Supporting information

Solvothermal Reaction and Piezoelectric Response of Oriented $KNbO_3$ Polycrystal

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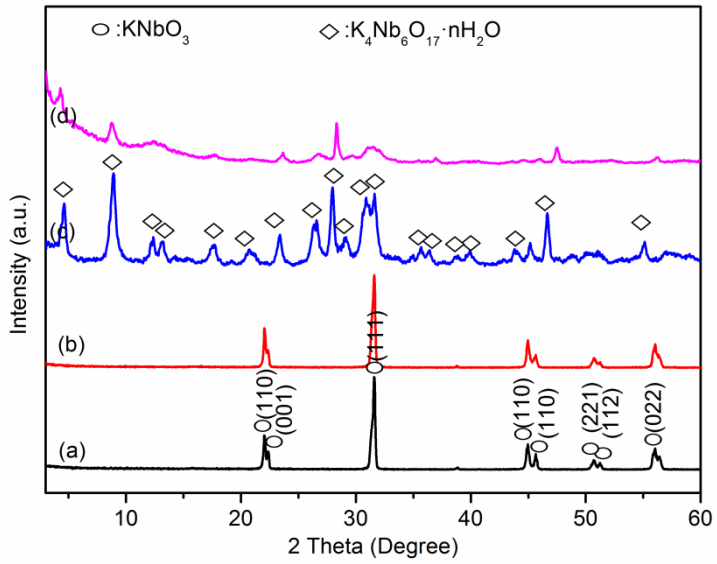


Figure S1. XRD patterns of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/isopropylamine mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h,

respectively.

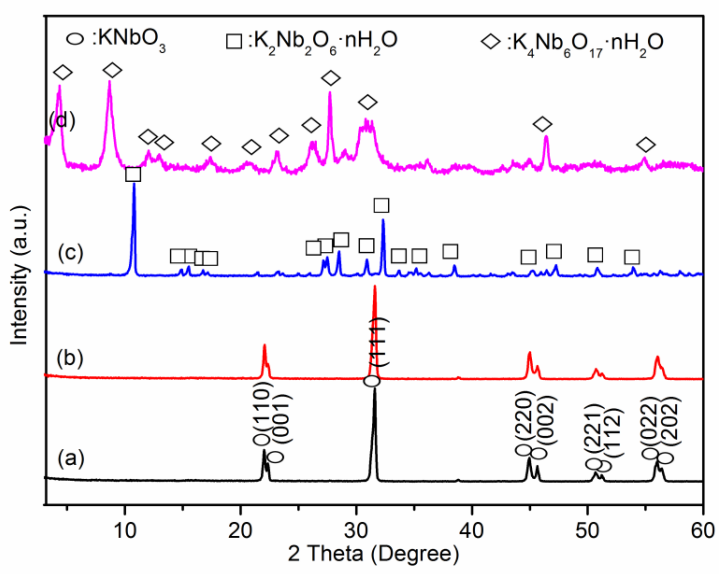


Figure S2. XRD patterns of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/propylamine mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

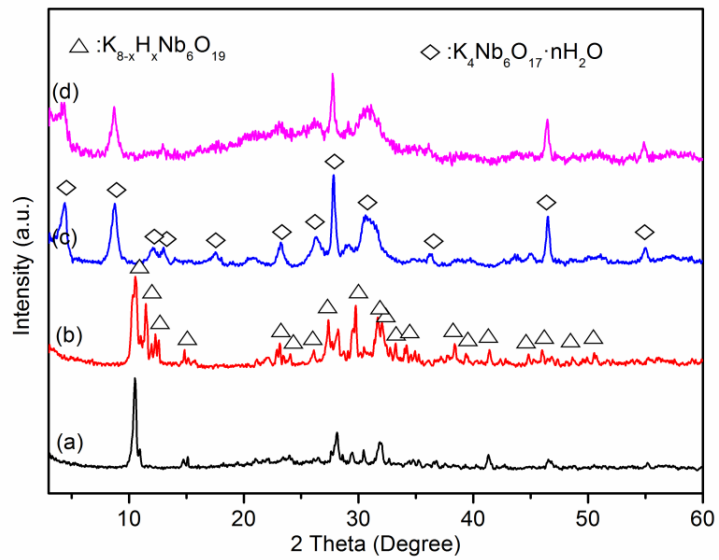


Figure S3. XRD patterns of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/ethyacetate mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

