

## OBTAINING AND CHARACTERIZING OF BULK AMORPHOUS STEELS

### Goal of the project

This project was aimed processing and characterization of bulk amorphous steels from the Fe-Cr- (Mo, Mn) - (Y, Ga) -C- (B, Si, P) family by casting in copper mold and using ferro-alloys as raw materials.

### Short description of the project

Two families of alloys were studied: Fe-Cr-Mo-Nb-C-Si-Ga and Fe-Cr-Mo-Nb-C-Si-Y.

There were obtained alloys in the form of  $\varnothing 3 \times 50$  mm bars and in the form of discs of  $\varnothing \square 10 \times 1$  mm by pressure casting in cooper mold method (fig.1).



Fig. 1 Obtained alloys

The structural analysis showed that both alloys with Ga and Y have the amorphous structure at concentrations of at least 4% at. Ga and Y respectively.

The obtained alloys have good thermal stability (crystallization temperature,  $T_x$ , is over 630oC), but Ga alloy has a better glass forming ability (GFA).

The alloy with Ga has mechanical strengths,  $R_m$ , and corrosion resistance, expressed by the corrosion rate,  $v_{cor}$ , superior to alloy with Y but is fragile. Y-alloys instead have a ductile behavior, having plastic deformation before breaking.

### Implementation period

21.11.2017 – 31.12.2018

### Budget

46.500 RON (10000 EUR)

### Main activities

- The establishment of the optimal composition of the master alloy;
- Elaboration and characterization of the master alloy;
- Optimizing chemical composition based on structural analysis;
- Constructional-technological design of copper molds for alloy casting;
- -Establishing the casting technology of the alloy developed in the form of cylindrical bars or discs;
- Structural characterization of obtained alloys;
- Determination of mechanical properties;
- Determination of corrosion resistance.

### Results

1. Project team members participated in two international conferences:

- 7th International Conference on Advanced Materials and Structures, AMS 2018, March 28-31, 2018, Timișoara, with the paper "Simulation of Thermal Field in Bulk Amorphous Steels" - ISI Quoted Conference;
- The 25th International Symposium on Metastable, Amorphous and Nanostructured Materials (ISMANAM 2018), 2-6 July 2018, Rome, Italy, with the paper "Synthesis and characterization of bulk amorphous steel using industrial ferro-alloys" - selected papers will be published in ISI quoted journals

2. An article "Influence of Co substitution for Cr on glass forming ability and mechanical properties in Fe-based bulk metallic glass" was sent to HELIYON - Elsevier magazine, accepted for publication with revised manuscript.

### Applicability and transferability of the results:

Bulk amorphous steel (BAS), has drawn great attention for structural and functional applications due to the unique properties such as high fracture strength, high hardness, excellent corrosion resistance. In addition, the Fe-based BAS can be fabricated by using industrial ferrous-alloys, significantly reducing the production cost. Consequently, Fe-based BAS can be an excellent choice for medical implants, surgical tools and other biomedical related parts. They can also be used in fabrication of microgear for micromotors.

### Research team

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