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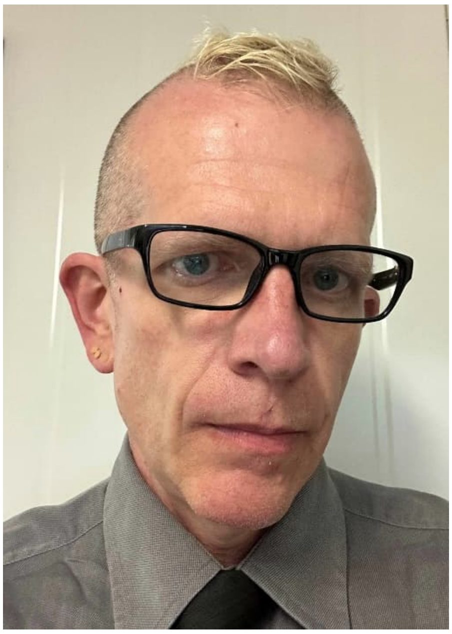

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November 14 (Tue.) 14:00-14:40 Room 315

A Study on the Homogeneity of Plastic Deformation and its Importance to Tensile Ductility in Al-Si-Cu-Mg (C355) Investment Castings.

Alloy C355 was originally developed for aerospace applications and today finds utilization in various aircraft components that operate at intermediate temperatures, such as aircraft superchargers covers, fuel pump bodies, compressor pistons, air or water-cooled cylinder heads, crankcases and various other applications where its high temperature resistance may be beneficial. Although the alloy is compositionally similar to other types of Al-Si-Mg-X alloys, a key difference comes about due to the presence of copper, which facilitates the formation of the Q/Q' phase, (Al5Cu2Mg8Si6). The presence of this phase may facilitate unusual thermal stability under some conditions as the precipitate resists coarsening. Moreover, its microstructure can be tailored through precise heat treatment processes, making it even more versatile for a wide range of applications. However, C355 is also normally somewhat limited by the presence of Copper, and most specifications usually include typical elongation values of less than 4% (see for example AMS 4215 and AMS 21180).

Importantly, it has also been shown that alloys containing the Q/Q' phase may display improved tensile ductility at room temperature when the composition is tailored to have an atomic ratio of Cu:Mg of close to 1:1. In the current paper, a hypothesis is investigated that may provide significant insight to the development of tensile mechanical properties in investment cast aluminium alloys. That is, by instituting a combination of good casting practice and alloy design together with heat treatments designed to promote homogeneous deformation, the usual limits of maximum ductility in Al-Si alloys might no longer apply. This may then mean that if deformation is particularly homogenous as a result, the material could keep necking to high elongations without unstable failure. As a result, ductility could significantly exceed the usual limits of Al-Si-X alloys. The current paper describes the outcomes of a study to investigate the abovementioned hypothesis. It will be shown that unexpected combinations of tensile mechanical properties may be realized, that include minimum values of elongation greater than 20% in C355 alloy while still maintaining compliance with manufacturing specifications.