Role of Yttrium addition on the improvement of the plasticity in the Cu-Zr-Ti metallic glass system

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Yttrium is known to exhibit a high atomic radius, contributing to the maximum disorder principle. It also shows a strong affinity with oxygen. This reaction contributes to stabilize the liquid phase and delay the crystallization in metallic glasses. Moreover increasing the GFA, micro-alloying of Y is also responsible of an improvement of a lot of properties, as for example, corrosion resistance, thermal stability, biocompatibility and also the plasticity of the sample. However no clear explanations have been presented about this beneficial effect.

In this work, after determining the optimum quantity of Yttrium to add, the characterization of this material was conducted. 1 at. % of Y in the Cu-Zr-Ti leads to an increase of 2% of plastic strain. The microstructure was precisely studied using Transmission Electron Microscopy (TEM) observations and some explanation about this improvement can be discussed. Yttrium nano-precipitates with a core-shell structure were observed. This leads to an improvement of the ductility of the material, due to the nano-crystallized areas induced by the precipitates. EDX and EELS analysis were also used to confirm that they correspond to yttria.

Corrosion behaviour was also investigated in several electrolyte mediums and 1 at. % Y increases the corrosion potential to -0.23 V/SCE which is close to the Ti-6Al-4V alloy. NaCl solution and NaCl solution with 4g/L of albumin were used. These proteins adsorbed on the sample surface to create a passive level and avoid the immediate dissolution due to the main Cu content. They drastically change the material corrosion behaviour.

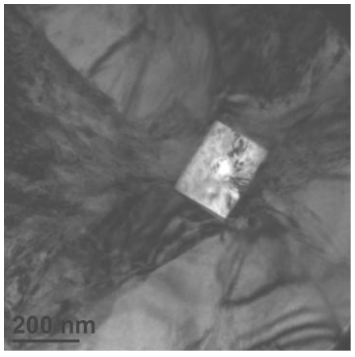

Figure 1 : TEM observations of an Yttria precipitate