Supporting Information

Improved catalytic transfer hydrogenation of biomass-derived aldehydes with metal-loaded aluminum phosphate

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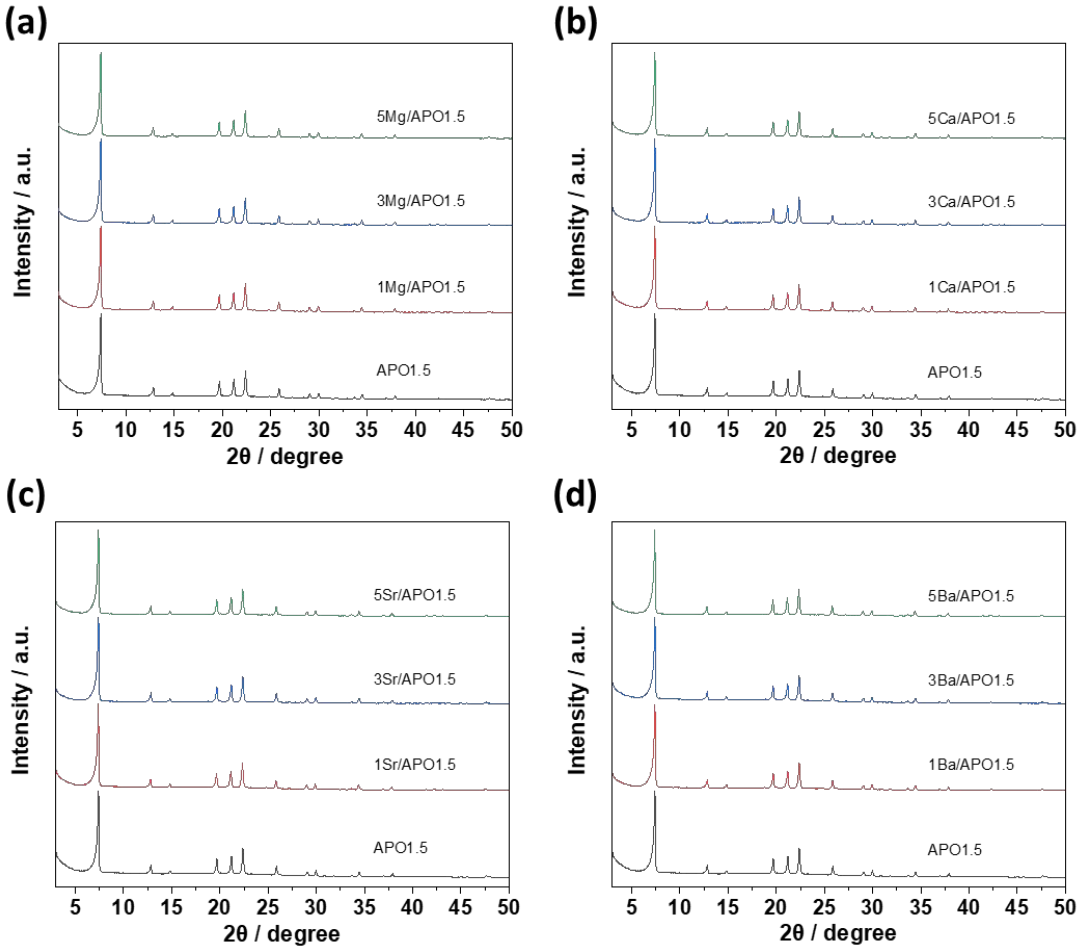

Figure S1. XRD patterns of AEM-loaded APO1.5 catalysts.

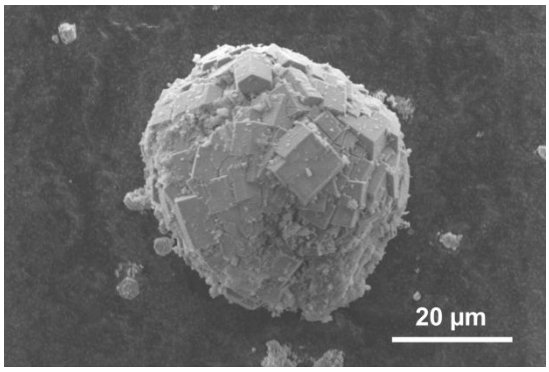

Figure S2. SEM image of APO1.5 catalyst.

