Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Supporting Information

Insights on Seed Selection Criteria of SAPO-34 Synthesis: Structure Units and Chemical Microenvironment

*Xiaosi Zhang,[ab] Miao Yang,[*a] Ye Wang,[ac] Caiyi Lou,[ab] Shutao Xu,[a] Peng Tian*[a] and Zhongmin Liu[ab]*

[a] National Engineering Research Center of Lower-Carbon Catalysis Technology, Dalian National Laboratory for Clean Energy, iChEM (Collaborative Innovation Center of Chemistry for Energy Materials), Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian 116023, (P. R. China)

[b] University of Chinese Academy of Sciences, Beijing 100049, (P. R. China)

[c] Green Catalysis Centre, College of Chemistry, Zhengzhou University, Zhengzhou 450001, (P. R. China)

*Corresponding authors: yangmiao@dicp.ac.cn; tianpeng@dicp.ac.cn

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1. Supplementary Tables

Table S1 The collections of various seeds.

Seed samples	Gel molar composition	T/°C	t/h	Elemental composition	
	$SiO_2/Al_2O_3/P_2O_5/H_2O/R$			Measured by XRF	SAR [a]
CHA-0.19-0.5	1 SAPO-34-BM:4 DEA:0.4 H_2O (mass ratio)	200	2	$Al_{0.508}Si_{0.187}P_{0.305}O_2$	0.37
CHA-0.20-2[1]	0.31/1/1/100/1.5 PIP/4.5 TEA (seed) [b]	200	24	$Al_{0.459}Si_{0.199}P_{0.341}O_2$	0.43
CHA-0.19-10 (MS)	1/1/0.8/100/2.5 MOR	200	24	$Al_{0.468}Si_{0.191}P_{0.341}O_2$	0.41
CHA-0-0.5 (MS)	0/1/1/50/2.5 Py/0.4 HF	200	24	$Al_{0.505}P_{0.495}O_2$	0
CHA-0.06-1[2]	0.2/0.8/1/50/1.8 TEA/1.5 TEABr	120	96	$Al_{0.491}Si_{0.062}P_{0.447}O_2$	0.13
CHA-0.10-2 (MS)	0.6/1/0.8/100/2.5 MOR (seed) [b]	200	2	$Al_{0.505}Si_{0.100}P_{0.395}O_2$	0.20
CHA-0.15-1[3]	0.75/1/1/50/0.4 TEAOH/2.6 TEA	200	24	$Al_{0.458}Si_{0.145}P_{0.398}O_2$	0.32
CHA-0.91-0.5[4]	20/10/0/440/2.0 TMAdaOH/1.0 Na_2O	160	96	$Al_{0.09}Si_{0.91}O_2$	10.13
LEV-0.18-5[5]	0.5/1.0/0.96/55/1.35 HMI	200	25	$Al_{0.457}Si_{0.175}P_{0.368}O_2$	0.38
AFX-0.22-8[6]	0.6/0.8/1.0/50/2.0 TMHDA	200	48	$Al_{0.437}Si_{0.222}P_{0.341}O_2$	0.51
AEI-0.07-1[7]	0.4/1/1/50/1.8 DIEA	160	48	$Al_{0.513}Si_{0.066}P_{0.421}O_2$	0.13
AEI-0.03-0.5[7]	0.1/1/1/50/2 DIEA	160	65	$Al_{0.498}Si_{0.032}P_{0.470}O_2$	0.06
AEI-0-0.5[8]	0/1/1/50/1.8 DIEA	160	24	$Al_{0.518}P_{0.482}O_2$	0
LTA-0.17-1[9]	0.35/0.5/0.4/50/2.0 DPA/0.15 C_{16}TAB	200	24	$Al_{0.463}Si_{0.168}P_{0.369}O_2$	0.35
RHO-0.25-0.5[10]	0.6/0.5/0.4/50/1.5 DEA/0.2 C_{18}TAB	200	24	$Al_{0.444}Si_{0.253}P_{0.303}O_2$	0.57
RHO-0.33-8[11]	1.7/1.0/1.0167.0/5.0 DMEDA	200	12	$Al_{0.444}Si_{0.332}P_{0.224}O_2$	0.75
SOD-0.18-0.3[12]	1.0/1.0/1.0/60/1.5 TMAOH/1.0 TMEDA	200	24	$Al_{0.499}Si_{0.183}P_{0.318}O_2$	0.37

a SAR refers to the Si/Al molar ratio.

