

MICROSTRUCTURAL CHARACTERIZATION OF AA - 7050 ALLOY SLABS (II)

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În lucrare se prezintă microstructura șleburilor din aliajul 7050 turnate turnate în instalația Wagstaff în diferite zone (A...F) a secțiunii transversale a șleburilor. Prin microscopie electronică (SEM, EDS) au fost puse în evidență morfologia fazelor intermetalice intergranulare și intragranulare și s-au identificat compoziția acestora. S-au observat faze intergranulare cu conținut de Al, Mg, Cu și Zn și o fază intragranulară care conține Mg și Zn.

S-a remarcat de asemenea, prezența unor incluziuni intermetalice de tipul CaMoSi care provin din materia prima utilizată la elaborarea aliajului 7050 și care influențează negativ deformarea plastică a șleburilor.

In the paper the microstructure of 7050 DC cast slabs in Wagstaff installation, in different zones of transverse section of slabs is presented. The morphologies and composition of intergrain and intragrain phases was put in evidence by electron microscopy (SEM,EDS).

Intergrain phases which contains Al, Mg,Cu and Zn and intragrain phase with Mg and Zn was observed.

Also, it was remarked the presence of intermetallic inclusions of CaMoSi which originate in the raw materials utilized at the melting of 7050 alloy and which have a negative influence on the plastic deformation of the slabs.

Keywords: aluminum alloy, slab, SEM, EDS

1. Introduction

Al-Zn-Mg-Cu alloys are used primarily for structural components in aerospace applications [1-3].

The aim of the present work is to investigate the intergrain and intragrain compounds morphology and their distribution in three different zone (D,E and F) of AA 7050 aluminum as-cast slabs.

The aim of the present work is to investigate the intergrain and intragrain compounds morphology and their distribution in different zone of AA 7050 aluminum as-cast slabs in Wagstaff installation.

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2. Experimental procedures

The chemical composition of the investigated AA 7050 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 the supplier.

Table 1

Chemical composition of as-cast slabs of AA 7050

Element	Zn	Mg	Mn	Cu	Fe	Si	Cr	Ti	Al
%wt	5.95	2.28	0.021	2.20	0.11	0.065	0.0025	0.035	balance

The samples D, E, and F have been prevailed with 4 mm thickness from the half of free surface of a 500 mm thick slab. The samples polished and have been etched with Keller's reactant.

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 general microstructures of the D, E, F zone samples in figures 1-3, puts in evidence the presence of an light intergrain compounds and some dark colour particles (Fig.1), also light coarse intergrain phases ($\text{ss}\alpha\text{-Al}$ grains), dark colour phases and fine intergrain phases (polyhedral and acicular) (Fig.2). In Fig.4 the sizes of the grains (100-130 μm) and an intergrain compounds network and a fine intermetallic phases network have been observed.

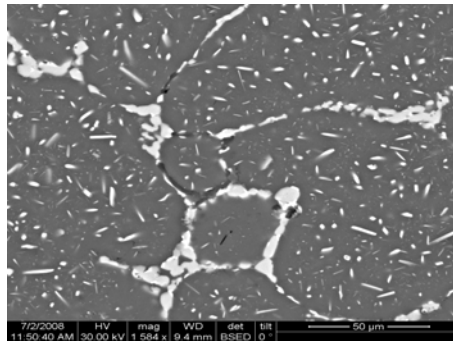


Fig. 1. Sample microstructure taken from D zone of the slab (1500 x)

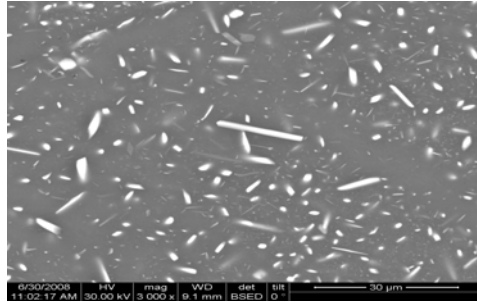


Fig. 2 a. Sample microstructure taken from E zone of slab with intragrain compounds (3000 x)

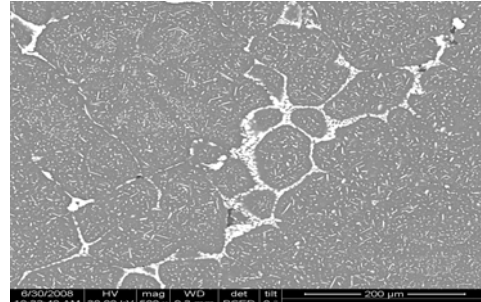


Fig. 2 b. Sample microstructure taken from E zone of slab, with intergrain compounds (500 x)