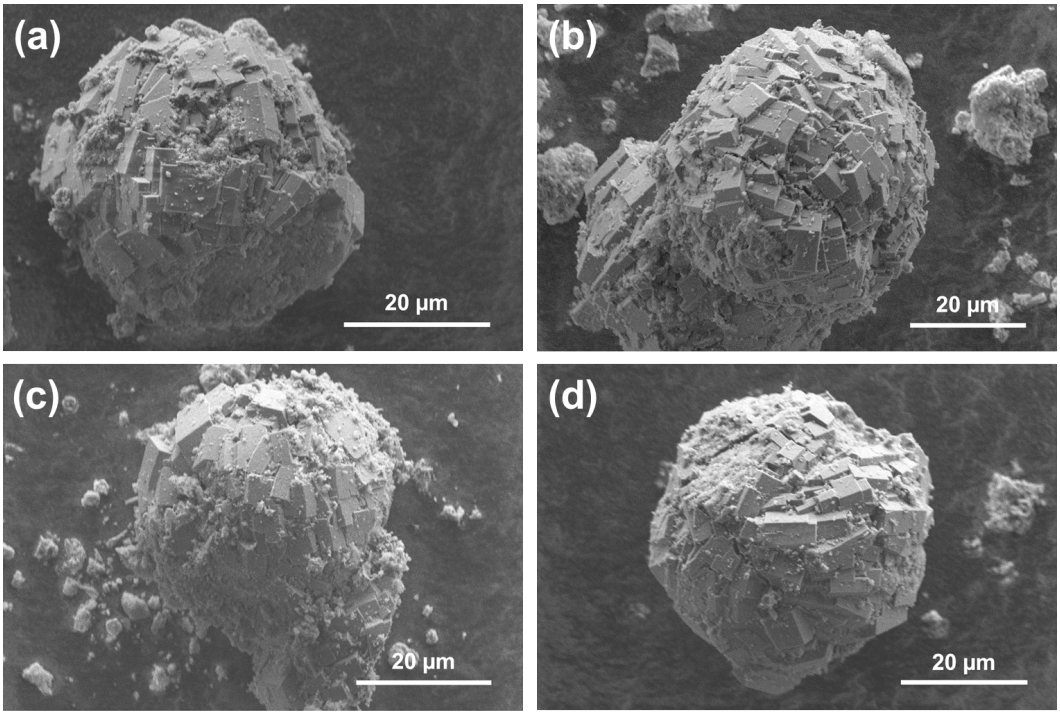

Figure S3. SEM images of (a) 5Mg/APO1.5, (b) 5Ca/APO1.5, (c) 5Sr/APO1.5, and (d) 5Ba/APO1.5 catalysts.

