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Cu-Fe-Zn (Copper-Iron-Zinc)

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In their early work, [1934Bau] investigated Cu-rich alloys containing a few mass% of Fe and presented a number of isothermal and vertical sections. Later, [1992Rag] reviewed and presented full isothermal sections at 1000 and ~700 °C from the studies of [1980Bud]. In a recent update, [2008Rag] briefly reviewed an isothermal section at 460 °C near the Zn corner from the work of [2008Ave]. A thermodynamic description applicable to Cu-rich alloys was developed by [2008Mie].

Binary Systems

There are no intermediate phases in the Cu-Fe system. A metastable liquid miscibility gap has been experimentally measured in this system. The Cu-Zn phase diagram [Massalski2] is characterized by a series of peritectic reactions, which yield CuZn (β, bcc), CuZn (β′, CsCl-type cubic), Cu_5Zn_8 (γ, $D8_2$-type cubic), $CuZn_3$ (δ, $B2$, CsCl-type cubic), and $CuZn_4$ (ε, cph). The intermediate phases in the Fe-Zn system [Massalski2] are: Γ (Fe_3Zn_{10}; Cu_5Zn_8-type cubic), Γ_1 ($Fe_{11}Zn_{40}$; cubic, space group $F\bar{4}3m$, 408 atoms/cell), δ ($FeZn_{10}$; $FeZn_{10}$-type hexagonal), and ζ ($CoZn_{13}$-type monoclinic).

Computed Ternary Phase Equilibria

In the thermodynamic description, [2008Mie] modeled the liquid, face centered cubic (fcc), body centered cubic (bcc), close packed hexagonal (cph), and the cubic γ phase of the Cu-Zn binary system as substitutional solutions. Ternary interaction parameters were introduced for the liquid, fcc, and bcc phases. It is doubtful whether a single lattice description is applicable to the γ phase, which has the Cu_5Zn_8-type of structure with a homogeneity range. The Fe-Zn binary compounds were treated as stoichiometric compounds, with nil solubility of the third component. Experimental data on phase equilibria from [1934Bau] and [1952Haw] and data on the Zn activity in liquid solutions from [1987Ryc] were used in the optimization.

A liquidus projection, two full isothermal sections at 1200 and 1000 °C, six isothermal sections for Cu-rich alloys at 900, 800, 700, 672, 600, and 500 °C were computed. Also, four vertical sections at 0.5 and 0.9 mass% Fe and at 64 and 75 mass% Cu, respectively, were computed. The computed sections were compared mainly with the experimental data of [1934Bau]. As examples, the full isothermal section at 1000 °C, the Cu-rich isothermal section at 800 °C and the vertical section at 0.5 mass% Fe are shown in Fig. 1-3. The agreement with the data of [1934Bau] (Fig. 2 and 3) is satisfactory.

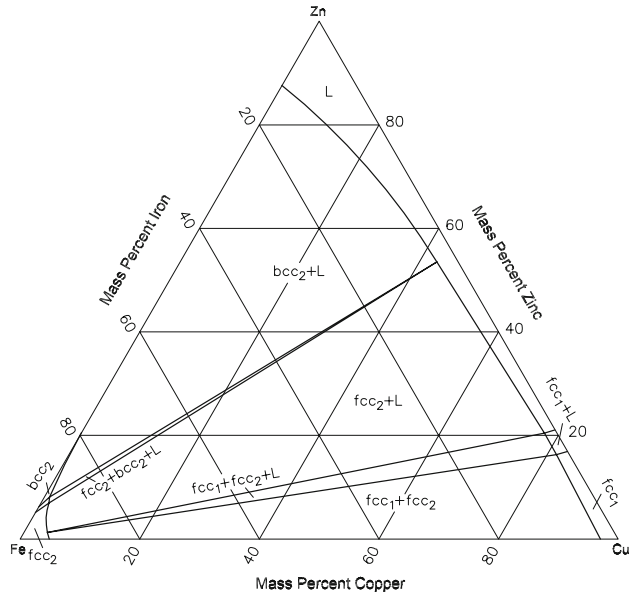

Fig. 1 Cu-Fe-Zn computed isothermal section at 1000 °C [2008Mie]

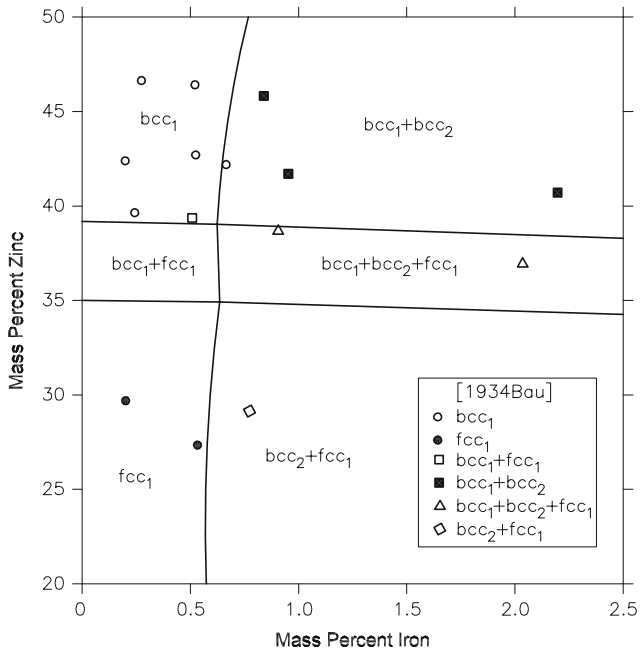

Fig. 2 Cu-Fe-Zn computed isothermal section at 800 °C for Cu-rich alloys [2008Mie]

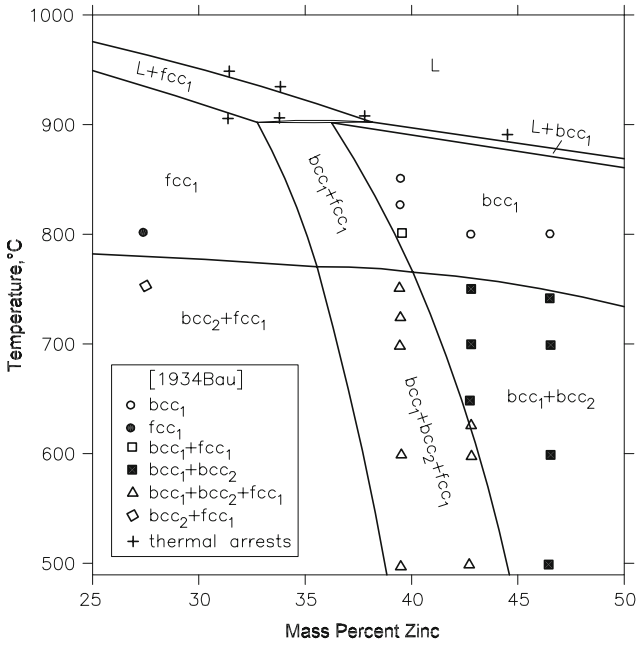

Fig. 3 Cu-Fe-Zn computed vertical section at 0.5 mass% Fe [2008Mie]

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