Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supplementary Information

Water assisted high proton conductance in a pure-inorganic framework vanadoborate

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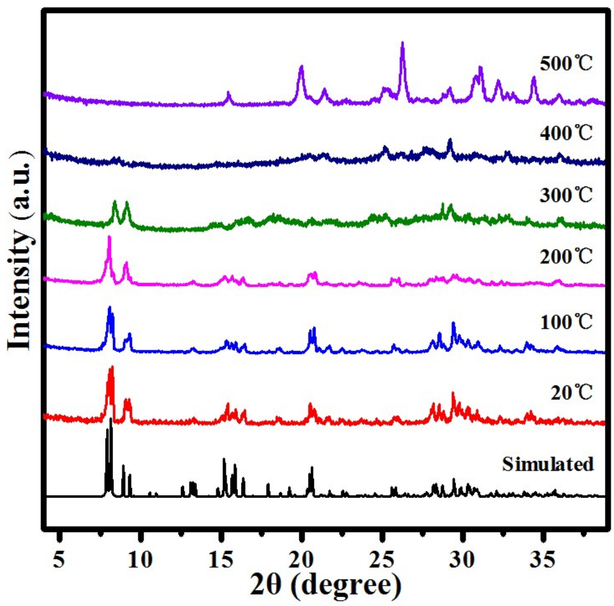

Fig. S1. In situ powder X-ray diffraction patterns of **1** in air.

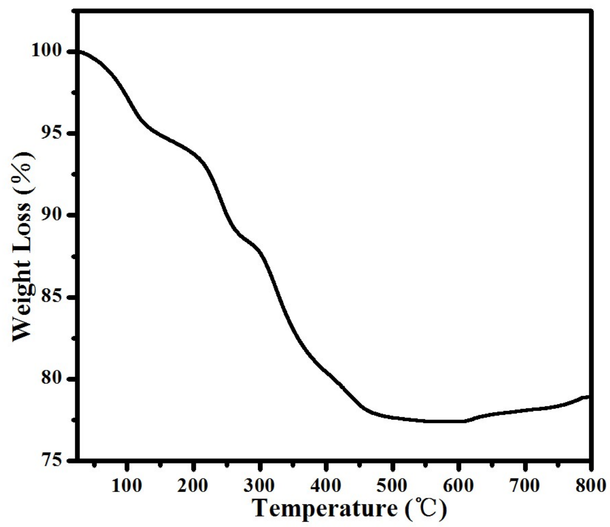

Fig. S2. TG curve of **1** in air.

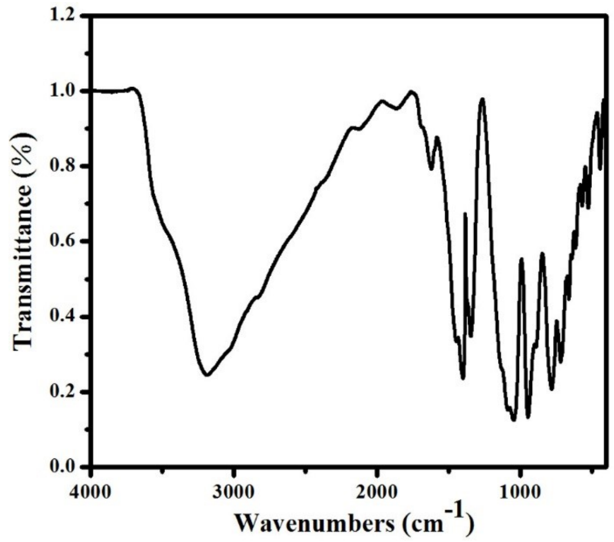

Fig. S3. The FT-IR spectrum of **1**.

