

Volumetric properties and the ion-interaction parameters of the binary system (CsB₅O₈ + H₂O) at temperatures from (283.15 to 363.15) K and 101 kPa

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Introduction

Cesium (Cs), known as the significant and expensive alkaline metal element, is widely applied in industrial, agricultural and medical fields^[1]. Cesium resources were distributed and dispersed in salt lake brines, associated with other minerals.



Fig.1 Applications of cesium and its compounds

Reliable data on physical properties such as density and apparent molar volumes are of interest to develop separation and purification process for minerals, as well as partial molar volumes of electrolytes can provide valuable information about the structural interactions for the ion – ion, ion – solvent and solvent – solvent^[2].

Experimental

The CsB₅O₈ · 4H₂O was synthesized according to the phase diagram of system Cs₂O – B₂O₃ – H₂O. The stock solution was prepared with DDW and synthetic CsB₅O₈ · 4H₂O in the glove box filled with nitrogen. The densities for aqueous solutions of CsB₅O₈ were measured by an Anton Paar Digital vibrating-tube densimeter with a precision of 1.0 × 10⁻⁵ g cm⁻³ with an uncertainty of ± 1.4 mg cm⁻³.



Fig.2 Digital densimeters (Anton Paar, Austria)



Fig.3 TG – DSC LABSYS evo (Setaram, France)

Results and Discussion

Thermal expansion coefficient

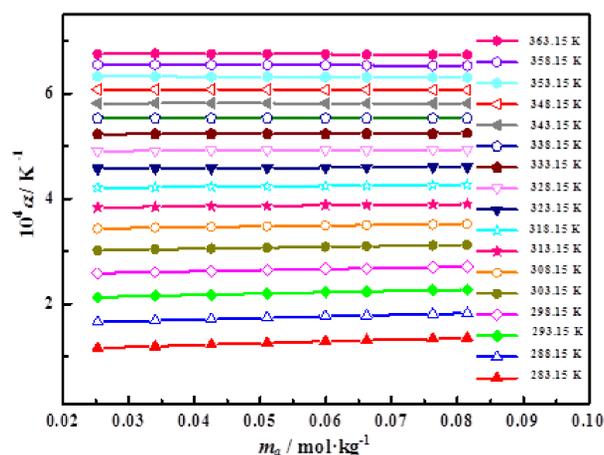


Fig.4 The coefficient of thermal expansion of CsB₅O₈ aqueous solution against temperature and molality at 101 kPa

Apparent molar volumes

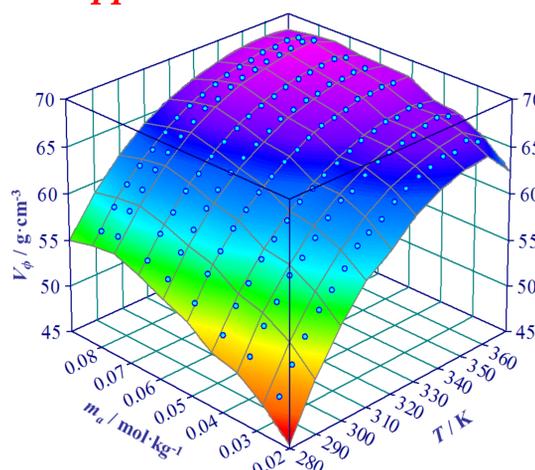


Fig.5 Apparent molar volumes of CsB₅O₈ aqueous solution against temperature and molality at 101 kPa

Apparent molar expansibility of solute

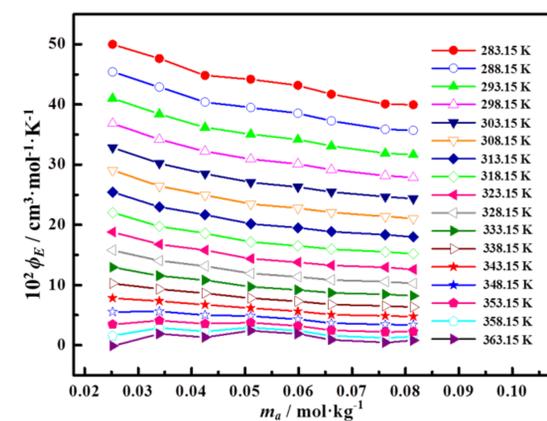


Fig.6 Apparent molar expansibility of solute of CsB₅O₈ aqueous solution against temperature and molality at 101 kPa

Conclusion

The experimental data on the volumetric properties of the aqueous solution system (CsB₅O₈ + H₂O) from 283.15 K to 363.15 K at 101 kPa are reported for the first time. According to experimental data, apparent molar volume, apparent molar expansibility of solute and the coefficient of thermal expansion of the CsB₅O₈ aqueous solution were calculated. The Pitzer single-salt parameters for Cs[B₅O₆(OH)₄] as well as temperature-dependence correlations were obtained for the first time on the basis of Pitzer ion-interaction apparent molar volume model of electrolytes^[3].

References

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