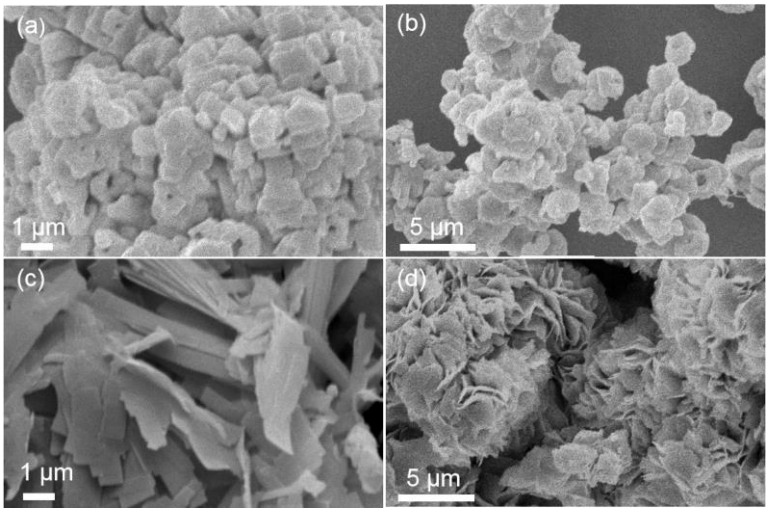


Figure S4. SEM images of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/isopropylamine mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

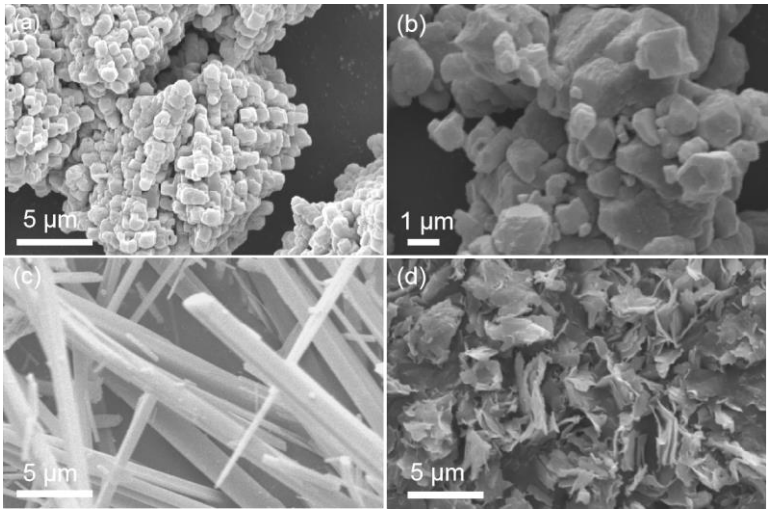


Figure S5. SEM images of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/propylamine mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

