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Al-Si-Sm (Aluminum-Silicon-Samarium)

V. Raghavan

Recently, [2001Mar] determined a liquidus projection for Al-rich alloys of this ternary system.

Binary Systems

The Al-Si phase diagram is a simple eutectic system with the eutectic reaction at 577 °C and 12.2 at.% Si. In the Al-Sm system [Massalski2], the following intermediate phases are known: $Al_{11}Sm_3$ ($D1_3$, Al_4Ba-type tetragonal), Al_3Sm ($D0_{19}$, Ni_3Sn-type hexagonal), Al_2Sm ($C15$, $MgCu_2$-type cubic), AlSm (AlEr-type orthorhombic), and $AlSm_2$ ($C23$, Co_2Si-type orthorhombic). The Si-Sm phase diagram [Massalski2] depicts the following compounds: Sm_5Si_3 ($D8_8$, Mn_5Si_3-type hexagonal), Sm_5Si_4 (Sm_5Ge_4-type tetragonal), SmSi ($B27$, FeB-type orthorhombic), Sm_3Si_5 ($C32$, AlB_2-type hexagonal), $\alpha SmSi_2$ ($\alpha GdSi_2$-type orthorhombic), and $\beta SmSi_2$ (C_c, $\alpha ThSi_2$-type tetragonal).

Ternary Phase Equilibria

Two ternary phases Al_2Si_2Sm and Al_3SiSm_6 (tetragonal, space group $I4/mcm$, a = 1.178 nm and c = 1.534 nm) were previously reported in this system. [2001Mar] reported an additional phase at the composition AlSiSm, with the $\alpha ThSi_2$-type tetragonal structure and lattice parameters of a = 0.4155 nm and c = 1.4428 nm. It is not known whether this phase originates from the binary phase $\beta SiSm_2$ with the same structure.

With starting metals of 99.997% Al, 99.999% Si, and 99.9% Sm, [2001Mar] melted 30 Al-rich ternary alloys, using previously-prepared Al-Si and Al-Sm master alloys. Differential thermal analysis was carried out at a cooling rate of 5 °C/min. The phase equilibria were studied with optical and scanning electron microscopy, energy dispersive x-ray spectroscopy, and x-ray diffraction. Based on the results, [2001Mar] constructed a partial liquidus surface for Al-rich alloys, shown in Fig. 1. The primary phases of crystallization are (Al), (Si), Al_3Sm, AlSiSm and Al_2Si_2Sm. Three four-phase invariant reactions were found on the liquidus surface. U_1, U_2, and E occur at 625, 585, and 567 °C respectively.

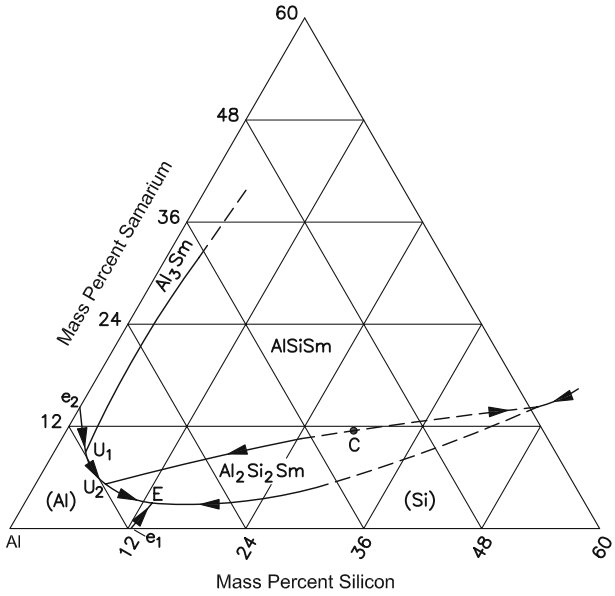

Fig. 1 Al-Si-Sm partial liquidus projection for Al-rich alloys [2001Mar]

Reference

2001Mar: B. Markoli, S. Spaic, and F. Zupanic, The Constitution of Alloys in the Al-Rich Corner of the Al-Si-Sm Ternary System, *Z. Metallkd.*, 2001, **92**(9), p 1098-1102