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Natural ageing behaviour in Al-Cu alloys containing Sc and Zr

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The 2xxx series Al-Cu alloys have been extensively used as engineering structures and components of lightweight vehicles due to their excellent strength-to-weight ratio. Recent research has demonstrated that further substantial enhancement in the strength of Al-Cu alloys could be achieved by adding Sc and Zr by forming nano-sized $Al_3(Sc, Zr)$ dispersoids. However, further development and manufacturing of these new Sc and Zr-containing Al-Cu alloys are limited by a lack of basic understanding of the effect of $Al_3(Sc, Zr)$ dispersoids on the microstructural evolution during room temperature storage after quenching from solution treatment (called natural ageing). In this work, therefore, we have studied the effect of $Al_3(Sc, Zr)$ dispersoids on natural ageing behaviour in an Al-4wt.%Cu-0.1wt.%Sc-0.1wt.%Zr alloy using small-angle neutron and x-ray scattering (SANS and SAXS). The hardness measurement shows that the presence of $Al_3(Sc, Zr)$ dispersoids significantly delays the natural ageing kinetics of Al-Cu alloys. SANS was used to quantify the size distribution of $Al_3(Sc, Zr)$ dispersoids which is $\sim 25 \pm 3$ nm. In-situ SAXS results show that the presence of $Al_3(Sc, Zr)$ dispersoids results in a significant delay in the solute clustering formation during natural ageing. This is attributed to the suppression of the natural ageing kinetics in the Al-Cu-Sc-Zr alloys. These results were confirmed by differential scanning calorimetry (DSC) and high resolution transmission electron microscopy (TEM). The suppression mechanism is hypothesized to come from the dispersoids and Sc solute acting as vacancy sinks which slows down the diffusion of solute at room temperatures.

Level of Expertise

Early Career <5 Years

Presenter Gender

Man

Pronouns

Which facility did you use for your research

Australian Centre for Neutron Scattering

Students Only - Are you interested in AINSE student funding

Do you wish to take part in the Student Poster Slam

Condition of submission

Yes

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