Supplementary Material for

The structure and size of some hydrated ions and the ions channels selectivity

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Instructions:

MATLAB 7.11 R2010b was used to finish all numerical calculations and fits.

Consulting the structural parameters [1] of the coordination shell of ions, the radii of coordinated ions, Na^+, K^+, Rb^+, Cs^+, Cl^-, Br^- and I^- are successively taken as 0.24, 0.27, 0.29, 0.295, 0.32, 0.34 and 0.35nm. According to the spatial constraints,[2] when fit the data of $\frac{p_w}{p_w^*}$ and the molarities c with equation (8), the critical volume concentration c_{cr} of NaCl, KCl, NaBr, KBr, RbCl, RbBr, CsCl, CsBr, RbI and CsI in aqueous solution are taken as 4.73, 4.04, 4.26, 3.49, 3.66, 3.32, 3.57, 3.24, 3.17 and 3.10 M (molarity) respectively.

- **The $(v_s - Hv_w)$ and v_s in aqueous solution of NaCl**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and dd2, and m1 and m2 are the relative densities 1000*(d-d0), and molalities for aqueous solutions [3-4] of NaCl at 25℃ respectively, d0 (0.997047) is the density (g/cm^3) of pure water [5] used by the literatures, and 58.4428 and 18.0153 are the molar mass of NaCl and water respectively.

```
d0=0.997047;
dd1=[0.415 1.650 2.380 3.261 3.905 4.611 5.089 6.508 8.094 10.205 12.132 13.333 14.580
16.965 20.126 27.378 34.436 39.432 53.636 73.625 88.787 109.459];
m1=[0.01000 0.03994 0.05773 0.07924 0.09500 0.11233 0.12410 0.15909 0.19837 0.25093
0.29918 0.32936 0.36079 0.42120 0.5018 0.6889 0.8741 1.0069 1.3923 1.9546 2.3971 3.0234];
dd2=[38.933 48.796 57.540 67.528 73.894 75.235 83.760 91.243 100.841 106.970 108.045
124.038 138.134 153.162 167.162 180.036 195.522];
m2=[0.99472 1.26102 1.50179 1.78243 1.96500 2.00338 2.25174 2.47333 2.76245 2.95143
2.98355 3.48710 3.94470 4.44730 4.93030 5.38590 5.95180];
dd=[dd1 dd2];
d=(dd+1000*d0)/1000;
m=[m1 m2];
mw=1000;
ms=58.4428*m;
NWMS=mw./ms*58.4428/18.0153;
MSMW=18.0153*ms./(mw*58.4428);
VMW=18.0153*(ms+mw)./(d.*mw);
VMS=58.4428*(ms+mw)./(d.*ms);
```

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99% and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 18.07 (18.07, 18.07)

b = 18.97 (18.42, 19.53)

Goodness of fit:

SSE: 54.35

R-square: 1

Adjusted R-square: 1

RMSE: 1.212

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 20.8 (20.43, 21.17)

b = 18.04 (18.03, 18.06)

Goodness of fit:

SSE: 0.01802

R-square: 0.9985

Adjusted R-square: 0.9984

RMSE: 0.02237

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[6] for aqueous solution of NaCl at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0
5.2];
dp=ppval(cor,mp);
a=[3.1476 3.1268 3.1058 3.0846 3.0631 3.0413 3.0192 2.9968 2.9740 2.9509 2.9274 2.9035
2.8793 2.8547 2.8298 2.8044 2.7786 2.7525 2.7259 2.6989 2.6716 2.6438 2.6156 2.5871 2.5581
2.5287]/3.1686;
c=mp.*dp./(mp*58.4428+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3) and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 = 0.02852 (0.02449, 0.03255)

b2 = 1.532 (1.257, 1.807)

vs = 0.08327 (0.07994, 0.08661)

Goodness of fit:

SSE: 2.024e-005

R-square: 0.9998

Adjusted R-square: 0.9998

RMSE: 0.000938

(Here the highest c is 4.6735M)