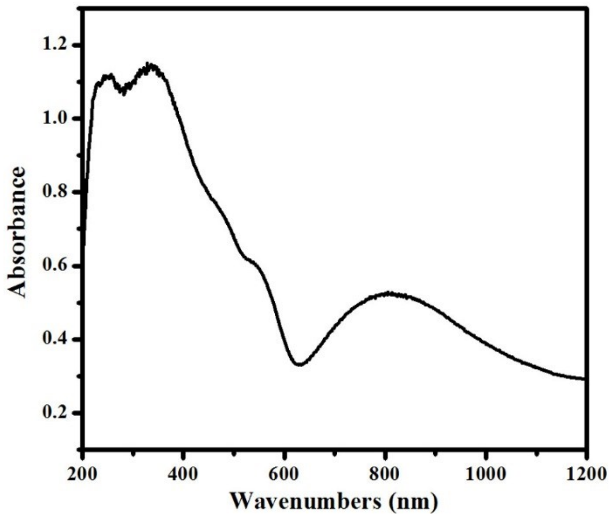

Fig. S4. UV-Vis-NIR diffuse reflectance spectrum of **1**.

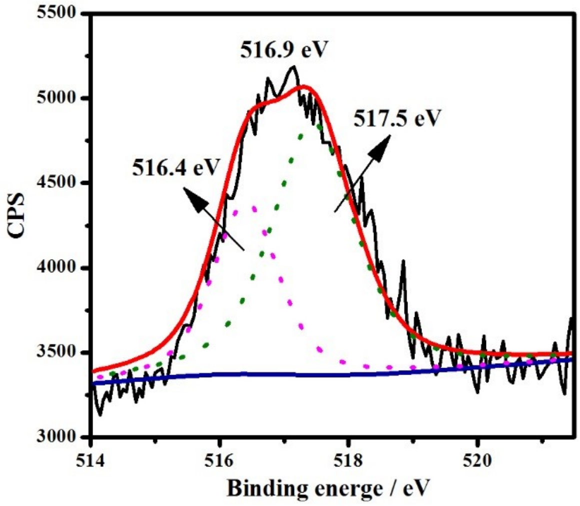

Fig. S5. XPS spectrum of vanadium in $H_{10}[V_{12}B_{18}O_{54}(OH)_6]\cdot 20H_2O$. The peak at 516.4 eV is attributed to V^{4+} and a shoulder at about 517.5 eV is assigned to for V^{5+}.

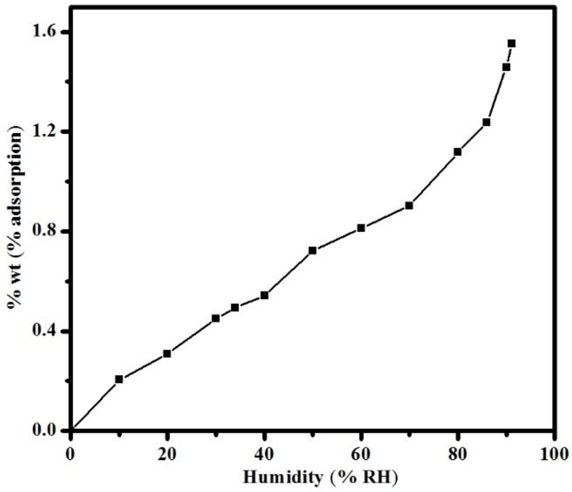

Fig. S6. The water adsorption isotherm of **1** at 293 K.

