Cr-Fe-Y (Chromium-Iron-Yttrium)

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The study of this ternary system by [1959Far] was reviewed by [1992Rag], who presented two tentative isothermal sections at ~ 1240 and 600 °C. Recently, [2010He] reinvestigated this system at 500 °C and confirmed the presence of a previously-reported ternary compound $(\text{Fe,Cr})_{12}\text{Y}$.

Binary Systems

In the Fe-Cr phase diagram, a gamma loop restricts the fcc region to about 12 at.% Cr. The bcc α phase is stable over a large region. The intermediate phase σ ($D8_b$ -type

tetragonal) forms from α at 820 °C around the mid-composition and decomposes eutectoidally at 545 °C to Fe-rich bcc (α) and Cr-rich bcc (α') phases. The Fe-Y system is characterized by the presence of four compounds: Fe_2Y ($C15$, MgCu_2 -type cubic), Fe_3Y (Be_3Nb -type rhombohedral), Fe_{23}Y_6 ($D8_a$, $\text{Mn}_{23}\text{Th}_6$ -type cubic) and Fe_{17}Y_2 ($\text{Ni}_{17}\text{Th}_2$ -type hexagonal or $\text{Th}_2\text{Zn}_{17}$ -type rhombohedral). The Cr-Y system is of the simple eutectic type with no intermediate phases.

Ternary Isothermal Section

With starting metals of 99.9% Cr, 99.99% Fe and 99.9% Y, [2010He] arc-melted under Ar atm 188 alloys. The alloys were given a final anneal at 500 °C for 10 days and quenched in liquid nitrogen. The phase equilibria were studied with x-ray powder diffraction, differential thermal analysis, and scanning electron microscopy equipped with energy dispersive x-ray spectroscopy.

The isothermal section constructed by [2010He] is shown in Fig. 1. The previously-reported compound $\text{YFe}_{12-x}\text{Cr}_x$ ($x = 2.1-3.4$) (ThMn_{12} -type tetragonal) is present. The other known compound $\text{Y}_3(\text{Fe,Cr})_{29}$ was not found at 500 °C [2010He]. The binary compounds Fe_{17}Y_2 , Fe_{23}Y_6 and Fe_2Y dissolve up to 18, 6 and 6 at.% Cr respectively.

Fig. 1 Cr-Fe-Y isothermal section at 500 °C [2010He]. Narrow two-phase regions are omitted

References

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