

# Al-Li-Sc (Aluminum-Lithium-Scandium)

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An isothermal section at 450 °C and three vertical sections in the Al-rich region were determined for this ternary system by [1998Fri].

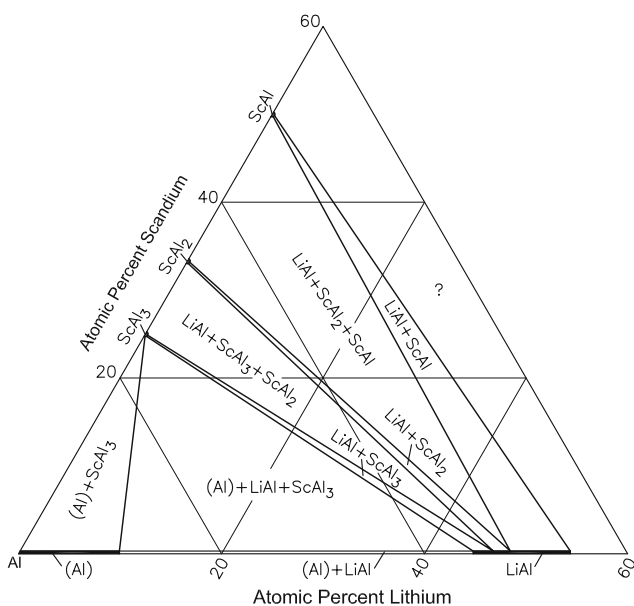
## Binary Systems

The Al-Li phase diagram [2007Hal] depicts the following intermediate phases: LiAl (45-55 at.% Li; *B32*, NaTi-type cubic),  $\text{Li}_3\text{Al}_2$  ( $\text{Bi}_2\text{Te}_3$ -type rhombohedral), and  $\text{Li}_9\text{Al}_4$  (stable below 335 °C; monoclinic and another form). The Al-Sc phase diagram [1999Cac, Massalski2] depicts the following intermediate compounds:  $\text{ScAl}_3$  (*L12*, AuCu<sub>3</sub>-type cubic),  $\text{ScAl}_2$  (*C15*, MgCu<sub>2</sub>-type cubic),  $\text{ScAl}$  (*B2*, CsCl-type cubic), and  $\text{Sc}_2\text{Al}$  (*B82*, Ni<sub>2</sub>In-type hexagonal). The Li-Sc phase diagram does not appear to have been studied.

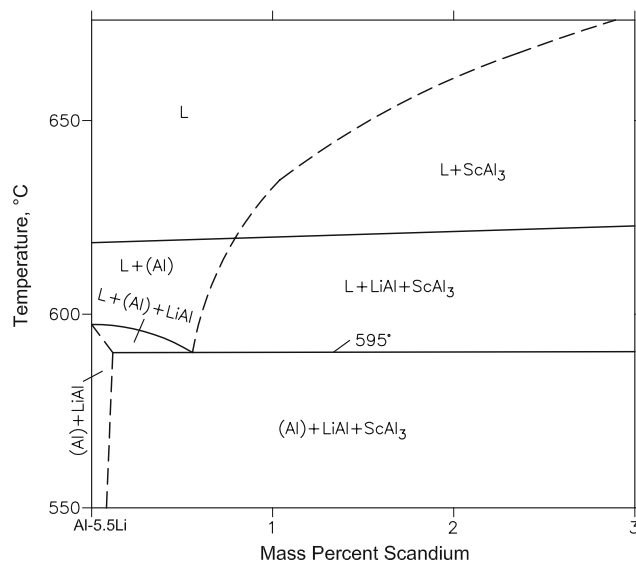
## Ternary Phase Equilibria

With starting metals of 99.99% Al, 99.8% Li, and 99.875% Sc, [1998Fri] studied a number of alloys containing up to 15 mass% Li and 65 mass% Sc. The alloys were melted in a resistance furnace under a flux cover or in an arc furnace under Ar atm. For the isothermal studies, the alloys

