I. TEMPERATURE DEPENDENCE OF SHEAR VISCOSITY AND PERMITTIVITY OF PURE WATER

Temperature dependence of the shear viscosity of pure water was computed via the following correlation proposed, basing on the data from Recommended Reference Materials for the Realization of Physicochemical Properties[1] between 0 °C and 100 °C, in paper[2] by M.Laliberté:

$$\eta_0 = \frac{t + 246}{(0.05594t + 5.2842)t + 137.37}, \tag{1}$$

where η_0 is in mPa·s, and t is in °C.

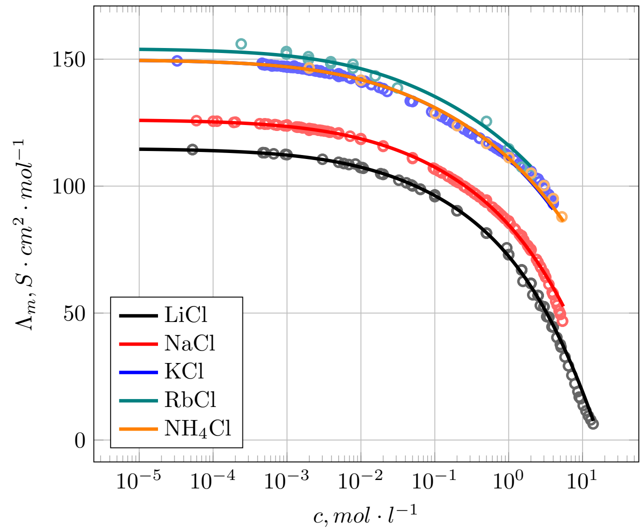
Temperature dependence of the permittivity of pure water, measured over the range from 0.1 °C to 99 °C, fit the following equation[3]:

$$\varepsilon_0 = 87.740 - 0.40008t + 9.398 \times 10^{-4}t^2 - 1.410 \times 10^{-6}t^3, \tag{2}$$

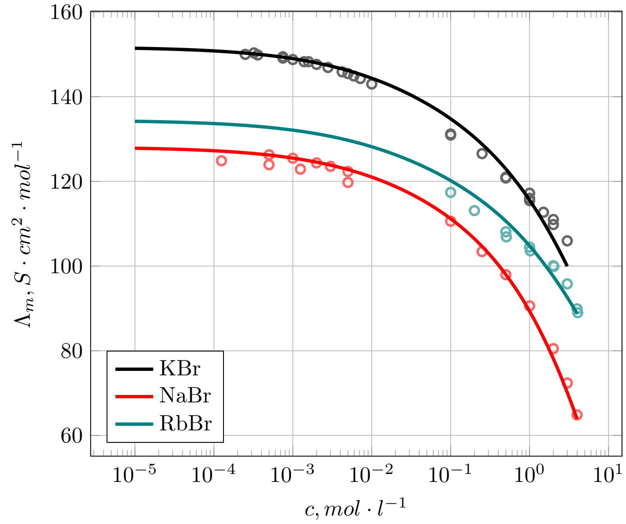
where t is the temperature in °C.

II. FIT OF THE CONCENTRATION DEPENDENCE OF AQUEOUS ELECTROLYTE SOLUTIONS MOLAR ELECTRICAL CONDUCTIVITY

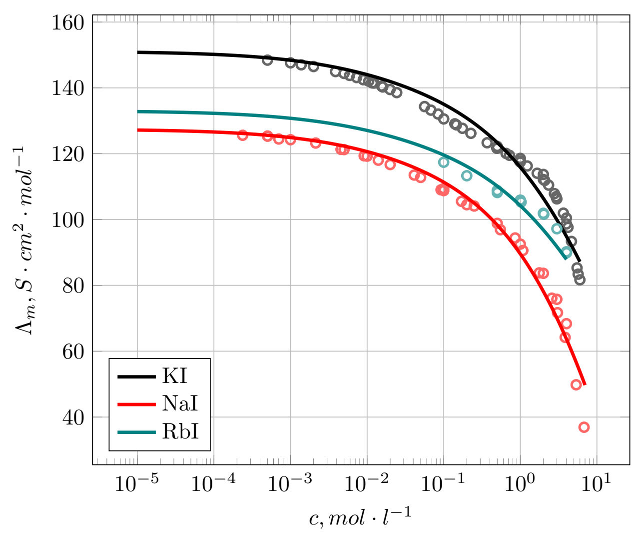
Figs. 1, 2, 6 and 4 show the comparison of the theoretical and experimental molar electrical conductivity as a function of concentration for a set of 1:1, 2:1, 3:1 and 2:1 aqueous electrolyte solutions. Experimental data were taken from compilation by R.Holze[4]. Solid lines are the best fit of the model. Obtained fitting parameters are shown in the table **??** in the main text.



