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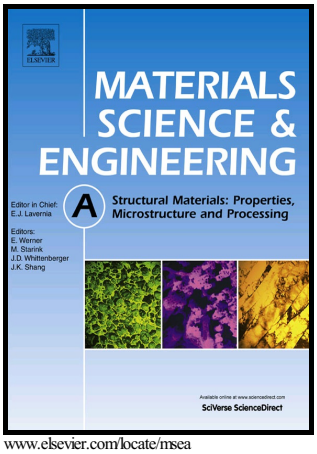

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Over-ageing of an Al-Mg-Si alloy with Silicon excess

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Abstract

Keywords: aluminium alloy, ageing, precipitation, thermoelectric power, transmission electron microscopy, atom probe tomography, hardness, JMAK modelling

The over-ageing of an Al-Mg-Si alloy with Silicon excess was investigated using global thermoelectric power (TEP) and hardness measurements combined with local techniques (Transmission Electron Microscopy (TEM) and Atom Probe Tomography (APT)), in order to highlight how the peak-aged microstructure obtained by a T6 treatment evolves in use conditions at temperatures between 100°C and 350°C, leading to a progressive loss of mechanical strength. First, TEP was found to be relevant to study the over-ageing kinetics of the alloy due to its perfect correlation with hardness and its sensitivity to the microstructural changes occurring after peak hardness. Then, APT and TEM observations clearly showed that over-ageing is due to the progressive replacement of the β" phase by a succession of different types of semi-coherent phases (firstly, of Type B and then of Type A and Type C) and by an extensive precipitation of pure silicon particles. At the highest temperature (T=350°C), it was highlighted that the influence of manganese cannot be neglected. From these studies, an experimental Isothermal Transformation Curve could be proposed in the investigated temperature range. Lastly, the decrease in mechanical strength taking place during isothermal and non-isothermal ageing from a T6 state was experimentally characterised and successfully analysed using the JMAK formalism.

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