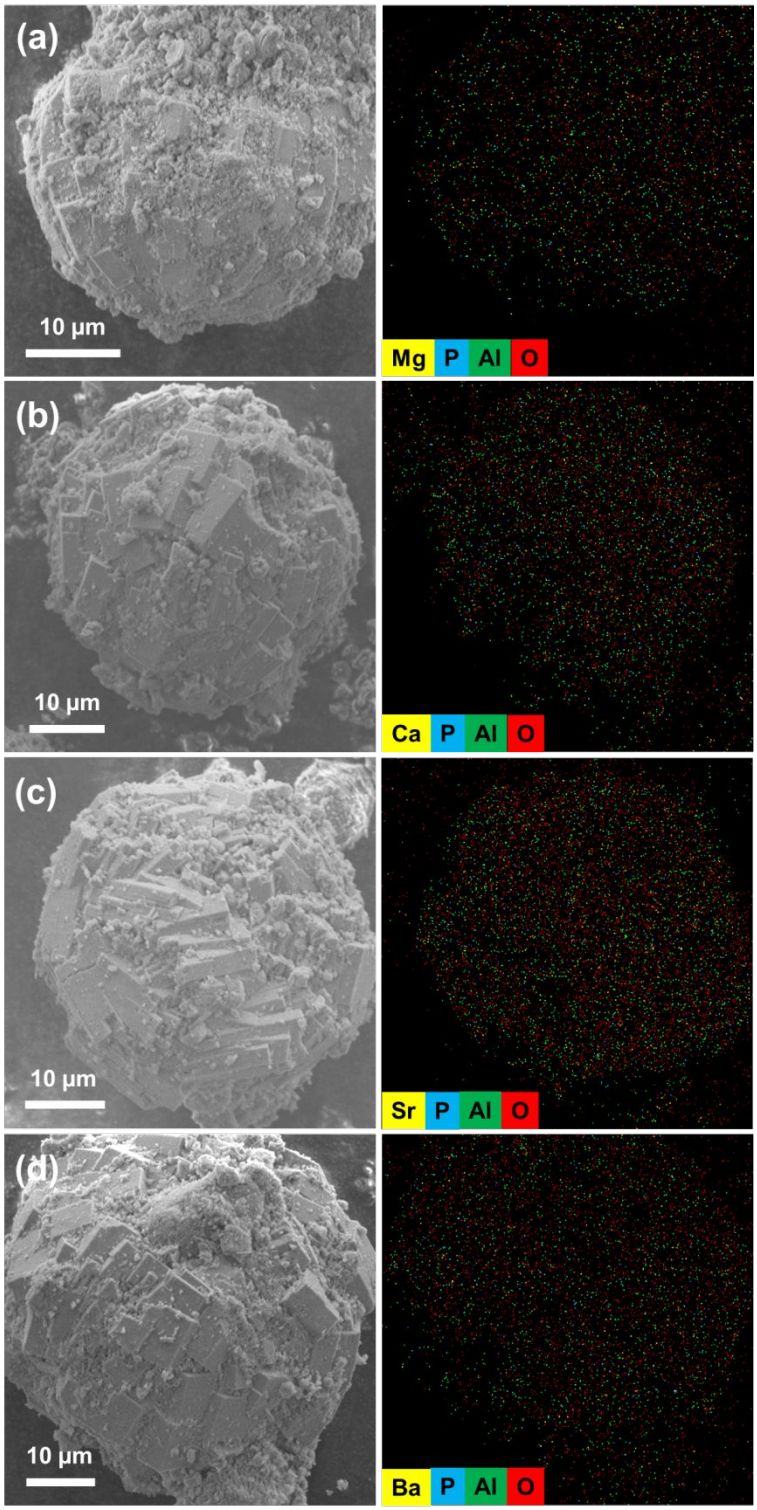

Figure S4. EDS mapping of (a) 5Mg/APO1.5, (b) 5Ca/APO1.5, (c) 5Sr/APO1.5, and (d) 5Ba/APO1.5 catalysts.

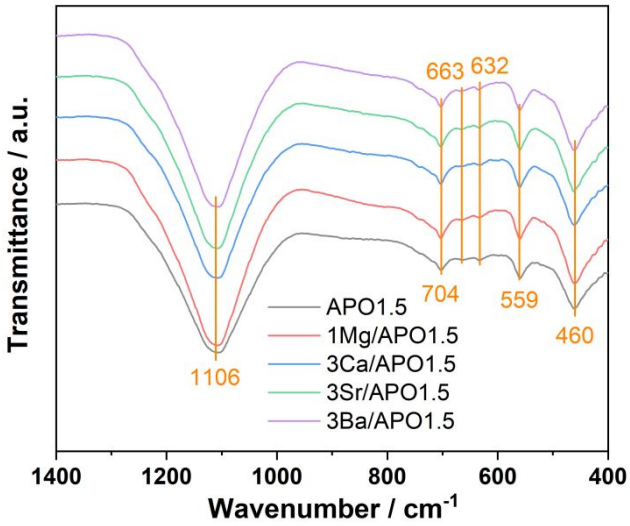

Figure S5. FT-IR spectra of APO1.5 and AEM-loaded APO1.5 catalysts.

