JOINING STEELS BY MEANS OF AN AMORPHOUS WELDING PROCESS

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***Abstract*— The *Laboratorio de Sólidos Amorfos* started research on amorphous bonding processes in 1998. Since the beginning of 2000 a three year project devoted to this subject "Joining metals by amorphous metals diffusion" has been subsidized by the ANPCyT[‡] and Siderca. In this work the antecedents of the project are summarized, the welding method is described and the results obtained up to now are reported.**

***Keywords*— amorphous bonding, welding, amorphous metals, steel.**

I. INTRODUCTION

The *Laboratorio de Sólidos Amorfos (LSA)* was born as a consequence of the basic research on liquid semiconductors performed in the 70's in the Physics Department. In the early 80's a group devoted to the study of semiconducting glasses and amorphous metals produced by means of rapid solidification techniques (Quintana et al. 1979), and analyzed employing X-ray diffractometry and Mössbauer spectrometry consolidated as a new laboratory, the LSA. The early works were devoted to the glass forming ability of several binary and ternary chalcogenide based systems (Quintana et al. 1982, Arcondo et al. 1984, Arcondo et al. 1985 a-b, Fontana et al. 1992). By the end of this period, the glass forming mechanisms of a collection of Mg based alloy were studied. These alloys are MgSnX (X= Cu, Ni, Zn and Ga) and MgZnPb (Mingolo et al. 1986, Sirkin et al. 1987, Mingolo et al. 1989, Vicente et al. 1991, Arcondo et al. 1991a, Vicente et al. 1992, Fontana and Arcondo, 1994, Fontana and Arcondo, 1995, Somoza et al. 1995).

Once the rapid solidification melt spinning technique was implemented in the *Laboratorio de Sólidos Amorfos,* work on Fe or Ni based multicomponent systems began. Among them FeB, NiB, FeNiB, FeBSn, NiBSn, FeNiBSn (Boudard et al. 1991, Arcondo et al. 1991b, Arcondo et al. 1994 a-d)

After this, a new stage started, characterized by the diversification of the properties studied and the opening to the collaboration with European research groups. Two main lines, metallic and chalcogenide glasses, have been developed. The amorphous metals line, included as well the study of nanostructured alloys obtained by means of a controlled crystallization process of FeSiB (Moya et al, 1997a) and several light amorphous metals (Audebert et al. 1997a). The glass forming ability, the structure (Audebert et al. 1997b), the mechanical (Moya et al. 1997b) (Young´s modulus, microhardness, tensile strenght, plasticity and fracture) and magnetic (coercivity, saturation, remanence and permeability) (Moya et al. 1999) properties, the corrosion resistance (Audebert et al. 1998), in acid and basic media, and the crystallization processes have been analyzed. The systems studied were FeSiBSn, FeSiBNb, FeSiBNbSn, FeSiBNbCu, FeSiBNbCuX (X= Al, Cr, Ag, C, etc.), AlFeX (X=Nb, Sb, MM: Mishmetal, a Rare Earths mixture) and Mg(Cu, Al)MM. The chalcogenide glasses line main interests have been the structure and electric and mass transport studies and the crystallization kinetics (Fontana et al. 2000a, Fontana et al. 2000b).

In the early 90's a new project tending to the development of a centrifugal atomization device to produce metallic powders with the aim to obtain sintered pieces of high mechanical resistance was initiated. The systems studied were CoCrWC and FeMnAlSiC (Ozols et al. 1999, Ozols et al. 1996). This line is oriented nowadays towards the elaboration of soft magnetic nucleus employing preisolated powder particles. The systems under study are NiFeMo, FeCoV and NiFeCo.

The results of these works are reported in more than 100 papers in international journals and the contribution of the *Laboratorio de Sólidos Amorfos* to the formation of human resources has been expressed in 10 doctoral thesis in Physics and Engineering.

The above mentioned lines are supplemented at the present time with a technological project oriented to the development of metallic joints employing amorphous metals layers and a recently initiated project oriented to the modification of metallic or semiconducting surfaces employing laser discharges.

II. METHODS

A. Amorphous Welding Method

Let us assume that two bars of a metal α are aligned with their slightly polished butts in contact with a thin amorphous layer L (Fig. 1). The composition of L is not far from an eutectic point which components are α and β (Fig. 2). The melting temperature of L (T_L) is lower

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