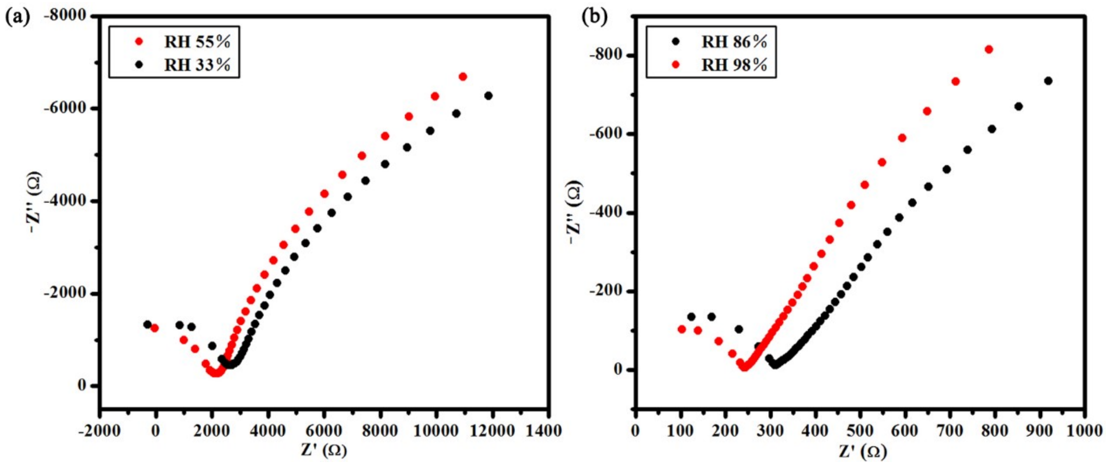

Fig. S7. Nyquist plot of compound **1** at 293 K 33% RH and 55% RH (a), 86% RH and 98% RH (b) for second time.

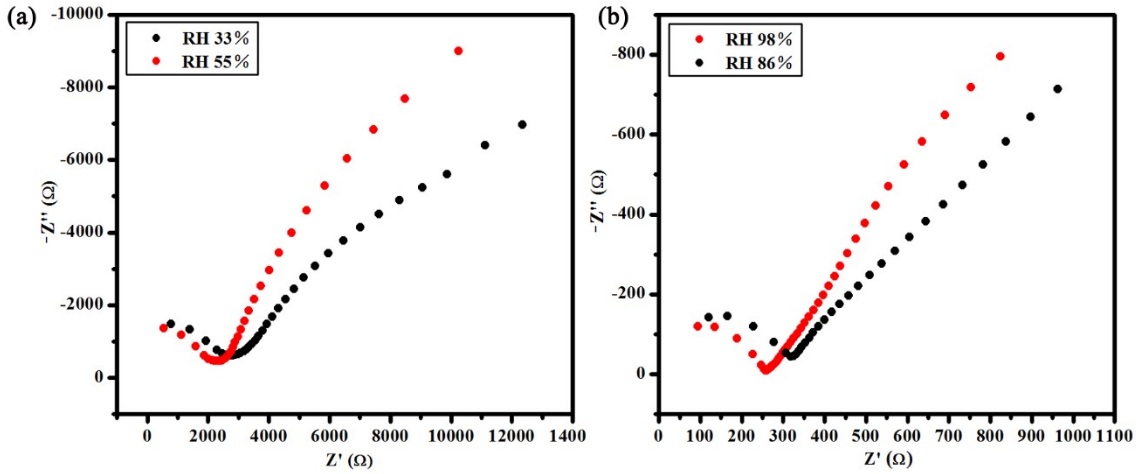

Fig. S8. Nyquist plot of compound **1** at 293 K 33% RH and 55% RH (a), 86% RH and 98% RH (b) for third time.

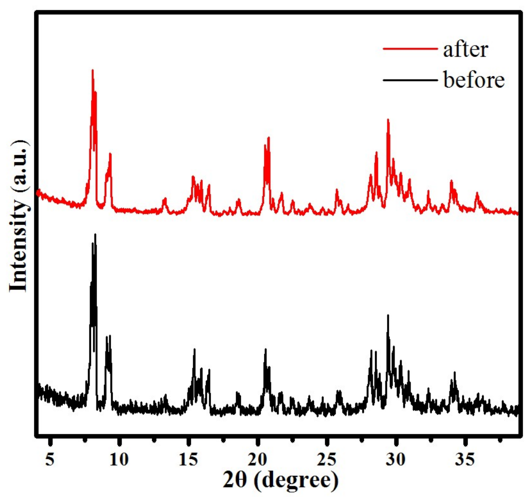

Fig. S9. The XRD patterns of the sample (black) and the pellet used impedance measurement (red).

Table S1. Bond lengths [Å] for **1**.