b The seed used here was SAPO-34-BM, and the nominal amount of seeds used in experiments was 5wt % (calculated relative to the total mass of oxides in the gel).

Table S2. Textural properties of the seeds.

Seeds	Surface area ($m^2 g^{-1}$) [a]			Pore volume ($cm^3 g^{-1}$) [b]	
	S_{total}	S_{micro}	S_{ext}	V_{mic}	V_{total}
SAPO-34-BM	51.42	28.07	23.35	0.013	0.079
AFX-0.22-8 (SAPO-56)	494.28	433.94	**60.35**	0.211	0.296
LEV-0.18-5 (SAPO-35)	521.22	475.41	45.82	0.222	0.285
AEI-0.07-1 (SAPO-18)	508.68	482.72	25.96	0.237	0.300

a S_{total}: BET surface area; S_{micro}: t-plot micropore surface area; S_{ext}=S_{total} - S_{micro}.

b V_{total} is evaluated at P/P0=0.97; V_{micro}=t-plot micropore volume.

Table S3. Textural properties of the samples for the MTO evaluation.

Samples	Surface area ($m^2 g^{-1}$) [a]			Pore volume ($cm^3 g^{-1}$) [b]	
	S_{total}	S_{micro}	S_{ext}	V_{mic}	V_{total}
S-0.6-8h	484.9	484.8	0.13	0.244	0.247
$S_{\mathbf{AFX}\text{-}0.22\text{-}8}$-2h	494.7	492.7	2.0	0.260	0.305
$S_{\mathbf{AEI}\text{-}0.07\text{-}1}$-8h	546.5	544.6	1.9	0.268	0.279

a S_{total}: BET surface area; S_{micro}: t-plot micropore surface area; $S_{ext}=S_{total} - S_{micro}$.

b V_{total} is evaluated at $P/P_0=0.97$; V_{micro}=t-plot micropore volume.

