and pore size distributions for the Al-TMPS solids.

### III) Supplementary data for ammonia thermo-desorption

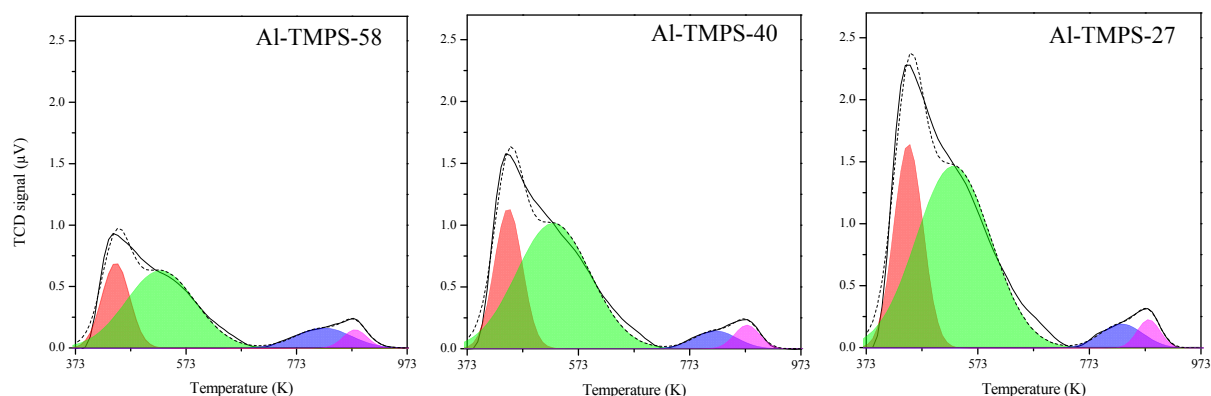


**Fig. S3** Ammonia temperature programmed desorption profiles for the TMPS solids.

The  $\text{NH}_3$ -TPD profiles of the aluminium-containing samples were fitted using the Origin 8.5 software. Four components were taken into account:

- weak sites, at  $\sim 446$  K (peak 1),
- medium sites, at  $\sim 528$  K (peak 2)
- strong sites with 2 components at 820-830 K (peak 3) and  $\sim 878$  K (peak 4).

The obtained curves are presented in Figure S4 and the peaks positions and relative area summarized in Table S1.



