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Al-Li-Zr (Aluminum-Lithium-Zirconium)

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The phase equilibria of this system were computed by [1989Sau], who presented a liquidus projection and three isothermal sections at 500, 300, and 100 °C for Al-rich alloys. Recently, [2002Zat] determined an isothermal section at 197 °C, which depicts two ternary compounds.

Table 1 Al-Li-Zr crystal structure and lattice parameter data [2002Zat]

Phase	Composition, atomic %	Pearson symbol	Space group	Prototype	Lattice parameter, nm
$ZrLi_2Al$ (τ_1)	25 Al 50 Li 25 Zr	*cF*16	$F\bar{4}3m$	$CuHg_2Ti$	a = 0.6633
$Zr_{5-x}Li_{x+y}Al_3$ (τ_2) (x = 0.2 – 1, y = 0 – 1)	33.3-37.5 Al 13.3-2.5 Li 53.3-60 Zr	*hP*18	$P6_3/mcm$	Ti_5Ga_4	a = 0.81336-0.81757 c = 0.57029-0.56909
$ZrLi_xAl_{3-x}$ (x = 0.2) (a)	75-70 Al 0-5 Li 25 Zr	*tI*16	*I*4/*mmm*	···	a = 0.4014-0.4009 c = 1.7282-1.7277

(a) Solid solution based on $ZrAl_3$

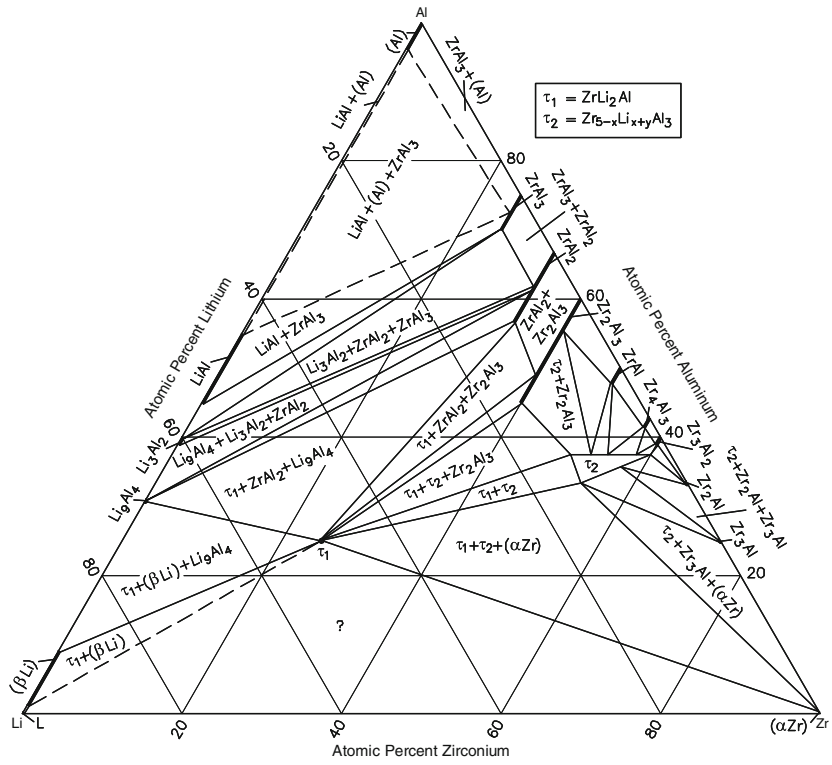

Fig. 1 Al-Li-Zr tentative isothermal section at 197 °C [2002Zat]. Narrow two-phase regions are omitted

Binary Systems

The Al-Li phase diagram [Massalski2, 1989Sau, 1991Goe] has the following intermediate phases: LiAl (45-55 at.% Li; *B*32, NaTl-type cubic), Li_3Al_2 (C33, Bi_2Te_3-type rhombohedral), Li_9Al_4 (two modifications stable below 330 °C). The Al-Zr phase diagram [Massalski2] depicts the following intermediate phases: $ZrAl_3$ ($D0_{23}$-type tetragonal), $ZrAl_2$ ($C14$, $MgZn_2$-type hexagonal), Zr_2Al_3 (Zr_2Al_3-type orthorhombic), ZrAl (B_f, CrB-type orthorhombic), Zr_5Al_4 (Ga_4Ti_5-type hexagonal), Zr_4Al_3(Ir_4Al_3-type hexagonal), Zr_3Al_2 (Zr_3Al_2-type tetragonal), Zr_5Al_3 ($D8_m$, W_5Si_3-type tetragonal), Zr_2Al ($B8_2$, Ni_2In-type hexagonal), and Zr_3Al ($L1_2$, $AuCu_3$-type cubic). There are no intermediate phases in the Li-Zr system. The mutual solubility between Li and Zr is negligible.

Ternary Compounds

Two ternary compounds were found by [2002Zat] at 197 °C: $ZrLi_2Al$ (denoted τ_1 here and as 1 by [2002Zat]) and $Zr_{5-x}Li_{x+y}Al_3$ ($x = 0.2 - 1$, $y = 0 - 1$; denoted τ_2 here and as 2 by [2002Zat]). The structural characteristics of these compounds are listed in Table 1.

Isothermal Section

With starting metals of 99.99% Al, 99.0% Li and 99.98% Zr, [2002Zat] arc-melted 65 alloys under Ar atm. The alloys were annealed at 197 °C (470 K) for 400 h and quenched in water. The phase equilibria were studied with x-ray powder diffraction. The tentative isothermal section constructed by [2002Zat] at 197 °C is shown in Fig. 1. The phase relationships near the Li-Zr side are not known. The ternary compounds τ_1 and τ_2 are present. The binary compounds $ZrAl_3$, $ZrAl_2$ and Zr_2Al_3 dissolve 5, 10 and 15 at.% Li respectively, with Li substituting for Al. The variation in the lattice parameters of $ZrAl_3$ with Li content is listed in Table 1.

References

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