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Microstructure, Mechanical, Electrical and Thermal Properties of the Al-Si-Ni Ternary Alloy

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Abstract : In recent years, the use of the aluminum based alloys in the industry and technology are increasing. Alloying elements in aluminum have further been improving the strength and stiffness properties that provide superior compared to other metals. In this study, investigation of physical properties (microstructure, microhardness, tensile strength, electrical conductivity and thermal properties) in the Al-12.6wt.%Si-%2wt.Ni ternary alloy were investigated. Al-Si-Ni alloy was prepared in a graphite crucible under vacuum atmosphere. The samples were directionally solidified upwards with different growth rate (V) at constant temperature gradient G (7.73 K/mm). The microstructures (flake spacings, λ), microhardness (HV), ultimate tensile strength, electrical resistivity and thermal properties enthalpy of fusion and specific heat and melting temperature) of the samples were measured. Influence of the growth rate and flake spacings on microhardness, ultimate tensile strength and electrical resistivity were investigated and relationships between them were experimentally obtained by using regression analysis. According to results, λ values decrease with increasing V, but microhardness, ultimate tensile strength, electrical resistivity values increase with increasing V. Variations of electrical resistivity for cast samples with the temperature in the range of 300-1200 K were also measured by using a standard dc four-point probe technique. The enthalpy of fusion and specific heat for the same alloy was also determined by means of differential scanning calorimeter (DSC) from heating trace during the transformation from liquid to solid. The results obtained in this work were compared with the previous similar experimental results obtained for binary and ternary alloys.

Keywords : electrical resistivity, enthalpy, microhardness, solidification, tensile stress
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