Electronic Supplementary Information

Preparation of New Microporous Europium Silicate Molecular Sieve by Selective Leaching of Alkali Metal Cations of Europium Silicate Eu-AV-9

Hiroki Noda,[a] Masakazu Koike,[a,b] Rika Sakai,[a] Hiroaki Wada,[a,b] Atsushi Shimojima,*[a,b] and Kazuyuki Kuroda*[a,b]

a. *Department of Applied Chemistry, Faculty of Science and Engineering, Waseda University, 3-4-1 Okubo, Shinjuku-ku, Tokyo 169-8555, Japan.*
b. *Kagami Memorial Research Institute for Materials Science and Technology, Waseda University, 2-8-26 Nishiwaseda, Shinjuku-ku, Tokyo 169-0051, Japan.*

*E-mail：shimojima@waseda.jp
kuroda@waseda.jp

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Experimental Details

Analysis of the reagent $EuCl_3 \cdot 6H_2O$

The XPS spectrum of $EuCl_3 \cdot 6H_2O$ (Fig. S7) shows that $EuCl_3 \cdot 6H_2O$ contains 22% of Eu^{2+}, though Eu^{2+} may be locally distributed. The presence of Eu^{2+} in the starting reagent $EuCl_3 \cdot 6H_2O$ was previously reported.[1] On the other hand, the Cl/Eu ratio estimated by ICP analysis and ion chromatography was determined to be 3, and the value is consistent with the ratio calculated from the chemical formula of $EuCl_3 \cdot 6H_2O$. This can be interpreted by assuming that one of the water molecules coordinated to Eu^{2+} is H_3O^+,[2] suggesting that the reagent $EuCl_3 \cdot 6H_2O$ is composed of 78% $EuCl_3 \cdot 6H_2O$ and 22% $EuCl_3 \cdot 5H_2O(H_3O)$.

Data

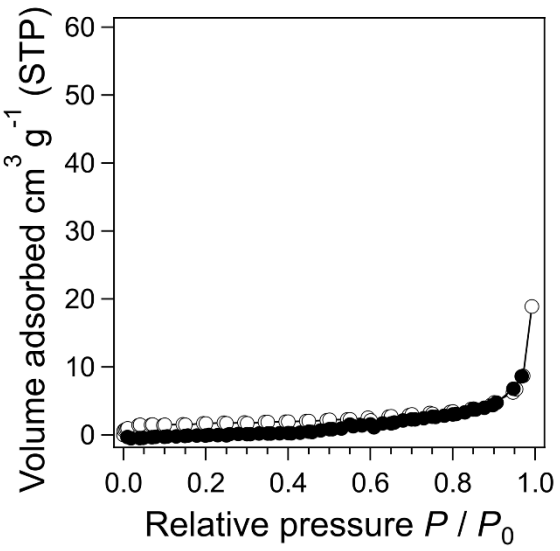

Figure S1 N_2 adsorption-desorption isotherms of Eu-AV-9.

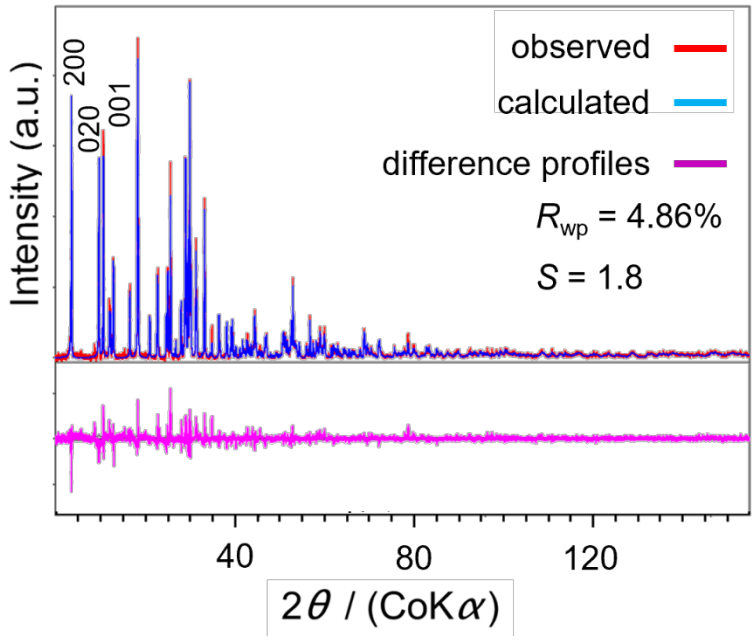

Figure S2 Powder XRD pattern and the Rietveld refinement of Eu-AV-9.