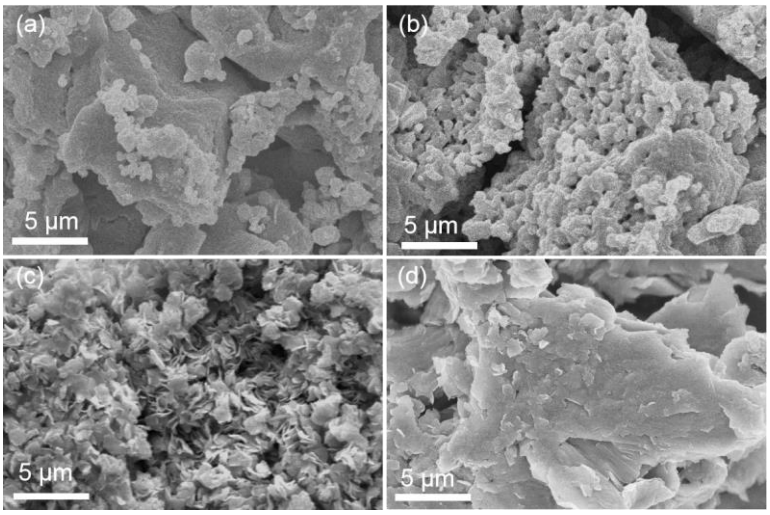


Figure S6. SEM images of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/ethyacetate mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

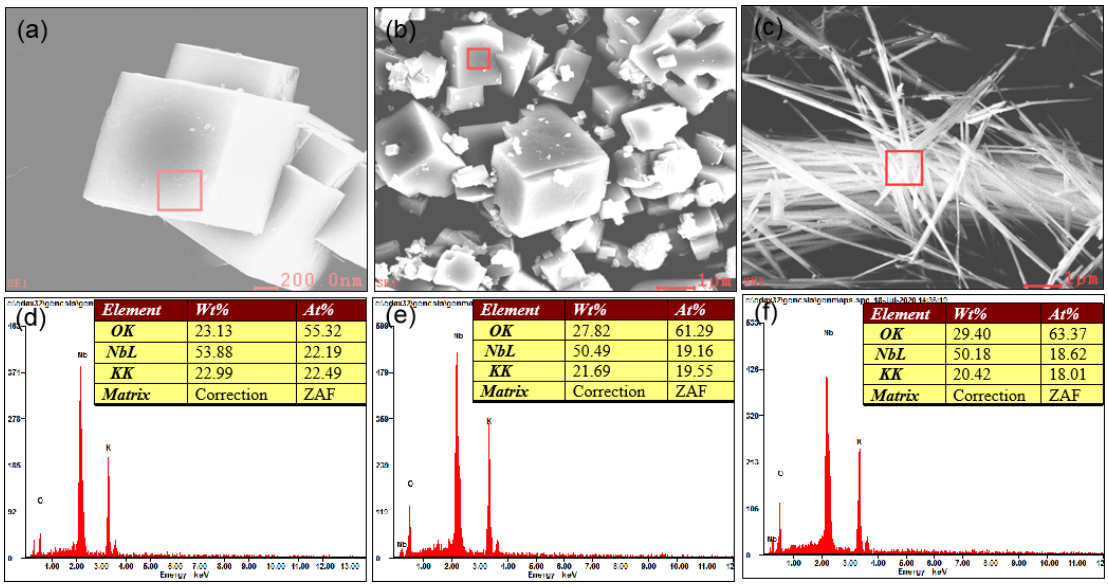


Figure S7. EDS images of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/ethylnediamine mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25 and (c) 12 : 15 at 230 °C for 12 h, respectively, (d), (e) and (f) are the element maps of (a), (b) and (c).

