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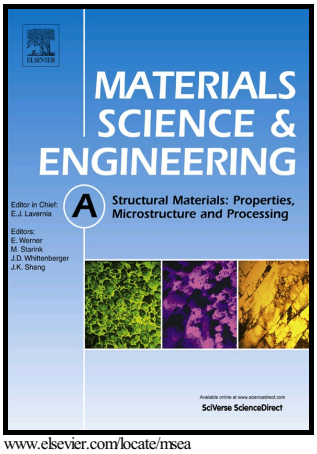


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# Nanoscale Zr-containing precipitates; a solution for significant improvement of high-temperature strength in Al-Si-Cu-Mg alloys

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**Abstract:**

This work aims to reveal the valuable role of Zr in cast Al-Si-Cu-Mg alloys utilised at elevated temperatures. Furthermore, this work wants to improve high temperature tensile properties of the industrially popular Al7Si0.5Cu alloy by tuning alloying elements. The Al7Si2Cu0.2Zr alloy, subjected to well-tuned heat treatment process, was benchmarked against the conventional Al7Si0.5Cu alloy. Microstructural investigation showed that the main strengthening phases in the Al7Si2Cu0.2Zr alloy are θ′, Q′, Al-Si-Cu-Zr and Al-Si-Zr precipitates. Two Zr-containing precipitates (Al-Si-Cu-Zr and Al-Si-Zr) with the size of 80-200 nm are formed during solutionising at530 °C, which can be considered as the first ageing step. Other two Cu-containing precipitates (θ′ and Q′) at the size of 20 nm are formed during ageing (170 °C). Nano-sized Zr-containing precipitates are mostly exhibited elliptical morphology with coherent/semi-coherent interfaces with the α-Al matrix, making them more stable at elevated temperatures. As a result, the yield strength is improved at room temperature from 261 to 291 MPa, and the ultimate tensile strength (UTS) is improved from 282 to 335 MPa for the Al7Si2Cu0.2Zr alloy, compared with the Al7Si0.5Cu alloy. Moreover, the mechanical properties are significantly improved at elevated temperatures. The