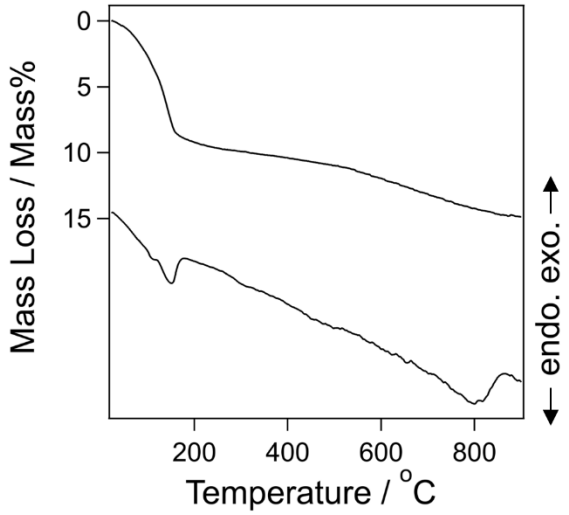

Figure S3 TG-DTA curves of Eu-AV-9 (top: TG curve, bottom: DTA curve).

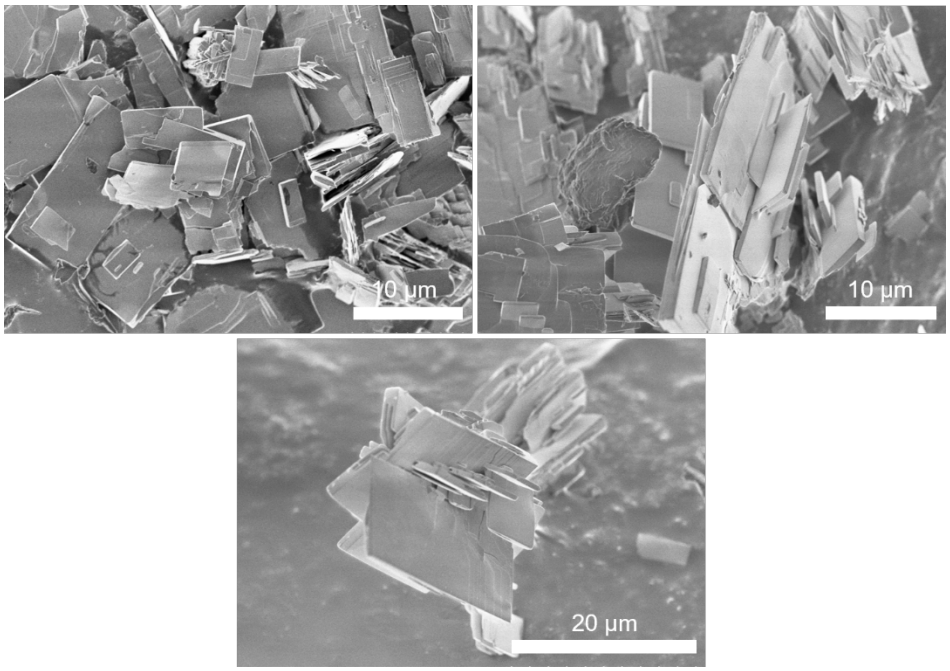

Figure S4 SEM images of Eu-AV-9.

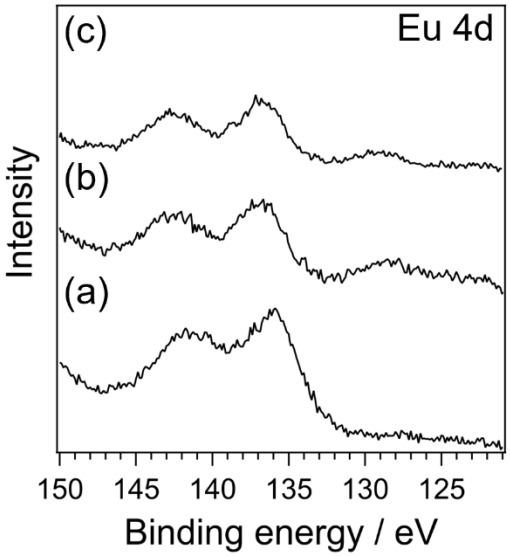

Figure S5 Eu 4d XPS profiles of a) Eu-AV-9, b) Ac1-Eu-AV-9, and c) Ac14-Eu-AV-9.

