MICROSTRUCTURAL CHARACTERIZATION OF AA - 7175 ALLOY SLABS

Nicole PANAIT[1], Mariana CIURDAS[2], Robert STEPHAN[3]

Caracterizarea microstructurală (SEM , EDS) a aliajelor din seria AA -7175, punând în evidenţă prezenţă fazelor primare din şleburile turnate în instalaţia Wagstaff pentru diferite aplicaţii şi procese de elaborare prin forjare. Probele prelevate din zone diferite ale şlebului au fost şlefuite şi atacate cu soluţie de atac Keller. Se observă prezenţa fazelor existente datorită efectului compoziţional, punând în evidenţă morfologia acestor compuşi precum şi segregarea zincului în soluţia solidă.

The microstructural characterization (SEM,EDS) of the AA 7175 aluminum alloy has indicated the presence of different phases formed during the primary processing of large ingots (casted in Wagstaff installation) intended for furher processing by forging. Samples prevailed from different zones of the casted slab, were polished and etched with Keller's reactant. The phases that have been identified had a complex morphology and their nature was affected by a compositional effect as a result of Zn segregation of Zn in the solid solution matrix of the alloy.

Keywords: aluminum alloy, slab, SEM, EDS, segregation of Zn

1. Introduction

AA 7175 series (Al-Zn-Mg-Cu) high strength aluminum alloys are used primarily for structural components in aerospace applications like rivets, aircraft structural parts, bolts and s.c [1-3]. The combination of high strength, resistance to stress corrosion cracking (scc) and high fracture toughness has made the alloy a major factor in the aerospace industry [4]. The alloy is often utilized in compressive load design considerations. Alloy 7175 is typically used in applications where improved formability and toughness are desired.

The aim of the present work is to investigate the compounds *morp*hology and distribution in different zone of AA 7175 aluminum as-cast slabs.

[1] PhD student, Faculty of Materials Science and Engineering , University POLITEHNICA of Bucharest, Romania
[2] Lecturer, Faculty of Materials Science and Engineering , University POLITEHNICA of Bucharest, Romania, E-mail: ciurdasmariana@yahoo.com
[3] PhD student, Faculty of Materials Science and Engineering , University POLITEHNICA of Bucharest, Romania

2. Experimental procedures

The chemical composition of the investigated AA 7175 alloy is given in Table 1. The chemical compositions of the as-cast alloys were determined by means of a spectrometer analyzer and the results were in reasonable agreement with those provided by supplier.

Table 1.

Chemical composition (average) of as-cast slabs of AA 7175

Element	Zn	Mg	Mn	Cu	Fe	Si	Cr	Ti	Ca	Mo
%wt	5,47	2,45	0,13	1,52	2,23	0,14	0,2	0,043	0,002	0,0003

The slabs sampling was prevailed from A zone, polished and etched with Keller' reactant (figure 1).

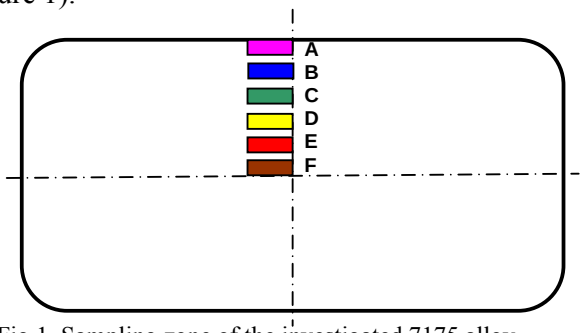


Fig 1. Sampling zone of the investigated 7175 alloy

For microstructural analysis, the samples were analyzed using scanning electron microscope SEM FEI Quanta Inspect F with electron beam and energy dispersive X-ray spectrometry (EDS) analyzer. The advantage of the SEM is a much larger field of view over a large range of magnifications and the ease to accurately quantify the composition using EDX analysis [5].

3. Results and discussion

The microstructure of the A zone sample in figure 2, puts in evidence the presence of the aluminum base solid solution, with different shape and sizes of grains (50 -150 μm); the segregation of Zn in solid solution was observed.

