THERMODYNAMICS OF LIQUID NITROGEN SOLUTIONS IN CHROMIUM

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Abstract: A simple theory of thermodynamic properties of liquid nitrogen solutions in Fe-Cr alloys is proposed. The theory based on the lattice model of the considered solutions. The model assumes a FCC lattice. In the lattice sites of this lattice are the atoms of Fe and Cr. Nitrogen atoms are located in octahedral interstices. The nitrogen atom interacts only with the metal atoms located in the lattice sites neighboring to this atom. It is assumed that the energy of this interaction depends neither on the composition nor on the temperature. It is supposed that the solution in the Fe-Cr system is perfect. Within the framework of the proposed theory a relationship is obtained that expresses the value of the Sieverts law constant for the solubility of N in liquid Cr through the similar constant for the solubility of N in liquid Fe and the Wagner N-Cr interaction coefficient in liquid Fe. A relationship is also obtained which expresses the partial enthalpy of nitrogen dissolution in liquid Cr through the similar quantity for N in liquid Fe and Wagner N-Cr interaction coefficient in liquid Fe. A formula deduced that establishes a connection between the Wagner N-Fe interaction coefficient in liquid Cr and N-Cr interaction coefficient in liquid Fe. Using the formulas obtained the value of the Sieverts law constant for the solubility of nitrogen in liquid Cr, the enthalpy of dissolution of N in liquid Cr and the value of the Wagner N-Fe interaction coefficient in liquid Cr extrapolated to a temperature of 1873 K are calculated. The results of the calculation are compared with the results of the experimental study of the solubility of nitrogen in liquid Cr carried out by different researchers using different methods. The result of the theory are in the best agreement with experimental data obtained by the sampling method (F. Ishii, Ya. Iguchi, Sh. Ban-ya, 1986).The values of the Wagner N-N interaction coefficient in liquid Cr and liquid Fe are discussed.

Keywords: thermodynamics, statistical mechanics, solutions, nitrogen, chromium, iron, activity coefficient, enthalpy, Wagner interaction coefficient, Sieverts law.

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