- **The $(v_s - Hv_w)$ and v_s in aqueous solution of KCl**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and dd2, and m1 and m2 are the relative densities (1000*(d-d0), and molalities for aqueous solutions [7-8] of KCl respectively, 0.997045 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literatures, and 74.5513 and 18.0153 are the molar mass of KCl and water respectively.

```
d0=0.997045;
dd1=[4.681 9.270 14.008 18.392 23.004 27.894 32.693 36.996 41.401 44.656];
m1=[0.09974 0.19910 0.30304 0.40037 0.50389 0.61488 0.72503 0.82477 0.92801 1.00491];
dd2=[2.387 2.644 4.086 4.514 20.064 20.678 39.660 40.133 59.700 59.925 78.205 97.981 98.280
116.628 117.065 134.965 135.138 152.558 153.399 167.300 167.566];
m2=[0.05103 0.05581 0.08769 0.09635 0.43865 0.45498 0.89356 0.90321 1.37765 1.38366
1.84381 2.36692 2.37450 2.88083 2.89358 3.41002 3.41230 3.93177 3.95785 4.40004 4.40058];
dd=[dd1 dd2];
d=(dd+1000*d0)/1000;
m=[m1 m2];
mw=1000
ms=74.5513*m
NWMS=mw./ms*74.5513/18.0153
VMS=74.5513*(ms+mw)./(d.*ms)
MSMW=18.0153*ms./(mw*74.5513)
VMW=18.0153*(ms+mw)./(d.*mw)
```

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 18.07 (18.06, 18.07)
b = 29.66 (29.08, 30.24)

Goodness of fit:
SSE: 28.2
R-square: 1
Adjusted R-square: 1
RMSE: 0.986

For equation (5):

General model:
f(x) = a*x+b
Coefficients (with 99% confidence bounds):
a = 31.23 (30.92, 31.54)
b = 18.04 (18.03, 18.05)

Goodness of fit:
SSE: 0.007596
R-square: 0.9996
Adjusted R-square: 0.9996
RMSE: 0.01618

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[6] for aqueous solution of KCl at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.4];
dp=ppval(cor,mp)
a=[3.1478 3.1275 3.1074 3.0873 3.0672 3.0471 3.0270 3.0068 2.9865 2.9662 2.9458 2.9253
2.9048 2.8841 2.8634 2.8425 2.8215 2.8004 2.7792 2.7579 2.7148]/3.1686;
c=mp.*dp./(mp*74.5513+1000)*1000
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3) and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:
f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)
Coefficients (with 99% confidence bounds):
b1 = 0.01368 (0.0107, 0.01666)
b2 = 1.713 (1.356, 2.07)
vs = 0.06534 (0.06256, 0.06811)

Goodness of fit:

SSE: 3.19e-006

R-square: 0.9999

Adjusted R-square: 0.9999

RMSE: 0.000421

(Here the highest c is 3.8576M)

- **The $(v_s - Hv_w)$ and v_s in aqueous solution of NaBr**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and dd2, and m1 and m2 are the relative densities (1000*(d-d0), and molalities for aqueous solutions [3, 9] of NaBr respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literatures, and 102.8938 and 18.0153 are the molar mass of NaBr and water respectively.

```
d0=0.997047
dd1=[2.222 3.260 5.452 7.653 9.764 12.601 15.422 19.729 25.807 28.677 32.596 7.939 15.676 30.900 45.975 60.687 75.967];
m1=[0.02800 0.04117 0.06911 0.09728 0.12439 0.16096 0.19744 0.25335 0.33265 0.37026 0.42177 0.10095 0.20072 0.39946 0.59905 0.7967 1.0054];
dd2=[75.07 116.68 144.25 171.34 209.64 239.99 271.51 342.50];
m2=[1.0000 1.5797 1.9972 2.4066 3.001 3.4833 3.9955 5.1927];
dd=[dd1 dd2];
m=[m1 m2];
d=(dd+1000*d0)/1000;
ms= 102.8938*m
mw=1000
NWMS=mw./ms* 102.8938/18.0153
MSMW=18.0153*ms./(mw* 102.8938)
VMW=18.0153*(ms+mw)./(d.*mw)
VMS= 102.8938*(ms+mw)./(d.*ms)
```

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99% and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	18.07	(18.07, 18.07)
b =	25.68	(24.97, 26.39)

Goodness of fit:

SSE: 24.84

R-square: 1

Adjusted R-square: 1

RMSE: 1.039

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 27.48 (27.2, 27.75)

b = 18.05 (18.04, 18.06)

Goodness of fit:

SSE: 0.003526

R-square: 0.9997

Adjusted R-square: 0.9997

RMSE: 0.01238

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[10] for aqueous solution of NaBr at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5 4.0 4.5];
dp=ppval(cor,mp);
a=[3.1579 3.1474 3.1369 3.1263 3.1156 3.1049 3.0940 3.0830 3.0718 3.0606 3.0378 3.0146
2.9908 2.9666 2.9419 2.8780 2.8110 2.7409 2.6678 2.5917]/3.1686;
c=mp.*dp./(mp*102.8938+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3) and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 = 0.02914 (0.02399, 0.03429)

b2 = 2.218 (1.719, 2.716)

vs = 0.08892 (0.08422, 0.09361)

Goodness of fit:

SSE: 1.764e-005

R-square: 0.9997

Adjusted R-square: 0.9996

RMSE: 0.001019

(Here the highest c is 3.9954M)