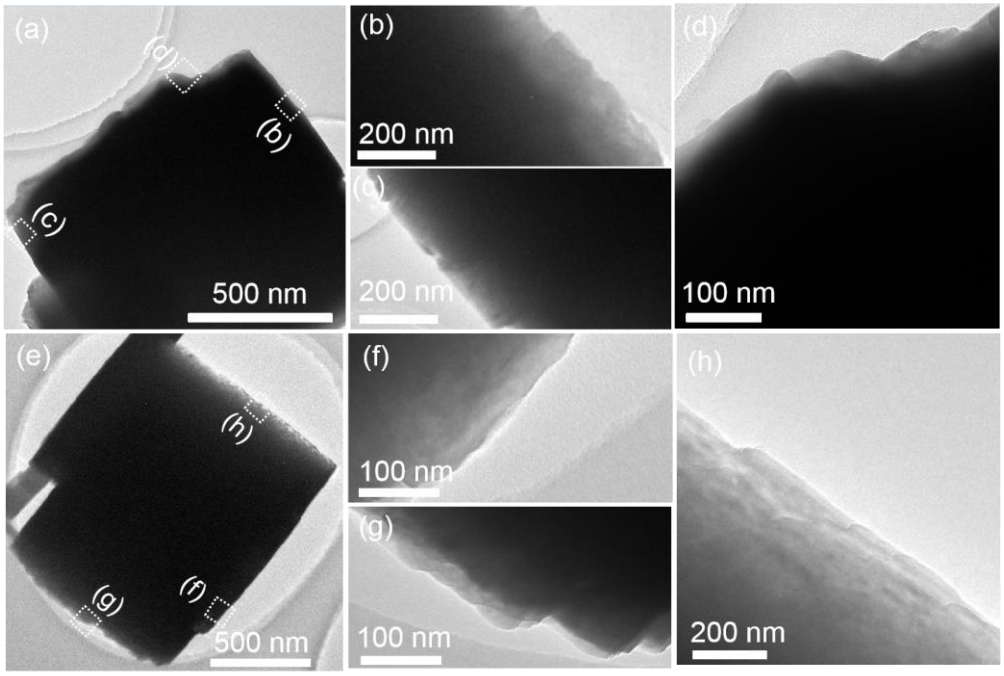
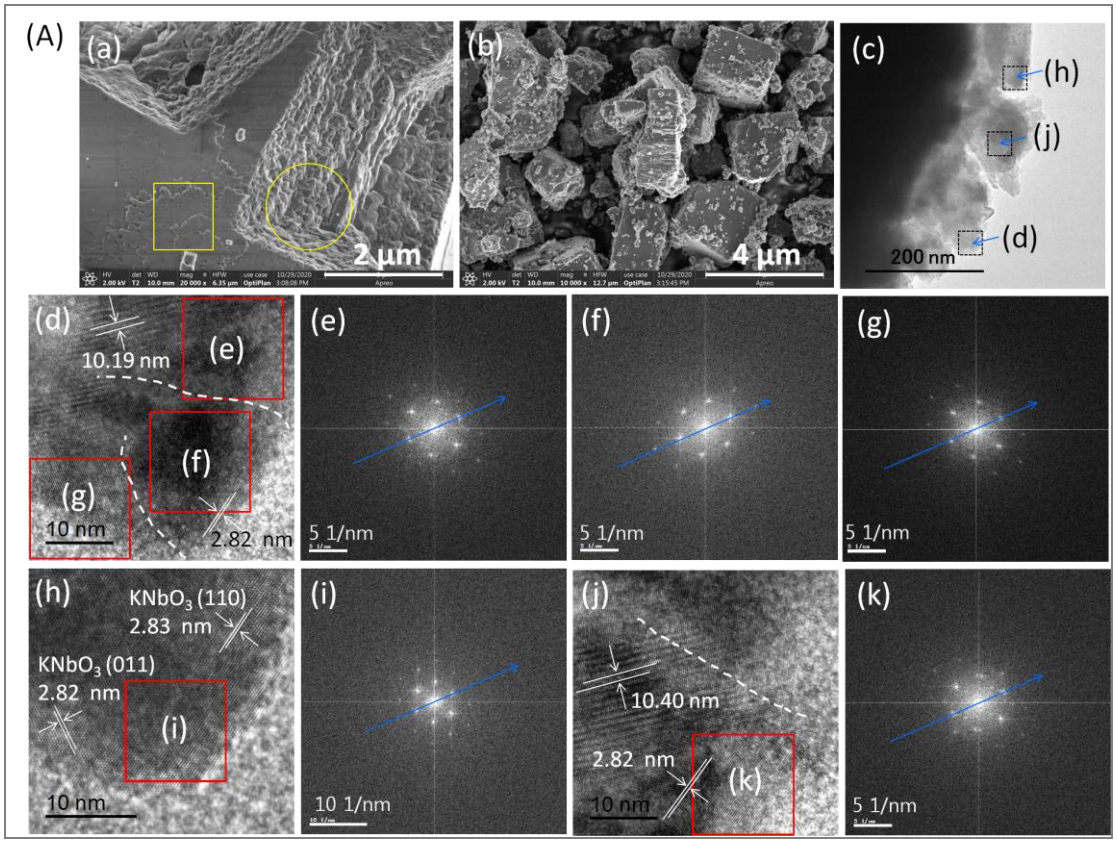