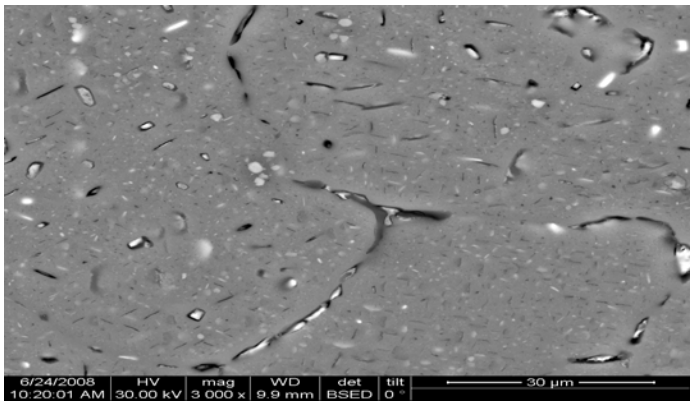
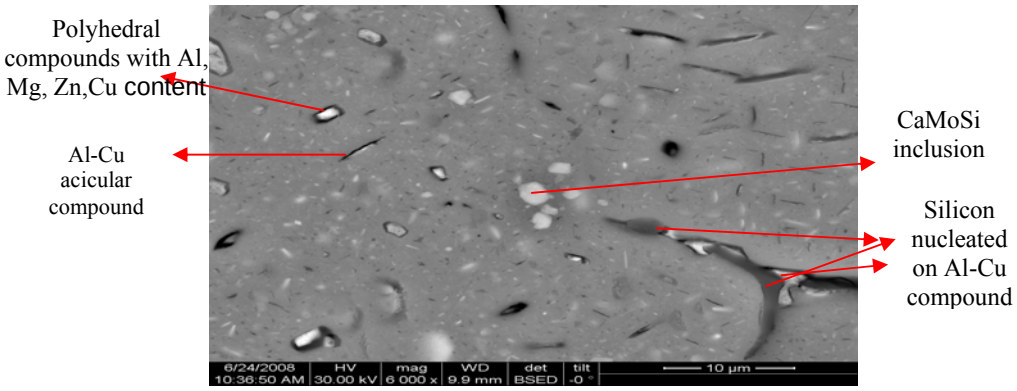
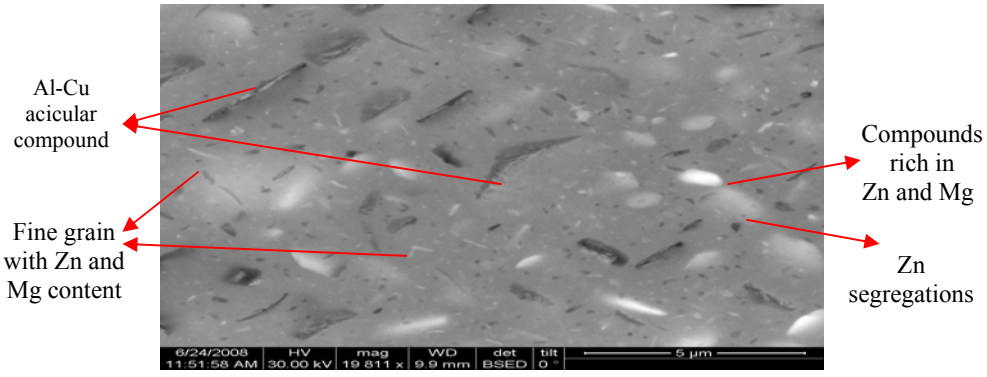


Fig.2. Sample microstructure taken from A zone of slab (3000 x)



(a)



(b)

Fig 3. BSE micrographs of the A sample at high magnification: (a) x 6000, (b) x 20000

A discontinuous compounds lattice of medium to dark contrast was observed on the backscattering images at high magnifications,(6000 x and 20000 x) . Bright contrast compounds (with Cu content), nucleated on silicon particles (figure 3) were observed at the grain boundaries.

Acicular compounds which contain Al and Cu as well as very fine (2-3 μm), polyhedral compounds like Mg_3Zn precipitate within grains were also observed. Ternary MoCaSi phase is journed during solidification at the grain boundary.