2. Supplementary Figures

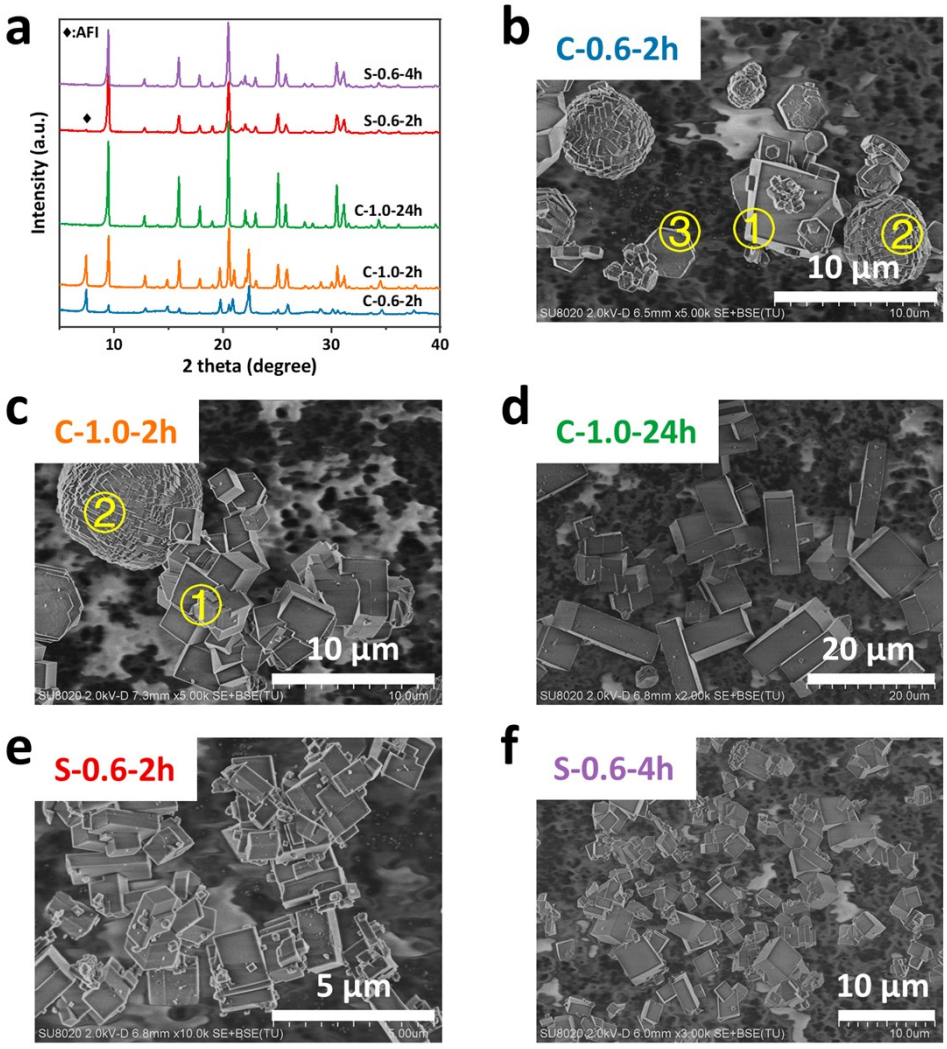

Fig. S1. (a) The powder XRD patterns and (b-f) SEM images of relevant products. The numbers inserted in b and c represent different crystal phases. The statistical averages of elemental compositions for C-0.6-2h: ① $Al_{0.511}Si_{0.102}P_{0.387}O_2$, ② $Al_{0.530}Si_{0.045}P_{0.425}O_2$, ③ $Al_{0.529}Si_{0.042}P_{0.430}O_2$; for C-1.0-2h, ① $Al_{0.513}Si_{0.106}P_{0.381}O_2$, ② $Al_{0.503}Si_{0.057}P_{0.440}O_2$.

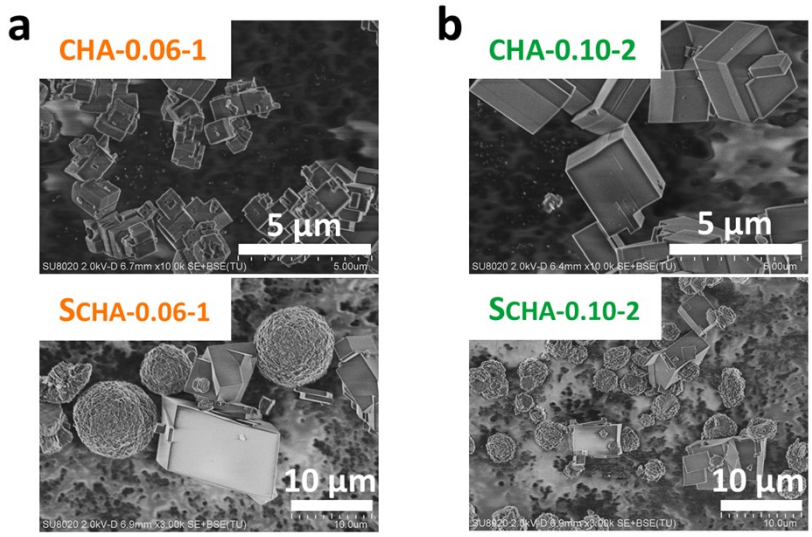

Fig. S2. The SEM images of SAPO-34 seeds with different Si contents (top) and the corresponding seed-assisted synthesis products (bottom).

