Electronic supplementary information

Single-step preparation of zinco- and aluminosilicate delaminated MWW layers for catalytic conversion of glucose†

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Table S1 Physicochemical properties of catalysts prepared in this study

	BET surface area (m^2 g^{-1})[b]			ICP elemental analysis				Acid concentration (μmol g^{-1})[e]		
Catalyst[a]	Total	External	Micropore	Si/B	Si/Zn_{Total}	$Si/Zn_{Framework}$[d]	Si/Al	Brønsted	Lewis	Total
B-MWW	477	25	452	9.5	-	-	-	0	n.d.	-
Zn-DML-100	474	112	362	21	25	25	-	84	n.d.	-
Zn-DML-120	452	142	310	25	9.3	16	-	31	n.d.	-
Zn-DML-140	271	173	98	49	4.6	12	-	13	178	191
Zn-DML-160	165	165	0	240	3.5	10	-	0	84	84
$Zn_{0.75}Al_{0.25}$-DML-160	322	105	217	1100	190	190	26	137	240	377
$Zn_{0.50}Al_{0.50}$-DML-160	427	137	291	1100	230	230	8.4	153	266	419
$Zn_{0.25}Al_{0.75}$-DML-160	372	68	304	1200	410	410	8.4	135	172	307
Al-DML-160	304	66	238	6800	-	-	12	136	143	279
SnAl-BEA	527	120	407	-	130[c]	-	620	8	65	73

[a] Calcined at 550 °C for 8 h. [b] Calculated from N_2 sorption isotherms (Fig. S5†). [c] Si/Sn molar ratio. [d] Calculated under the assumption that the number of framework tetrahedral atoms is 72 including 65.2 Si atoms, which are same to those of B-MWW. [e] The concentrations of Brønsted and Lewis acid sites were determined from the intensities of the pyridine-adsorbed IR bands at approximately 1550 and 1450 cm^{-1}, respectively (Figs. 6 and S6†). n.d. means that it cannot be determined due to the background spectrum.

Table S2 Relative integrated areas of Zn $2p_{3/2}$ XPS spectra of the Zn-containing catalysts employed in this study

Catalyst	Area (a.u.)			Area ratio (A/B)
	Framework Zn at 1023 eV (A)	ZnO at 1022 eV (B)	Total area (A + B)	
Zn-DML-100	4600	2450	7050	1.88
Zn-DML-120	14000	8500	22500	1.65
Zn-DML-140	12000	17000	29000	0.71
Zn-DML-160	7000	27500	34500	0.25
$Zn_{0.75}Al_{0.25}$-DML-160	17000	18000	35000	0.94