The identification of elements was done by EDS microanalysis (figure 4).

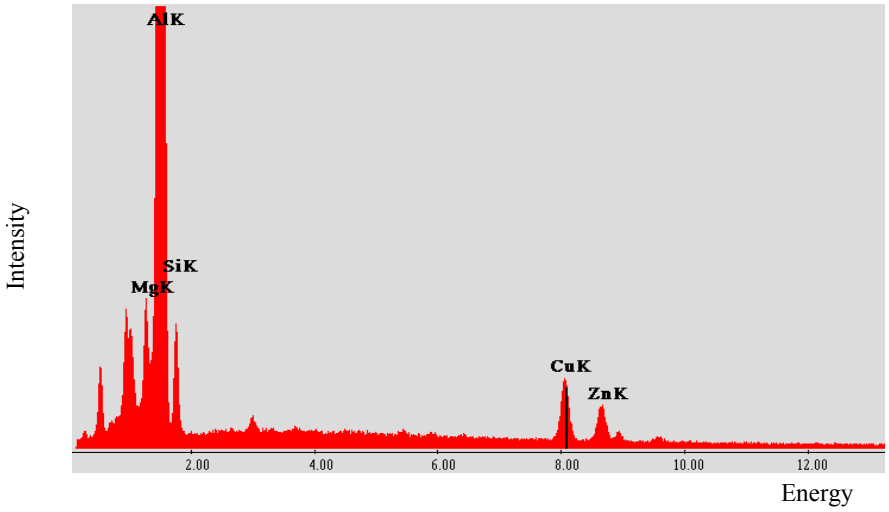


Fig. 4. EDS microanalysis of the A sample

The presence of the acicular $CuAl_2$ compound was observed in the microstructure at high magnification (figure 5).

