Al-Cu-Mg-Zr (Aluminum-Copper-Magnesium-Zirconium)

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Recently, [2011Rok] determined an isothermal section for this quaternary system in the Al-rich region at 490 °C and at 0.3 mass% Zr. Earlier, [1992Dob] had reported a vertical section at 0.3 Zr and 4 Cu (mass%).

Lower Order Systems

For brief descriptions of the binary systems, see [Massalski2]. The binary compounds CuAl_2 (C16-type tetragonal, denoted θ) and ZrAl_3 ($D0_{23}$ -type tetragonal) are present in the Al-rich alloys investigated by [2011Rok]. Four ternary phases, besides Laves phase modifications, are known in the Al-Cu-Mg system, see [2007Rag] for an update. Among these, CuMgAl_2 (BRe_3 -type orthorhombic, denoted S) appears in the Al-rich quaternary alloys [2011Rok]. There are ten ternary phases in the Al-Cu-Zr system [2011Rag], but none of them were found in the quaternary alloys of [2011Rok]. The experimental data on the Al-Mg-Zr system were compiled by [1995Vil]. No ternary phases are known in this system.

Quaternary Phase Equilibria

With starting metals of 99.99% Al, 99.96% Cu, 99.96% Mg and 99.8% Zr, [2011Rok] melted quaternary alloys in a resistance furnace, using prior-made Al-Cu and Al-Zr master alloys and a flux covering to prevent Mg evaporation. The alloys were given a final anneal at 490 °C for 15 h and quenched in water. The phase equilibria were studied with optical microscopy, x-ray powder diffraction and electron probe microanalysis. The measured compositions of the co-existing phases were listed for one ternary alloy and two quaternary alloys. The isothermal section constructed by [2011Rok] at 490 °C and at 0.3 mass% Zr in the Al-rich region is shown in Fig. 1. The binary compounds CuAl_2 (θ) and ZrAl_3 and the ternary phase CuMgAl_2 (S) are present. The component concentrations in the compounds

Fig. 1 Al-Cu-Mg-Zr isothermal section in the Al-rich region at 490 °C and at 0.3 mass% Zr [2011Rok]

were near stoichiometric values, with no solubility of other components. A four-phase field of $(\text{Al}) + \theta + \text{S} + \text{ZrAl}_3$ is seen in Fig. 1.

References

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