Type of presentation: Poster

MS-9-P-3530 Microscopy of Phase Transformations in Commercial Aluminium Alloys

Solange P. Y.[1], Benjamin H.[1], Rosario A. M.[2]

[1]Universidad de Oriente. Instituto de Investigaciones en Biomedicina y Ciencias Aplicadas. Departamento de Ciencia de los Materiales. Laboratorio de Caracterización de Materiales. Cumaná, Sucre –Venezuela., [2]Universidad de Oriente. Instituto de Investigaciones en Biomedicina y Ciencias Aplicadas. Departamento de Ciencia de los Materiales. Laboratorio de Caracterización de Materiales. Cumaná, Sucre –Venezuela., [3]Universidad de los Andes. Departamento de Física. Laboratorio de Análisis Químico Estructural de Materiales (LAQUEM). Mérida, Venezuela

Email of the presenting author: dupar99@gmail.com

Commercial aluminium alloys (AA) 6000 (Al-Mg-Si) and 3000 (Al-Mn) series, are mainly made for extrusion and rolling respectively. In industry, the casting alloys are homogenized to dissolve and / or transforming the rich second phase particles in Fe and producing a fine and homogeneous grain structure and new intermetallics, which results in increased ductility and improved properties for the extrusion and rolling, respectively. In this work commercial aluminium alloys made by the Venezuelan company CVG-ALCASA were used to characterize the transformation β→α of these intermetallics during homogeneization of the alloys Al-Mg-Si (6063) and Al-Mn (3003), appreciating that they change their shape, composition, crystalline structure, size and distribution. In the case of the AA 6063 the monoclinic β-(AlFeSi) phase is transformed to a cubic β-(AlFeSi) phase. Meanwhile, in AA3003 alloy the orthorhombic β-(AlFeSi) phase is transformed in phase α-(AlFeMnSi), cubic. Homogenization heat treatment was conducted for the AA6063 at 560 °C (range of β→α transformation) for 4 hours and for the AA3003 alloy heat treatment temperature was 500 °C for 1 hour. In both cases, the cooling was conducted at a rate of about 200 °C/hour. Transmission electron microscopy (H-600 TEM operated at 100 KV) and scanning electron microscopy in the secondary electron emission mode (SEM S-2500) coupled to an energy dispersive spectrometer (EDS) Thermo Noran was used. In the case of the AA6063 (ALMgSi), TEM observations allowed to establish the kinetics and possible mechanism of β→α transformation. It was observed that the particles α-(AlFeSi) of globular morphology nucleate on the β-(AlFeSi) rod-like phase (Figure 1). During processing, the β-phase intermetallics are gradually replaced by a dispersion of particles α (Figure 2). Subsequently, islands of α particles grow and are rounded at the expense of the β phase remaining (Figure 3). Microstructural observations of the AA3003 alloy revealed that during transformation β→α, the β phase is consumed by the growth of α phase, resulting in a duplex β//α combination. In the case, the β→α transformation takes place through the eutectoid decomposition of the β-(AlFeMn) phase, but requires silicon diffusion from the matrix along the interface between β and α. The SEM image of the alloy AA3003 (Figure 4) shows the growth of α phase at the expense of β phase, which is confirmed by the corresponding EDS spectrum. Because the α phase has higher contrast than the β phase, the SEM images can be used to demonstrate key features of the transformation.

Acknowledgement: This research was supported by IIBCAUDO of the University of Oriente.

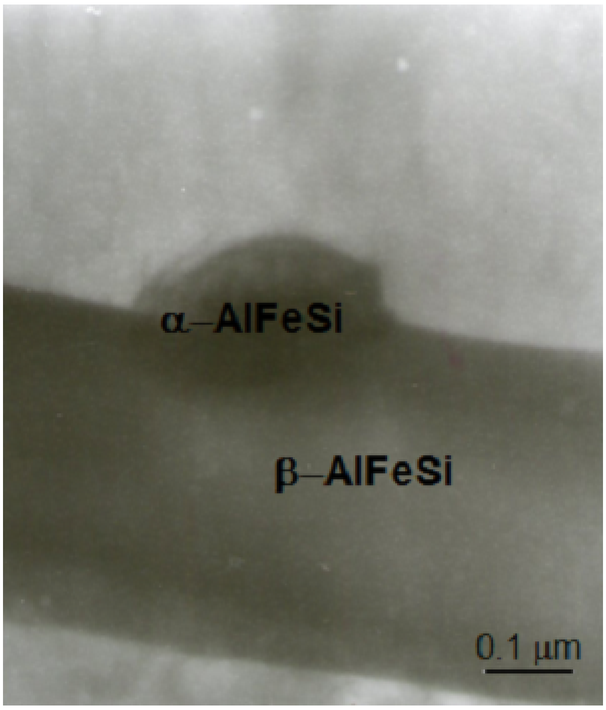

Fig. 1: Nucleation mechanism of α-(AlFeSi) particles from the β-(AlFeSi) phase.