**Fig. S4** Curve fitting of the  $\text{NH}_3$ -TPD.

**Table S1.**  $\text{NH}_3$ -TPD profiles decomposition peaks properties for the Al-containing catalysts.

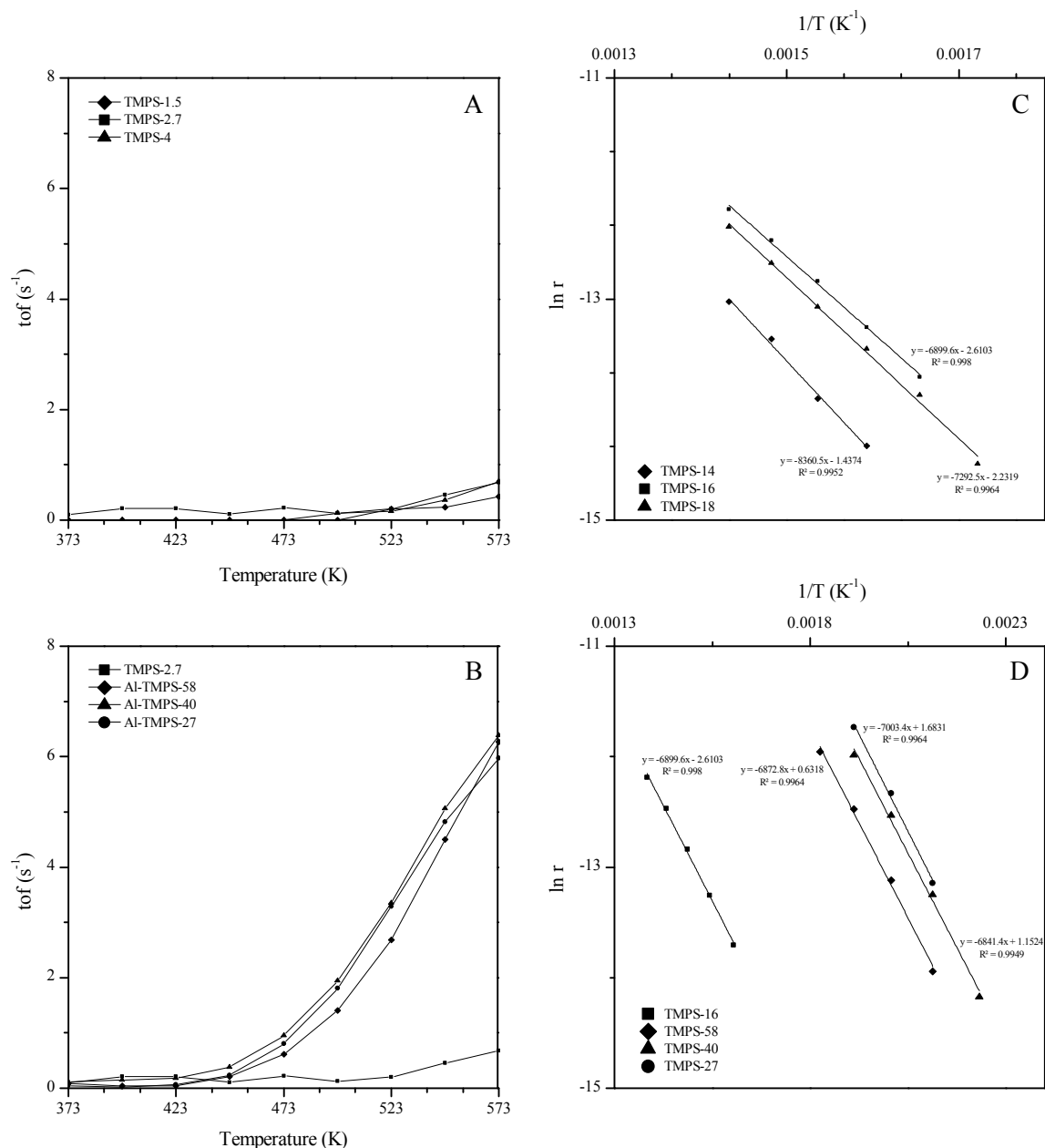
	Peak 1			Peak 2			Peak 3			Peak 4		
	Temp. (K)	Area	Fraction (%)	Temp. (K)	Area	Fraction (%)	Temp. (K)	Area	Fraction (%)	Temp. (K)	Area	Fraction (%)
Al-TMPS-58	446	43	25	527	99	58	822	20	12	879	8	5
Al-TMPS-40	447	71	27	528	168	64	819	14	5	876	11	4
Al-TMPS-27	449	107	28	530	245	64	831	19	5	879	12	3

#### IV) Catalytic activity in methanol conversion to dimethyl ether

the turn-over frequency (TOF), was calculated using the following formula:

$$\text{TOF} = \frac{r_{\text{MeOH}} \times \text{SSA}}{\text{TPD}}$$

with TOF : turn-over frequency ( $\text{s}^{-1}$ )  
 $r_{\text{MeOH}}$  : rate of methanol conversion ( $\text{mol} \cdot \text{s}^{-1} \cdot \text{m}^{-2}$ )  
 SSA : specific surface area ( $\text{m}^2$ )  
 TPD : acid site content (mol), determined by  $\text{NH}_3$ -TPD



**Fig. S5** Catalytic activity of the silica and aluminosilicates: turnover frequencies as a function of temperature over A) TMPS solids, B) Al-TMPS solids, and associated Arrhenius plots in presence of C) TMPS solids and D) Al-TMPS solids.