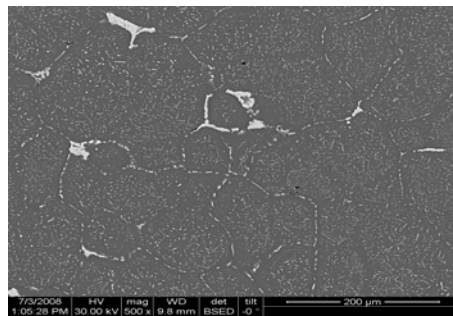


Fig. 3. Sample microstructure taken from F zone of the slab (500 x)

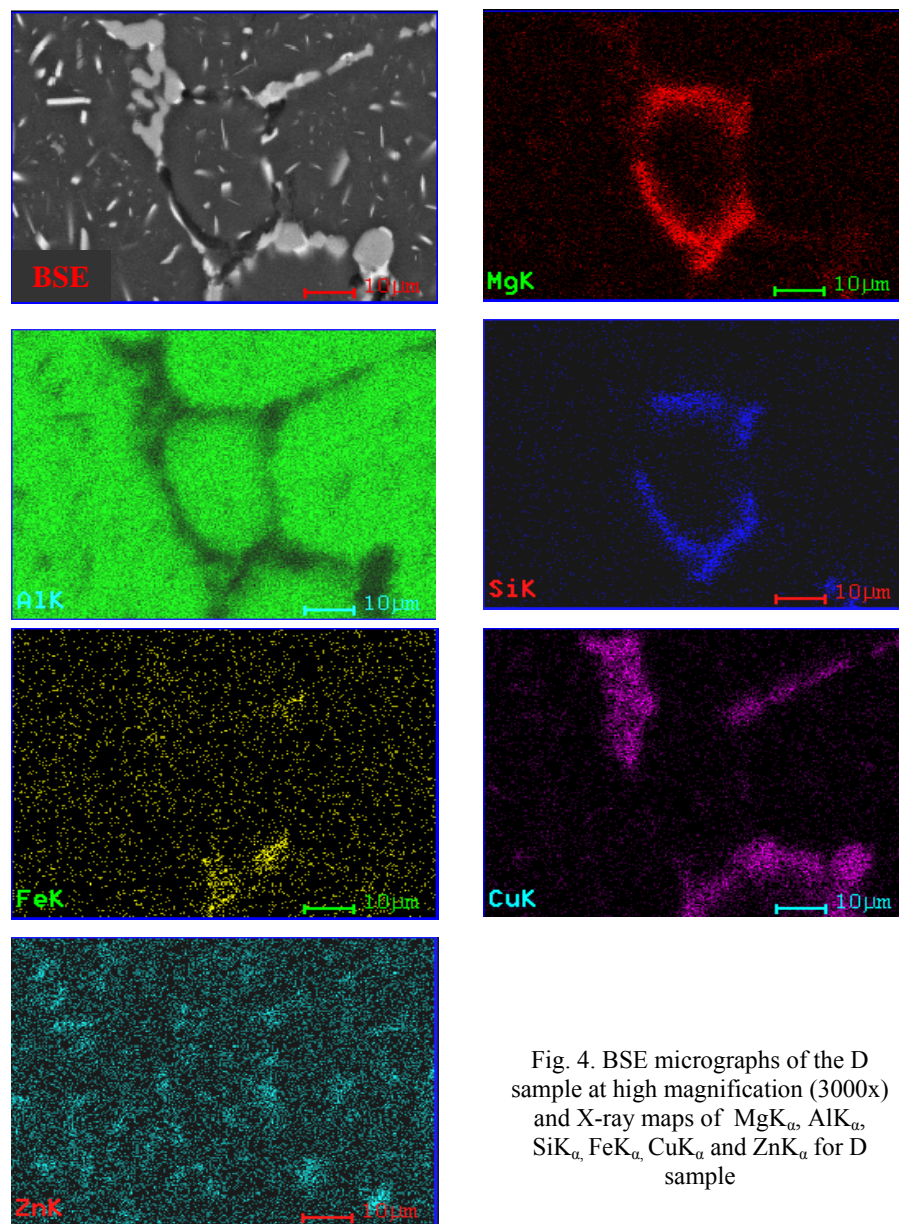


Fig. 4. BSE micrographs of the D sample at high magnification (3000x) and X-ray maps of MgK_α , AlK_α , SiK_α , FeK_α , CuK_α and ZnK_α for D sample