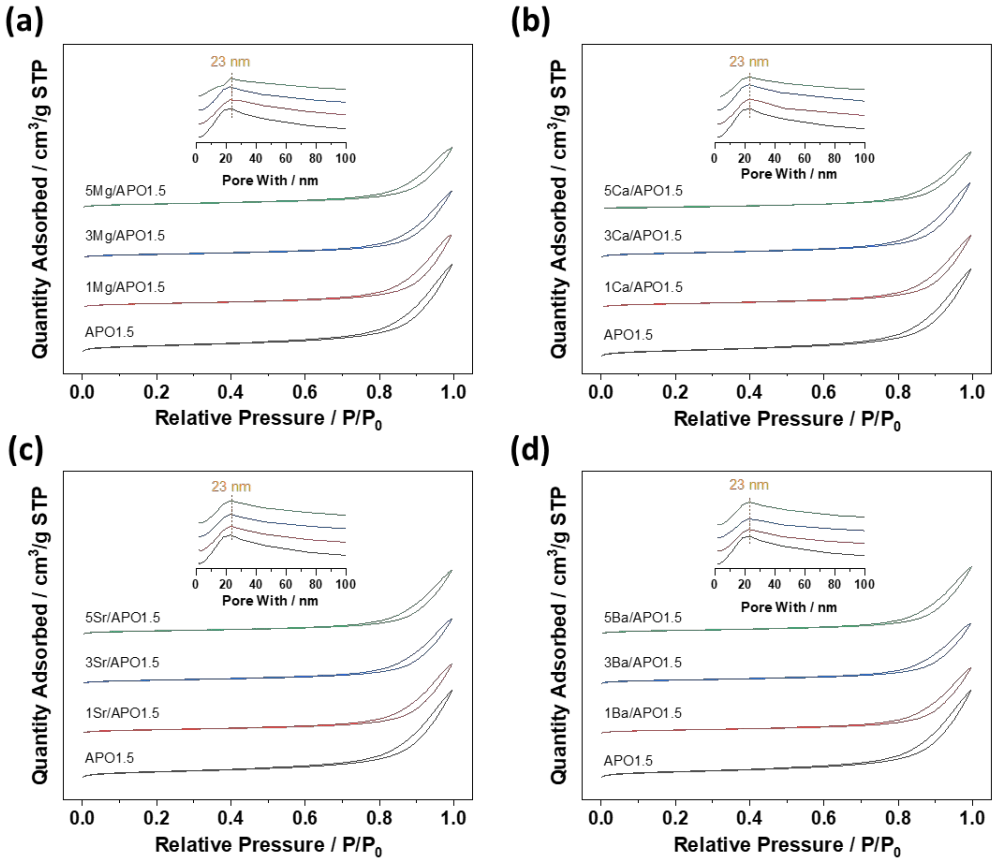

Figure S6. N_2 adsorption-desorption isotherms (inset: BJH mesopore size distribution) of APO1.5 and AEM-loaded APO1.5 catalysts.