- **The $(v_s - Hv_w)$ and v_s in aqueous solution of KBr**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and d2, and c1 and c2 are the relative densities (1000*(d-d0) and the densities (d), and molarities for aqueous solutions [3, 11] of KBr respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literature[3], and 119.0023 and 18.0153 are the molar mass of KBr and water respectively.

```
d0=0.997047
dd1=[5.076 9.203 16.320 20.892 26.630 33.139 49.256 65.092 79.316];
d1=(dd1+1000*d0)/1000;
c1=[0.05975 0.10855 0.19289 0.24722 0.31552 0.39315 0.5859 0.7760 0.9472];
d2=[1.000089 1.000160 1.000417 1.000841 1.001695 1.004256 1.008492 1.016955 1.042194
1.080449 1.083718 1.166031 1.166167 1.249592 1.307264];
c2=[0.001000 0.002000 0.005000 0.010005 0.020001 0.050001 0.099899 0.199882 0.499927
0.959172 0.998357 1.999826 2.003090 3.030933 3.749274];
c=[c1 c2];
d=[d1 d2*d0];
ms= 119.0023*c
mw=d*1000-ms
m=ms./mw*1000/119.0023
NWMS=mw./ms*119.0023/18.0153
MSMW=18.0153*ms./(mw*119.0023)
VMW=18.0153*(ms+mw)./(d.*mw)
VMS=119.0023*(ms+mw)./(d.*ms)
```

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	18.07	(18.07, 18.07)
b =	35.37	(34.43, 36.32)

Goodness of fit:

SSE: 51.78

R-square: 1

Adjusted R-square: 1

RMSE: 1.534

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 37.14 (36.75, 37.53)

b = 18.06 (18.05, 18.07)

Goodness of fit:

SSE: 0.004191

R-square: 0.9997

Adjusted R-square: 0.9997

RMSE: 0.0138

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[10] for aqueous solution of KBr at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
m=c./mw*1000
cor=spline(m,c);
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5 4.0];
c=ppval(cor,mp);
a=[3.1580 3.1477 3.1375 3.1273 3.1172 3.1070 3.0969 3.0867 3.0766 3.0664 3.0460 3.0256
3.0051 2.9846 2.9639 2.9120 2.8595 2.8065 2.7527]/3.1686;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3) and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 = 0.01288 (0.01038, 0.01537)

b2 = 2.272 (1.828, 2.716)

vs = 0.06627 (0.0638, 0.06875)

Goodness of fit:

SSE: 2.091e-006

R-square: 0.9999

Adjusted R-square: 0.9999

RMSE: 0.0003615

(Here the highest c is 3.4813M)

- **The fitted values of $(v_s - Hv_w)$ and v_s in aqueous solution of RbCl**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and d2, and m1 and ws are the relative densities (1000*(d-d0) and the densities (d), and molarities and Wt.% for aqueous solutions [3, 12] of RbCl respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literatures, and 120.9205 and 18.0153 are the molar mass of RbCl and water respectively.

```
d0=0.997047
dd1=[1.789 2.685 3.533 4.410 5.268 7.072 7.977 14.014 21.793 34.555 50.162 67.822 83.580];
d1=(dd1+1000*d0)/1000;
m1=[0.02023 0.03039 0.04002 0.04999 0.05975 0.08034 0.09068 0.16000 0.25011 0.39774
0.5857 0.8001 0.9949];
ws=[4 6 8 10 12 14 16 18 20 22 24 26 28 35 40 45];
ww=100-ws
m2=ws./( 120.9205*ww).*1000
d2=[1.02693 1.04239 1.05823 1.07448 1.09117 1.10832 1.12595 1.14408 1.16273 1.18192
1.20167 1.22201 1.24296 1.32151 1.38318 1.45018];
m=[m1 m2];
d=[d1 d2];
ms= 120.9205*m
mw=1000
NWMS=mw./ms* 120.9205/18.0153
MSMW=18.0153*ms./(mw* 120.9205)
VMW=18.0153*(ms+mw)./(d.*mw)
VMS= 120.9205*(ms+mw)./(d.*ms)
```

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	18.07	(18.07, 18.07)
b =	34.41	(33.74, 35.08)

Goodness of fit:

SSE: 34.08

R-square: 1

Adjusted R-square: 1

RMSE: 1.123

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 36.68 (36.19, 37.17)

b = 18.04 (18.02, 18.06)

Goodness of fit:

SSE: 0.02312

R-square: 0.9994

Adjusted R-square: 0.9993

RMSE: 0.02927

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[13] for aqueous solution of RbCl at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5 4.0];
dp=ppval(cor,mp);
a=[3.1581 3.1480 3.1380 3.1281 3.1182 3.1083 3.0985 3.0886 3.0788 3.0689 3.0492 3.0294
3.0096 2.9897 2.9698 2.9199 2.8699 2.8197 2.7694]/3.1686;
c=mp.*dp./(mp*120.9205+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 = 0.01028 (0.008225, 0.01233)

b2 = 2.196 (1.778, 2.614)

vs = 0.06168 (0.05964, 0.06372)

Goodness of fit:

SSE: 1.303e-006

R-square: 0.9999

Adjusted R-square: 0.9999

RMSE: 0.0002854

(Here the highest c is 3.4876M)

- **The fitted values of $(v_s - Hv_w)$ and v_s in aqueous solution of CsCl**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where

dd1 and d2, and m1 and ws are the relative densities (1000*(d-d0) and the densities, and molarities and Wt.% for aqueous solutions [3,12] of CsCl respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literatures, and 168.3581 and 18.0153 are the molar mass of CsCl and water respectively.

```
d0=0.997047
dd1=[1.289 5.135 7.677 10.233 31.667 50.148 74.637 98.545];
d1=(dd1+1000*d0)/1000;
m1=[0.01003 0.04002 0.05991 0.07996 0.24992 0.39896 0.5998 0.7999];
ws=[4 6 8 10 12 14 16 18 20 22 24 26 28 35 40 45 50];
ww=100-ws
m2=ws./( 168.3581*ww).*1000
d2=[1.02839 1.04472 1.06153 1.07884 1.09668 1.11507 1.13404 1.15362 1.17385 1.19476
1.21638 1.23874 1.26187 1.34960 1.41964 1.49688 1.58245];
m=[m1 m2];
d=[d1 d2];
ms= 168.3581*m
mw=1000
NWMS=mw./ms* 168.3581/18.0153
MSMW=18.0153*ms./(mw* 168.3581)
VMW=18.0153*(ms+mw)./(d.*mw)
VMS= 168.3581*(ms+mw)./(d.*ms)
```

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	18.07	(18.07, 18.07)
b =	41.45	(40.77, 42.13)

Goodness of fit:

SSE: 29.85

R-square: 1

Adjusted R-square: 1

RMSE: 1.139

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	43.72	(43.26, 44.18)
b =	18.04	(18.02, 18.05)

Goodness of fit:
SSE: 0.01177
R-square: 0.9997
Adjusted R-square: 0.9997
RMSE: 0.02262

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[13] for aqueous solution of CsCl at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5 4.0];
dp=ppval(cor,mp);
a=[3.1582 3.1482 3.1384 3.1288 3.1192 3.1096 3.1001 3.0905 3.0810 3.0715 3.0524 3.0334
3.0143 2.9951 2.9760 2.9278 2.8793 2.8304 2.7813]/3.1686;
c=mp.*dp./(mp*168.3581+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), start: b1=0.1, b2=1, vs=0.1, and the result is as follow.

General model:
f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)
Coefficients (with 99% confidence bounds):

b1 =	0.01297	(0.01011, 0.01583)
b2 =	2.09	(1.692, 2.488)
vs =	0.06395	(0.06111, 0.06679)

Goodness of fit:
SSE: 2.141e-006
R-square: 0.9999
Adjusted R-square: 0.9999
RMSE: 0.0003658
(Here the highest c is 3.4019M)

- **The fitted values of $(v_s - Hv_w)$ and v_s in aqueous solution of RbBr**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and d2, and m1 and ws are the relative densities (1000*(d-d0) and the densities (d), and molarities and Wt.% for aqueous solutions [3,12] of RbBr respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literatures, and 165.3718 and 18.0153 are the molar mass of RbBr and water respectively.

d0=0.997047

dd1=[5.060 6.328 8.756 11.268 12.532 15.012 17.489 27.367 39.548 58.919 87.364 115.211];

d1=(dd1+1000*d0)/1000;

m1=[0.04026 0.05038 0.06979 0.08992 0.09999 0.12000 0.13996 0.21998 0.31961 0.47998 0.7199 0.9600];

ws=[4 6 8 10 12 14 16 18 20 22 24 26 28 35 40 45 50];

ww=100-ws

m2=ws./(165.3718*ww).*1000

d2=[1.02833 1.04464 1.06143 1.07872 1.09653 1.11489 1.13383 1.15338 1.17357 1.19443 1.21600 1.23832 1.26143 1.34917 1.41924 1.49654 1.58222];

m=[m1 m2];

d=[d1 d2];

ms= 165.3718*m

mw=1000

NWMS=mw./ms* 165.3718/18.0153

MSMW=18.0153*ms./(mw* 165.3718)