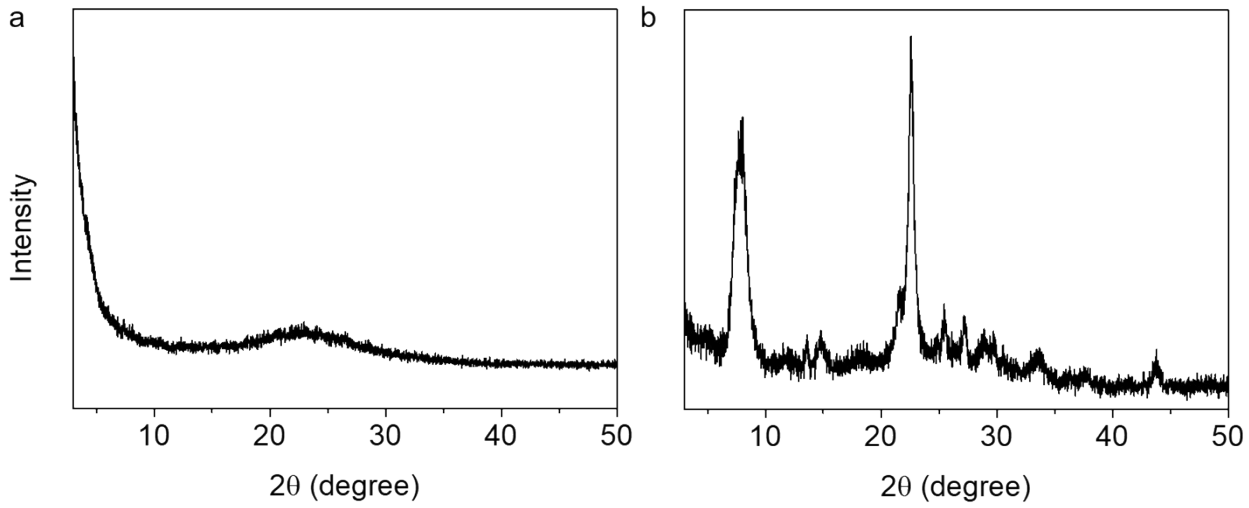

Fig. S1 Powder XRD patterns of (a) delaminated B-MWW and (b) SnAl-BEA.

