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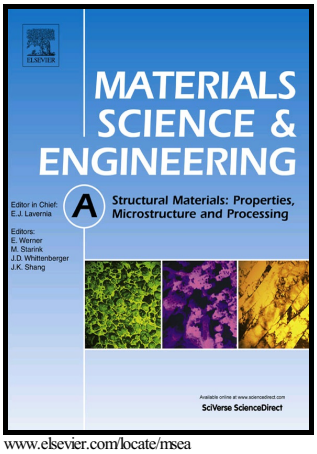

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Effect of Sc addition and T6 aging treatment on the microstructure modification and mechanical properties of A356 alloy

S. L. Pramod[a], Ravikirana[a,b], A. K. Prasada Rao[c], *B. S. Murty[a] and *Srinivasa R. Bakshi[a]

[a]Department of Metallurgical and Materials Engineering, Indian Institute of Technology, Madras, Chennai 600 036, India

[b]Department of Physics and Nanotechnology, SRM University, Chennai 603 203, India

[c]College of Engineering and Design, Alliance University, Bengaluru, 562 106, India

*Corresponding Authors.

Tel.: +91 4422574781, Email address: sbakshi@iitm.ac.in (Srinivasa Rao Bakshi)

Tel.: +914422574754, Email address: murty@iitm.ac.in (B. S. Murty)

Abstract

Effect of Sc addition and T6 aging treatment on the secondary dendritic arm spacing (SDAS), modification of eutectic Si morphology, β-Al_5FeSi and π-$Al_8Mg_3Si_6Fe_1$ phases and its effect on mechanical properties in A356 alloy has been investigated. Addition of 0.4 wt.% Sc in A356 alloy resulted in a 50% reduction in the secondary dendritic arm spacing (SDAS). Sc addition changed the morphology of eutectic Si from plate like to fibrous and globular. The needle like morphology of β-Al_5FeSi phase in A356 alloy changed to $Al_5Fe(Si,Sc)$ phase having smaller size and irregular morphology. Transmission electron microscopy (TEM) diffraction pattern and Energy dispersive spectroscopy (EDS) analysis revealed the presence of β-Al_5FeSi and π-$Al_8Mg_3Si_6Fe_1$ phases in A356 alloy which changed to β-$Al_5Fe(Si.Sc)$, π-$Al_8Mg_3(Si,Sc)_6Fe_1$ and additional V-$AlSi_2Sc_2$ phase was observed in Sc containing alloys. Addition of 0.4 wt.% Sc to A356 alloy improved its Vickers hardness, Ultimate tensile strength (UTS), Yield strength (YS) and ductility by 20%, 25%, 20% and 30% respectively. Artificial aging treatment resulted in significant improvement in the tensile properties for both A356 and Sc added A356 alloys.

Keywords: Electron microscopy; Aluminium alloys; Intermetallics; Casting; Age hardening; Phase transformation

1. Introduction