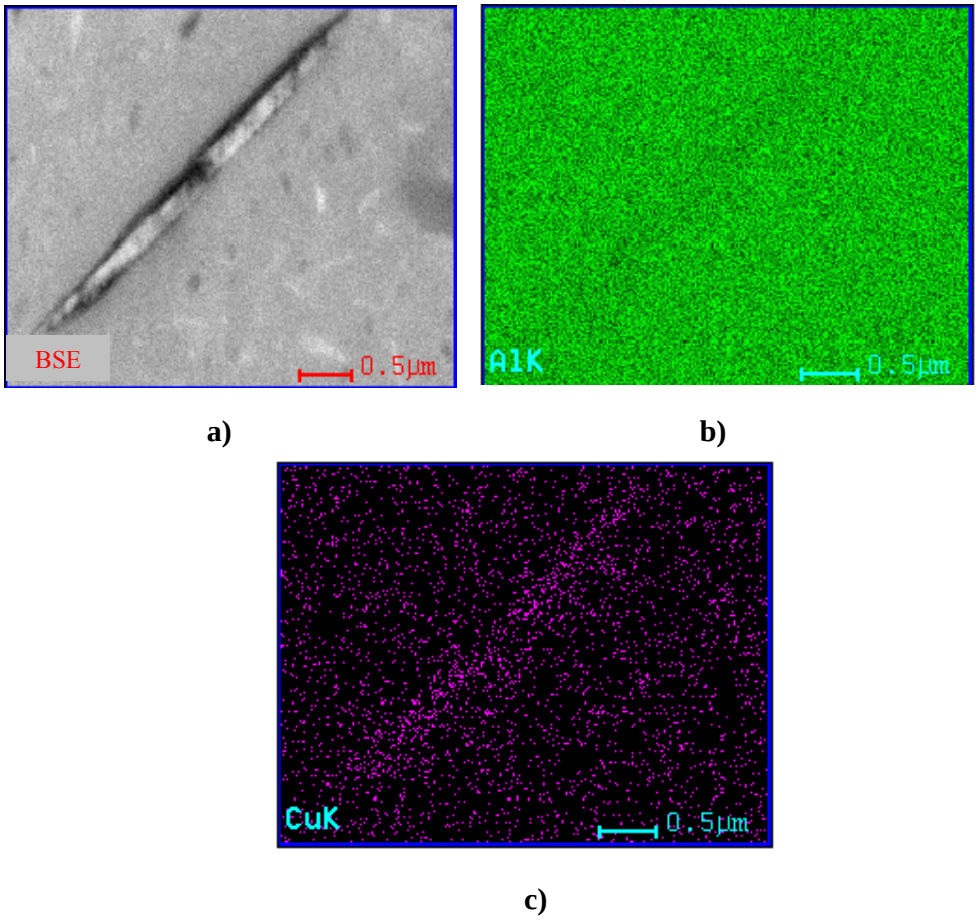


Fig. 5. SEM micrographs of a microzone which contains $CuAl_2$ compound (a) and X-ray maps for AlK_α (b) şi CuK_α (c)

Fine Mg_3Zn precipitates (light compounds) located within the grain are clearly seen in figure 6.

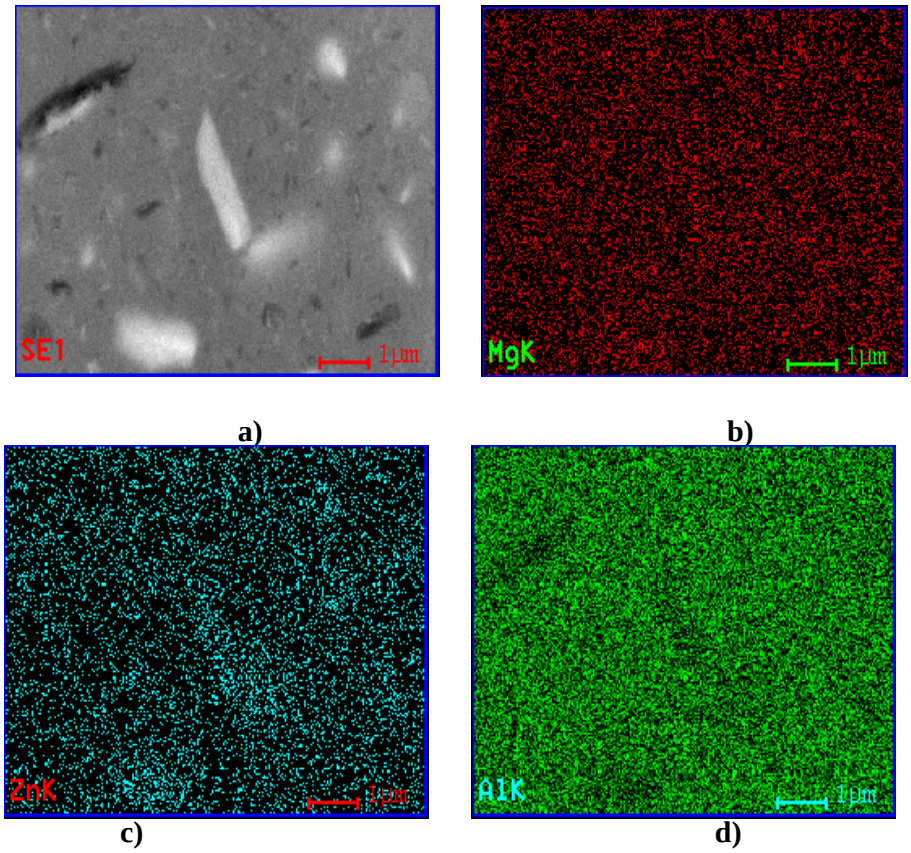


Fig. 6. SEM micrographs of a microzone which contains the fine Mg_3Zn precipitate within the grain (a) and X-ray maps of MgK_α (b), ZnK_α (c), AlK_α (d)

In figure 7 on can observed the precipitation of polyhedral Mg_3Zn phase and CaMoSi elongated compound.