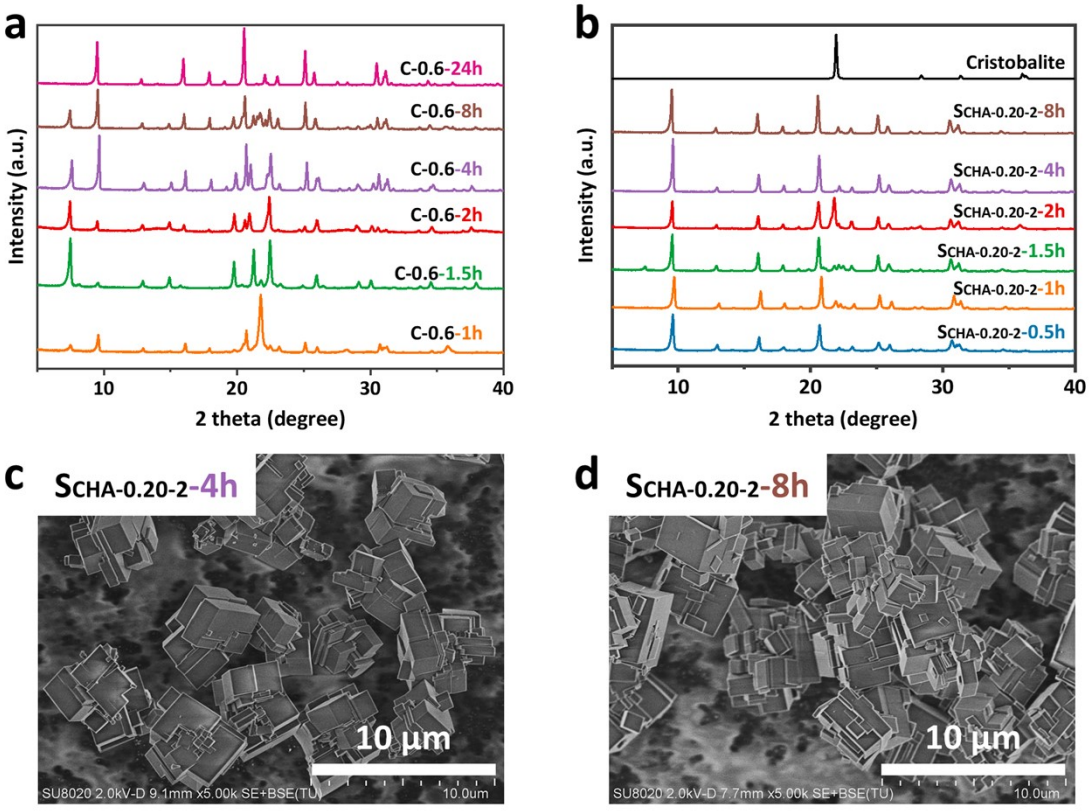

Fig. S3. XRD patterns of the products synthesized without seed (a) and seeded by **CHA**-0.20-2 (b) with different reaction times, and SEM images (c, d) of the products seeded by **CHA**-0.20-2. (Note: There was no solid product after 0.5 h without seed.)