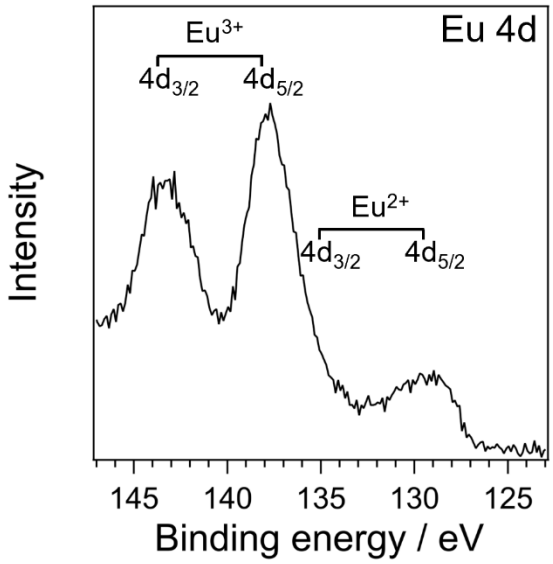

Figure S6 Eu 4d XPS spectrum of $EuCl_3 \cdot 6H_2O$.

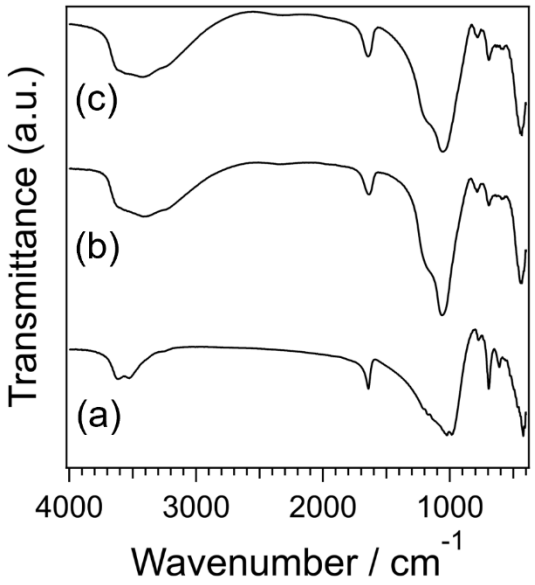

Figure S7 FT-IR spectra of a) Eu-AV-9, b) Ac1-Eu-AV-9 and c) Ac14-Eu-AV-9. The O–H stretching vibrations were observed around 3400–3700 cm^{-1} and H–O–H deformation vibration was observed at 1640 cm^{-1}, which indicates the presence of hydrated water.[3] The band around 1000 cm^{-1} was assigned to Si–O–Si (possibly including Si–O–Eu) stretching vibration in Eu-AV-9, Ac1-Eu-AV-9, and Ac14-Eu-AV-9.[4]

