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Ag-Al-La (Silver-Aluminum-Lanthanum)

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Kuzma et al. [1995Kuz] determined an isothermal section for this system at 397 °C (670 K), which depicts five ternary compounds.

Binary Systems

The Ag-Al phase diagram [Massalski2] depicts three intermediate phases: Ag_3Al (20.5-29.8 at.% Al; denoted β, body-centered cubic; stable between 778 and ~600 °C), Ag_2Al (22.9-41.9 at.% Al; denoted δ, close-packed hexagonal), and μ (21-24 at.% Al, stable below 450 °C; *A*13, βMn-type cubic). The Ag-La phase diagram [2001Oka] has the following intermediate phases: βAg_5La, αAg_5La ($MgZn_2$-type?), $Ag_{51}La_{14}$ ($Ag_{51}Gd_{14}$-type hexagonal), Ag_2La ($CeCu_2$-type orthorhombic), and AgLa (*B*2, CsCl-type cubic). The Al-La phase diagram [2006Zho] depicts the following intermediate phases: La_3Al ($D0_{19}$, Ni_3Sn-type hexagonal), LaAl (CeAl-type orthorhombic), $LaAl_2$ (*C*15, $MgCu_2$-type cubic), La_3Al_7 (stable between 1240 and 1091 °C; *C*32, AlB_2-type hexagonal), $LaAl_3$ (Ni_3Sn-type hexagonal), βLa_3Al_{11} ($D1_3$, Al_4Ba-type tetragonal), and αLa_3Al_{11} (αLa_3Al_{11}-type orthorhombic).

Ternary Phases

The ternary compounds of this system τ_1 to τ_5 (denoted 1-5 by [1995Kuz) that are present at 397 °C (670 K) are listed in Table 1. An additional ternary compound $La(Ag_{0.38}Al_{0.62})_3$ (see Table 1) found at 597 °C was not stable at 397 °C [1995Kuz]. The ternary solid solutions based on the binary compounds $Ag_{51}La_{14}$, Ag_2La and AgLa dissolve 5.8, 32.3 and 17 at.% Al respectively. The compounds αLa_3Al_{11}, and $LaAl_2$ dissolve 5.7 and 10 at.% Ag respectively [1995Kuz].

Isothermal Section

With starting metals of 99.9% Ag, 99.99% Al, and 99.5% La, [1995Kuz] arc-melted under Ar atm 95 alloys. The alloys were annealed at 397 °C (670 K) for 700-1000 h and quenched in water. The phase equilibria were studied by x-ray powder diffraction. The isothermal section at 397 °C constructed by [1995Kuz] is redrawn in Fig. 1, to agree with the accepted binary data. The μ phase present along the Al-Ag side was omitted by [1995Kuz]. The locations of τ_1 to τ_5 shown in Fig. 1 are at the values listed by [1995Kuz]. Due to some difference between the listed value of τ_3 and that shown in the figure drawn by [1995Kuz], the triangulations of ($\tau_1 + \tau_2 + \tau_3$) and ($\tau_2 + \tau_3 + \tau_4$) appear in Fig. 1, in place of ($\tau_1 + \tau_3 + \tau_4$) and ($\tau_1 + \tau_2 + \tau_4$) shown in the figure of [1995Kuz].

Table 1 Ag-Al-La crystal structure and lattice parameter data [1995Kuz]

Phase	Composition, at.%	Pearson symbol	Space group	Prototype	Lattice parameter, nm
$La(Ag_{0.55}Al_{0.45})_{11}$ (τ_1)	50.4 Ag 41.3 Al 8.3 La	*tI*48	$I4_1/amd$	$BaCd_{11}$	a = 1.1065 c = 0.7123
$La_{1.6}(Ag_{0.44}Al_{0.56})_{17}$ (τ_2)	40.2 Ag 51.2 Al 8.6 La	*hP*38	$P6_3/mmc$	$Ni_{17}Th_2$	a = 0.9408 c = 1.3681
$La_2(Ag_{0.52\text{-}0.65}Al_{0.48\text{-}0.35})_{17}$ (τ_3)	46.5-58.2 Ag 42.9-31.3 Al 10.5 La	*hR*19	$R\bar{3}m$	$Zn_{17}Th_2$	a = 0.9448* c = 0.9144
$La(Ag_{0.55\text{-}0.76}Al_{0.45\text{-}0.24})_5$ (τ_4)	45.8-63.3 Ag 37.5-20Al 16.7 La	*hP*6	$P6/mmm$	$CaCu_5$	a = 0.5568* c = 0.4468
$La(Ag_{0.16\text{-}0.29}Al_{0.84\text{-}0.71})_4$ (τ_5)	12.8-23.2 Ag 67.2-56.8 Al 20 La	*tI*10	$I4/mmm$	Al_4Ba	a = 0.4361* c = 1.1037
$La(Ag_{0.33}Al_{0.67})_3$	25 Ag 50 Al 25 La	*hR*12	$R\bar{3}m$	$PuNi_3$	a = 0.57013 c = 2.7166

*Lattice parameters are at $La_2Ag_{8.84}Al_{8.16}$, $LaAg_{2.75}Al_{2.25}$, and $LaAg_{0.64}Al_{3.36}$, respectively

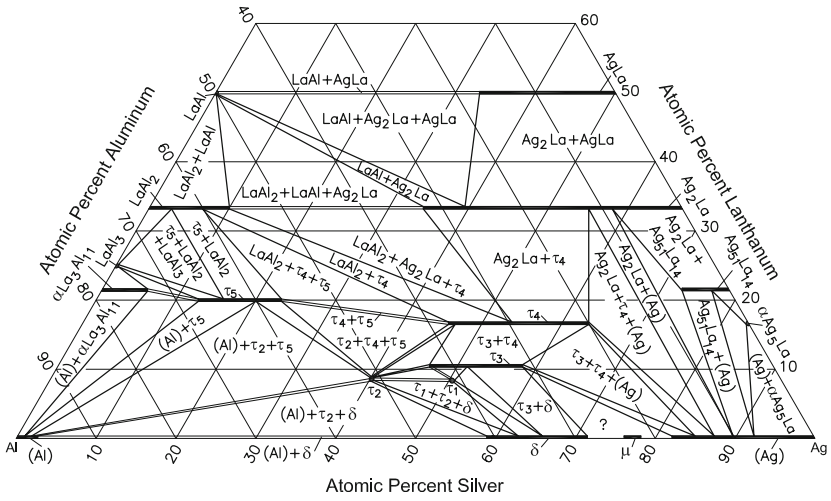

Fig. 1 Ag-Al-La isothermal section at 397 °C [1995Kuz]

References

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