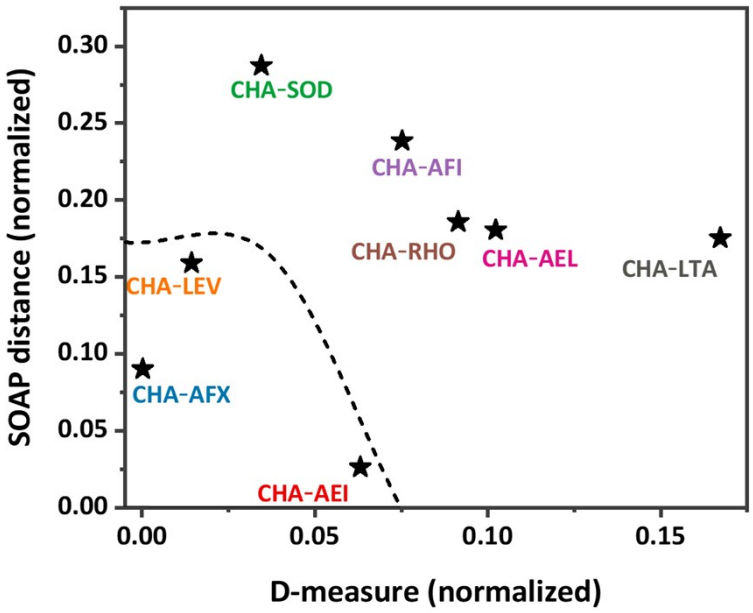

Fig. S4. The similarity between different topology structures and **CHA**[13].

