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The Cs-Li (Cesium-Lithium) System

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Equilibrium Diagram

The assessed Cs-Li phase diagram (Fig. 1) is a simple system that exhibits virtually complete immiscibility in both the liquid and solid states. At higher temperatures, the diagram is dominated by the vapor phase protruding from the Cs side.

The diagram is similar to the K-Li, Li-Na, and Li-Rb systems. The extent of immiscibility is expected to be the most pronounced in this system, because Li and Cs have the smallest and largest alkali-metal atomic diameters, respectively.

As reported by [Shunk] and [Hansen], the Cs-Li system has been investigated by [39Boh] (thermal analyses) and by [62Cue] (solubility measurements). More recently, density measurements of Cs in Li have been reported by [70Nov]. The crystal structures of the pure elements are listed in Table 1.

Table 2 lists data of [62Cue] for the solubility of Cs in Li corresponding to two experimental runs. Applying a regression analysis to the data, the following expression for the solubility of Cs in Li as a function of temperature, in K, can be calculated:

$$\log (\text{at.\% Cs}) = 4.43 - 6594/T \qquad \text{(Eq 1)}$$

A comparison of the measured and smoothed data is also given in Table 2.

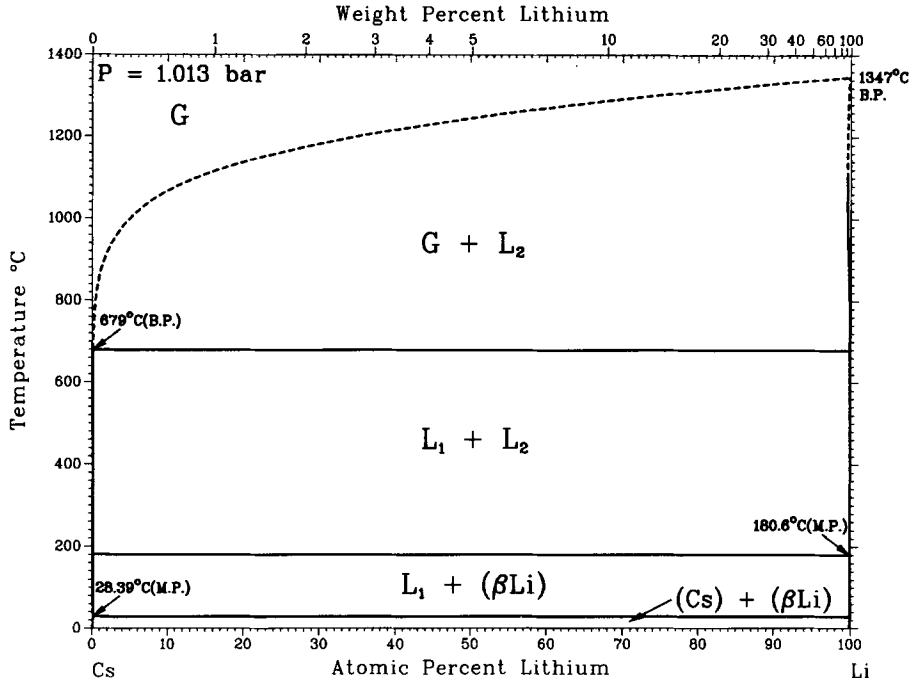
[70Nov] reported density measurements in the range 25 to 1100 °C and calculated a solubility of 7.5 wt.% Cs (42.2 at.% Cs) in Li at 1100 °C. It is unlikely that solubility is extensive at this temperature. At 1100 °C, the vapor pressure of Cs is approximately 11.3 atm, and at 1 atm a Cs-Li liquid alloy with 42.2 at.% Cs would be unstable. [70Nov] did not report the total pressure.

In Fig. 1, the Li(L_2) portion of the phase diagram up to 1100 °C was taken from Eq 1. Transition temperatures were taken from [83Cha], [King1], and [King2]. The

Table 1 Cs-Li Crystal Structure and Lattice Parameter Data

Phase	Composition, at.% Li	Pearson symbol	Space group	Strukturbericht designation	Prototype	Lattice parameters, nm a	c	Comment
(Cs)	0.00	*cI2*	$Im\bar{3}m$	*A2*	W	0.6141	...	25 °C
(αLi)	100.00	*hP2*	$P6_3/mmc$	*A3*	Mg	0.3111	0.5093	<75 K
(βLi)	100.00	*cI2*	$Im\bar{3}m$	*A2*	W	0.35093	...	25 °C

Fig. 1 Assessed Cs-Li Phase Diagram



C.W. Bale, 1989.

Table 2 Solubility of Cs in Liquid Li

Temperature, °C	Composition, at.% Cs [62Cue](a)	[62Cue](b)	Eq 1
1093	0.336	0.704	0.403
1038	0.159	0.200	0.253
982	0.174	0.179	0.151
760	0.007	0.018	0.011
181	...	...	10^{-10}

(a) First experimental run. (b) Second experimental run.

vapor phase boundary was calculated by assuming an ideal gas with P(total) = P(Li)+ P(Li_2) + P(Cs)+ P(Cs_2) = 1 atm in equilibrium with the liquid where $a_{Li(L)}$ = 1. Thermodynamic data for the gas phase calculation were taken from the compilation of [73Bar].

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