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Ag-Al-Tb (Silver-Aluminum-Terbium)

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Recently, [2001Gum] determined an isothermal section for this system at 597 °C (870 K), which depicts eight ternary compounds.

Binary Systems

The Ag-Al phase diagram 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-Tb diagram depicts the following intermediate phases: $Ag_{51}Tb_{14}$ ($Ag_{51}Gd_{14}$-type hexagonal), Ag_2Tb ($C11_b$, $MoSi_2$-type tetragonal), and AgTb (*B*2, CsCl-type cubic). The Al-Tb phase diagram depicts the following intermediate phases: Tb_2Al (*C*23, Co_2Si-type orthorhombic), Tb_3Al_2 (Zr_3Al_2-type tetragonal), TbAl (ErAl-type orthorhombic), $TbAl_2$ (*C*15, $MgCu_2$-type cubic), and $TbAl_3$ ($BaPb_3$-type or $HoAl_3$-type rhombohedral). See [Massalski2] for the above diagrams.

Ternary Phases

The known ternary compounds of this system are listed in Table 1 from [2001Gum]. The compounds labeled τ_1 to τ_8 (denoted 1 to 8 by [2001Gum]) are present at 597 °C (870 K). The last-listed compound $TbAgAl_3$ was not found at 597 °C by [2001Gum]. It may be noted that $TbAgAl_3$ and $Tb_3Ag_{2.5}Al_{8.5}$ (τ_6) are both derivatives of Al_4Ba-type of structure. Among the binary phases, AgTb and $TbAl_2$ dissolve 25 at.% Al and 8 at.% Ag respectively.

Table 1 Ag-Al-Tb crystal structure and lattice parameter data [2001Gum]

Phase	Composition, at.%	Pearson symbol	Space group	Prototype	Lattice parameter, nm
$TbAg_{5.2\text{-}5.8}Al_{6.8\text{-}6.2}$ (τ_1)	40-44.6 Ag 52.3-47.7 Al 7.7 Tb	*tI*26	*I*4/*mmm*	$ThMn_{12}$	*a* = 0.9142 *c* = 0.5444
$Tb_{1.8}Ag_{8.0\text{-}8.6}Al_{9.0\text{-}8.4}$ (τ_2)	42.6-45.7 Ag 47.9-44.7 Al 9.6 Tb	*hP*38	*P*6$_3$/*mmc*	Th_2Ni_{17}	*a* = 0.92815* *c* = 0.90715
$Tb_8Ag_{21.1}Al_{44.9}$ (τ_3)	28.5 Ag 60.7 Al 10.8 Tb	*tI*?	*I*4/*mmm*	$Yb_8Cu_{17}Al_{49}$	*a* = 0.88099 *c* = 1.6771
$TbAg_{2.4\text{-}3.0}Al_{2.8\text{-}2.2}$ (τ_4)	38.7-48.4 Ag 45.2-35.5 Al 16.1 Tb	*hP*?	*P*6$_3$/*mmc*	$DyAg_{2.4}Al_{2.6}$	*a* = 0.91739* *c* = 0.94151
~ $Tb_{18}Ag_{57}Al_{25}$ (τ_5)	57 Ag 25 Al 18 Tb	...	...	...	...
$Tb_3Ag_{2.5}Al_{8.5}$ (τ_6)	17.9 Ag 60.7 Al 21.4 Tb	*oI*28	*Immm*	αLa_3Al_{11}	*a* = 0.43026 *b* = 1.25972 *c* = 1.00160
$TbAg_{0.9}Al_{2.1}$ (τ_7)	22.5 Ag 52.5 Al 25 Tb	*hR*12	*R*$\bar{3}$*m*	$PuNi_3$	*a* = 0.55461 *c* = 2.6286
$TbAg_{1.1}Al_{0.9}$ (τ_8)	36.7 Ag 30 Al 33.3 Tb	*oI*12	*Imma*	$CeCu_2$	*a* = 0.45866 *b* = 0.71666 *c* = 0.78652
$TbAgAl_3$	20 Ag 60 Al 20 Tb	*oI*?	*Immm*	*o*-$CeNi_2Sb_2$	*a* = 0.4304 *b* = 0.4189 *c* = 1.0003

* Lattice parameters are for $Tb_{1.8}Ag_{8.6}Al_{8.4}$ and $TbAg_{2.7}Al_{2.5}$, respectively

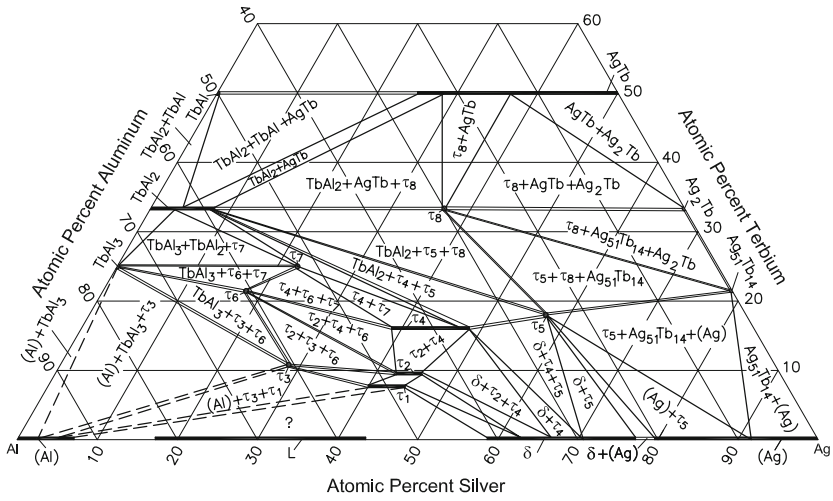

Fig. 1 Ag-Al-Tb isothermal section at 597 °C (870 K) [2001Gum]

Isothermal Section

With starting metals of 99.95% Ag, 99.95% Al, and 99.5% Tb, [2001Gum] arc-melted under Ar atm 49 alloys with Tb content up to 50 at.%. The alloys were annealed at 597 °C (870 K) for ~1000 h and quenched in water. The phase equilibria were studied with x-ray powder diffraction. The isothermal section at 597 °C is redrawn in Fig. 1, to agree with the accepted binary data. The compositions of the ternary phases shown in Fig. 1 are from the listed values of [2001Gum].

References

2001Gum: R.V. Gumeniuk, B.M. Stelmakhovych, and Yu.B. Kuzma, The Tb-Ag-Al System, *J. Alloys Compd.*, 2001, **321**, p 132-137