VMW=18.0153*(ms+mw)./(d.*mw)

VMS= 165.3718*(ms+mw)./(d.*ms)

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	18.07	(18.07, 18.07)
b =	41.07	(40.52, 41.63)

Goodness of fit:

SSE: 20.95

R-square: 1

Adjusted R-square: 1

RMSE: 0.8809

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	42.93	(42.54, 43.32)
b =	18.04	(18.03, 18.06)

Goodness of fit:

SSE: 0.01145

R-square: 0.9997

Adjusted R-square: 0.9997
RMSE: 0.02059

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[10] for aqueous solution of RbBr at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5 4.0];
dp=ppval(cor,mp);
a=[3.1581 3.1479 3.1379 3.1279 3.1180 3.1081 3.0983 3.0884 3.0786 3.0688 3.0493 3.0297
3.0102 2.9907 2.9713 2.9226 2.8739 2.8252 2.7762]/3.1686;
c=mp.*dp./(mp*165.3718+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.01051	(0.008076, 0.01295)
b2 =	2.155	(1.705, 2.605)
vs =	0.06224	(0.05981, 0.06467)

Goodness of fit:

SSE: 1.646e-006
R-square: 0.9999
Adjusted R-square: 0.9999
RMSE: 0.0003207

(Here the highest c is 3.4102M)

- **The fitted values of $(v_s - Hv_w)$ and v_s in aqueous solution of CsBr**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and d2, and m1 and ws are the relative densities (1000*(d-d0) and the densities (d), and molarities and Wt.% for aqueous solutions [3, 12] of CsBr) respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literatures, and 212.8094 and 18.0153 are the molar mass of CsBr and water respectively.

```
d0=0.997047
dd1=[6.596 8.418 9.918 11.339 13.207 16.503 23.077 52.110 77.445 114.690 148.404];
d1=(dd1+1000*d0)/1000;
m1=[0.03981 0.05084 0.05994 0.06856 0.07991 0.09998 0.14015 0.31991 0.47968 0.7197
0.9424];
```

```
ws=[4 6 8 10 12 14 16 18 20 22 24 26 28 35 40 45 50];
ww=100-ws
m2=ws./(212.8094*ww).*1000
d2=[1.02918 1.04597 1.06328 1.08114 1.09958 1.11863 1.13832 1.15869 1.17978 1.20162
1.22425 1.24772 1.27208 1.36503 1.43986 1.52305 1.61610];
m=[m1 m2];
d=[d1 d2];
ms= 212.8094*m
mw=1000
NWMS=mw./ms* 212.8094/18.0153
MSMW=18.0153*ms./(mw* 212.8094)
VMW=18.0153*(ms+mw)./(d.*mw)
VMS= 212.8094*(ms+mw)./(d.*ms)
```

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	18.07	(18.07, 18.07)
b =	48.21	(47.74, 48.68)

Goodness of fit:

SSE: 13.29

R-square: 1

Adjusted R-square: 1

RMSE: 0.7151

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a =	49.73	(49.38, 50.08)
b =	18.05	(18.04, 18.06)

Goodness of fit:

SSE: 0.005129

R-square: 0.9998

Adjusted R-square: 0.9998

RMSE: 0.01404

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}(a)^{10}$ for

aqueous solution of CsBr at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5 4.0];
dp=ppval(cor,mp);
a=[3.1582 3.1482 3.1384 3.1288 3.1193 3.1098 3.1004 3.0910 3.0816 3.0723 3.0537 3.0351
3.0166 2.9980 2.9795 2.9328 2.8855 2.8375 2.7884]/3.1686;
c=mp.*dp./(mp*212.8094+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.01517	(0.01104, 0.01931)
b2 =	1.95	(1.545, 2.355)
vs =	0.06617	(0.06209, 0.07025)

Goodness of fit:

SSE: 3.692e-006

R-square: 0.9998

Adjusted R-square: 0.9998

RMSE: 0.0004804

(Here the highest c is 3.3286M)

- **The fitted values of $(v_s - Hv_w)$ and v_s in aqueous solution of RbI**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and d2, m1 and ws are the relative densities (1000*(d-d0) and the densities (d), and molarities and Wt.% for aqueous solutions [3, 12] of RbI respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literatures, and 212.3723 and 18.0153 are the molar mass of RbI and water respectively.

```
d0=0.997047
dd1=[1.615 3.227 4.712 6.442 9.654 12.843 16.048 34.893 75.257 111.258];
d1=(dd1+1000*d0)/1000;
m1=[0.01000 0.01999 0.02921 0.03997 0.05998 0.07991 0.09999 0.21914 0.48002 0.71911];
ws=[4 6 8 10 12 14 16 18 20 22 24 26 28 35 40 45 50];
ww=100-ws
m2=ws./( 212.3723*ww).*1000
d2=[1.02831 1.04464 1.06147 1.07883 1.09675 1.11525 1.13436 1.15411 1.17453 1.19566
```