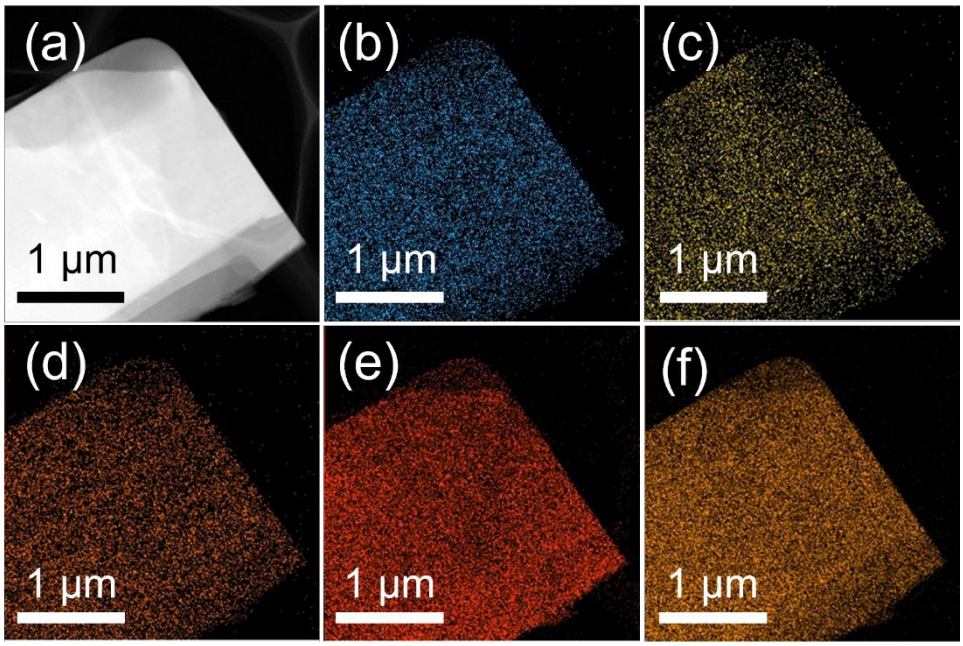

Figure S8 STEM-EDS mapping images of Eu-AV-9. (a) STEM image, and (b) Eu, (c) K, (d) Na, (e) O, and (f) Si mapping images.

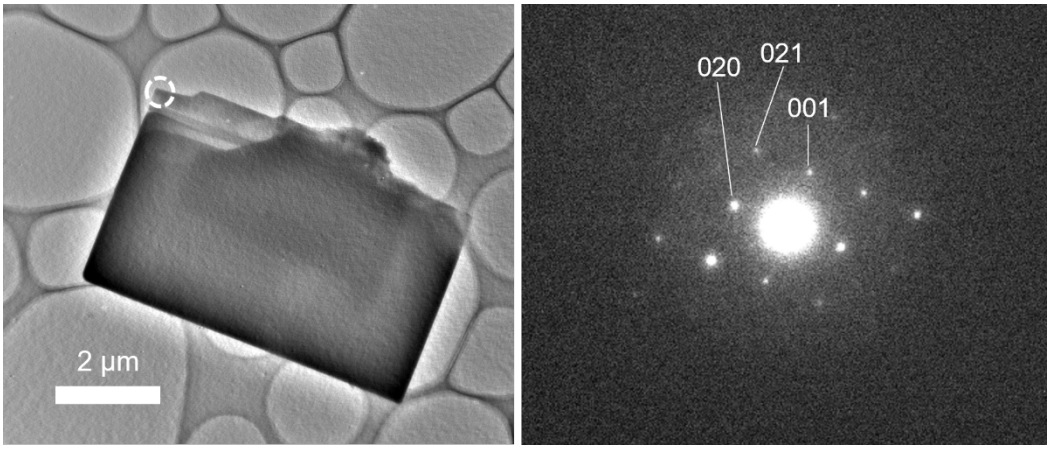

Figure S9 TEM image and ED pattern of the sample treated for 14 d of acid treatment at the higher acetic acid concentration (ED pattern was obtained from the area shown by the white dot circle in the TEM image).

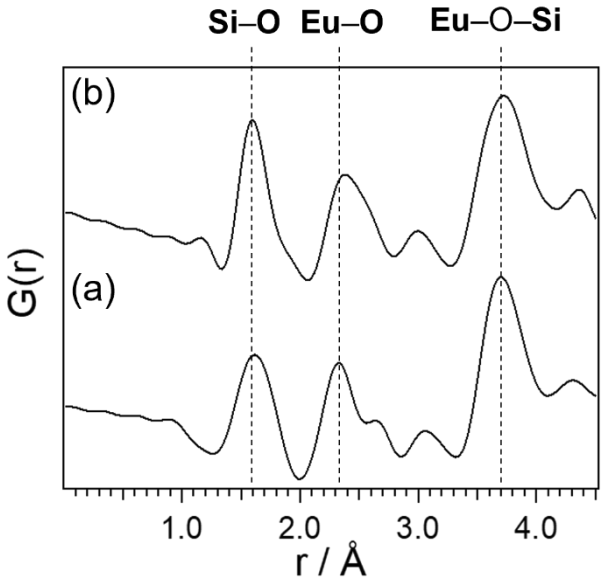

Figure S10 PDF analysis of (a) Eu-AV-9 and (b) Ac14-Eu-AV-9.

