Phase transitions in the Cu-15.0at.%Al-10.5at.%Mn-1.6at.%X alloys (X= Ag, Ga and Gd)

[1]*Leandro Santos da Silva (IC), **[1]Ricardo Alexandre Galdino da Silva (PQ)**

[1]Universidade Federal de São Paulo (UNIFESP)
**e-mail: ls.silva@unifesp.br*
Keywords: *Cu-Al-Mn alloys, Phase transitions.*

Abstract

In this work was discussed the stable phase transitions in the Cu-15.0at%Al-10.5at%Mn-1.6at.%X alloys with X= Ag, Ga and Gd.

Introduction

Some Cu-based alloys have a huge importance, not only commercial but also in studies on solid state. The main reason for the high interest in this kind of alloys is because they show a specific property, the shape memory effect (SME), which has relation with the martensitic reaction[1]. Among all the Cu-based alloys, Cu-Al-Mn system has SME on interesting conditions and can also present magnetic properties. Martensitic transformation in Cu-Al-Mn alloys occurs between 123 K and 373 K, depending on its composition [2]. It is possible to change physical and chemical properties of these alloys with additions of alloying elements, thus modifying its phase transformations and mechanical properties. In this work intend to analyze the effects of the additions of Ag, Ga and Gd on the stable phase transitions of the Cu-15.0at.%Al-10.5at.%Mn-1.6at.%X alloys.

Results and Discussion

Fig. 1 shows the DSC curves obtained for annealed samples of the studied alloys. In the curves one can observe the presence of four endothermic thermal events (E_1, E_2, E_3 and E_4). According to Cu-Al-Mn system, the events E_1 and E_2 are associated with inverse of the spinodal decomposition reaction $L2_{1(f)}+DO_3 \rightarrow DO_3$ and $L2_{1(f)} \rightarrow L2_{1(p)}$ transition[3,4]. The event E_3 is ascribed to $\alpha+T_3\text{-}Cu_3Mn_2Al \rightarrow \beta+\alpha+T_3\text{-}Cu_3Mn_2Al$ reaction and $DO_3 \rightarrow B2$ order-disorder transition[3,4]. Peak E_4 is related to the $\beta+\alpha+T_3\text{-}Cu_3Mn_2Al \rightarrow \beta+\alpha+\gamma$ transition and $B2 \rightarrow A2$ order-disorder transition[3,4]. The most important effect of the Ag, Ga and Gd additions are associated with peaks E_3 and E_4. In these ones can be observed that the enthalpy change is related atomic radius variation. Fig. 2 shows the optical micrographs obtained from studied alloys. It was observed that the alloying elements modify the alloys grain boundaries. This result indicates that the atomic radius of the element added is inversely proportional to the superficial area of the phases presented at the grain boundaries of the alloys.

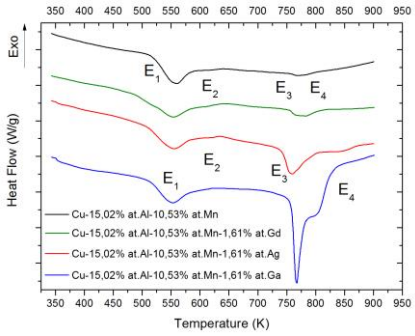

Figure 1. DSC curves obtained with heating rate of 10 K/min.

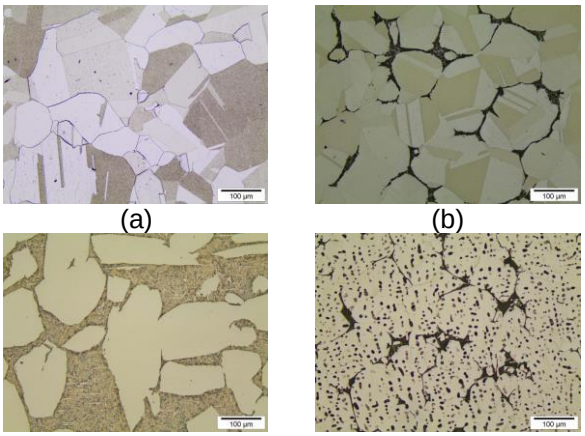

Figure 2. Optical micrographs obtained for the alloys (a) Cu-15.0%at.Al-10.5%at.Mn, Cu-15.0%at.Al-10.5%at.Mn-1.6%at.X with X (b) Ag, (c) Ga and (d) Gd.

Conclusions

The additions of Ag, Ga and Gd modify the high temperature transitions. The alloying element additions modify the grain boundaries. This is associated with the defects formation in the crystal lattice and the relative fraction of the intermetallic compounds. Because of this, the added elements change phase transformations of the studied alloys.

Acknowledgements

The authors thank to FAPESP for the financial support.

[1] Castilho, W. S.; Silva, E. P. Sinergia, **2011**, 12, 99-108.
[2] Sutou, Y. et al. Acta Materialia, **2009**, 57, 5748-5758.
[3] Bouchard, M.; Thomas, G. Acta Metallurgica, **1975**, 23, 1485-1500.
[4] Sutou et al. Mater. Scie. Technol., **2008**, 24, 896-901.