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Al-Mg-Ni (Aluminum-Magnesium-Nickel)

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The early work on this system reviewed by [1993Pri] presented a vertical section along the Mg_2Al_3-$NiAl_3$ join and a liquidus projection in the Al-rich region. Recently, [2008He] determined two isothermal sections for this system at 700 and 427 °C, which depict the ternary compound Ni_2Mg_3Al (denoted τ here).

Binary Systems

The Al-Mg phase diagram [1998Lia] has the following intermediate phases: Mg_2Al_3 (cubic, labeled β), R or ε (rhombohedral), and $Mg_{17}Al_{12}$ (*A*12, αMn-type cubic, denoted γ). The Al-Ni phase diagram [1993Oka] shows five intermediate phases: $NiAl_3$ ($D0_{11}$, Fe_3C-type orthorhombic), Ni_2Al_3 ($D5_{13}$-type hexagonal, denoted δ), NiAl (*B*2, CsCl-type cubic, denoted β), Ni_5Al_3 (Ga_3Pt_5-type orthorhombic), and Ni_3Al ($L1_2$, $AuCu_3$-type cubic, denoted γ′). The Mg-Ni phase diagram [Massalski2] depicts two intermediate compounds: Mg_2Ni (hexagonal, space group $P6_222$) and $MgNi_2$ (*C*36-type hexagonal).

Ternary Isothermal Sections

With starting metal powders of 99.5% Al, 99.5% Mg, and 99.9% Ni, [2008He] sintered 14 ternary powder compacts, which were given a final anneal at 700 °C for 20 d or at 427 °C for 25 d and quenched in water. The phase equilibria were studied with x-ray powder diffraction, optical and scanning electron microscopy. The local phase compositions were measured by energy dispersive x-ray spectroscopy or electron probe microanalysis and listed. The isothermal sections at 700 and 427 °C constructed by [2008He] are redrawn in Fig. 1 and 2 to agree with the accepted binary data. The dotted phase boundaries are tentative, as no experimental measurements were done in the region, where liquid or (Ni) is present. The ternary phase τ (Ni_2Mg_3Al; $NiTi_2$-type cubic, with a = 1.15742 nm) is present at the stoichiometric composition at 700 °C. At 427 °C, it has a small homogeneity region with a lattice parameter range of a = 1.15563-1.15733 nm. At 700 °C (Fig. 1), NiAl dissolves ~17 at.% Mg and $MgNi_2$ dissolves ~10 at.% Al. At 427 °C (Fig. 2), NiAl and Ni_2Al_3 dissolve ~ 16 and 2.5 at.% Mg [2008He]. $MgNi_2$ dissolves ~ 10 at.% Al. The solubility of Mg in NiAl indicated in Fig. 1 and 2 is, however, lower than

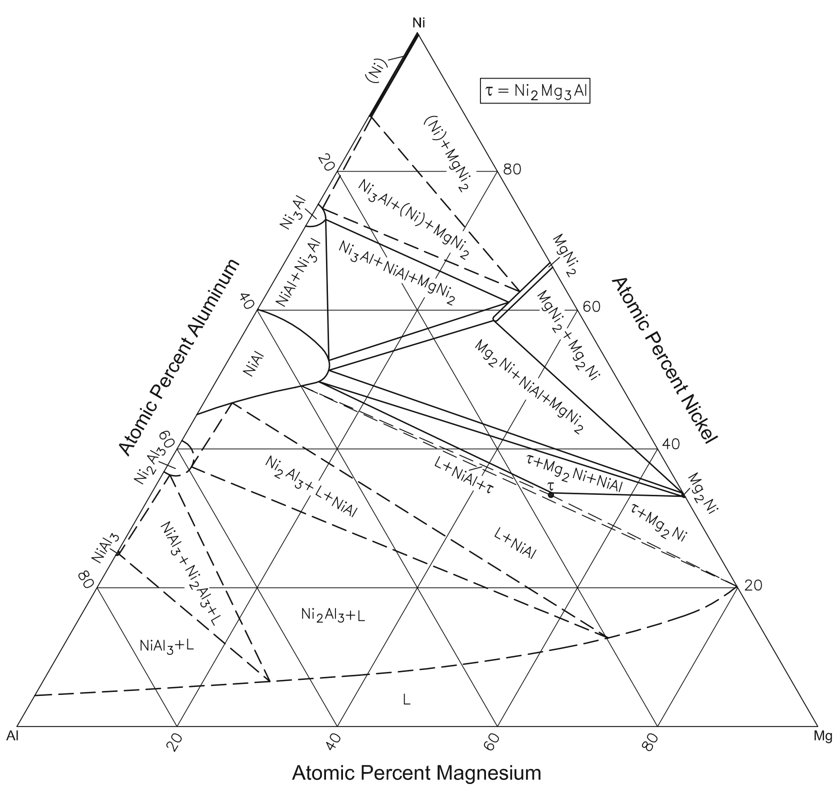

Fig. 1 Al-Mg-Ni isothermal section at 700 °C [2008He]

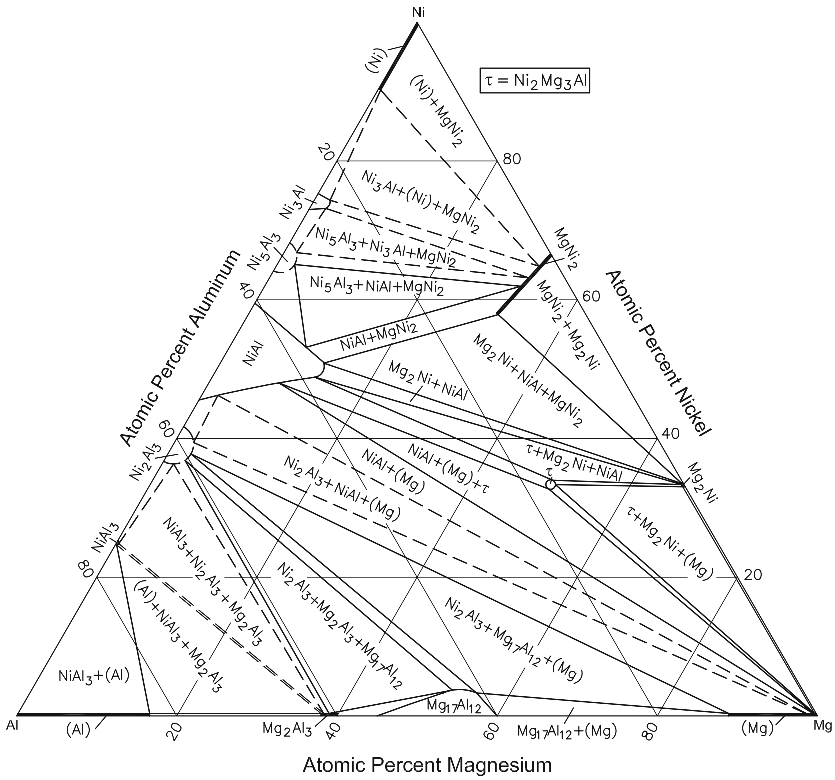

Fig. 2 Al-Mg-Ni isothermal section at 427 °C [2008He]

16-17 at.% and is as given in the figures of [2008He]. In the samples annealed at 427 °C, two weak diffraction peaks were seen, which were indexed as MgO. This oxygen contamination was attributed to residual oxygen or moisture in the samples during processing.

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