1.21754 1.24020 1.26368 1.35307 1.42481 1.50428 1.59281];
m=[m1 m2];
d=[d1 d2];
ms= 212.3723*m
mw=1000
NWMS=mw./ms* 212.3723/18.0153
MSMW=18.0153*ms./(mw*212.3723)
VMW=18.0153*(ms+mw)./(d.*mw)
VMS= 212.3723*(ms+mw)./(d.*ms)

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 18.07 (18.07, 18.07)

b = 51.92 (51.45, 52.38)

Goodness of fit:

SSE: 15.1

R-square: 1

Adjusted R-square: 1

RMSE: 0.7772

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 53.46 (53.13, 53.78)

b = 18.05 (18.04, 18.06)

Goodness of fit:

SSE: 0.004313

R-square: 0.9999

Adjusted R-square: 0.9999

RMSE: 0.01313

Further run the following program to obtain the c corresponding to $\frac{p_w}{p_w^*}$(a)[14] for aqueous solution of RbI at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[16] at 25℃.

cor=spline(m,d);

```
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5];
dp=ppval(cor,mp);
a=[3.1581 3.1480 3.1380 3.1281 3.1184 3.1086 3.0989 3.0893 3.0796 3.0700 3.0509 3.0308
3.0115 2.9922 2.9729 2.9247 2.8763 2.8278]/3.1686;
c=mp.*dp./(mp*212.3723+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.01198	(0.009357, 0.01461)
b2 =	2.482	(1.993, 2.97)
vs =	0.06484	(0.06206, 0.06761)

Goodness of fit:

SSE: 1.35e-006

R-square: 0.9999

Adjusted R-square: 0.9999

RMSE: 0.0003001

(Here the highest c is 3.0835M)

- **The fitted values of $(v_s - Hv_w)$ and v_s in aqueous solution of CsI**

Run the following program to obtain NWMS, VMS, MSMW and VMW, where dd1 and d2, and m1 and ws are the relative densities (1000*(d-d0) and the densities (d), and molarities and Wt.% for aqueous solutions [3, 12] of CsI respectively, 0.997047 (d0) is the density (g/cm^3) of pure water [5] at 25℃ used by the literature, and 259.8099 and 18.0153 are the molar mass of CsI and water respectively.

```
d0=0.997047
dd1=[4.032 6.057 10.044 12.047 15.704 18.024 20.013 27.938 43.661 63.077 93.685 138.370];
d1=(dd1+1000*d0)/1000;
m1=[0.02001 0.03009 0.04998 0.05999 0.07831 0.08996 0.09996 0.13994 0.21989 0.31978
0.47988 0.7195];
ws=[4 6 8 10 12 14 16 18 20 22 24 26 28 35 40 45];
ww=100-ws
m2=ws./( 259.8099*ww).*1000
d2=[1.02899 1.04570 1.06294 1.08074 1.09912 1.11811 1.13775 1.15808 1.17915 1.20099
1.22364 1.24715 1.27157 1.36497 1.44044 1.52460];
m=[m1 m2];
d=[d1 d2];
```

ms= 259.8099*m
mw=1000
NWMS=mw./ms* 259.8099/18.0153
MSMW=18.0153*ms./(mw* 259.8099)
VMW=18.0153*(ms+mw)./(d.*mw)
VMS= 259.8099*(ms+mw)./(d.*ms)

Fit the data of VMS and NWMS, VMW and MSMW with equation (4) and (5) respectively, where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow respectively.

For equation (4):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 18.07 (18.07, 18.07)

b = 59.12 (58.77, 59.46)

Goodness of fit:

SSE: 7.836

R-square: 1

Adjusted R-square: 1

RMSE: 0.549

For equation (5):

General model:

f(x) = a*x+b

Coefficients (with 99% confidence bounds):

a = 60.12 (59.93, 60.32)

b = 18.06 (18.06, 18.06)

Goodness of fit:

SSE: 0.0007065

R-square: 1

Adjusted R-square: 1

RMSE: 0.005213

Further run the following program to obtain the cs corresponding to $\frac{p_w}{p_w^*}$(a)[14] for aqueous solution of CsI at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$) and 3.1686kPa is the vapor pressure of pure water[5] at 25℃.