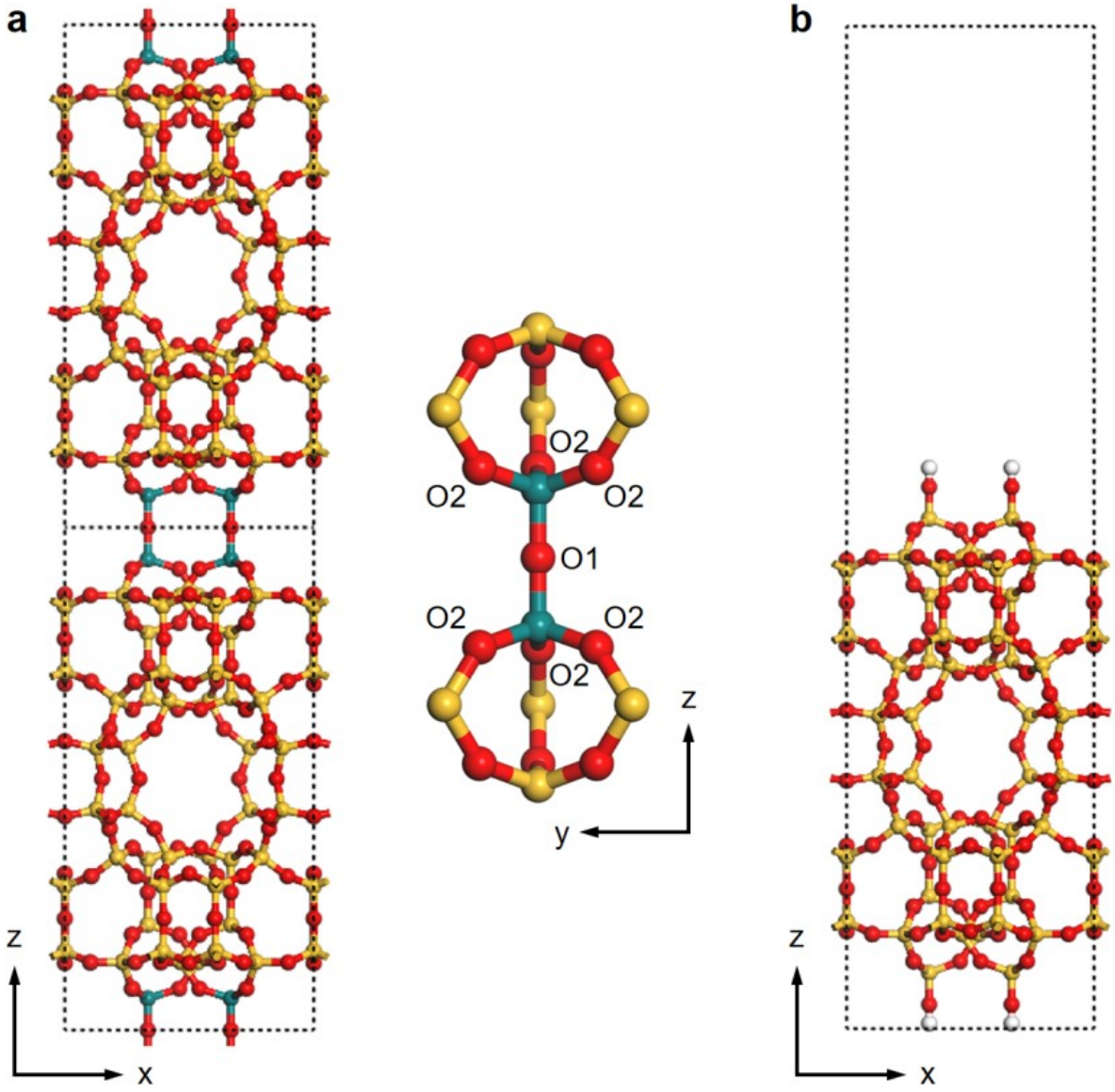

Fig. S2 Initial structures of (a) 3D and (b) 2D MWW silicates for DFT calculation. Si, yellow; O, red; H, white. The Si1 atoms of 3D MWW structure, which are connected with O1 and O2 atoms, are marked in green.

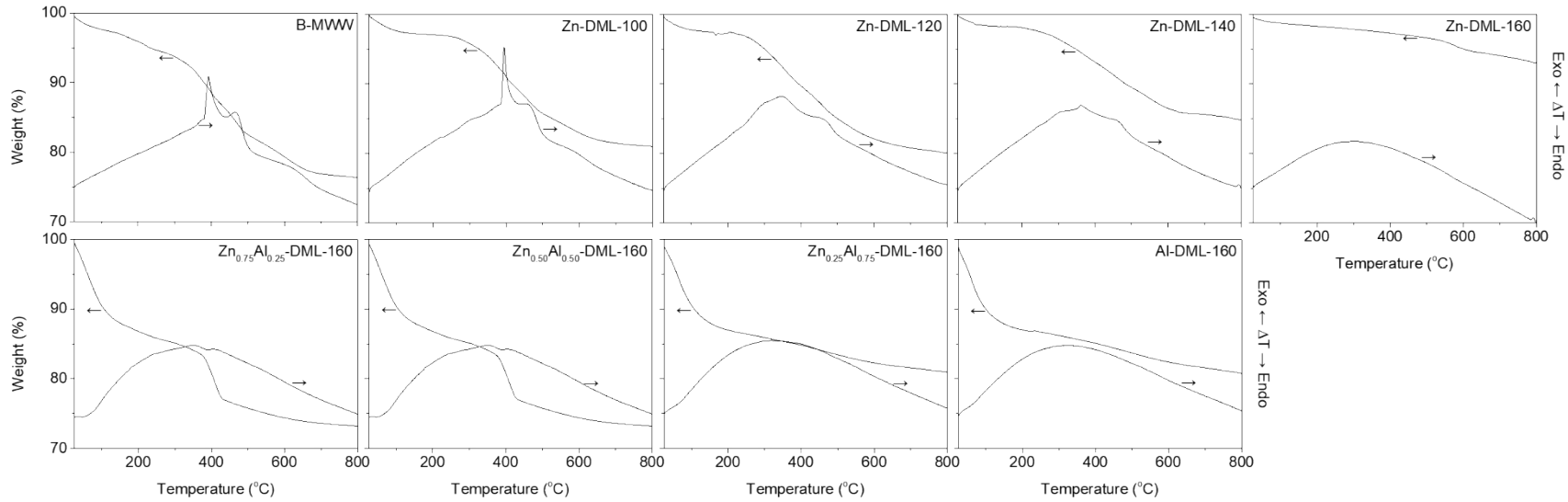

Fig. S3 TGA/DTA curves for the as-synthesized B-MWW(P), Zn-DML-*x*, and Zn_yAl_z-DML-160 samples.

