Materials Chemistry and Physics 240 (2020) 122073

Contents lists available at ScienceDirect

Materials Chemistry and Physics

journal homepage: www.elsevier.com/locate/matchemphys

Isothermal and non-isothermal precipitation kinetics in Al–Mg–Si-(Ag) alloy

Oussama. Djema [a], Mabrouk. Bouabdallah [a], Riad. Badji [b,*], Amr. Saadi [c], Nabil. Kherrouba [b], Amane. Sahli [a,d]

[a] Engineering Laboratory of Seismic and Structural Dynamics, National Polytechnic School, Algiers, Algeria
[b] Research Centre in Industrial Technologies CRTI, B. P 64, Cheraga Algiers, Algeria
[c] Materials Engineering Laboratory, Polytechnic Military School, Algiers, Algeria
[d] Department of Fuel, Nuclear Research Centre of Draria CRND, Draria, Algiers, Algeria

HIGHLIGHTS

- The Ag addition modifies the precipitation sequence of the 6063 alloy.
- The β'' phase precipitation proceeds in two processes during continuous heating.
- The β'' phase precipitation is controlled by migration of Mg and Si solute atoms.
- The formation of pre-β'' phase enhances the precipitation kinetic of the β'' phase.

ARTICLE INFO

Keywords:
6063 aluminium alloy
Ag addition
Precipitation kinetics
JMA model
Additivity concept

ABSTRACT

In the present work, isothermal and non-isothermal precipitation kinetics in a 6063 aluminium alloy containing a small silver (Ag) addition have been investigated using Vickers microhardness and Differential Scanning Calorimetry (DSC) measurements respectively. Isothermal kinetics analysis showed that β'' phase precipitation obeyed the Johnson-Mehl-Avrami (JMA) model. The DSC analysis revealed that Ag addition modified the precipitation sequence in the investigated 6063 aluminium alloy through the formation of an additional metastable pre-β'' phase. An approach based on the additivity concept has been applied to the heating DSC diagrams to investigate the β'' phase precipitation. The obtained Avrami exponent values from this approach led to suggest that the β'' phase precipitation proceeded through two processes during continuous heating. The Avrami exponent value obtained at the final stage of the transformation was consistent with that obtained from the isothermal analysis, whereas the corresponding activation energy was higher than the one calculated from the isothermal analysis and Kissinger's method. It was also established that the precipitation kinetics of the β'' phase was enhanced by the formation of the precursor phase pre-β''.