```
cor=spline(m,d);
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0];
dp=ppval(cor,mp);
a=[3.1582 3.1483 3.1386 3.1290 3.1196 3.1102 3.1009 3.0917 3.0825 3.0734 3.0553 3.0373
```

3.0195 3.0018 2.9843 2.9411 2.8986]/3.1686;
c=mp.*dp./(mp*259.8099+1000)*1000;

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.004519	(0.002604, 0.006434)
b2 =	2.69	(1.791, 3.588)
vs =	0.05381	(0.05165, 0.05597)

Goodness of fit:

SSE: 4.133e-007

R-square: 1

Adjusted R-square: 0.9999

RMSE: 0.0001718

However, the calculated values of H by using v_s 0.05381 (0.05165, 0.05597) and the intercepts $(v_s - N_{cw}v_w)$ (59.12 (58.77, 59.46)) are negative. Considering that the real highest c is only 2.5349M but the highest valid concentration is 3.10M, in order to make the distribution of the data points symmetry and uniform, disregarding some data, again fit the data of a and c with equation (8). The results are as follows.

Example 1

cor=spline(m,d);
mp=[0.1 0.5 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0];
dp=ppval(cor,mp);
a=[3.1582 3.1196 3.0734 3.0553 3.0373 3.0195 3.0018 2.9843 2.9411 2.8986]/3.1686;
c=mp.*dp./(mp*259.8099+1000)*1000;

Fit the data of aw and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.007194	(0.004702, 0.009685)
b2 =	2.15	(1.575, 2.725)
vs =	0.05677	(0.05409, 0.05944)

Goodness of fit:

SSE: 9.434e-008

R-square: 1
Adjusted R-square: 1
RMSE: 0.0001161

Example 2

```
cor=spline(m,d);
mp=[0.2 0.6 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0];
dp=ppval(cor,mp);
a=[3.1483 3.1102 3.0734 3.0553 3.0373 3.0195 3.0018 2.9843 2.9411 2.8986]/3.1686;
c=mp.*dp./(mp*259.8099+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.0071	(0.004557, 0.009643)
b2 =	2.166	(1.576, 2.755)
vs =	0.05667	(0.05393, 0.0594)

Goodness of fit:
SSE: 1.073e-007
R-square: 1
Adjusted R-square: 1
RMSE: 0.0001238

Example 3

```
cor=spline(m,d);
mp=[0.3 0.7 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0];
dp=ppval(cor,mp);
a=[3.1386 3.1009 3.0734 3.0553 3.0373 3.0195 3.0018 2.9843 2.9411 2.8986]/3.1686;
c=mp.*dp./(mp*259.8099+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3), and start: b1=0.1, b2=1, vs=0.1.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.007182	(0.004742, 0.009622)
b2 =	2.147	(1.616, 2.678)
vs =	0.05675	(0.05413, 0.05938)

Goodness of fit:
SSE: 9.741e-008
R-square: 1

Adjusted R-square: 1
RMSE: 0.000118

To sum up, the v_s of CsI in water is taken as 0.05944 $dm^3 \cdot mol^{-1}$.

On application of equation (4) and (8) to aqueous solutions of $CaCl_2$

Run the following program to obtain NWMS and VMS,, where dd and m are the relative densities [4] (1000*(d-d0) and molarities for aqueous solution of $CaCl_2$ respectively, 0.997047 (d0)[5] is the density (g/cm^3) of pure water [5] at 25℃ used by the literature, and 110.9940 and 18.0153 are the molar mass of $CaCl_2$ and water respectively (the green data are the arithmetic mean value).

```
d0=0.997047;
dd=[4.568 8.700 44.042 81.498 125.468 162.196 181.401 251.240 263.800 285.686 341.557
372.586 390.022 413.788];
m=[0.05001 0.09583 0.50190 0.95590 1.52060 2.02090 2.29340 3.35450 3.55790 3.92350
4.93050 5.54980 5.92220 6.46440];
d=(dd+1000*d0)/1000;
mw=1000;
ms= 110.9940*m;
NWMS=mw./ms* 110.9940/18.0153;
VMS= 110.9940*(ms+mw)./(d.*ms);
```

Fit the data of VMS and NWMS equation (4), where confidence level: 99%, and custom equation: y=a*x+b. The results are as follow.

General model:
f(x) = a*x+b
Coefficients (with 99% confidence bounds):
a = 18.06 (18.05, 18.07)
b = 28.57 (25.56, 31.58)

Goodness of fit:
SSE: 132.9
R-square: 1
Adjusted R-square: 1
RMSE: 3.328

Further run the following program to obtain the c corresponding to water activity a at 25℃ for aqueous solution [15] of $CaCl_2$ at molalities (mp), where c is the volume concentration ($mol \cdot dm^{-3}$).