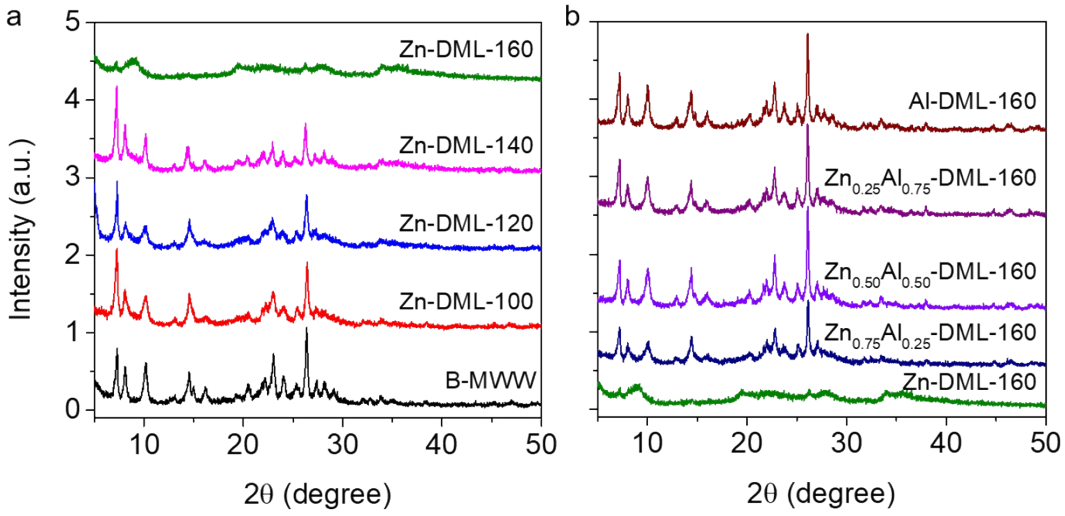

Fig. S4 Powder XRD patterns of calcined (a) B-MWW and Zn-DML-*x* and (b) Zn_yAl_z-DML-160 catalysts.

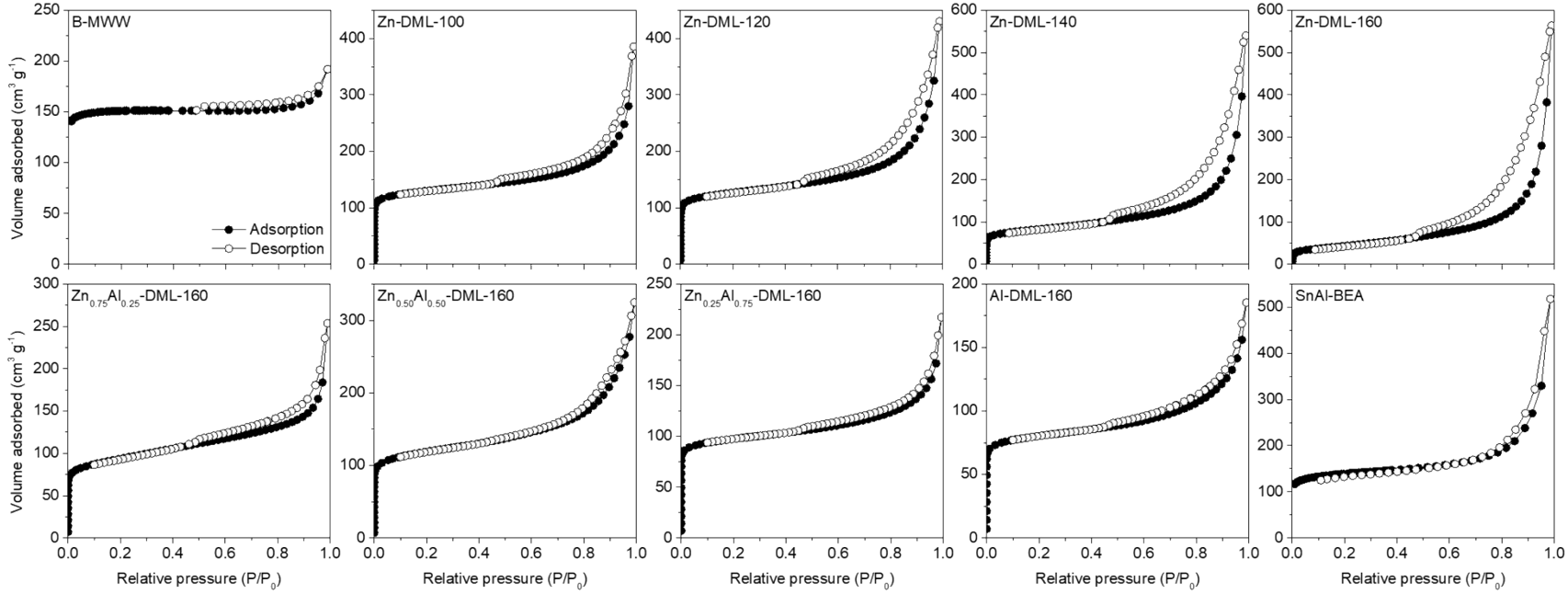

Fig. S5 N_2 sorption isotherms of calcined B-MWW, Zn-DML-*x*, Zn_yAl_z-DML-160, and SnAl-BEA catalysts.

