Title: Enhanced plasticity of FeCoBSiNb bulk glassy alloys by controlling the structure heterogeneity with Cu addition

Abstract: Fe-based bulk glassy alloys (BGAs) have attracted great attention due to their ultrahigh strength, large elastic strain and excellent soft magnetic properties, but the most significant disadvantage of the BGAs is the lack of macroscopic plasticity (usually less than 0.5% compressive plastic strain) at room temperature. For industrial applications, it is of great interest to develop novel Fe-based BGAs with good plasticity in a high strength level. This issue has been actually the subject of intense research in recent years.

In this work, the FeCoBSiNbCu BGAs with diameters up to 4 mm were successfully prepared by copper mold casting method. The structure, thermal stability, mechanical behavior and magnetic softness of these alloys were systematically investigated by X-ray diffraction (XRD), differential scanning calorimeter (DSC), scanning and transmission electron microscope (SEM and TEM), mechanical and magnetic properties testing. It was found that the structural evolution was drastically activated through single phase to multi-phases transformation on crystallization behavior and the competition of multi-phases results in a good glass-forming ability. The $(Fe_{0.5}Co_{0.5})_{71.6}B_{20}Si_4Nb_4Cu_{0.4}$ BGA exhibits a high strength over 4 GPa and an enhanced plasticity of 3.7%, combined with good soft magnetic properties. A well-developed vein pattern on the fracture surface and highly dense multiple

shear bands throughout the overall rod were observed on the deformed specimen. The improved plasticity is strongly related to the nano-scale heterogeneous structure introduced to the glassy alloy by phase separation with minor Cu addition, which can hinder the propagation of shear bands, promote multiple shearing and enhance the plasticity. This work might have a guiding significance for a deep-understanding of the plastic deformation mechanism of Fe-based BGAs in a high strength level, and expects this alloy system as novel potential structural materials.