To put in evidence the intergrain phases : MgK_α , AlK_α , SiK_α , FeK_α , CuK_α și ZnK_α was done by X – ray analysis (Fig.4). The presence of dark Mg_2Si compound and light $FeAl_3$ and $CuMgAl - MgZn_2$ - solid solution was identified.

From X-ray maps (Fig.5) we can observe the presence of $Cu - Al_6Mg_4 - Mg_3Zn_3Al_2$ solid solution and polyhedral intragrain Mg_3Zn intragrain phases.

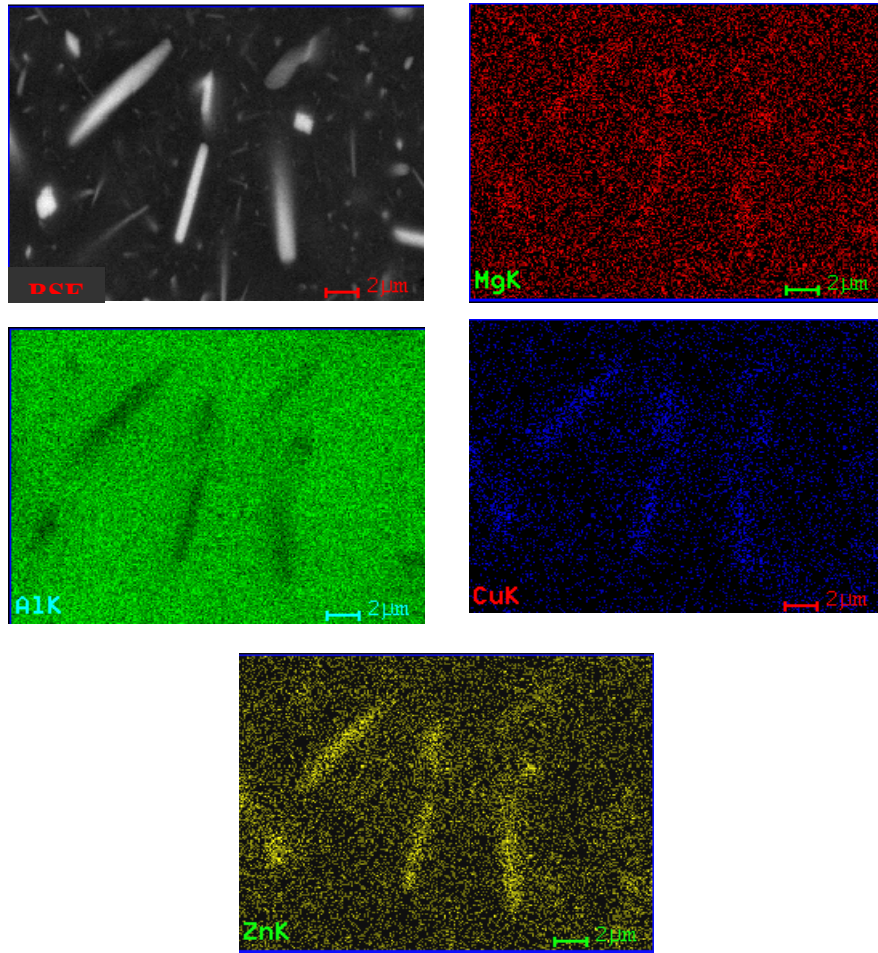


Fig. 5. BSE micrographs of the D sample at high magnification (5000x), and X-ray maps for MgK_α , AlK_α , CuK_α , and ZnK_α

Backscattering images at high magnifications and X-ray images (Fig.6) have put in evidence the presence of Mg_2Si and CuAlMg-MgZn_2 phases at the intergrain boundaries.

