Title: Thermal, magnetic and magnetocaloric properties of FeErNbB metallic glasses with high glass-forming ability

Abstract: As a diversified alloy family, Fe-based BMGs exhibit strong potential applications owing to their excellent good soft magnetic performances. Therefore, designing new Fe-based magnetocaloric material is very important part of research. Considerable researches have been carried out to explore the MCE performance of Fe-based amorphous alloys. However, most reported Fe-based magnetocaloric materials have their drawbacks. Some promising Fe-based magnetocaloric materials such as Fe87Zr7B4Co2, Fe80-xB12Cr8Gdx (x=1, 2, 3, 5, 8, 10, 11) metallic glass alloys exhibit a relatively high magnetic entropy change near room temperature, nevertheless, they have so poor GFA that only ribbon sample can be obtained. On the other hand, (Fe0.71RE0.05B0.24)96Nb4 (RE = Tm, Tb, Ho, Dy) BMGs have large GFA, but their values of TC are much higher than room temperature (over 450 K). Hence, there is considerable interest in designing Fe-based BMGs with good GFA and TC near room temperature.

For the purpose of designing novel Fe-based BMGs with good GFA and TC near room temperature, the substitution of Fe by Er in the Fe71Nb6B23 BMG was carried out. The comprehensive characteristics of Fe71-xErxNb6B23 (x = 0, 1, 3, 5, 7 at.%) bulk metallic glasses (BMGs), including the thermal properties, glass-forming ability, magnetocaloric effect and mechanical properties were

investigated. As a result, with increasing Er content up to 5 at%, the supercooled liquid region increases to 90 K, and BMG with a critical diameter of 4 mm is fabricated by copper mold casting. The regulation of Curie temperature is achieved by controlling the amount of Er. The resulting glass alloy system exhibits Curie temperature of 340-550 K, magnetic entropy change of 0.74-1.41 J/kg K, and refrigerant capacity of 56-112 J/kg in external magnetic field of 1.5 T. Moreover, the Fe71-xErxNb6B23 BMGs exhibit high saturation magnetic flux density of 0.43-1.09 T, high fracture strength of 3.09-4.65 GPa and high Vickers hardness of 1030-1090 kg/mm2, respectively. At the same time, the designed Fe64Er7Nb6B23 BMG is found to have a near room temperture Tc (~340K) and shows good GFA with a limited diameter of 2 mm. Considering these good overall characteristics, this glass alloy system can be employed as magnetic-refrigerant materials in temperature range of 340-550 K.

Keywords: Fe-based BMGs; Glass-forming ability; Mechanical properties; Magnetocaloric effect.