Figure S8. (a) and (e) TEM images of cuboid KN particles. (b-d) and (f-g) TEM images are the enlarged views of (a) and (e) images, respectively. The KN particles obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/ethylnediamine mixed solvent with volume ratios of (a) 0 : 27 and (b) 2 : 25 at 230 °C for 12 h, respectively.



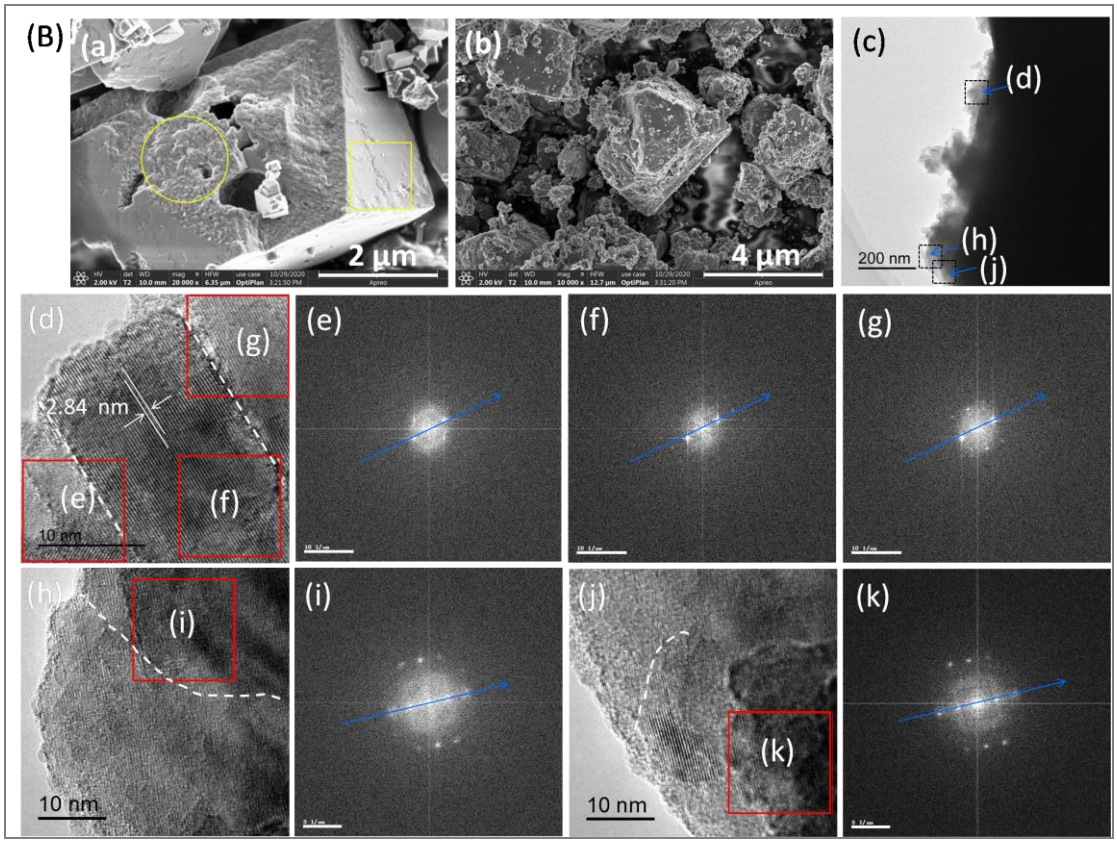


Figure S9. (A-a-b and B-a-b) HRSEM images, (A-c and B-c) TEM images, (A-d,h,j and B-d,h,j) HRTEM images, and (A-e-g,i,k and B-e-g,i,k) Fast Fourier Transform

(FFT) patterns of sliced cuboid KN particles obtained *via* the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/ethylnediamine mixed solvent with volume ratios of (A) 0 : 27 and (B) 2 : 25 at 230 °C for 12 h, respectively. The (A-d,h,j and B-d,h,j) HRTEM images are derived from the black dotted bordered rectangle in the (A-c and B-c) TEM images, respectively. The (A-e-g,i,k and B-e-g,i,k) FFT patterns are derived from the red square in the (A-d,h,j and B-d,h,j) HRTEM images, respectively.