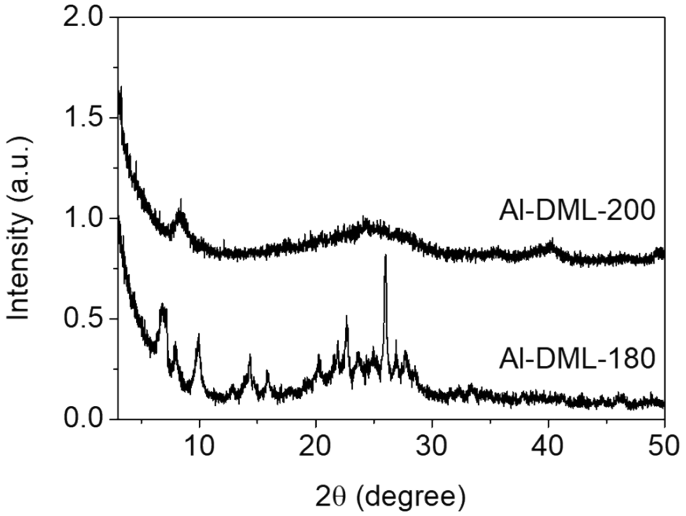

Fig. S6 Powder XRD patterns of as-synthesized Al-DML-180 and Al-DML-200 samples.

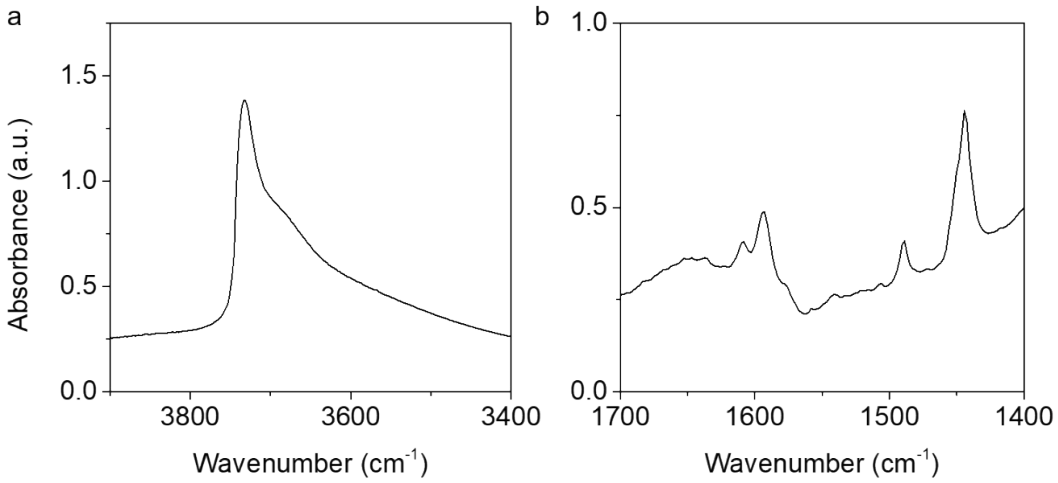

Fig. S7 (a) IR spectrum in the 3400–3900 region and (b) pyridine-adsorbed IR spectrum of SnAl-BEA.