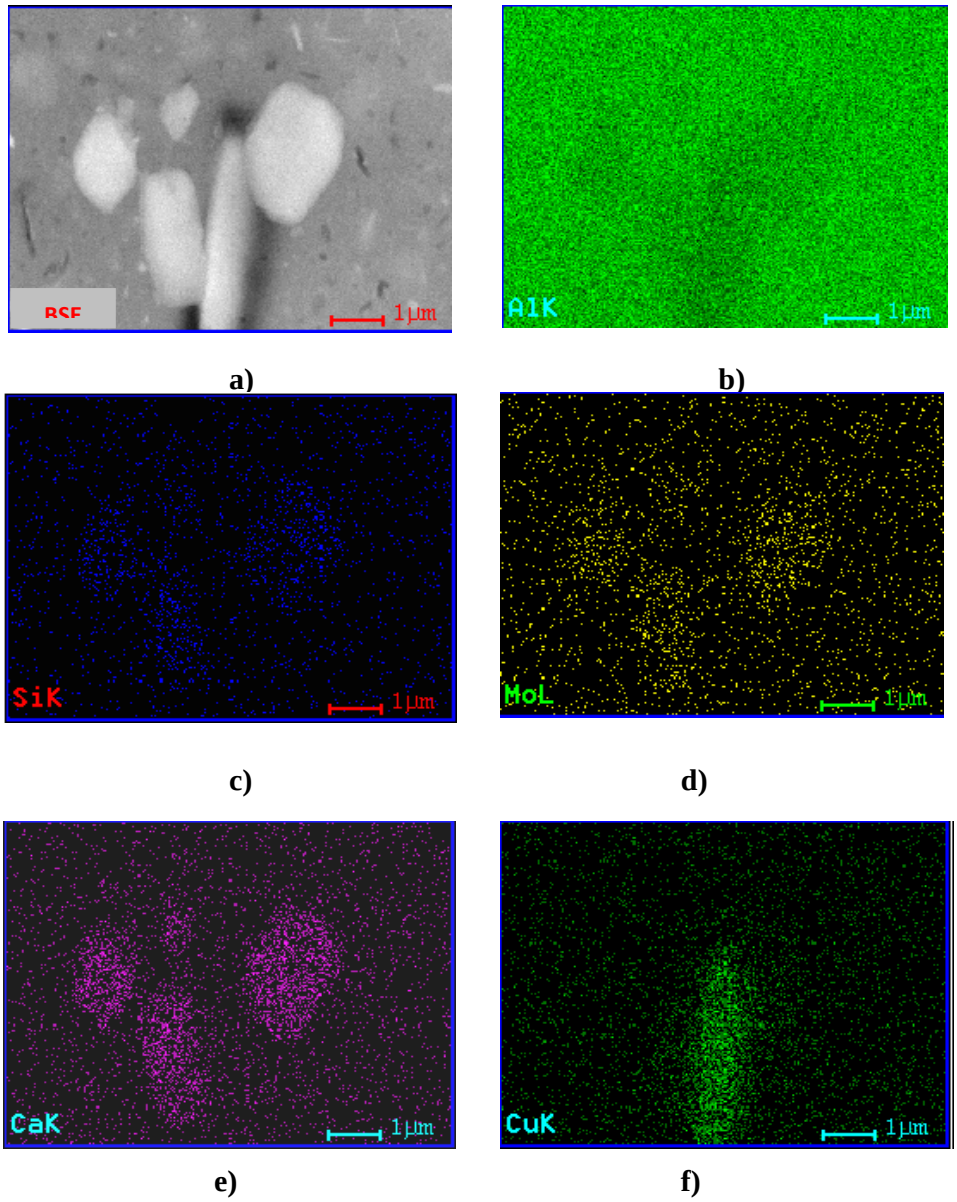


Fig. 7. SEM micrographs of a microzone which contains the fine Mg_3Zn and CaMoSi compounds (a) and X-ray maps of AlK_α (b), SiK (c) , MoK_α (d), CaK_α (e) and CuK_α(f)

The presence of fine Mg_3Zn and $CuAl_2$ phases precipitated within the grains are clearly seen in figure 8.