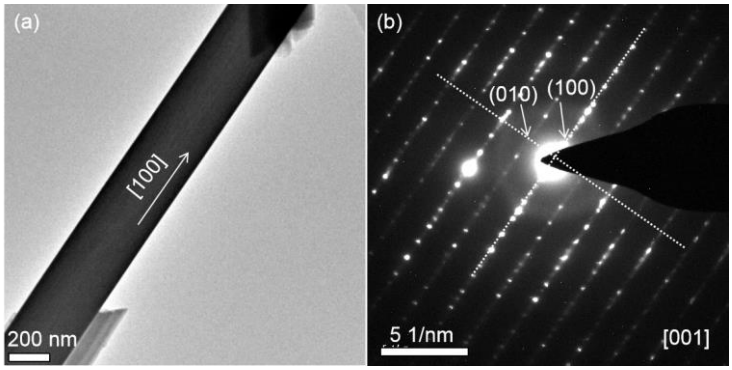


Figure S10. (a) TEM images and (b) SAED patterns of the samples obtained by solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/ethylnediamine (12 : 15) at 230 °C for 12 h, respectively.

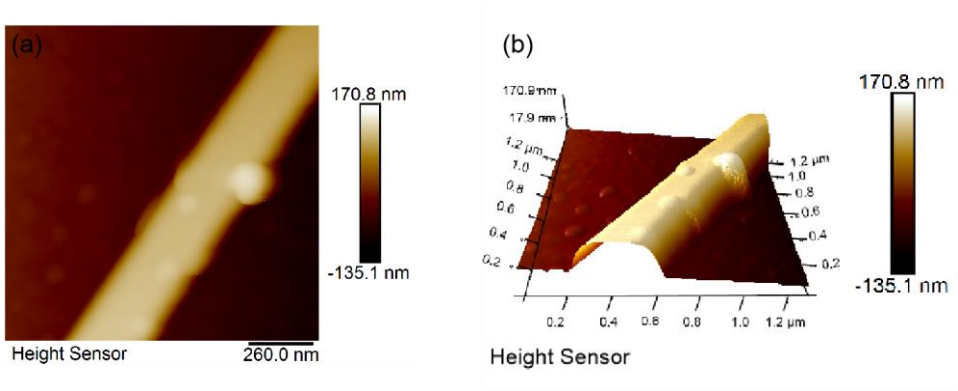


Figure S11. AFM topography images of cuboid $K_2Nb_2O_6 \cdot nH_2O$ polycrystals.