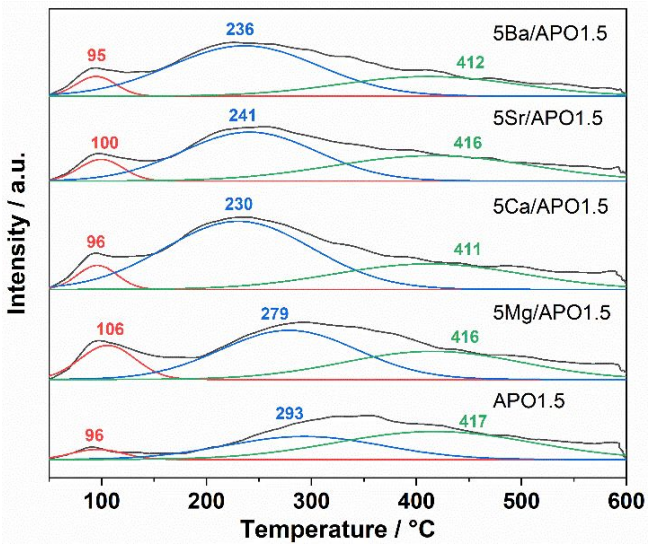

Figure S7. CO_2-TPD profiles of APO1.5, 5Mg/APO1.5, 5Ca/APO1.5, 5Sr/APO1.5 and 5Ba/APO1.5 catalysts.

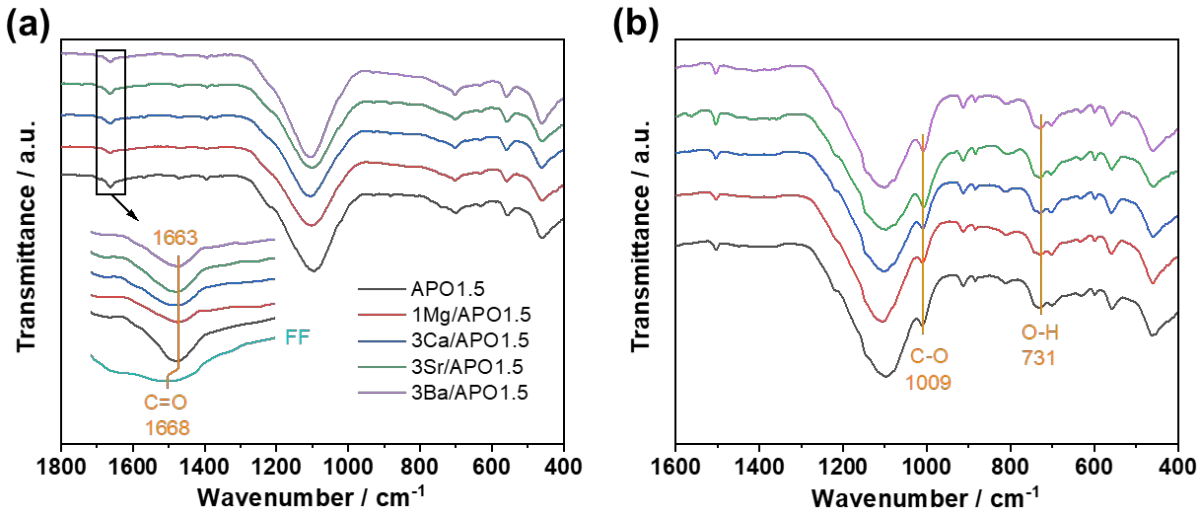

Figure S8. FT-IR spectra of APO1.5 and AEM-loaded APO1.5 catalysts with pre-adsorbed (a) FF and (b) FA.

