Science et Ingénierie
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Materials Science - Thesis Proposal

Surface Patterning Functionalization of Amorphous Metallic Alloys

Context and objectives of the thesis work

This thesis work aims at enhancing the functionalization of bulk metallic glasses (BMG) by finely modifying their surface structure. The use of BMG, i.e. of non-crystalline metallic alloys is a judicious choice because they present at the same time high potential properties (high mechanical properties, corrosion resistance and bio-compatibility for example) and the ability to be shaped at high temperature without any detrimental effect on their amorphous atomic structure. It is known in the literature that specific BMG (mostly Pt- and Pd-based) can efficiently replicate silicon or alumina nano-patterns. However, few studies are available in the scientific community on the behaviour of metallic glasses subjected to deformation at small scales and high temperature, especially on more conventional compositions (Zr-, Cu-, Ni-based) requiring more attention during the process (vacuum or controlled atmosphere) but enlarging the range of potential applications. This situation results from the fact that a combination of scientific knowledge, experimental know-how, technical equipment as well as characterization techniques are mandatory to achieve such results. Such conditions can be found at the SIMaP laboratory where a specific equipment for surface thermoforming at high temperature and under vacuum has recently been conceived and built.

The work will be dedicated to the understanding of the deformation of BMG at high temperature during the replication of fine (nano and micro) patterns on the material surface. More precisely, the PhD student will study the patterning process in order to adjust the experimental parameters to the intrinsic BMG bulk properties and to the targeted functional properties. To do so, he (she) will investigate in details the different compositions of the promising BMG to be produced, the moulds characteristics (materials, compatibility with the BMG, demoulding procedure, re-usability, patterns shapes and size etc.), the rheological behaviour of the BMG, the optimization of the experimental equipment for a tuneable and controlled patterning process, the replication quality (i.e. characterization of the surface design) and the functionalization properties.

Applicant's profile

The candidate must possess a scientific background in the domain of metallic materials. Interests and skills for experimental is mandatoy. Additional skills in processing, mechanical and microstructural characterization would be much appreciated. Nonetheless, the important collaborating work with various scientific partners requires good organizational, team-work and communication abilities from the candidate.

- **Location :** SIMaP laboratory, GPM2 group.
- **Duration** : 36 months.
- **Salary** : Public thesis scholarship (about 1750 € monthly).
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