

Ag-Fe-Nd (Silver-Iron-Neodymium)

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Recently, [2004Tak] studied the feasibility of Nd extraction from B-Fe-Nd magnet scrap, using molten Ag as the extraction medium. During this study, they determined an isothermal section for the Ag-Fe-Nd system at 1090 °C.

Binary Systems

The Ag-Fe phase diagram [Massalski2] shows very limited solubility between Ag and Fe in both the liquid and solid states. The Ag-Nd phase diagram [Massalski2] depicts several intermediate phases: $\text{Ag}_{51}\text{Nd}_{14}$ is hexagonal, $\beta\text{Ag}_2\text{Nd}$ is AlB_2 -type hexagonal, $\alpha\text{Ag}_2\text{Nd}$ is CeCu_2 -type orthorhombic, and AgNd is a CsCl-type cubic phase. None of these phases are stable at the temperature of interest here (1090 °C). The Fe-Nd phase diagram [1997Oka] depicts two intermediate compounds: $\text{Fe}_{17}\text{Nd}_2$ ($\text{Th}_2\text{Zn}_{17}$ -type rhombohedral) and $\text{Fe}_{17}\text{Nd}_5$ (hexagonal).

Ternary Isothermal Section

With starting metals of 99% Ag, 99% Fe, and an Fe-Nd alloy, [2004Tak] melted 7 Fe-poor compositions under Ar

atmosphere. The samples were annealed at 1090 °C (1363 K) for 24 h and quenched in water. The phase equilibria were studied by x-ray diffraction and energy dispersive x-ray spectroscopy. The isothermal section at 1090 °C constructed by [2004Tak] is redrawn in Fig. 1 to agree with the accepted binary data. A ternary compound of unknown structure (denoted τ here) was found at the composition $\text{Nd}_{8.5}\text{Fe}_{17.5}\text{Ag}$. [2004Tak] concluded that extraction of Nd from the B-Fe-Nd magnet scrap is feasible, as the Ag-Nd liquid with 50-52 at.% Nd exists in three-phase equilibrium with $\text{Fe}_{17}\text{Nd}_2$ and solid Fe. The effect of B in the scrap on the above equilibrium was found to be negligible.

References

- 1997Oka:** H. Okamoto, Fe-Nd (Iron-Neodymium), *J. Phase Equilibria*, 1997, **18**(1), p 106
- 2004Tak:** O. Takeda, T.H. Okabe, and Y. Umetsu, Phase Equilibrium of the System Ag-Fe-Nd, and Nd Extraction from Magnet Scraps Using Molten Silver, *J. Alloys Compd.*, 2004, **379**, p 305-313

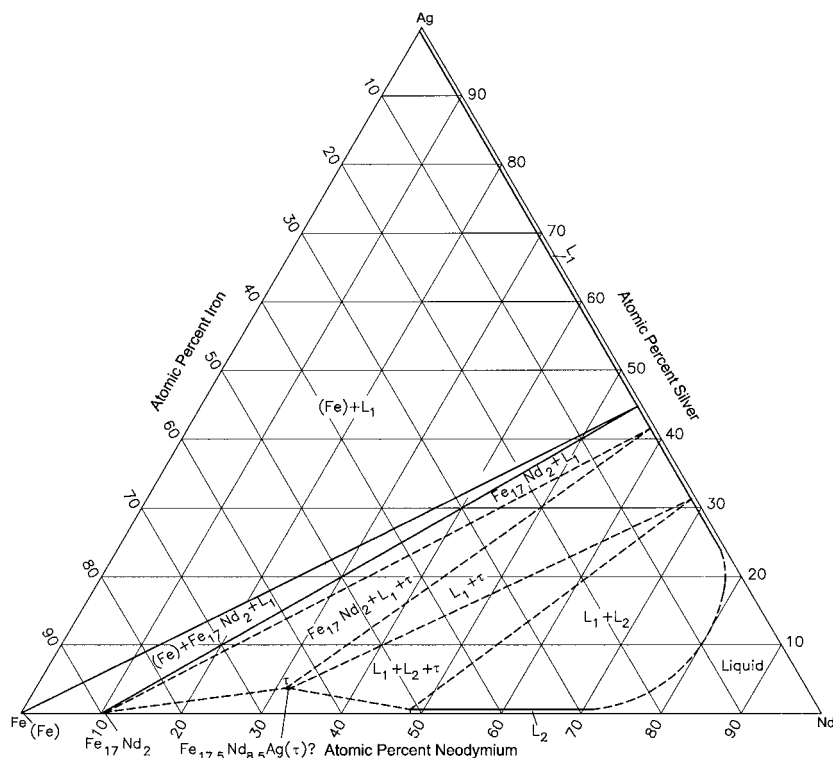


Fig. 1 Ag-Fe-Nd isothermal section at 1090 °C [2004Tak]