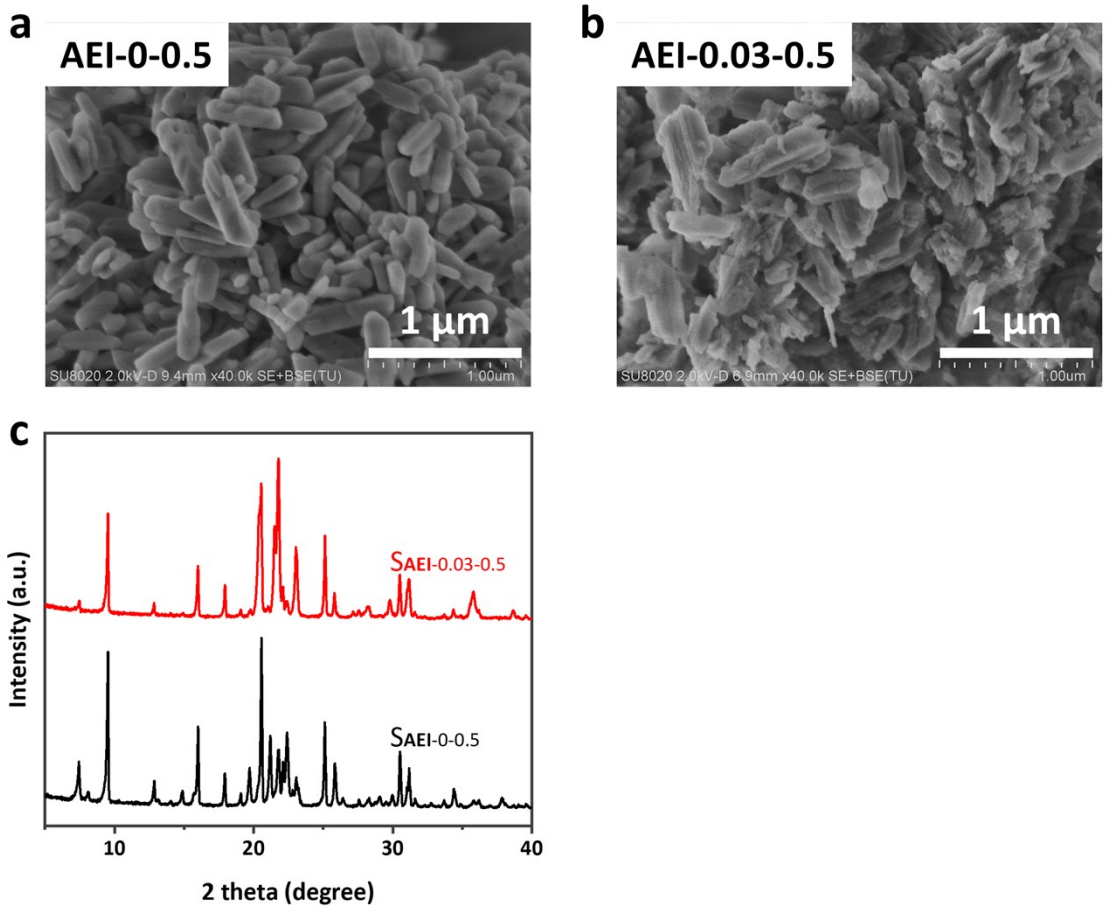

Fig. S5. The SEM images of seed (a) AlPO-18 (**AEI**-0-0.5) and (b) SAPO-18 (**AEI**-0.03-0.5), and (c) XRD patterns of the products seeded by AlPO-18 (**AEI**-0-0.5) and SAPO-18 (**AEI**-0.03-0.5). The gel composition and synthesis condition were the same as sample S-0.6-8h except the variation of seeds.

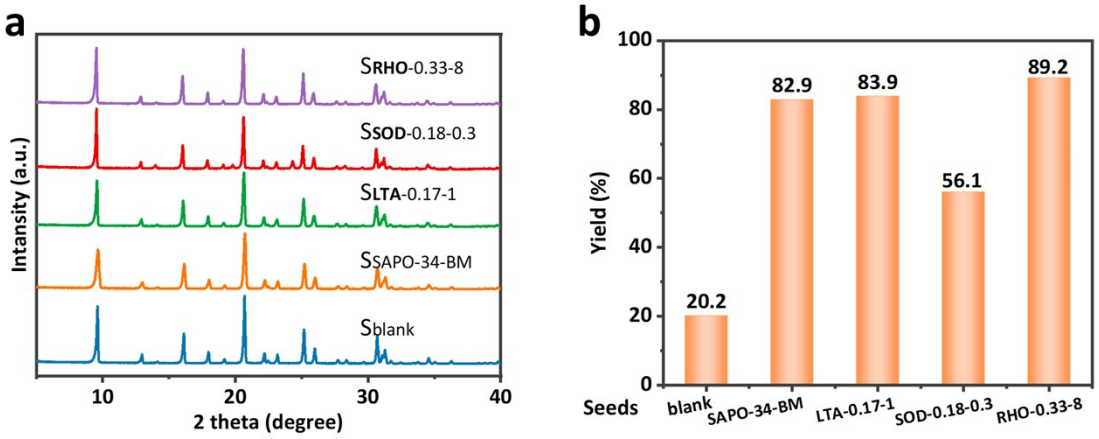

Fig. S6. The powder XRD patterns (a) and the solid yields (b) of the products assisted by seeds without ***d6r*** units in a concentrated MOR-templated system. Gel molar composition: $0.8P_2O_5$: $1.0Al_2O_3$: $0.6SiO_2$: 2.5MOR: $50.0H_2O$ (5wt % addition of seeds based on oxide dry mass at 200 °C for 2 h).

