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Analytical description of the LiCl-MCl (M-Na, K, Rb, Cs) low melting compositions and prediction of the LiCl-FrCl eutectic characteristics

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Abstract

Qualitative analysis of a number of the LiCl-MCl systems (M – Na, K, Rb, Cs) has shown that the liquidus curve of the unstudied LiCl-FrCl system bears a eutectic and a peritectic. In addition to qualitative analysis, analytic correlations between melting temperatures of low melting compounds of the LiCl–MCl systems were described in dependence to the atomic number of the s^1 element (M – Na, K, Rb, Cs), the Z_M/Z_{Li} atomic numbers ratio, melting points of the MCl, the T(MCl)–T(LiCl) melting points ratio, ionic radius of the M^+ (Na^+, K^+, Rb^+, Cs^+), and the $\Gamma_M{}^+/\Gamma_{Li}{}^+$ ionic radii ratio. The optimal equations were chosen from the analytic correlations obtained, using the least-squares method whereby the root-mean-square deviation is minimal, and the correlation coefficient is maximum.

The optimal equations were graphed for the eutectic temperatures of the LiCl–MCl systems and the eutectic characteristics of the LiCl-FrCl system were determined: 42.5 mole % FrCl, 595 °C. In order to confirm the adequacy of the equations obtained, the $T_e = f(x)$ rectilinear dependence is analytically described.

References

[1] I.K. Garkushin, I.M. Kondratyuk, E.M. Dvoryanova, E.G. Danilushkina. Analysis, prediction and experimental investigation of the systems containing halides of alkaline and alkaline-earth elements. *Ekaterinburg: Ural Academy of Science of Russia.* **2006**. 148p. (russian)
[2] G.I. Zamaldinova, A.I. Garkushin, S.N. Parfyonova, and I.K. Garkushin. Computing the characteristics of eutectic structure of LiI–FrI system on the basis of analytical description of low-melting structures of the series LiI–MI (M = Na, K, Rb, Cs). *Butlerov Communications*. **2012**. Vol.31. No.7. P.104-107. ROI: jbc-02/12-31-7-104
[3] G.I. Zamaldinova, and colleagues. Analytical description of eutectic temperatures and compositions of the LiF – MF (M – Na, K, Rb, Cs) systems and eutectic characteristics prediction of the LiF – FrF system. *Journal of Inorganic Chemistry.* **2012**. Vol.57. No.6. P.961-965. (russian)
[4] I.K. Garkushin, and colleagues. Evaluation of the LiBr–FrBr binary system eutectic based on the data on a number of the LiBr – MBr (M – Na, K, Rb, Cs) systems. News of Higher Educational Institutions. *Chemistry and Chemical Technology.* **2004**. Vol.47. No.9. P.28-31. (russian)
[5] N.N. Kalitkin. Numerical Methods. *Moscow: Nauka.* **1978**. 512p. (russian)
[6] Melting Diagrams of Salt Systems. Vol.1. Binary Systems with a common anion. Posipayko E.A. Alexeeva. *Moscow.* **1977**. 416p.
[7] Properties of inorganic compounds. Справочник. A.I. Efimov, L.P. Belorukova, I.V. Vasilkova, V.P. Chechev. *Leningrad: Khimiya.* **1983**. P.14-17. (russian)
[8] Handbook on the fusibility of anhydrous inorganic salt systems. Vol.2. N.K. Voskresenskaya, and others. *Leningrad-Moscow: USSR Academy of Science.* **1961**. (russian)
[9] Thermal constants for substances. No.X. Vol.1. Handbook. V.P. Glushko. *Moscow: USSR Academy of Science.* **1981**. 299p.
[10] Thermal constants for substances. No.X. Vol.2. Handbook. V.P. Glushko. *Moscow: USSR Academy of Science.* **1981**. 441p.