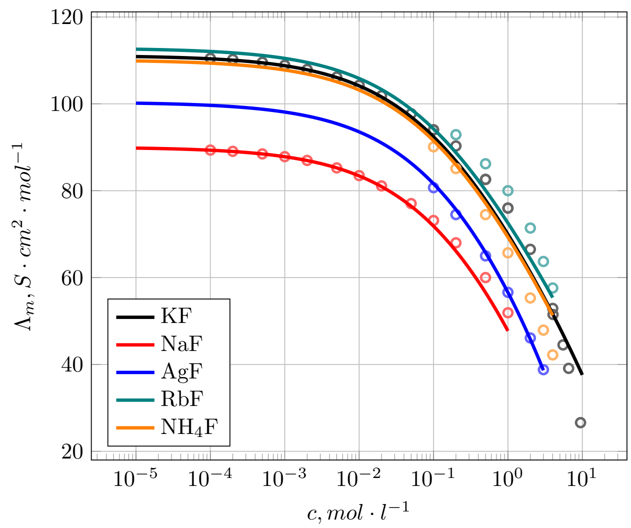
(a)



(b)

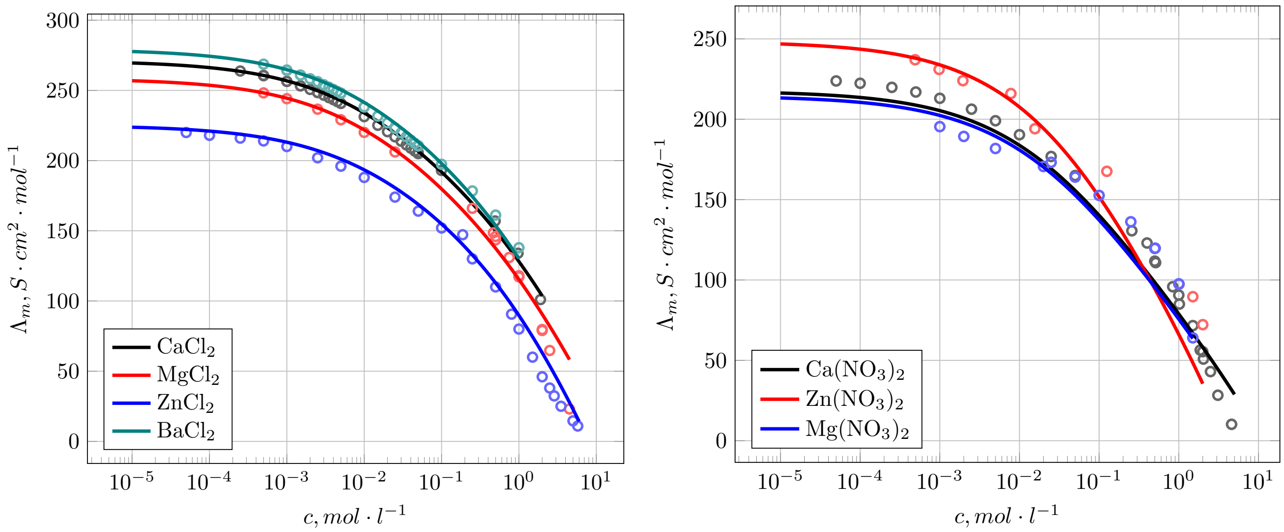


(c)



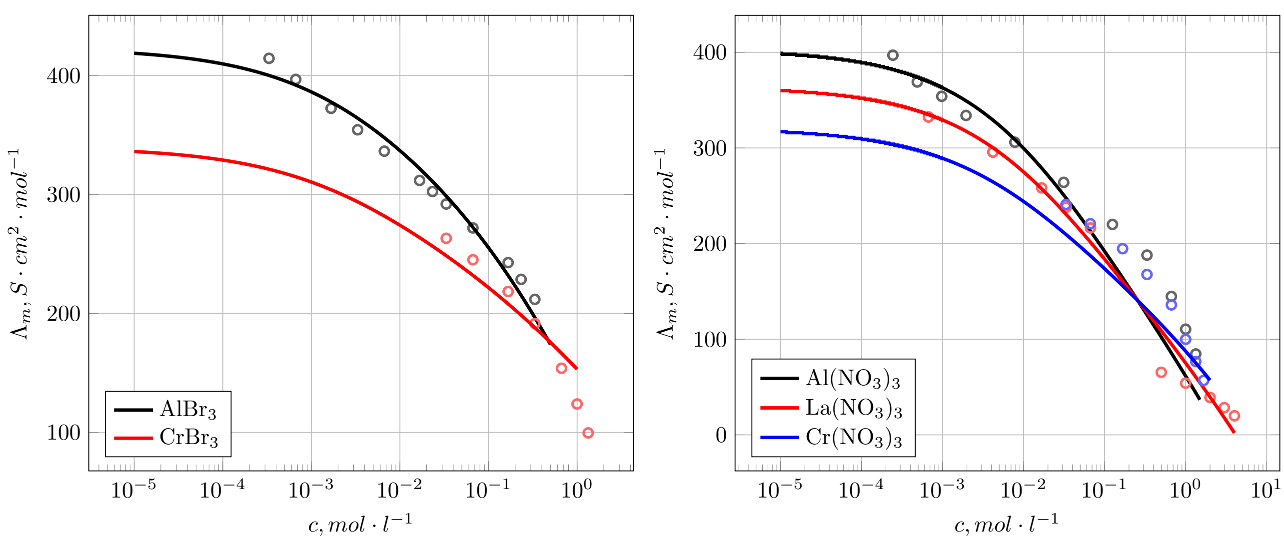
(d)

