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Fe-Mn-Tb (Iron-Manganese-Terbium)

V. Raghavan

The previous review of this system by [1992Rag] was limited to a summary of the lattice parameter variation of the continuous solid solutions along the $TbFe_2$-$TbMn_2$ and Tb_6Fe_{23}-Tb_6Mn_{23} joins. Ilyushin et al. [1994Ily] determined the phase relationships along the $TbFe_2$-$TbMn_2$ join as a function of pressure up to 8 GPa.

Binary Systems

The Fe-Mn phase diagram [1993Oka] has no intermediate phases. The face-centered-cubic phases γFe and γMn form a continuous solid solution. In the Fe-Tb system [Massalski2], there are four intermediate phases: the Th_2Ni_{17}-type hexagonal and the Th_2Zn_{17}-type rhombohedral modifications of Tb_2Fe_{17}, the Th_6Mn_{23}-type cubic phase Tb_6Fe_{23}, the $PuNi_3$-type rhombohedral phase $TbFe_3$, and the $MgCu_2$-type cubic phase $TbFe_2$. The Mn-Tb phase diagram [Massalski2] shows three intermediate phases: the $ThMn_{12}$-type tetragonal phase $TbMn_{12}$, the Th_6Mn_{23}-type cubic phase Tb_6Mn_{23}, and the $MgCu_2$-type cubic phase $TbMn_2$.

Ternary Phase Equilibria

With starting metals of purity of 99.99%, [1994Ily] levitation melted under Ar atm 13 alloy compositions along the $TbFe_2$-$TbMn_2$ join. The samples were then powdered and subjected to a high pressure of 1-8.0 GPa. The structure of the synthesized alloys was determined at ambient temperature by x-ray powder diffraction. At atmospheric pressure, the structure of all compositions $Tb(Fe_{1-x}Mn_x)_2$ is of the *C*15 cubic type. However, a detailed analysis of the x-ray patterns showed a rhombohedral distortion in the range $x \sim 0$ to 0.3. For the range $x \sim 0.3$ to 0.5, the distortion becomes more complex (closer to monoclinic). For $x \sim 0.5$ to 1.0, the alloys have the ideal cubic structure. At the $TbMn_2$ end, the cubic *C*15 phase is stable up to ~3 GPa of pressure. Above 6 GPa, the hexagonal *C*14 phase is stable. In between, a (*C*14 + *C*15) two-phase mixture prevails. The pressure-composition diagram constructed by [1994Ily] at room temperature is shown in Fig. 1.

References

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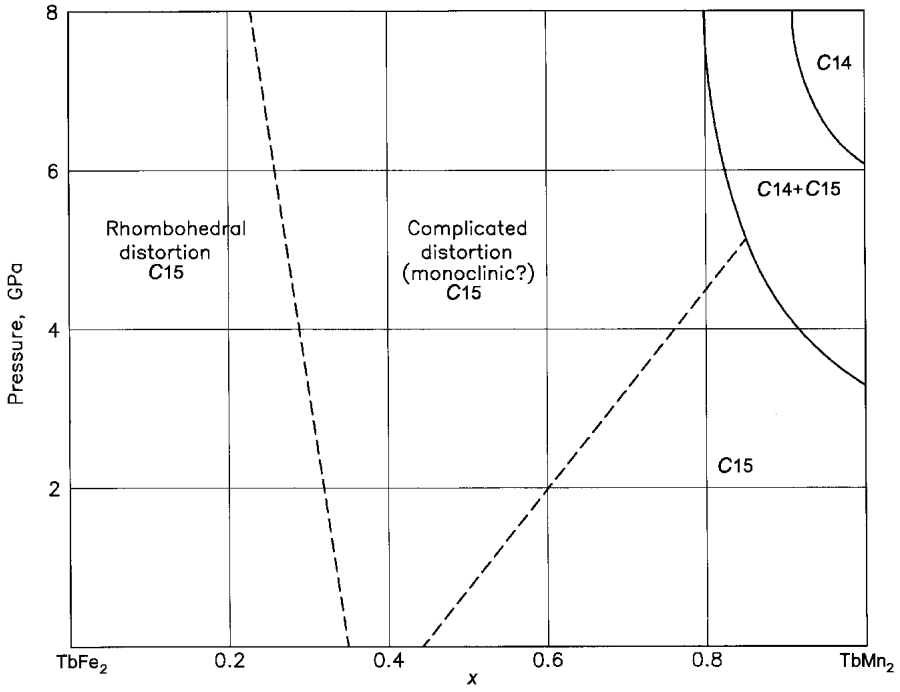

Fig. 1 Fe-Mn-Tb pressure-composition diagram for $Tb(Fe_{1-x}Mn_x)_2$ alloys at ~20 °C [1994Ily]