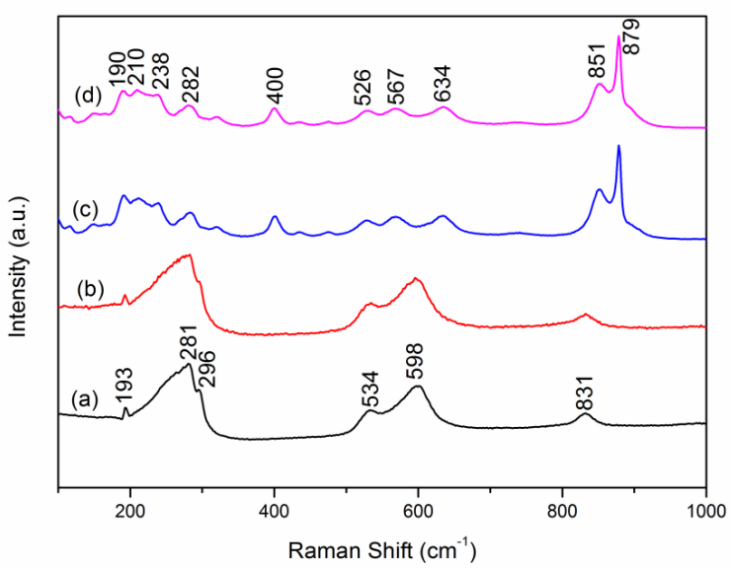


Figure S12. Raman spectra of the specimens obtained using the solvothermal treatment of 3 mL of PHN solution in 27 mL of the water/isopropylamine mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

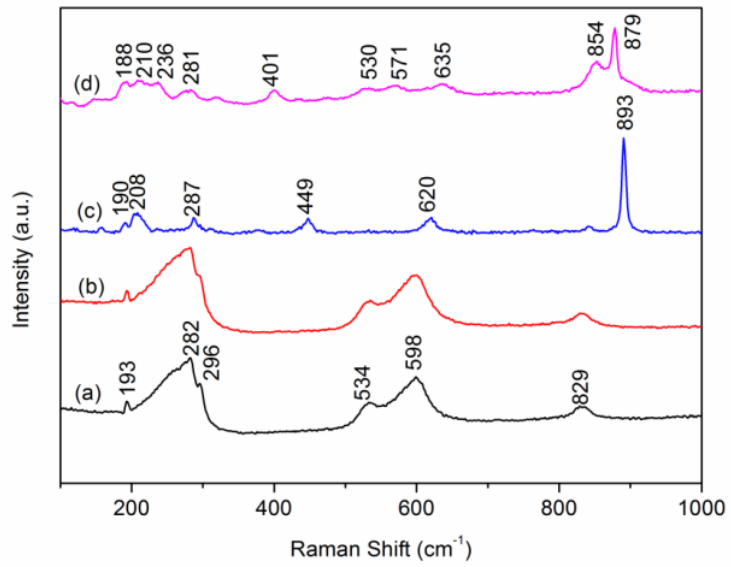


Figure S13. Raman spectra of the specimens obtained using the solvothermal treatment of 3 mL of PHN solution in 27 mL of the water/propylamine mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

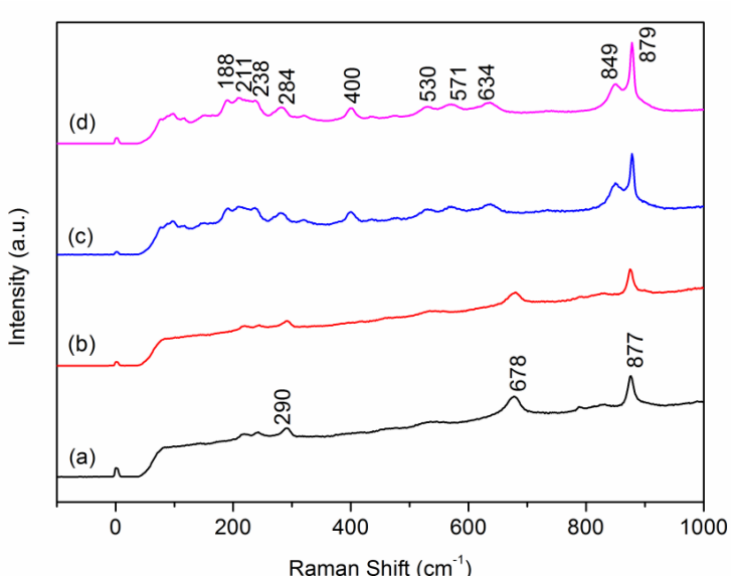


Figure S14. Raman spectra of the specimens obtained using the solvothermal treatments of 3 mL of PHN solution in 27 mL of the water/ethyacetate mixed solvent with volume ratios of (a) 0 : 27, (b) 2 : 25, (c) 12 : 15, (d) 17 : 10 at 230 °C for 12 h, respectively.