Figure 1: Molar electrical conductivity as a function of concentration for a set of aqueous electrolyte solutions: 1:1 chlorides (1a), 1:1 bromides (1b), 1:1 iodides (1c) and 1:1 fluorides (1d).



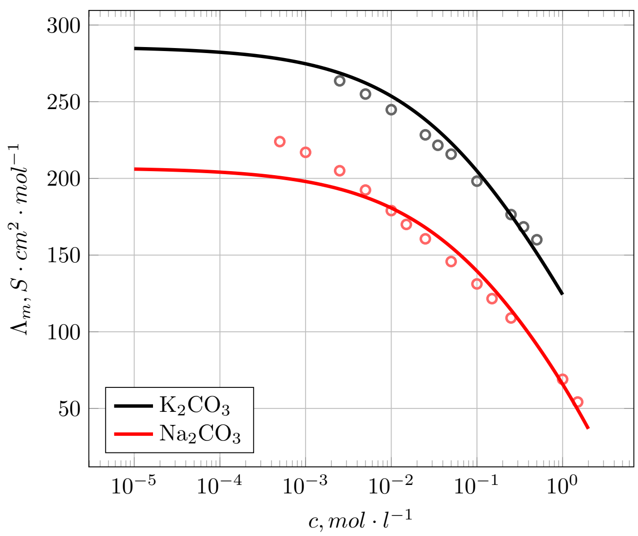
(a) (b)

Figure 2: Molar electrical conductivity as a function of concentration for a set of aqueous electrolyte solutions: 2:1 chlorides (2a) and 2:1 nitrates (2b).

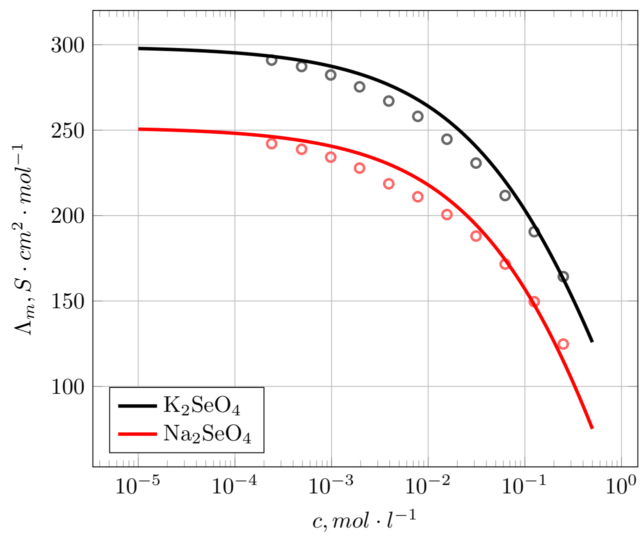


(a) (b)

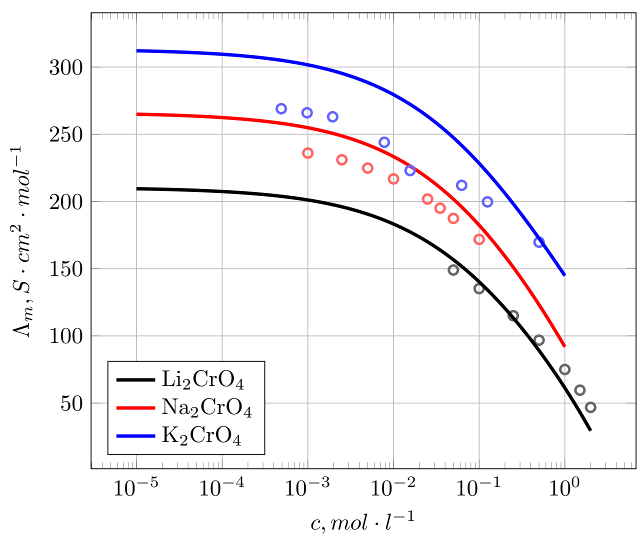
Figure 3: Molar electrical conductivity as a function of concentration for a set of aqueous electrolyte solutions: 3:1 bromides (3a) and 3:1 nitrates (3b).