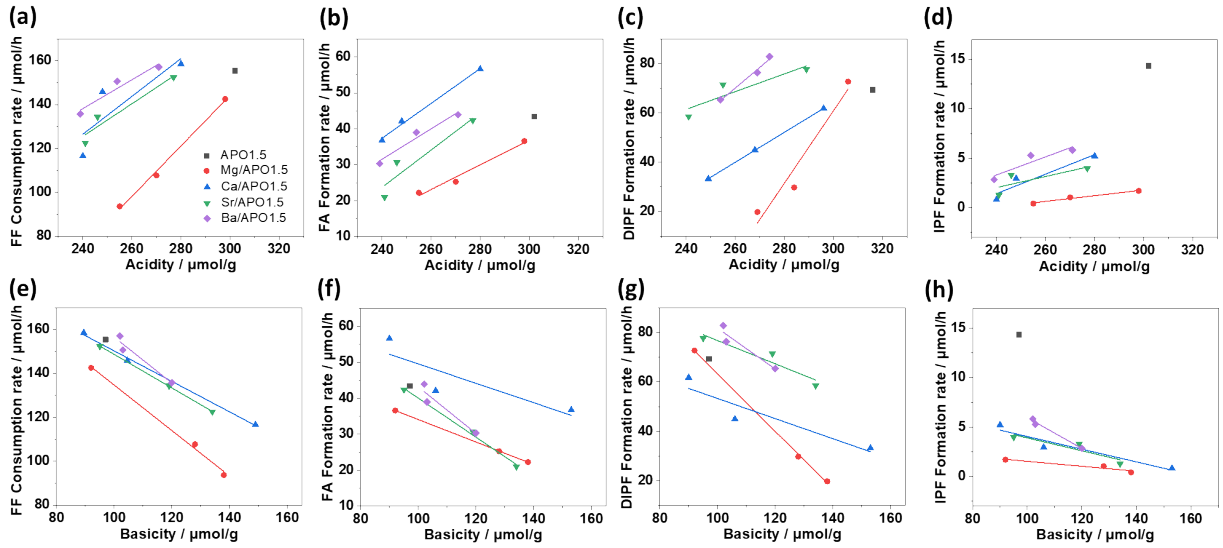

Figure S9. Correlations between acidity/basicity, FF consumption rate and FA/DIPF/IPF formation rate of the APO1.5 and AEM-loaded APO1.5 catalysts. Reaction conditions: (a)-(c) and (e)-(g) FF (96 mg, 1 mmol), catalyst (50 mg), 2-propanol (5 mL), 140˚C, 2 h; (d) and (h) FA (98 mg, 1 mmol), catalyst (50 mg), 2-propanol (5 mL), 140˚C, 6 h.

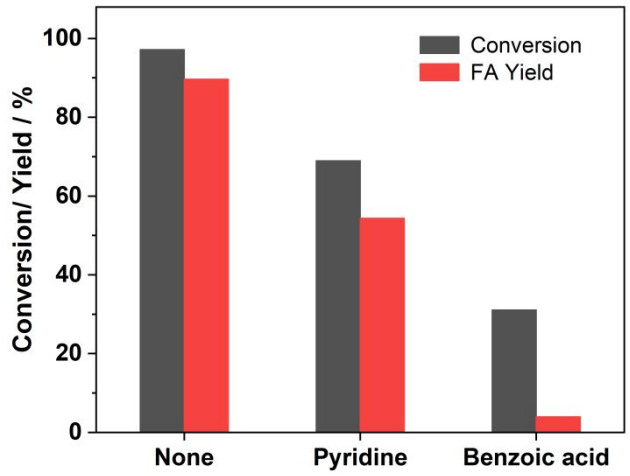

Figure S10. CTH of FF to FA with 3Ca/APO1.5 catalyst. Reaction conditions: FF (96 mg, 1 mmol), 3Ca/APO1.5 (50 mg), additive (100 mg), 2-propanol (5 mL), 140˚C, 48 h.

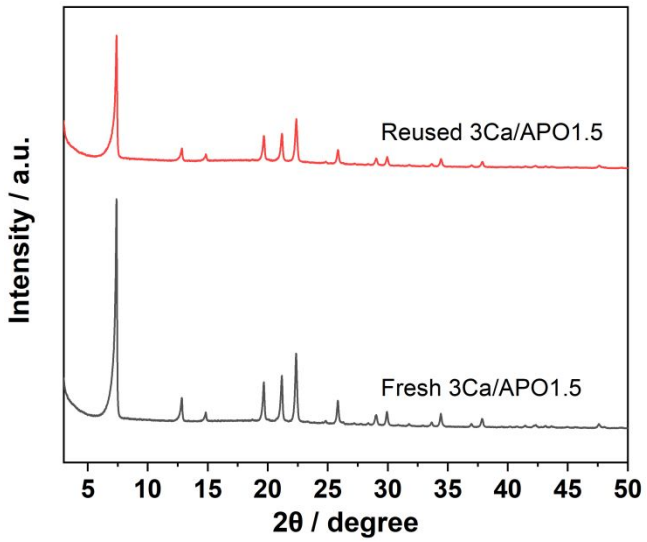

Figure S11. XRD patterns of fresh and reused (after four reaction cycles) 3Ca/APO1.5 catalyst.