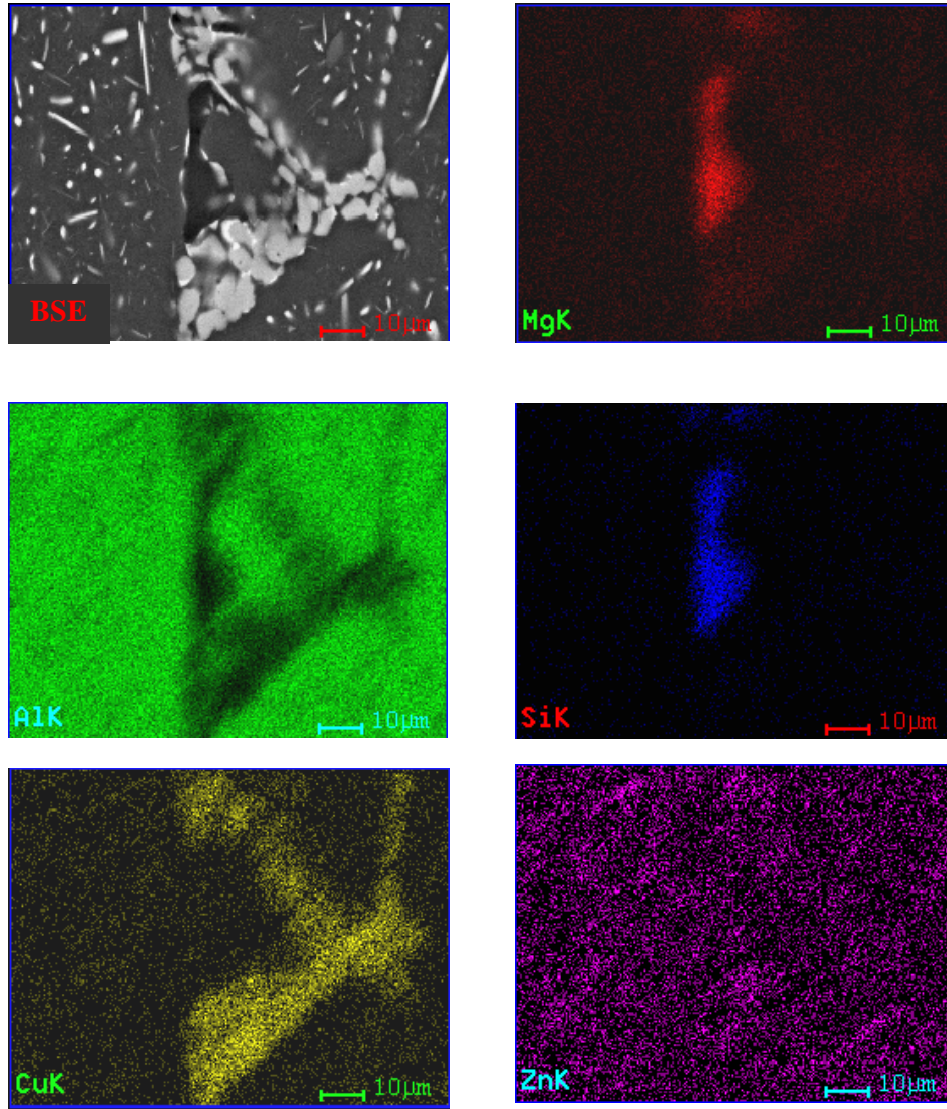


Fig. 6. BSE micrographs of the D sample at high magnification (3000x) and X-ray maps for MgK_α , AlK_α , SiK_α , CuK_α and ZnK_α

Fig. 7 shows a coarse intergrain phase of F sample.

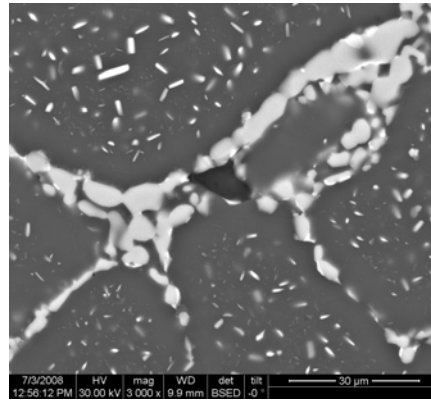


Fig. 7. BSE micrographs of the F sample at high magnification (3000x) put in evidence the big size intergrain compounds

The presence of light CuMgAl – MgZn₂ solid solution and dark Mg₂Si phases was observed in Fig.8.

