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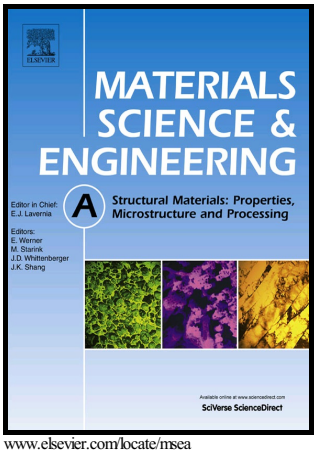

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Effects of Ni content on low cycle fatigue and mechanical properties of Al-12Si-0.9Cu-0.8Mg-*x*Ni at 350 °C

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Abstract

In order to study the effects of ε-Al_3Ni phase on elevated temperature properties, Al-12Si-0.9Cu-0.8Mg-*x*Ni alloys with Ni contents of 1.0%, 2.5% and 4.0%, respectively, were prepared by gravity casting and their microstructure, tensile and low cycle fatigue properties at 350 °C were investigated. The results show that the microstrucure mainly consists of α-Al, eutectic Si, ε-Al_3Ni, δ-Al_3CuNi, and Q-$Al_5Cu_2Mg_8Si_6$ phase. Thermodynamic calculation indicates that the ε-Al_3Ni weight fraction increases with Ni contents while other phase contents are kept constant, and this result is consistent with the microstructure and XRD analysis. With the increase of ε-Al_3Ni content, the tensile strength at 350 °C increases from 94 MPa to 116 MPa, while the elongation decreases from 2.8% to 2.0%. The Al-Si alloy with 2.5% Ni exhibits the optimal low cycle fatigue property with a fatigue strength coefficient of 198.29 MPa and fatigue strength exponent of -0.1295. The coarsening of ε-Al_3Ni phase is obvious with a higher Ni content of 4.0%, and the debonding of coarse ε-Al_3Ni phase accelerates the propagation of micro-cracks and degrades the fatigue properties The ε-Al_3Ni phase is beneficial to the mechanical properties of the alloys and thermally stable during fatigue test at 350 °C.

Keywords: *Al-Si alloys, Heat resistant, Low cycle fatigue, Microstructure,*

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