Early stages of precipitation in mould-cast, cold-rolled and heat-treated aluminium alloy AA7075 with Sc,Zr-addition

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Precipitation reactions of the commercial Al–Zn–Mg–Cu(–Sc–Zr) alloy in the mould-cast, cold-rolled and heat-treated states were characterized by electron microscopy, X-ray diffraction, thermal analysis, microhardness testing and positron annihilation spectroscopy. The initial microhardness values of the alloys reflect the cold rolling. The distinct changes in microhardness curves as well as in heat flow of the alloys studied are mainly caused by the dissolution of the clusters and precipitation of the particles from the Al–Zn–Mg–Cu system. Easier diffusion of Zn, Mg and Cu atoms along dislocations is responsible for the precipitation of Zn,Mg,Cu-containing particles at the lower temperatures compared to the mould-cast alloys. The mould-cast and cold-rolled alloys contain solute clusters rich in Mg and Zn. Clusters formed in the heat-treated alloys during natural ageing have similar composition but in addition to Mg and Zn contain also Cu. The Cu-concentration increases with increasing period of natural ageing. The mould-cast state and state after natural ageing contain in addition to solute agglomerates also vacancy clusters formed by agglomeration of thermal vacancies. Addition of Sc and Zr results in higher hardness above ~ 270 °C due to strengthening by the $Al_3(Sc,Zr)$ particles with good thermal stability. Sc and Zr have probably no influence on the development of solute clusters.

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