V(1)-O(18)	1.620(4)
V(1)-O(16)	1.925(4)
V(1)-O(12)	1.937(4)
V(1)-O(25)	1.955(4)
V(1)-O(22)	1.961(4)
V(2)-O(23)	1.629(4)
V(2)-O(14)	1.934(4)
V(2)-O(12)	1.939(4)
V(2)-O(11)	1.943 (3)
V(2)-O(20)	1.957(4)
V(3)-O(17)	1.637(4)
V(3)-O(25)	1.937(4)
V(3)-O(20)	1.938(3)
V(3)-O(12)	1.968(4)
V(3)-O(15)	2.004(4)
V(4)-O(21)	1.626(4)
V(4)-O(16)	1.929(4)
V(4)-O(14)	1.941(4)
V(4)-O(8)	1.948(4)
V(4)-O(29)	1.949(3)
V(5)-O(3)	1.626(4)
V(5)-O(8)	1.932(3)
V(5)-O(22)	1.932(4)
V(5)-O(16)	1.951(4)
V(5)-O(7)	2.036(3)
V(6)-O(19)	1.630(4)
V(6)-O(29)	1.919(4)
V(6)-O(11)	1.937(4)
V(6)-O(14)	1.958(4)
V(6)-O(6)	2.015(4)
B(13)-O(1)	1.356(7)
B(14)-O(1)	1.474(7)
B(10)-O(2)	1.433(7)
B(11)-O(2)	1.441(7)
B(15)-O(4)	1.366(7)
B(12)-O(4)	1.480(6)
B(16)-O(5)	1.322(7)
B(17)-O(5)	1.515(7)
B(11)-O(6)	1.515(7)
B(12)-O(6)	1.525(6)
B(10)-O(7)	1.507(7)
B(14)-O(7)	1.511(6)

B(8)-O(8)	1.467(7)
B(12)-O(9)	1.426(7)
B(17)-O(9)	1.457(6)
B(15)-O(10)	1.363(7)
B(11)-O(10)	1.470(6)
B(10)-O(11)	1.478(7)
B(8)-O(13)	1.444(7)
B(14)-O(13)	1.449(7)
B(8)-O(15)	1.514(6)
B(17)-O(15)	1.520(6)
B(14)-O(20)	1.483(7)
B(11)-O(22)	1.479(6)
B(16)-O(24)	1.405(7)
B(12)-O(25)	1.482(6)
B(16)-O(26)	1.371(7)
B(8)-O(26)	1.478(7)
B(13)-O(27)	1.383(7)
B(13)-O(28)	1.369(7)
B(10)-O(28)	1.485(7)
B(17)-O(29)	1.484(7)
B(15)-O(30)	1.373(7)
B(11)-O(2)	1.441(7)
B(11)-O(6)	1.515(7)
B(12)-O(6)	1.525(6)
B(17)-O(29)	1.484(7)

Table S2. Bond angles [deg] for **1**.

O18-V1-O16	108.24(19)
O18-V1-O12	106.06(18)
O16-V1-O12	93.96(16)
O18-V1-O25	107.48(18)
O16-V1-O25	144.24(16)
O12-V1-O25	77.79(15)
O18-V1-O22	108.77(18)
O16-V1-O22	78.06(15)
O12-V1-O22	145.04(15)
O25-V1-O22	88.99(16)
O18-V1-V5	111.74(15)
O16-V1-V5	39.26(11)
O12-V1-V5	126.63(11)
O25-V1-V5	122.11(11)
O22-V1-V5	38.92(11) .
O18-V1-V3	110.12(16)
O16-V1-V3	125.89(12)
O12-V1-V3	39.34(11)
O25-V1-V3	38.51(10)
O22-V1-V3	121.70(12)
V5-V1-V3	138.05(4)
O23-V2-O14	105.51(19)
O23-V2-O12	108.29(17)
O14-V2-O12	94.76(16)
O23-V2-O11	107.66(18)
O14-V2-O11	78.13(16)
O12-V2-O11	143.95(15)
O23-V2-O20	109.82(19)
O14-V2-O20	144.44(15)
O12-V2-O20	78.13(15)
O11-V2-O20	87.39(15)
O23-V2-V6	109.02(15)
O14-V2-V6	39.42(11)
O12-V2-V6	127.04(12)
O11-V2-V6	38.85(11)
O20-V2-V6	120.97(11)
O23-V2-V3	112.60(15)
O14-V2-V3	127.13(11)
O12-V2-V3	39.51(11)
O11-V2-V3	120.53(11)
O20-V2-V3	38.73(10)
V6-V2-V3	138.22(4)