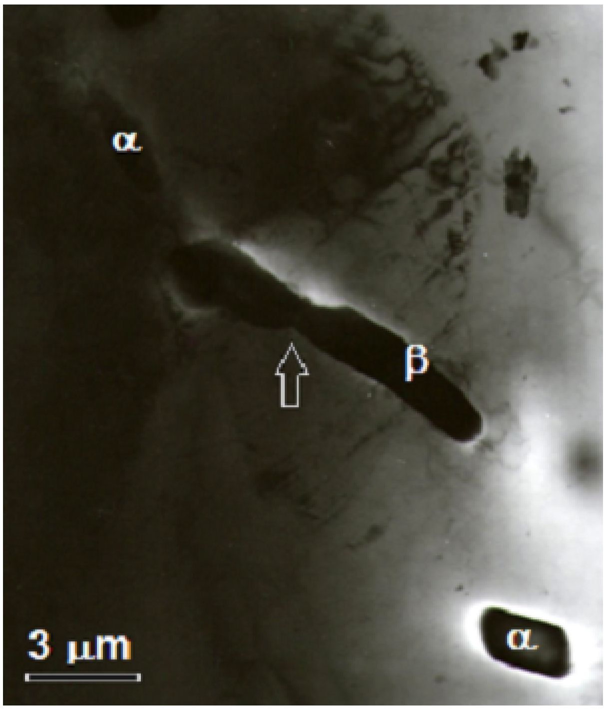

Fig. 2: TEM micrograph of the process of growing-strangulation.

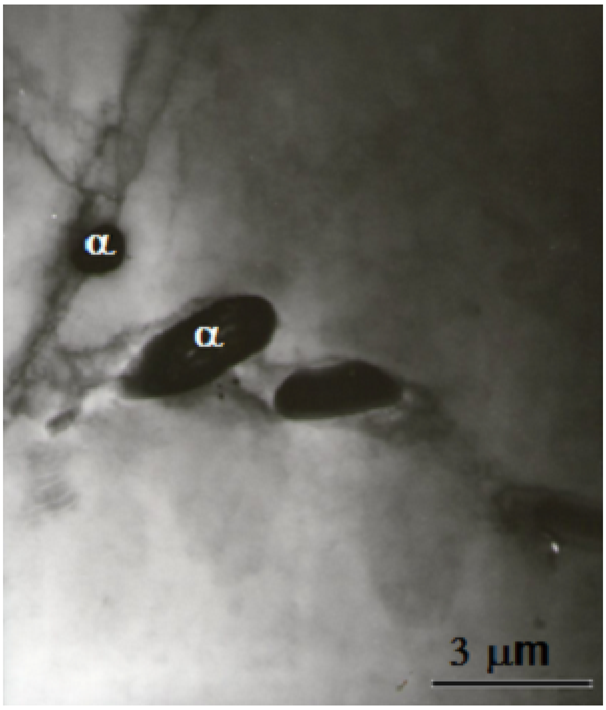

Fig. 3: TEM micrograph showing the separation of the new phase α-AlFeSi.

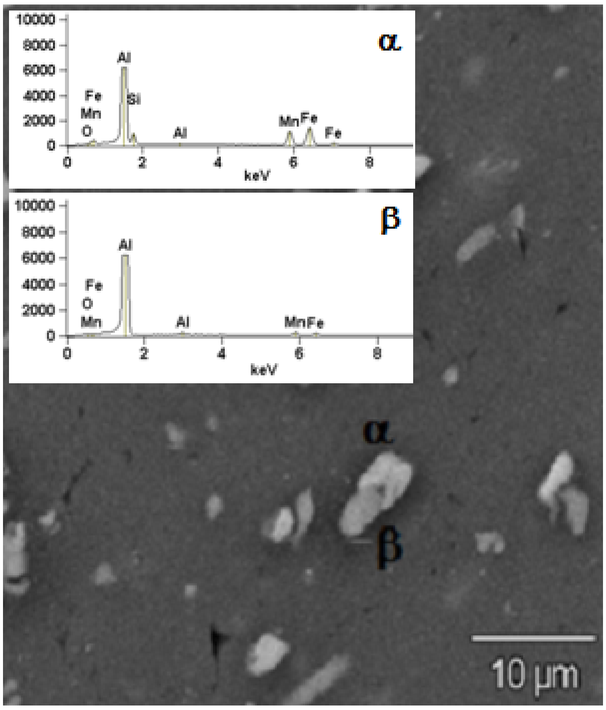

Fig. 4: SEM micrograph showing the growth mechanism of α-(AlFeMnSi) phase from the β-(AlFeMn) phase.