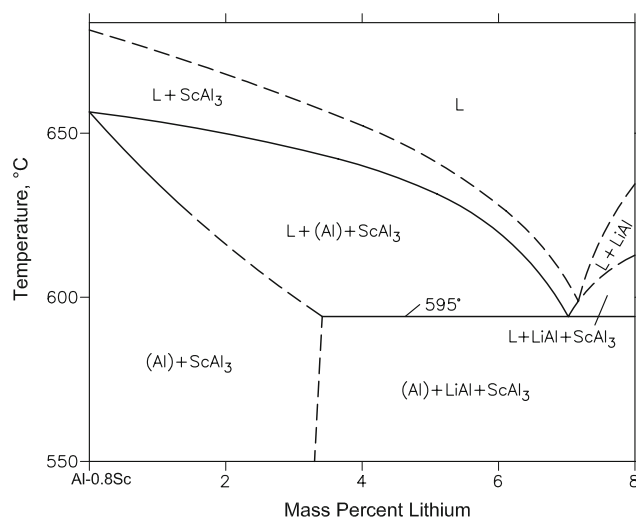
were annealed at 450 °C for 100 h and quenched in water. The phase equilibria were studied by differential thermal analysis, optical microscopy, x-ray powder diffraction, and x-ray spectral analysis. The isothermal section at 450 °C constructed by [1998Fri] is shown in Fig. 1. No ternary



**Fig. 1** Al-Li-Sc isothermal section at 450 °C for Al-rich alloys [1998Fri]

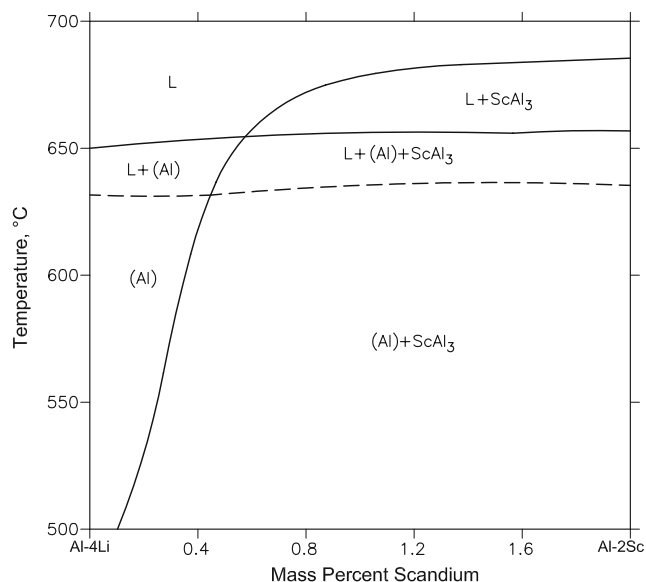


**Fig. 2** Al-Li-Sc vertical section at a constant content of 5.5 mass% Li [1998Fri]



**Fig. 3** Al-Li-Sc vertical section at a constant content of 0.8 mass% Sc [1998Fri]

## Section II: Phase Diagram Evaluations



**Fig. 4** Al-Li-Sc vertical section along the line joining Al-4 mass% Li and Al-2 mass% Sc [1998Fri]

compounds are present. The solubility of the third component in the binary compounds is very small. The metastable AuCu<sub>3</sub>-type binary phase LiAl<sub>3</sub> was not found in the ternary

alloys. The solubility of Li and Sc in Al remains practically the same in the ternary alloys as in the binary Al-Li and Al-Sc alloys.

Three vertical sections were determined by [1998Fri] in the Al-rich region shown in Fig. 2-4. The vertical section at constant contents of 5.5 mass% Li and 0.8 mass% Sc are shown in Fig. 2 and 3, respectively. Both figures depict an invariant horizontal line at 595 °C, corresponding the ternary eutectic reaction:  $L \leftrightarrow (Al) + LiAl + ScAl_3$  [1998Fri]. Figure 4 is a vertical section along the line joining Al-4 mass% Li and Al-2 mass% Sc. Here, LiAl does not appear in the equilibrium.

## References

- 1998Fri:** I.N. Fridlyander, L.L. Rokhlin, T.V. Dobatkina, V.V. Kinzhbalo, and A.T. Tyvanchuk, Phase Diagram of the Al-Li-Sc System, *Metally*, 1998, (1), p 131-135, in Russian; TR: *Russ. Metall.*, 1998, (1), p 161-166
- 1999Cac:** G. Cacciamani, P. Riani, B. Borzone, N. Parodi, A. Saccone, R. Ferro, A. Pisch, and R. Schmid-Fetzer, Thermodynamic Measurements and Assessment of the Al-Sc System, *Intermetallics*, 1999, 7(1), p 101-108
- 2007Hal:** B. Hallstedt and O. Kim, Thermodynamic Assessment of the Al-Li System, *Int. J. Mater. Res.*, 2007, 98(10), p 961-969