The Metastable Miscibility Gap in the Cu-Co-Fe System

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Some alloys, where the elements are characterized by large positive enthalpies of mixing, display a separation of the melt into two liquid phases, below a critical temperature. If this transformation occurs, the phase diagram is characterized by a monotectic or liquid miscibility gap. Some Cu-based alloys, like Cu-Fe and Cu-Co, display a liquid separation in the undercooled melt; the miscibility gap is therefore metastable. A considerable amount of work has been published on these two systems, assessing the position of the miscibility gap. The ternary Cu-Co-Fe system also displays a metastable monotectic miscibility region, but much less information is available in literature on this system.

This contribution reviews findings on the Cu-Co-Fe system, and presents new results on the liquid-liquid separation in this system. Differential Scanning Calorimetry (DSC) experiments have been carried out in order to measure the transformation temperatures of different compositions. After DSC processing, the calorimetric signals were related to the microstructures of the alloys, studied by SEM. The Cu-Co-Fe phase diagram has been calculated using CALPHAD, and the results of the calculations were then compared to the experimental transformation temperatures obtained by DSC.