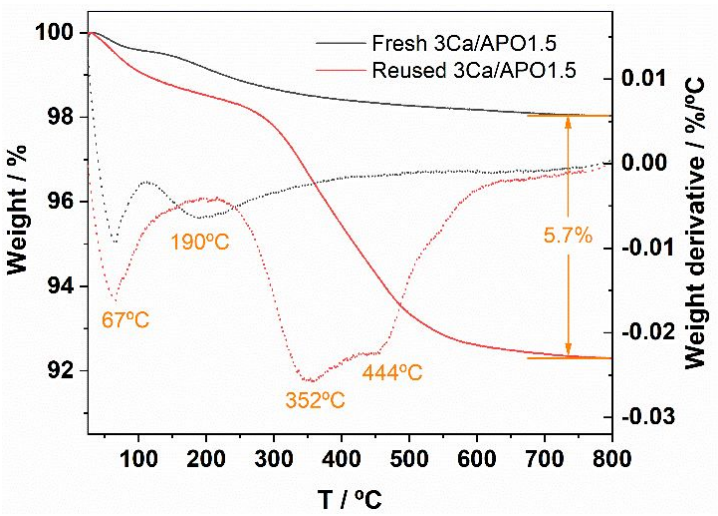

Figure S12. TG curves of fresh and reused (after four reaction cycles) 3Ca/APO1.5 catalyst.

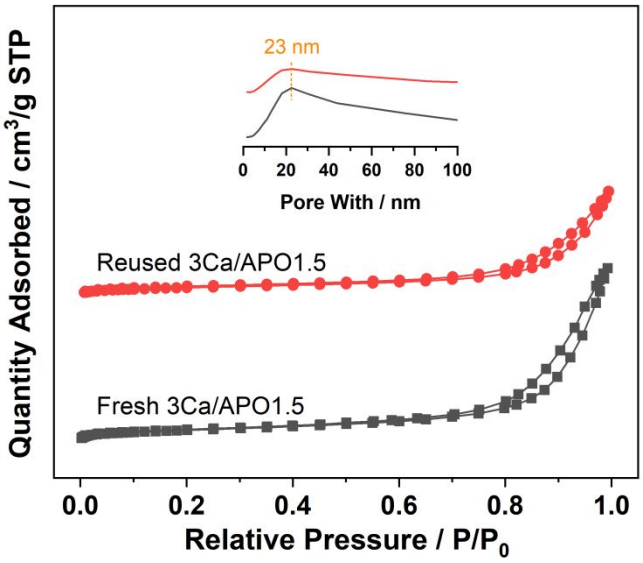

Figure S13. N_2 adsorption-desorption isotherms (inset: BJH mesopore size distribution) of fresh and reused (after four reaction cycles) 3Ca/APO1.5 catalyst.