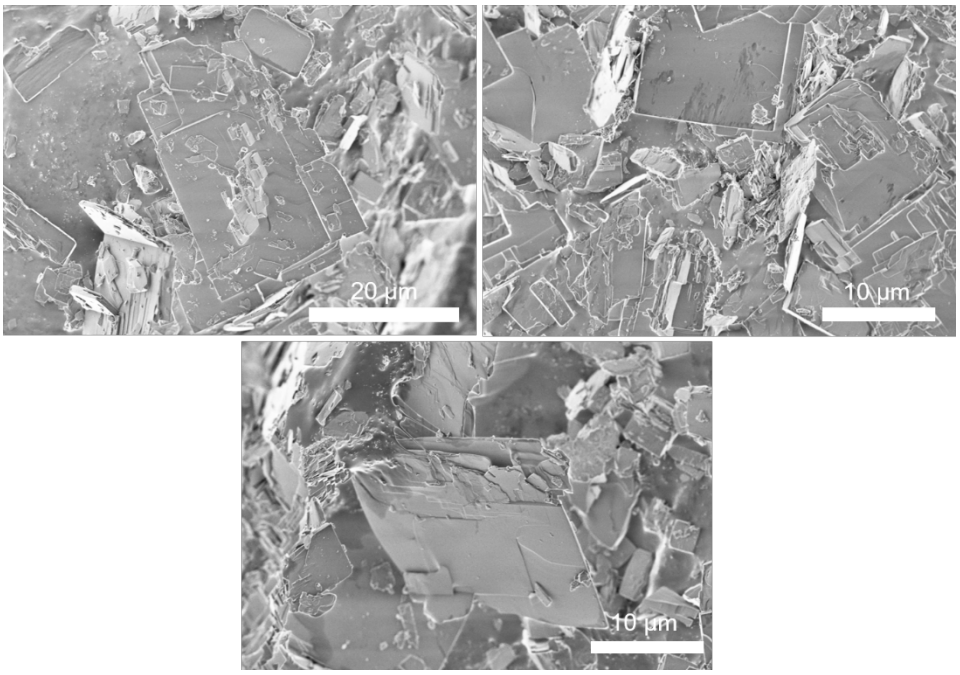

Figure S11 SEM images of Ac1-Eu-AV-9.

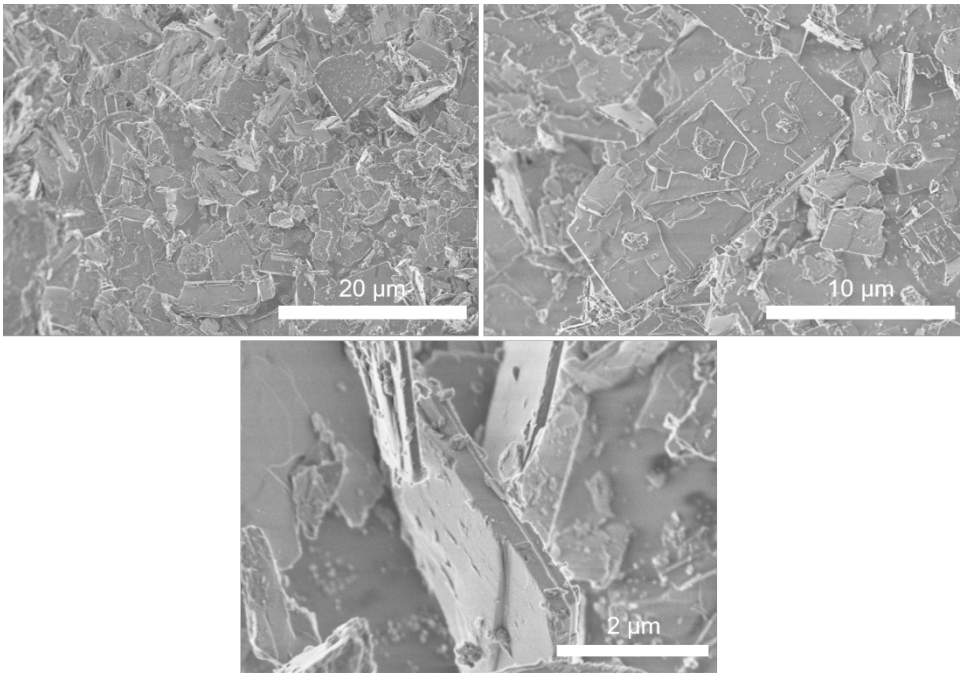

Figure S12 SEM images of Ac14-Eu-AV-9.

