
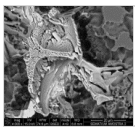
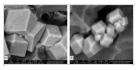
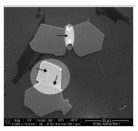
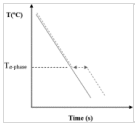

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Physical modification of intermetallic phases in Al–Si–Cu alloys

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Highlights

- Ultrasonic vibration (US) was applied to Al–Si–Cu alloy during cooling.
- US promotes α-Al globular structure and change size and morphology of α-$Al_{17}(Fe_{3.2}, Mn_{0.8})Si_2$.
- α-$Al_{17}(Fe_{3.2}, Mn_{0.8})Si_2$ phase appears as polyhedral crystals of different sizes.
- Polyhedral shape is due to heterogeneous nucleation and fracture of Chinese script particles.
- Ultrasound suppresses the formation of harmful β-$Al_9Fe_2Si_2$ phase.

Abstract

The effect of applying ultrasonic vibration to the melt during cooling on grain structure, type and morphology of intermetallic compounds in $AlSi_9Cu_3(Fe)$ alloy was studied, as well as their nucleation mechanism. Detailed intermetallics analysis was performed using a combination of SEM/EDS and XRD techniques in order to obtain the most possible reliable information. Results show that without ultrasonic treatment α-$Al_{17}(Fe_{3.2}, Mn_{0.8})Si_2$, α-$Al_8Fe_2Si$, β-$Al_9Fe_2Si_2$ and Al_2Cu are the intermetallic phases present in the as-cast samples. The application of ultrasonic vibration to the melt during cooling proved to be very effective in converting the α-intermetallics with Chinese script morphology to polyhedral crystals, suppressing at the same time the formation of the β-phase. Moreover, the application of this treatment only changes the morphology of α-intermetallics since its stoichiometry remains the same (α-$Al_{17}(Fe_{3.2}, Mn_{0.8})Si_2$). It was also verified that the application of acoustic energy to the melt promotes the change of α-Al grains from dendritic to a more globular structure. The ultrasonic treatment is also effective in promoting the fracture of polyhedral crystals of intermetallic phases, reducing their dimensions and causing their homogenous dispersion in the matrix.

Keywords

Intermetallic compounds; Solidification; Electron microscopy; Microstructure; Nucleation

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