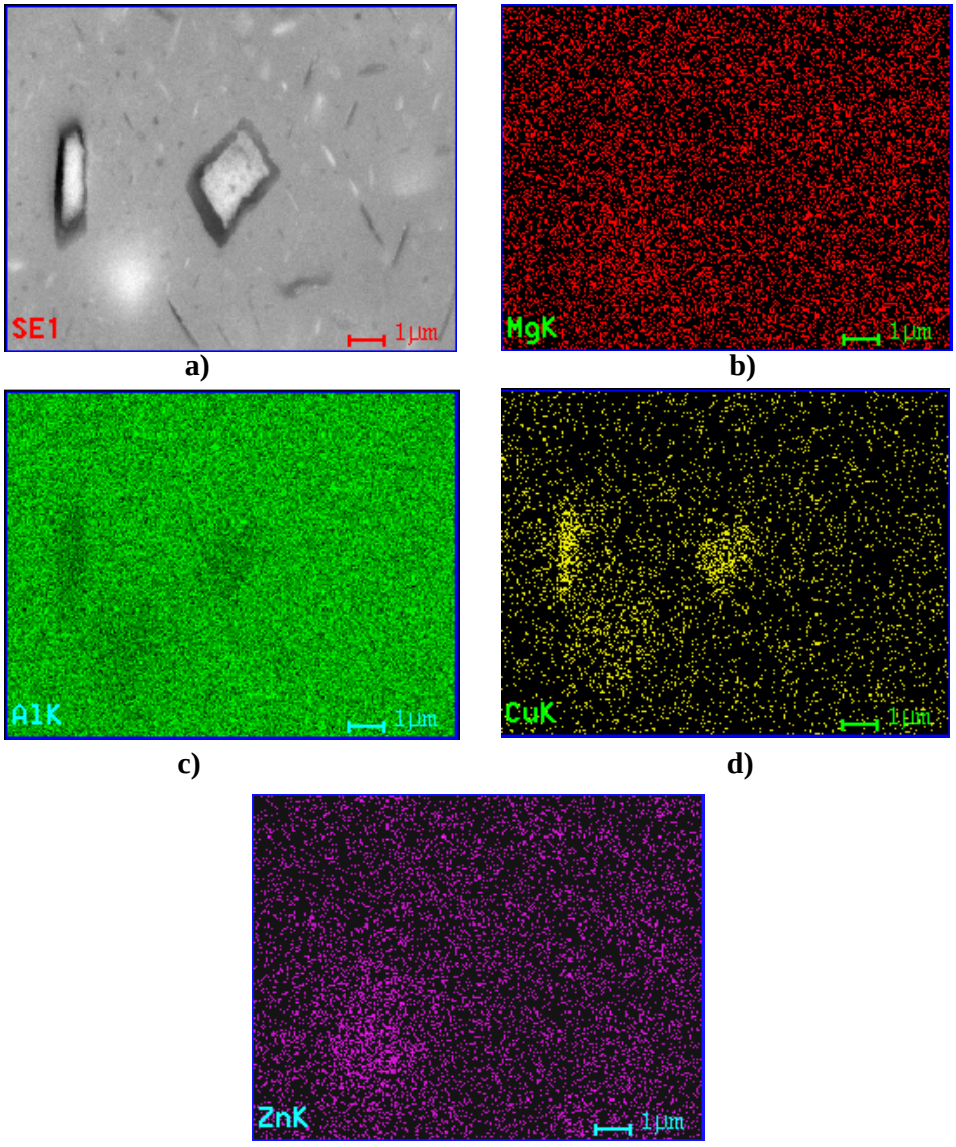


Fig.8. SEM micrograph (a) and X-ray maps of MgK_α (b), AlK_α (c) ,CuK_α (d), and ZnK_α (e) in the A sample.

4. Conclusions

1. The samples prevailed from a 7175 alloy slab casted in Wagstaff installation have been characterized by electronmicroscopy (SEM, EDS)
2. We found the presence of compounds between grains with content of Al, Mg, Cu, Zn as well as polyhedral precipitates within the grains that contained Mg and Zn.
3. X-ray analysis of images and EDS analysis we identified the presence of $CuAl_2$ acicular compounds and Mg_3Zn fine grain precipitate.
4. We have also remarked the presence of some inclusions like CaMoSi which can provide from the raw material and which can have a negative influence on the plastic deformation.
5. These findings show that it is impetuously necessary a much more careful preparation of the raw materials as well as an efficient treatment before casting (degassing, filtration).

R E F E R E N C E S

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