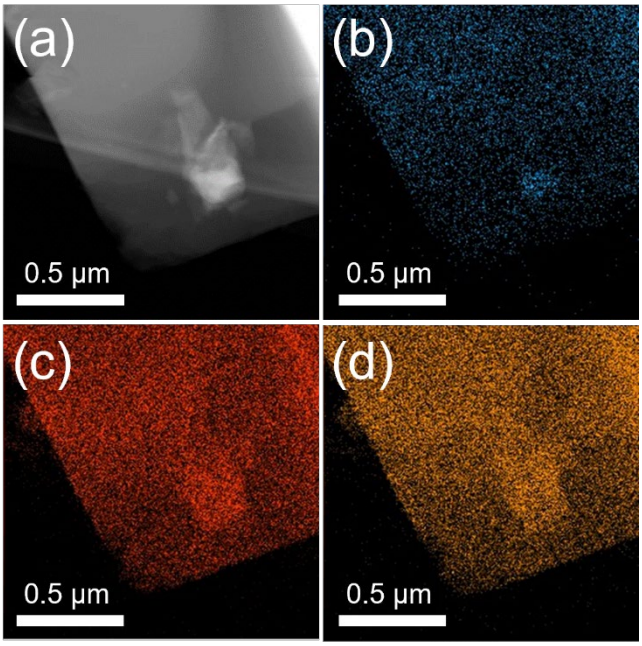

Figure S13 STEM-EDS mapping images of Ac14-Eu-AV-9. (a) STEM image, and (b) Eu, (c) K, and (d) Na mapping images.

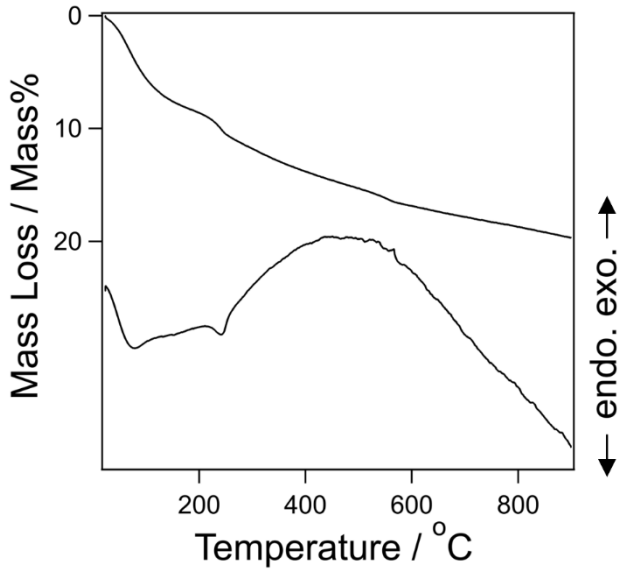

Figure S14 TG-DTA curves of Ac1-Eu-AV-9 (top: TG curve, bottom: DTA curve).

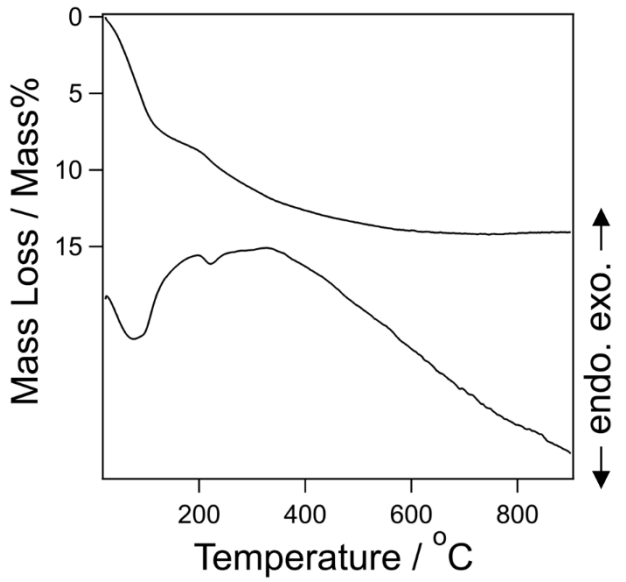

Figure S15 TG-DTA curves of Ac14-Eu-AV-9 (top: TG curve, bottom: DTA curve).