```
cor=spline(m,d);
```

```
mp=[0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.4 1.6 1.8 2.0 2.5 3.0 3.5 4.0 4.5];
dp=ppval(cor,mp);
phi=[0.854 0.862 0.876 0.894 0.917 0.940 0.963 0.988 1.017 1.046 1.107 1.171 1.237 1.305 1.376
1.568 1.779 1.981 2.182 2.383];
a=exp(-3*mp.*phi/55.51);
c=mp.*dp./(mp*102.8938+1000)*1000;
```

Fit the data of a and c with equation (8), where confidence level: 99%, custom equation: y = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3) and start: b1=0.1, b2=1, vs=0.1. The result is as follow.

General model:

f(x) = (1-vs*x)^(2/3)+b1*(1-exp(-b2*x))*x^(2/3)

Coefficients (with 99% confidence bounds):

b1 =	0.08584	(0.08, 0.09167)
b2 =	3.161	(2.469, 3.853)
vs =	0.1985	(0.1943, 0.2027)

Goodness of fit:

SSE: 0.0001208

R-square: 0.9996

Adjusted R-square: 0.9996

RMSE: 0.002666

References

(S1) Ohtaki, H.; Radnai, T. Structure and Dynamics of Hydrated Ions. *Chem. Rev.* **1993**, *93*, 1157.

(S2) Marcus, Y. Effect of Ions on the Structure of Water: Structure Making and Breaking. *Chem. Rev*. **2009**, *109*, 1346.

(S3) Fortier, J.-L.; Leduc, P.-A.; Desnoyers, J. E. Thermodynamic Properties of Alkali Halides. II. Enthalpies of Dilution and Heat Capacities in Water at 25℃. *J. Solution Chem*. *1974*, *3(4)*, 323.

(S4) Perron, G. Roux, A. and Desnoyers, *J. E. Can. J. Chem*. Heat capacities and volumes of NaCl, $MgCl_2$, $CaCl_2$, and $NiCl_2$ up to 6 molal in water. **198**1, *59*, 3049.

(S5) Kell, G. S. Density, thermal expansivity, and compressibility of liquid water from 0.deg. to 150.deg.. Correlations and tables for atmospheric pressure and saturation reviewed and expressed on 1968 temperature scale. *J. Chem. Eng. Data* **1975**, *20*, 97.

(S6) Partanen, J. I.; Covington, A. K. Re-Evaluation of the Thermodynamic Activity Quantities in Aqueous Sodium and Potassium Chloride Solutions at 25℃. *J. Chem.*

Eng. Data **2009**, *54*, 208.
(S7) Millero, F. J.; Ward, G. K.; Chetirkin, P. V. Relative sound velocities of sea salts at 25 ℃. *J. Acoust. Soc. Am.* **1977**, *61(6)*, 1492.
(S8) Dedick, E. A.; Hershey, J. P.; Sotolongo, S.; Stade, D. J.; Millero, F. J. The PVT Properties of Concentrated Aqueous Electrolytes IX. The Volume Properties of KCl and K_2SO_4 and their Mixtures with NaCl and Na_2SO_4 as a Function of Temperature. *J. Solution Chem*. **1990**, *19(4)*, 353.
(S9) Grzybkowskl, W.; Atkinson, G. Thermodynamics of Concentrated Electrolyte Mixtures. 8. Apparent Molal Volumes, Adiabatic Compressibilities, and Hydration Numbers of Aqueous $ZnBr_2$, $CaBr_2$, and NaBr at 25 ℃. *J. Chem. Eng. Data* **1986**, *31*, 309.
(S10) Partanen, J. I. Re-Evaluation of the Thermodynamic Activity Quantities in Aqueous Alkali Metal Bromide Solutions at 25 ℃. *J. Chem. Eng. Data* **2010**, *55*, 2202.
(S11) Jones, G.; Talley, S. K. The Viscosity of Aqueous Solutions as a Function of the Concentration. II. Potassium Bromide and Potassium Chloride. *J. Am. Chem. Soc*, **1933**, *55(10)*, 4124.
(S12) Pedersen, T. G.; Sejersen, L.; Ifft, J. B. The partial molar volumes of six alkali halides and their ions as a function of concentration. *Carlsberg Res. Commun*. **1977**, *42*, 211.
(S13) Partanen, J. I. Re-Evaluation of the Thermodynamic Activity Quantities in Aqueous Rubidium and Cesium Chloride Solutions at 25℃. *J. Chem. Eng. Data* **2010**, *55*, 249.
(S14) Partanen, J. I. Re-Evaluation of the Thermodynamic Activity Quantities in Aqueous Alkali Metal Iodide Solutions at 25 ℃. *J. Chem. Eng. Data* **2010**, *55*, 3708.
(S15) R. H. Stokes, *Trans. Faraday Soc.* 1948, **44**, 295.