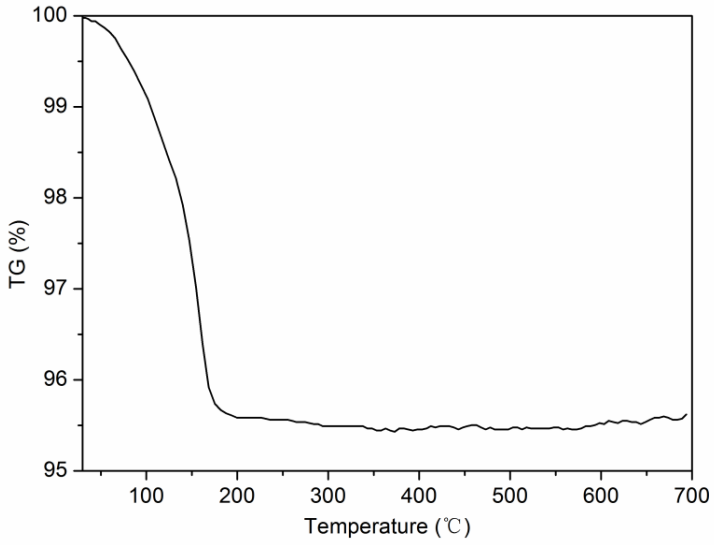


Figure S15. TG profiles of $K_2Nb_2O_6 \cdot nH_2O$ specimen.

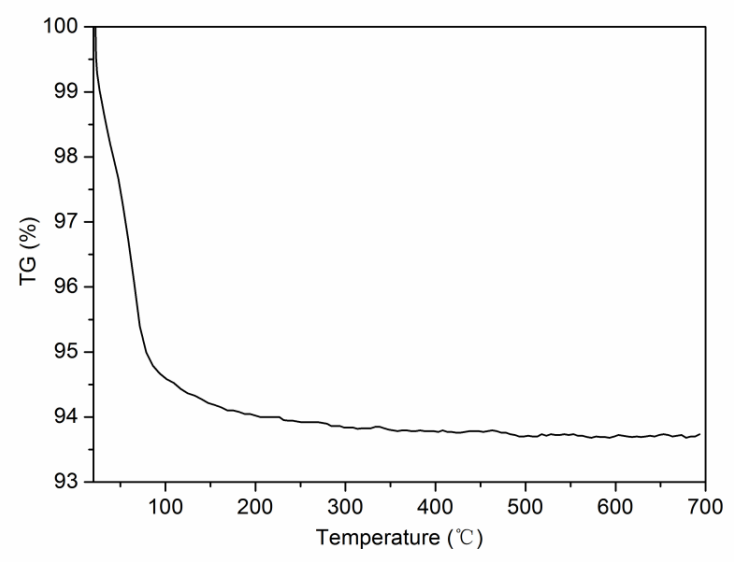
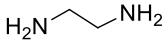
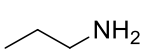
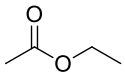


Figure S16. TG profiles of $K_4Nb_6O_{17}\cdot nH_2O$ specimen.

In this study, values of physical properties for the mentioned solvents are derived from reference [S1], and summarized in Table S1.

Table S1 Values of physical properties for the mentioned solvents[S1]

Molecular formulat	pK_1	pK_2	Viscosity (mN • s • m-1)	D¤ (C • m)	Surface tension a/ (dyn/cm)	b/ [dyn/(cm • °C)]
	6.85 (+2)	9.92 (+1)	1.54	1.99	44.77	0.1398
	10.568 (+1)	–	0.353	1.26	24.86	0.1243
	10.64 (+1)	–	0.36	–	19.91	0.09719
	–	–	0.455	1.81	26.29	0.1161
	–	–	1.078	1.69	24.05	0.0832

¤ *D*: dipole moment

(S1) LANGE’S HANDBOOK OF CHEMISTRY. James G. Speight, Ph.D. *Library of Congress Catalog Card Number* 84-643191, ISSN 0748-4585, 1998.