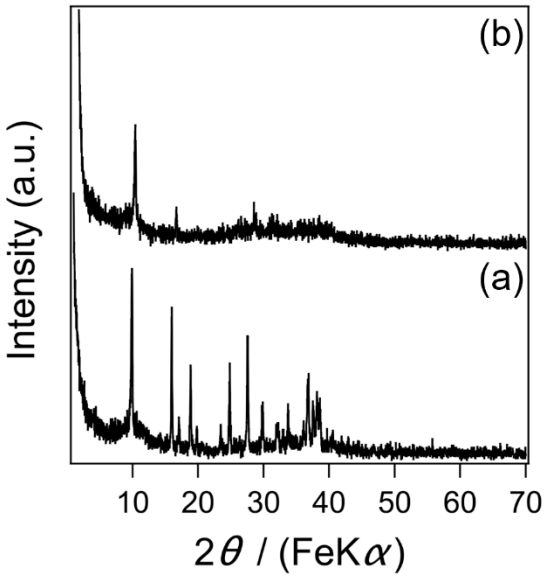

Figure S16 Powder XRD patterns of calcined Ac14-Eu-AV-9 ((a) 200 °C, (b) 300 °C).

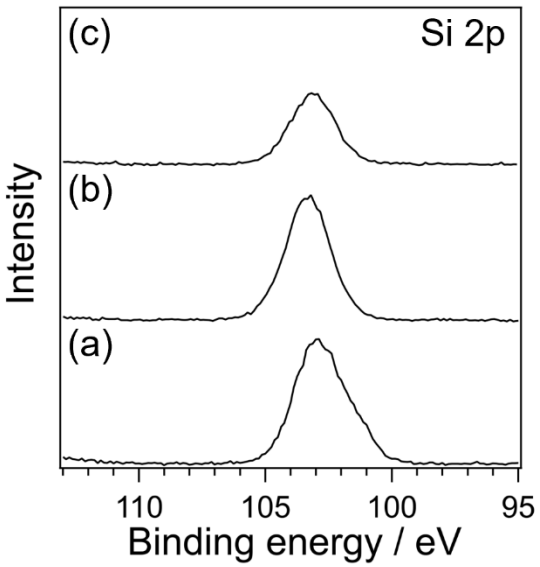

Figure S17 Si 2p XPS profiles of a) Eu-AV-9, b) Ac1-Eu-AV-9, and c) Ac14-Eu-AV-9.

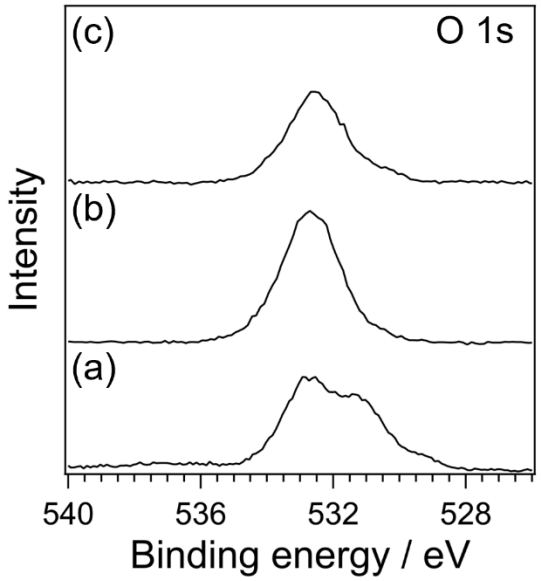

Figure S18 O 1s XPS profiles of a) Eu-AV-9, b) Ac1-Eu-AV-9, and c) Ac14-Eu-AV-9.