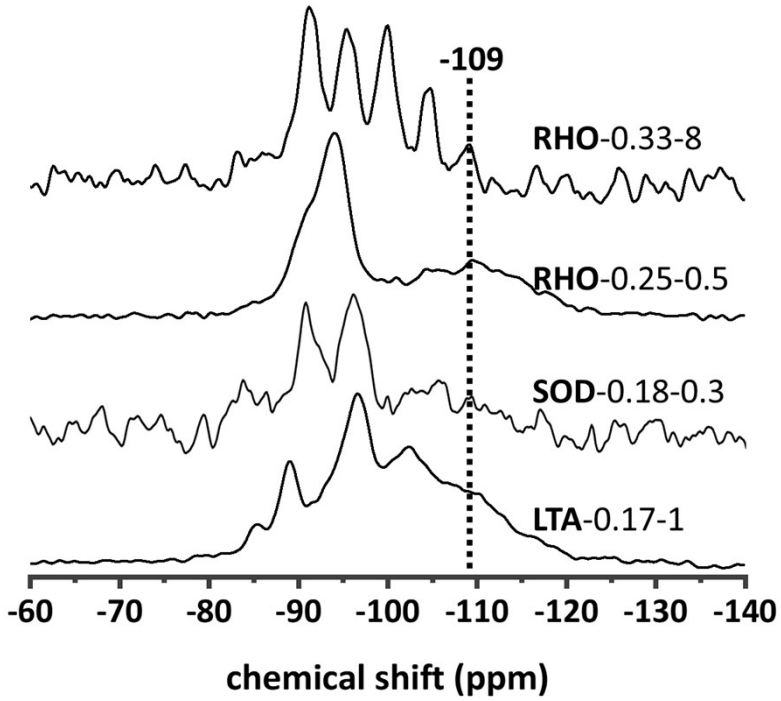

Fig. S7. Solid-state ^{29}Si MAS NMR spectra for the calcined SAPO seeds without ***d6r*** units in their structures.

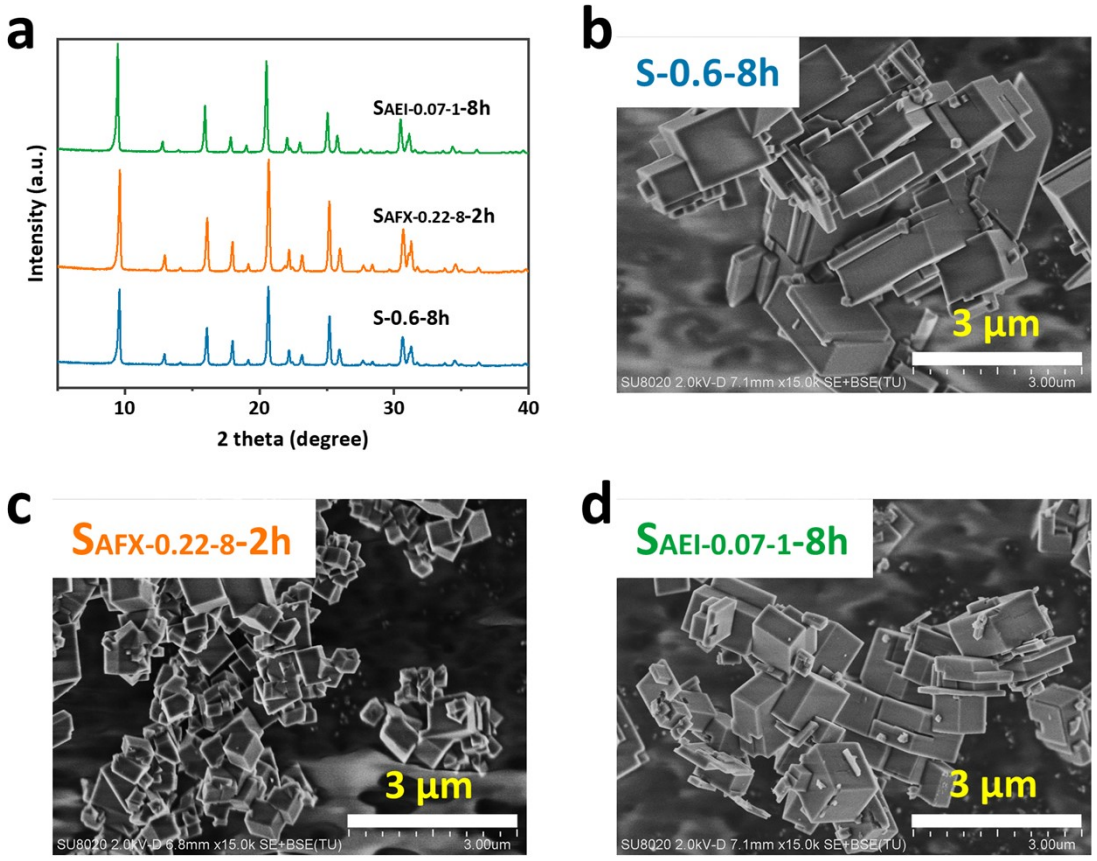

Fig. S8. The XRD patterns (a) and SEM images (b-d) of the samples for the MTO evaluation.

3. References

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