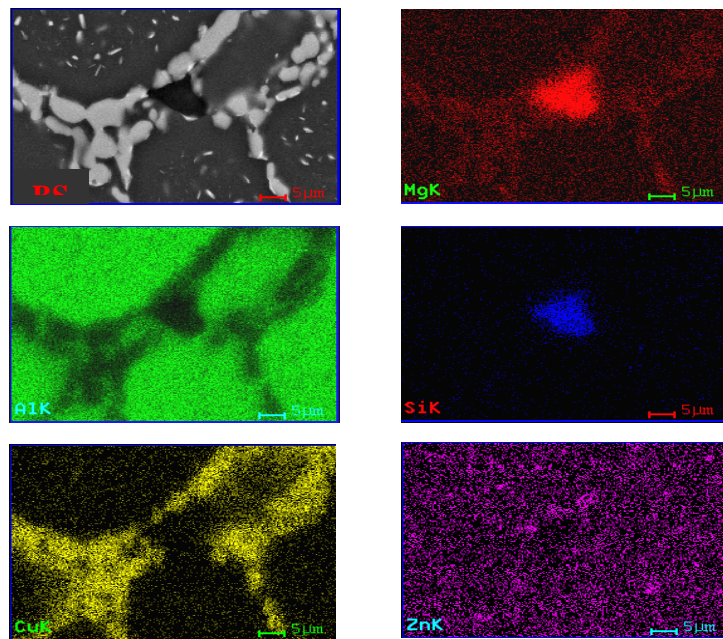


Fig. 8. BSE micrographs of the F sample at high magnification (5000x) and X-ray maps for MgK_α, AlK_α, SiK_α, CuK_α and ZnK_α

A high content of Si has been put in evidence by EDS microanalysis was observed. in the microzone presented in Fig.8.

Intragrain microstructure for F sample (Fig.9) has put in evidence the light compounds precipitation containing Zn, Mg and Cu (Fig.10).