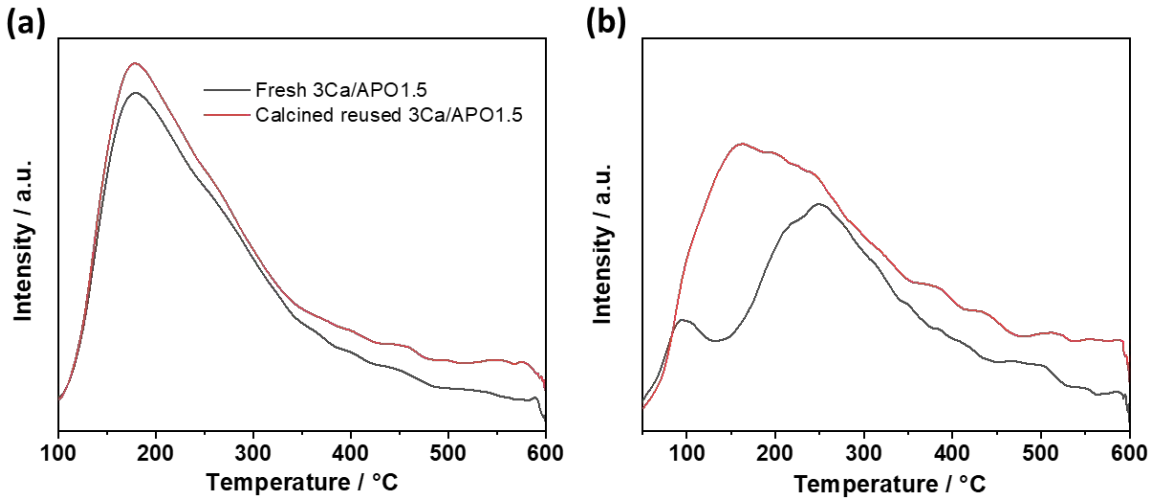

Figure S14. NH_3-TPD and CO_2-TPD profiles of calcined 3Ca/APO1.5 catalyst (after four reaction cycles).

Table S1. Crystalline size and unit cell size of APO1.5 and AEM-loaded APO1.5 catalysts.

Catalyst	Unit cell parameter		
	a (Å)	c (Å)	V (Å^3)
APO1.5	13.78	8.38	1378.08
1Mg/APO1.5	13.78	8.38	1378.08
3Mg/APO1.5	13.78	8.38	1378.08
5Mg/APO1.5	13.79	8.39	1381.72
1Ca/APO1.5	13.78	8.38	1378.08
3Ca/APO1.5	13.78	8.38	1378.08

5Ca/APO1.5	13.78	8.38	1378.08
1Sr/APO1.5	13.80	8.39	1383.73
3Sr/APO1.5	13.78	8.38	1378.08
5Sr/APO1.5	13.78	8.38	1378.08
1Ba/APO1.5	13.78	8.38	1378.08
3Ba/APO1.5	13.78	8.39	1379.72
5Ba/APO1.5	13.80	8.39	1383.73

Table S2. The conversion of FF using 2-propanol as H-donor over APO1.5 catalysts.[a]

Catalyst	Conversion (%)[b]	Product yield (%)[b]			
		FA	DIPF	IPF	IPL
APO1.5+CaO	58.3	27.1	5.8	5.95	0

[a] Reaction conditions: FF (96 mg, 1 mmol), catalyst (50 mg), 2-propanol (5 mL), 140˚C, 24 h. [b] Conversion and yield were quantified using GC. FA: furfuryl alcohol, DIPF: 2-(diisopropoxymethyl)furan, IPF: 2-(isopropoxymethyl)furan, IPL: isopropyl levulinate.

Table S3. Physical properties and compositions of 3Ca/APO1.5 catalysts.

Catalyst	Ca content (wt.%)[a]	S_{BET} (m^2/g)[b]	V_{total} (cm^3/g)[c]	V_{micro} (cm^3/g)[d]	V_{meso} (cm^3/g)[e]	Acidity (μmol/g)[f]	Basicity (μmol/g)[g]
3Ca/APO1.5	2.9	106	0.30	0.01	0.29	248	106
3Ca/APO1.5 (reused)[h]	2.2[i]	49	0.17	0.00	0.17	264[i]	198[i]

[a] Determined by XRF. [b] Calculated by Brunauer-Emmett-Teller (BET) method. [c] Calculated by single point adsorption at $P/P_0 = 0.95$. [d] Estimated by the t-plot method. [e] Calculated by subtraction of the micro pore volume from the total volume. [f] Determined by NH_3-TPD. [g] Determined by CO_2-TPD. [h] 3Ca/APO1.5 catalyst after four reaction cycles. [i] Calcined 3Ca/APO1.5 catalyst (after four reaction cycles).