(a)



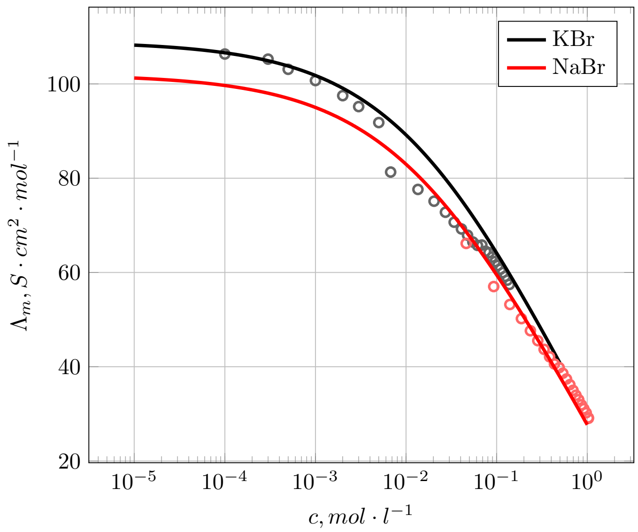
(b)



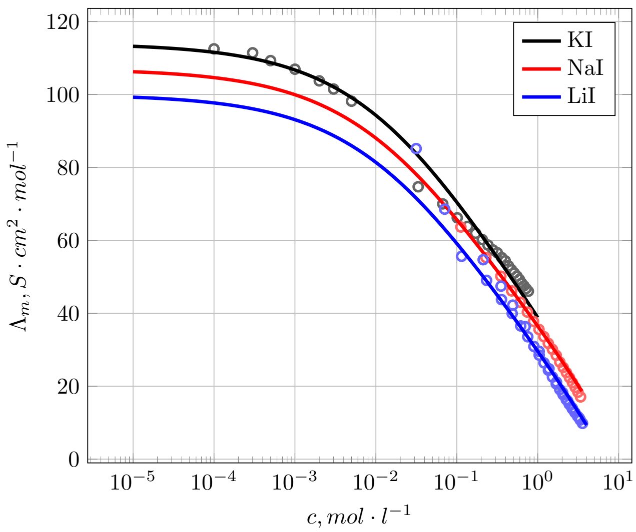
(c)

Figure 4: Molar electrical conductivity as a function of concentration for a set of aqueous electrolyte solutions: 1:2 carbonates (4a), 1:2 selenates (4b) and 1:2 chromates (4c).

III. FIT OF THE CONCENTRATION DEPENDENCE OF NON-AQUEOUS ELECTROLYTE SOLUTIONS MOLAR ELECTRICAL CONDUCTIVITY

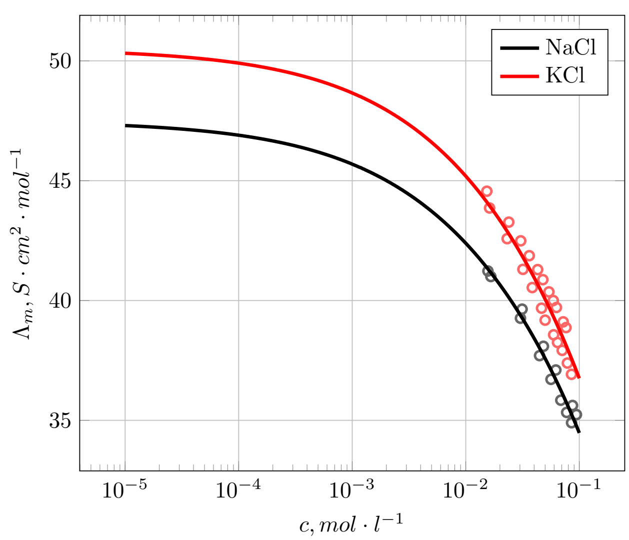


(a)



(b)

Figure 5: Molar electrical conductivity as a function of concentration for a set of methanol electrolyte solutions: bromides (5a) and iodides (5b).



(a)

Figure 6: Molar electrical conductivity as a function of concentration of formic acid electrolyte solutions.

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[2] M. Laliberte and W. E. Cooper, "Model for calculating the density of aqueous electrolyte solutions," Journal of Chemical & Engineering Data **49**, 1141–1151 (2004).

[3] C. Malmberg and A. Maryott, "Dielectric constant of water from 00 to 1000 c," Journal of research of the National Bureau of Standards **56**, 1–8 (1956).

[4] R. Holze, *Electrochemistry*, 1st ed., edited by M. D. Lechner, Landolt-Börnstein: Numerical Data and Functional Relationships in Science and Technology - New Series (Springer Berlin, Heidelberg, 2016).