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Al-C-Si (Aluminum-Carbon-Silicon)

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The previous experimental work on this system includes the efforts of [1987Ode], [1988Lee] and [1990Via]. The compilation by [1995Vil] presented a liquidus projection, isothermal sections at 2150, 2000, 900, 572, 557, and 500 °C and vertical sections along the Al_4C_3-SiC and Al-SiC joins. [1996Gro] reported a thermodynamic assessment of this system and computed isothermal sections at 2150 and 2000 °C, a vertical section along Al_4C_3-SiC join and a liquidus projection.

Binary Systems

The Al-C system depicts the stoichiometric compound Al_4C_3 ($D7_1$-type rhombohedral). The Al-Si phase diagram is a simple eutectic system with the eutectic reaction at 577 °C and 12.2 at.% Si. The C-Si phase diagram [Massalski2] depicts a stoichiometric phase SiC. The stable modification is βSiC ($B3$, sphalerite-type cubic).

Ternary Compounds

Two ternary compounds along the Al_4C_3-SiC join have been reported at $Al_4C_3 \cdot SiC$ (Al_5C_3N-type hexagonal; a = 0.32771 nm and c = 2.1676 nm, denoted τ_1 here) and at $2Al_4C_3 \cdot SiC$ (τ_2; $hP16$, a = 0.33127 nm and c = 1.9242 nm). The third reported phase at $Al_4C_3 \cdot 2SiC$ has not been confirmed. Also, no polymorphic transformation in $Al_4C_3 \cdot SiC$ has been confirmed.

Computed Phase Equilibria

In their thermodynamic description of this system, [1996Gro] modeled the liquid as a solution phase, using the interaction parameters for the liquid from the binary systems. The small solubilities of the other components in (Al), (Si) and Al_4C_3 were taken into account. The ternary compounds $Al_4C_3 \cdot SiC$ and $2Al_4C_3 \cdot SiC$ and SiC were treated as stoichiometric compounds and their Gibbs energy descriptions were obtained from heat capacity data. Two isothermal sections at 2150 and 2000 °C, a liquidus projection, and a vertical section along the Al_4C_3-SiC join were computed by [1996Gro]. The two isothermal sections are compared with the experimental data of [1987Ode] in Fig. 1 and 2. The agreement is satisfactory.

Recently, [2000Aks] demonstrated the use of the Al-C-Si phase equilibria below 1000 °C to the microstructural analysis of metal matrix composites containing particles or fibers of SiC.

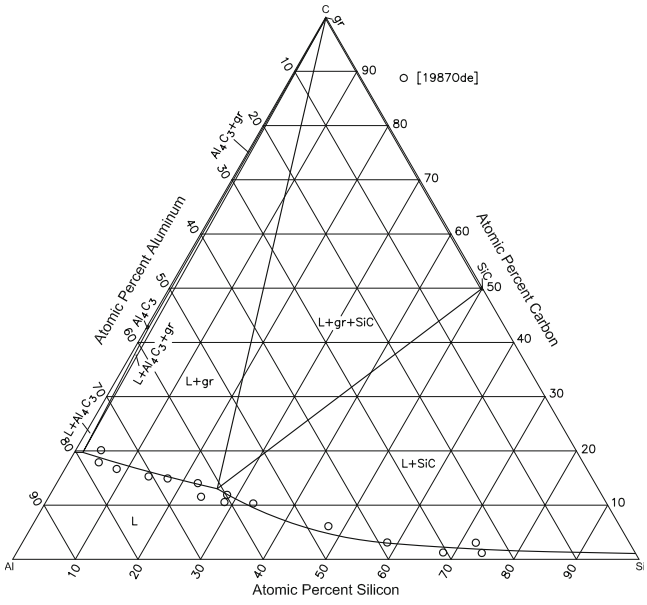

Fig. 1 Al-C-Si computed isothermal section at 2150 °C [1996Gro]

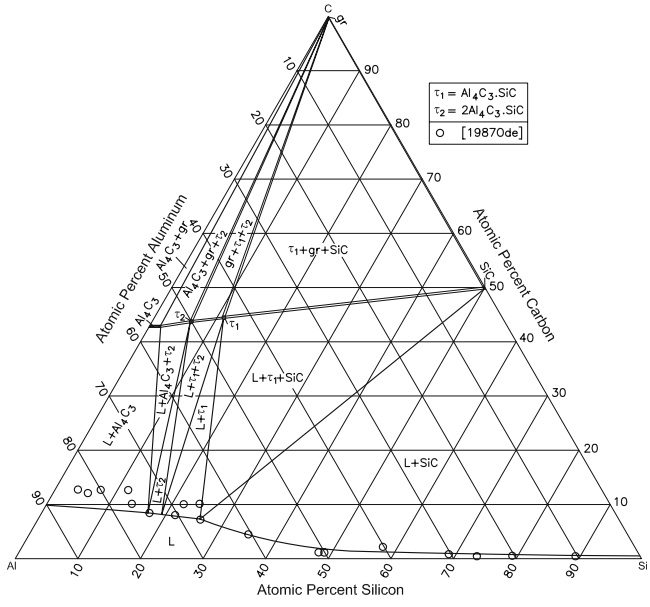

Fig. 2 Al-C-Si computed isothermal section at 2000 °C [1996Gro]

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