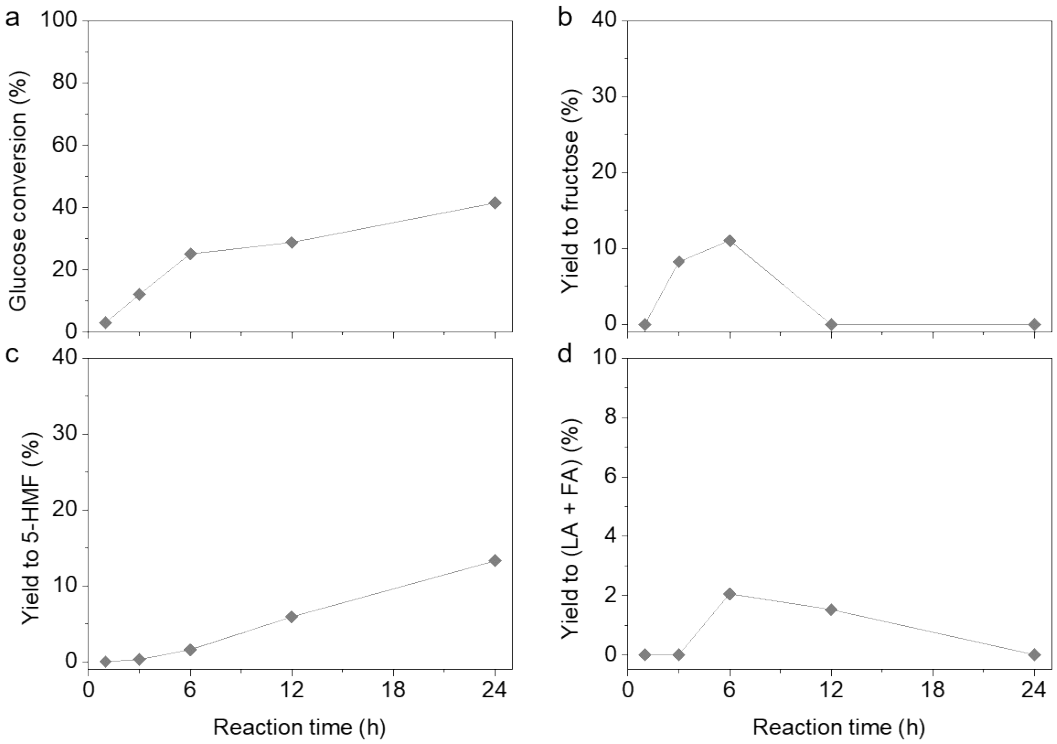

Fig. S8 (a) Glucose conversion and yields for (b) fructose, (c) HMF, and (d) LA + FA with no catalyst at 160 °C.

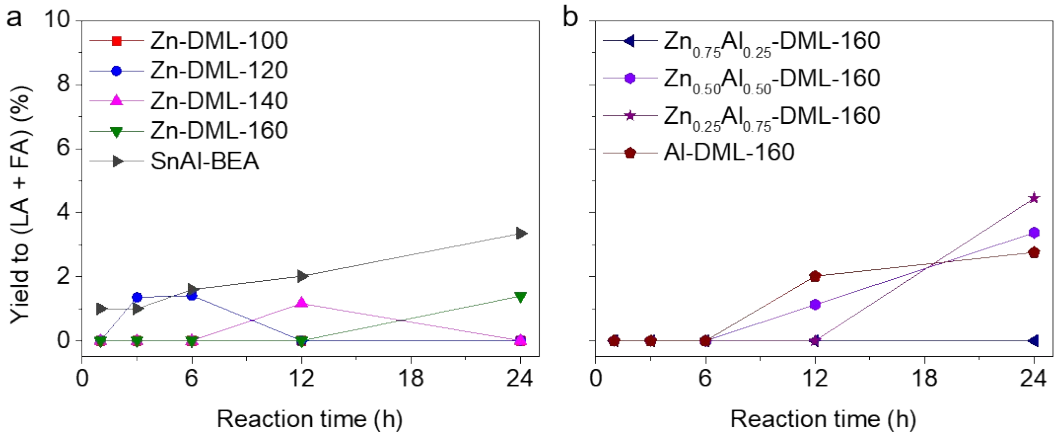

Fig. S9 Yields for LA + FA over (a) Zn-DML-*x* and SnAl-BEA and (b) Zn_yAl_z-DML-160 catalysts at 160 °C.