Thermophysical Properties of Five Binary Copper-Nickel Alloys

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Thermophysical properties (e.g. specific enthalpy, heat of fusion, electrical resistivity, thermal volume expansion) can be measured in the liquid phase up to very high temperatures by extreme fast pulse-heating methods as used by the authors. Heating rates of about 10^8 K/s are achievable by self-heating of a metallic specimen with a current of approximately 10 000 A. Pure elements seem to be still close to equilibrium condition ($<10^{10}$ K/s) as the obtained results are in good agreement to those obtained by static methods. However, this situation might be different for alloys. The rapid volume heating can 'delay' diffusion controlled phase-transitions at heating to higher temperatures or even makes them not noticeable anymore. The simple binary Cu-Ni system was chosen to test heating rate dependencies: this system is well known and shows a complete miscibility in the liquid and solid range of interest. This study is a first step to reveal the performance of our fast pulse-heating method being applied to simple and more complex alloys. The samples were die-cast and drawn to wires of 0.5 mm in diameter. Each composition (nominally $Cu_{85}Ni_{15}$, $Cu_{70}Ni_{30}$, $Cu_{55}Ni_{45}$, $Cu_{35}Ni_{65}$ and $Cu_{20}Ni_{80}$) was checked by a chemical analysis. Solidus and liquidus temperatures were measured by differential thermal analysis. Measured results of enthalpy, heat of fusion, heat capacity, electrical resistivity and volume thermal expansion will be presented. The results of density and electrical resistivity are compared to those recently obtained by electromagnetic levitation measurements, performed at the German Aerospace Center in Cologne.