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C-Co-Fe (Carbon-Cobalt-Iron)

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The review of this ternary system by [1988Ray] presented a liquidus projection, an isothermal section at 1000 °C for Fe-rich alloys and polythermal sections at ~5.5 mass% Co in the austenitic range and at 0.2, 0.7 and 4.75 mass% Co in the ferritic range. The computed phase equilibria of [1988Gui] and a reaction sequence were presented by [1994Rag]. The melting equilibria in the Fe-rich region under high pressure determined by [1994Koc] were reviewed in the update by [2002Rag]. Recently, [2008Had] redetermined the liquidus lines near the Fe corner and confirmed the presence of a minimum on the (L + fcc + graphite) univariant line.

Binary Systems

The C-Co phase diagram is a simple eutectic system with no stable intermediate phases. The Fe-C phase diagram is in the form of a double diagram, corresponding to the metastable equilibrium with cementite (Fe_3C) or the stable equilibrium with graphite (gr). In the stable diagram, the peritectic reaction at 1493 °C yields austenite (fcc). This is followed by the eutectic reaction at 1153 °C, which yields (fcc + gr). The eutectoidal decomposition of austenite occurs at 740 °C, yielding [ferrite (bcc) + gr]. The Co-Fe phase diagram is characterized by an extremely narrow solidification range. The continuous fcc phase forms through a peritectic reaction at 1499 °C and is stable over a wide range of temperature. The fcc → bcc transformation temperature of Fe is initially raised by the addition of Co, reaching a maximum at 985 °C. At 730 °C, the bcc phase of equiatomic composition orders to a CsCl-type *B*2 structure.

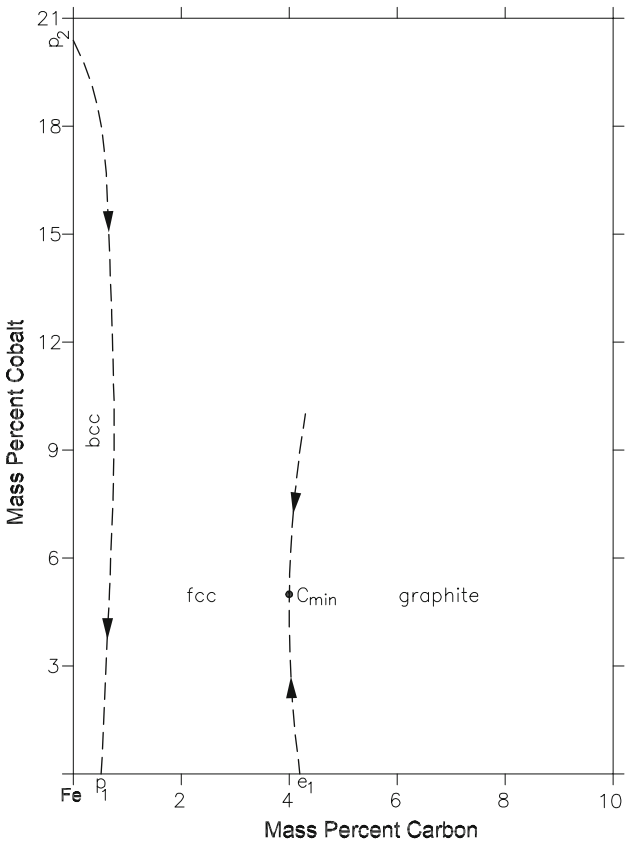

Fig. 1 C-Co-Fe liquidus projection near the Fe corner [2008Had]

Liquidus Projection of Fe-Rich Alloys

With starting metals of 99.98% Fe, 99.5% Co and graphite, [2008Had] arc-melted under Ar atm eight Fe-rich ternary alloys with Co and C contents up to 10 and 4.2 mass% respectively. Differential thermal analysis was carried out at a cooling rate of 10 °C per min. Optical and scanning electron metallography and x-ray powder diffraction were used to identify the phases. The partial liquidus projection for Fe-rich alloys constructed by [2008Had] is shown in Fig. 1. It is in agreement with that reviewed by [1988Ray] and that computed by [1988Gui]. The peritectic univariant line gently descends from the Fe-Co side to the Fe-C side. The eutectic univariant line shows a minimum at the critical point C_{min} at 1150 °C.

References

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