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Al-C-Cr-Fe-Mo (Aluminum-Carbon-Chromium-Iron-Molybdenum)

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Recently, [2008Kob] combined the diffusion-multiple technique with a precipitation anneal to determine the phase equilibria in the pseudo-quaternary system Fe_3Al-C-Cr-Mo at 800 °C.

Pseudo-Quaternary Phase Equilibria

Starting with high purity metals, [2008Kob] induction melted three ternary alloys Fe-26Al-5Cr, Fe-27Al-10Mo, and Fe-27Al-2C (at.%) to form the end members of the diffusion multiple. The assembly was first annealed at 1200 °C for 24 h, where Cr, Mo, and C dissolve in the *B*2 (Fe_3Al) matrix. The second anneal of a portion of the assembly was at 800 °C for 300 h to allow the precipitation of carbides. The microstructures were examined by optical microscopy and high resolution scanning electron microscopy. The compositions of the phases coexisting at the interfaces were measured by energy dispersive spectroscopy, with structure identification by electron backscatter diffraction.

The phases that occur in the composition range studied by [2008Kob] are Fe_3Al (*B*2, CsCl-type cubic) as the matrix phase and the precipitating carbide phases as described below. Fe_3AlC (denoted κ) has the $E2_1$ or $L'1_2$-type cubic structure, with C atoms in the octahedral voids of the $AuCu_3$-type cell. Cr_7C_3 has the $D10_1$-type orthorhombic structure. M_6C is $E9_3$-type carbide, with M = Al, Cr, Fe, and Mo. It occurs at two different compositions denoted M_6C (H) (high C and Cr) and M_6C (L) (low C and Cr). The M_2C-type carbide is not in equilibrium with the *B*2 matrix at 800 °C.

Partial isothermal tetrahedra were constructed by [2008Kob] at 800 °C. At Cr-rich compositions, the four-phase equilibrium of M_6C (H) + M_6C (L) + Cr_7C_3 + *B*2 was identified, Fig. 1. The compositions (in atomic percent) listed by [2008Kob] for the four co-existing phases are—M_6C(H): 14.5Fe13.6Al9.7Cr45Mo17.2C, M_6C(L): 22.1Fe 16.4Al3.3Cr45Mo13.2C, Cr_7C_3: 16.3Fe1.0Al50.5Cr2.2Mo30C, and *B*2 matrix: 68.6Fe27.9Al2.6Cr0.9Mo. At Cr-poor compositions, Fe_3AlC is stable and two four-phase equilibria were identified (Fig. 2): M_6C (H) + Cr_7C_3 + Fe_3AlC + *B*2 and M_6C (H) + M_6C (L) + Fe_3AlC + *B*2.

Reference

2008Kob: S. Kobayashi and S. Zaefferer, Determination of Phase Equilibria in the Fe_3Al-Cr-Mo-C Semi-Quaternary System Using a New Diffusion-Multiple Technique, *J. Alloys Compd.*, 2008, **452**, p 67-72

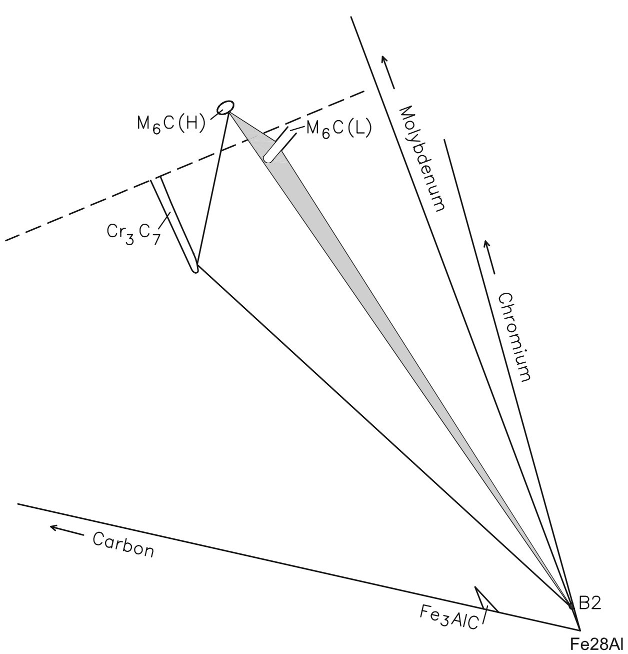

Fig. 1 Fe_3Al-Cr-Mo-C pseudo-quaternary partial phase equilibrium at 800 °C (Cr rich compositions) [2008Kob]

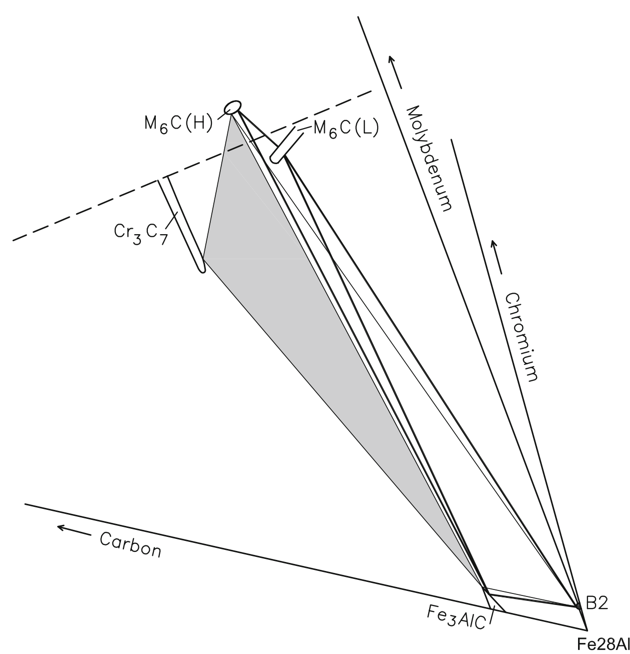

Fig. 2 Fe_3Al-Cr-Mo-C pseudo-quaternary partial phase equilibrium at 800 °C (Cr poor compositions) [2008Kob]