O17-V3-O25	109.52(17)
O17-V3-O20	110.16(17)
O25-V3-O20	138.03(16)
O17-V3-O12	108.02(18)
O25-V3-O12	77.46(15)
O20-V3-O12	77.88(15)
O17-V3-O15	106.33(18)
O25-V3-O15	90.83(15)
O20 V3 O15	90.78(14)
O12-V3-O15	145.65(15)
O17-V3-V2	112.60(14)
O25-V3-V2	110.94(11)
O20-V3-V2	39.18(11)
O12-V3-V2	38.82(10)
O15-V3-V2	124.22(10)
O17-V3-V1	112.73(15)
O25-V3-V1	38.93(11)
O20-V3-V1	110.81(11)
O12 V3 V1	38.59(11)
O15 V3 V1	123.74(11)
V2-V3-V1	74.70(3)
O21-V4-O16	108.58(18)
O21-V4-O14	106.55(19)
O16-V4-O14	93.26(16)
O21-V4-O8	109.0(2)
O16-V4-O8	79.05(15)
O14-V4-O8	144.21(16)
O21-V4-O29	108.21(18)
O16-V4-O29	143.17(16)
O14-V4-O29	77.91(15)
O8-V4-O29	87.52(15)
O21-V4-V5	111.51(15)
O16-V4-V5	39.86(11)
O14-V4-V5	126.61(12)
O8-V4-V5	39.40(10)
O29-V4-V5	121.26(11)
O21-V4-V6	110.17(15)
O16-V4-V6	125.56(13)
O14-V4-V6	39.58(11)
O8-V4-V6	120.65(11)
O29-V4-V6	38.46(11)
V5-V4-V6	138.19(4)
O3-V5-O8	110.33(19)
O3-V5-O22	108.79(18)

O8-V5-O22	139.25(16)
O3-V5-O16	108.92(18)
O8 V5 O16	78.91(15)
O22-V5-O16	78.13(15)
O3-V5-O7	104.21(18)
O8-V5-O7	89.86(14)
O22-V5-O7	91.35(15) .
O16 V5 O7	146.87(16) .
O3-V5-V4	112.58(14)
O8-V5-V4	39.79(10)
O22-V5-V4	112.59(11)
O16-V5-V4	39.33(11)
O7-V5-V4	124.85(10)
O3-V5-V1	112.21(15)
O8-V5-V1	112.34(11)
O22-V5-V1	39.60(10)
O16-V5-V1	38.65(11)
O7-V5-V1	125.54(11)
V4-V5-V1	75.79(3)
O19-V6-O29	110.93(19)
O19-V6-O11	109.61(19)
O29-V6-O11	137.25(16)
O19-V6-O14	106.79(18)
O29-V6-O14	78.24(15)
O11-V6-O14	77.70(15)
O19-V6-O6	106.19(17)
O29-V6- O6	90.17(15)
O11-V6-O6	91.21(15)
O14-V6-O6	147.02(15)
O19-V6-V4	112.16(15)
O29-V6-V4	39.19(10)
O11-V6-V4	111.10(11)
O14-V6-V4	39.18(11)
O6-V6-V4	124.34(11)
O19-V6-V2	111.09(15)
O29-V6-V2	111.38(11)
O11-V6-V2	39.00(10)
O14-V6-V2	38.84(11)
O6-V6-V2	125.13(11)
V4-V6-V2	75.36(4)
B13-O1-B14	121.6(4)
B10-O2-B11 .	121.3(4)
B15-O4-B12	121.8(4)
B16-O5-B17	122.6(4)
B11-O6-B12	
B11-O6-V6	
B12-O6-V6	
B10-O7-B14	
B10-O7-V5	
B14-O7-V5	

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	110.1(4)
	108.2(4)
	112.8(4)
	107.6(4)

Symmetry transformations used to generate equivalent atoms: [#1] -x+1/2,-y+3/2,-z+1