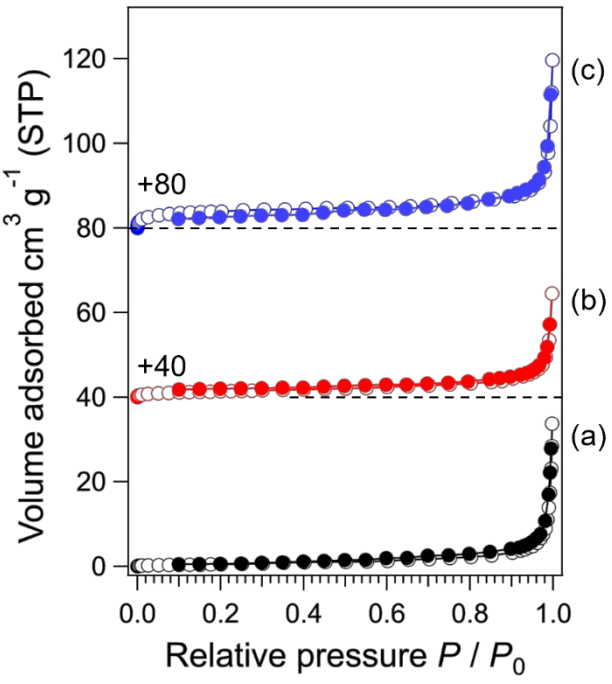

Figure S19 Ar adsorption-desorption isotherms of (a) Eu-AV-9 (black), (b) Ac1-Eu-AV-9 (red) and (c) Ac14-Eu-AV-9 (blue). Open circles indicate adsorption and closed circles indicate desorption.

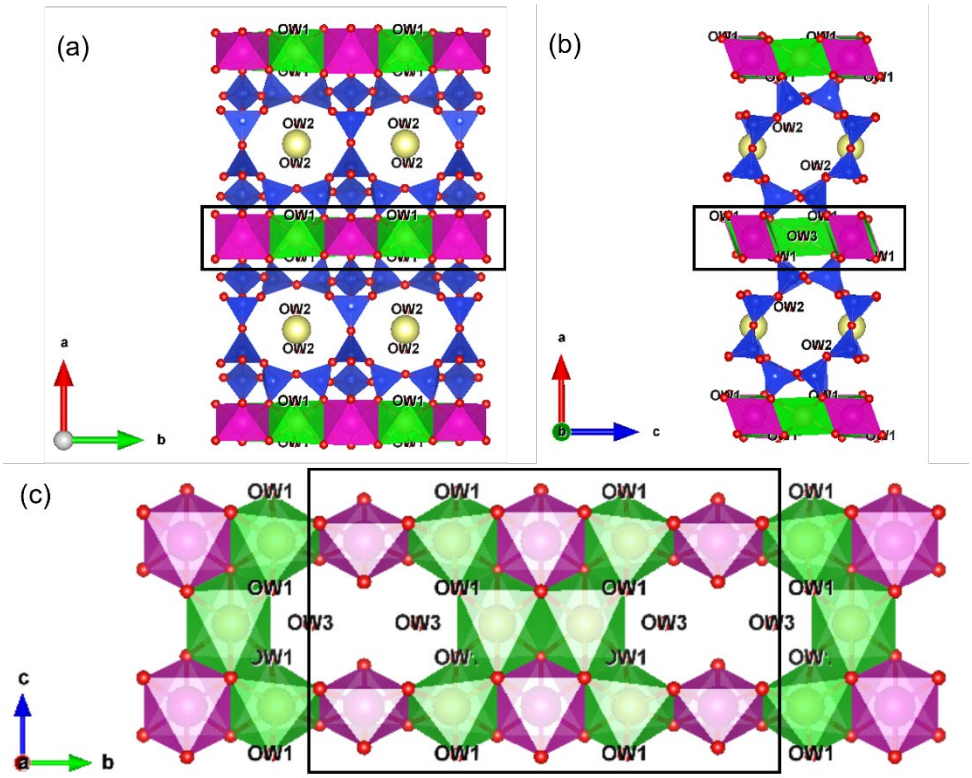

Figure S20 Location of hydrated H_2O molecules in Eu-AV-9. Blue, Si; red, O; purple, Eu; green, Na; and yellow, K (Hydrogen atoms of H_2O molecules are omitted for clarity). The black rectangle in (c) represents the same area as in (a) and (b). Water molecules OW1 and OW2 are coordinated with Na^+ and K^+, respectively. OW3 are coordinated with OW1. The Crystal structure model of Eu-AV-9 was created using VESTA software.[5]

Table S1 ICP analysis data of filtrate after acetic acid treatment of Eu-AV-9.

filtrate	Eu	Si
	/mass%	
Ac1	1.5	0.11
Ac14	6.7	0.43

References

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3 J. Rocha, P. Ferreira, Z. Lin, P. Brandão, A. Ferreira, and J. D. Pedrosa de Jesus, *J. Phys. Chem. B*, 1998, **102**, 4739.

4 D. Haranath, N. Gandhi, S. Sahai, M. Husain, V. Shanker., *Chem. Phys. Lett.*, 2010, **496**, 100.

5 K. Momma and F. Izumi, *J. Appl. Crystallogr*., 2011, **44**, 1272.