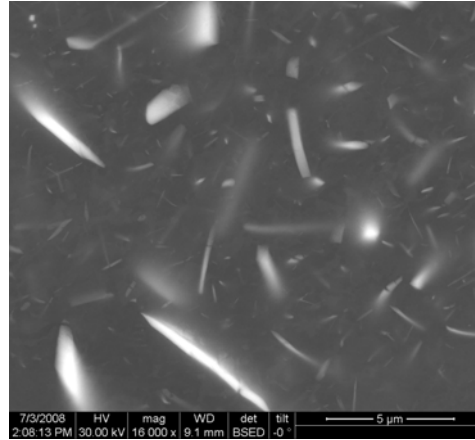


Fig. 9. Intragrain phases in F sample

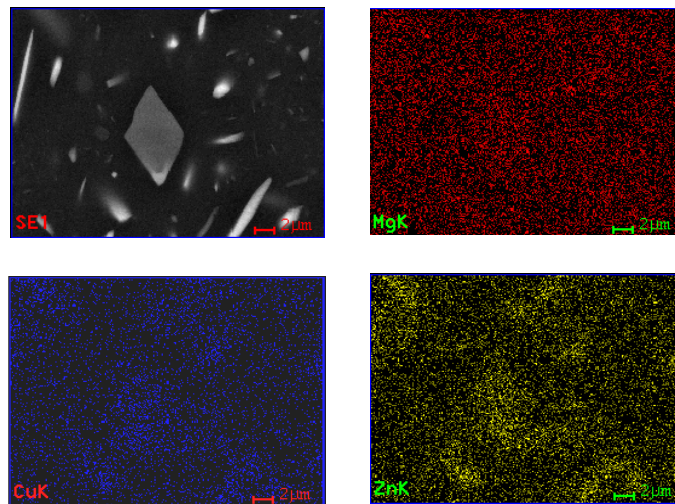
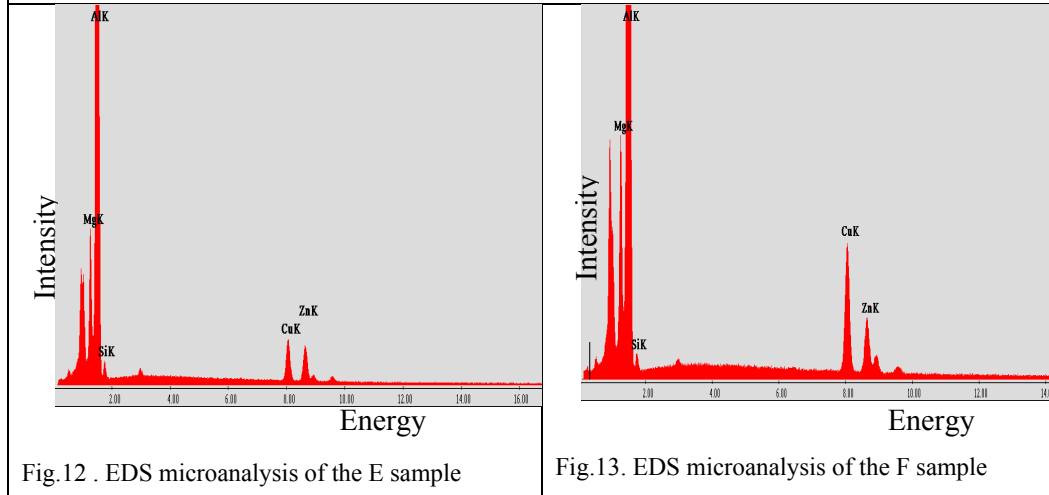
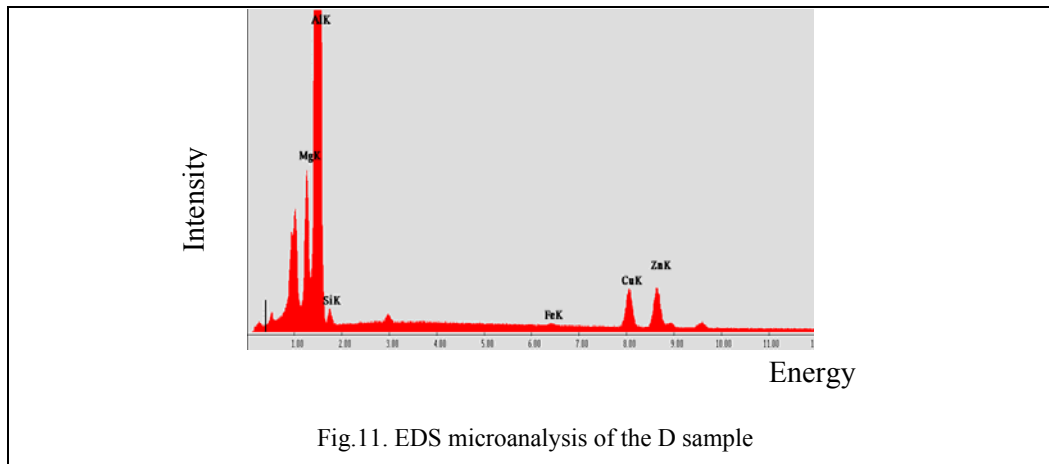


Fig. 10. BSE micrographs of the in intragrain phases F sample at high magnification (5000x) and X-ray maps for MgK_α , CuK_α and ZnK_α

The identification of elements was carried out by EDS microanalysis (Fig.11-13).



Conclusions

1. The samples prevailed from a 7050 alloy slab casted in Wagstaff installation have been characterized by electron microscopy (SEM, EDS).
2. The presence of intergrain phases with content of Al, Mg, Cu, Zn as well as polyhedral precipitates within the grains that contained Mg and Zn was observed.
3. Image analysis of images and EDS analysis have put in evidence the presence of CuAl_2 acicular compounds and Mg_2Si fine grain precipitate.
4. We have also remarked the presence of some inclusions like CaMoSi which originate in the raw material and which have a negative influence

on the plastic deformation.

REFERENCES

- [1] *L.F. Mondolfo*, Aluminium Alloys: Structure and Properties, ButterWorths, 1976.
- [2] *M. Ienciu, N. Panait, P. Moldovan, M. Buzatu*, Elaborarea și turnarea aliajelor neferoase speciale, (Elaborating and Moulding of Non-ferrous Alloys_in Romanian), Ed. Didactică și Pedagogică, Bucharest, 1982
- [3] *W. Schneider*, D.C.Casting of Aluminium Alloys-Past, Present and Future, Light Metals, 2002, p.953-960
- [4] *A.J. Bryant, R.A.P. Fielding*, Developments in Billet & Extrusion Metallurgy on the Operation of the Extrusion Process, Light Metals Age, Apr.1998, pag. 6-10
- [5] *Encyclopedia of Materials Characterization: Surfaces, Interfaces, Thin Films*, Edited by : C Richards Brundle et al., Butterworth – Hinemann, 1998.