Thermal conductivity of bulk metallic glasses under cryogenic conditions and applications

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Abstract: Bulk metallic glasses possess an amorphous structure without any atomic long range ordering unlike their crystalline counterparts. They exhibit particular properties due to this amorphous structure, which is very promising for future industrial applications. In particular, their thermal conductivity is very low compared to other metallic materials due to the absence of crystalline lattice. Thus, these alloys show some insulating properties, leading to low heat losses. This PhD work focuses on understanding the mechanisms that occur in thermal conductivity of bulk metallic glasses in order to identify suitable compositions. Several optimization methods have been carried out to minimize the thermal properties and resulted in the development of an optimized composition showing low thermal conductivity. Secondly, their joining ability has been studied with the aim to implement these alloys in an industrial device. Two different joining techniques have been faced to provide a short and a long term solution. Eventually, two patents which protect the use of beneficial compositions developed in this work have been filed. Besides, prototypes have been produced using the two processes studied in this work and show enhanced performances compared to the current solution.