Electronic Supplementary Information for

Magnetic anisotropy of iron-based metallic glassy fibers

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1. Synthetic procedures

Master ingots of $Fe_{74.5}Si_{10}B_{12}Cr_{3.5}$ based alloys were prepared by arc-melting a mixture of raw elements with a purity level of >99.9% in a Ti-gettered high purity argon atmosphere. The cylindrical rods of diameter in 8 mm were prepared by copper-mold casting under argon atmosphere. And the wires were fabricated by a melt-extraction method as shown in Fig. S1. The edge of angle of the Cu wheel (diameter about 200 mm) was fixed at an angle of 60°. The circumferential velocity V_w of the Cu wheel was 30 ms^{-1}. In this apparatus, the position of the cylindrical rods by induction melting could be controlled. The molten mother alloy was extracted by moving up the melt cylindrical rods under a high purity argon atmosphere, and forming a fine, rapidly cooled circular wire with a high surface-to-volume ratio.

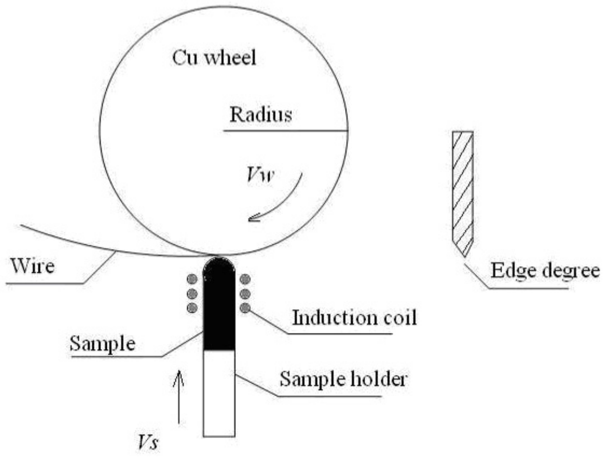

Fig. S1 Schematic illustration of a melt-extraction technique used in the present study, V_w is the circumferential velocity of the Cu wheel, V_s is the sample velocity.

2. Spin-flop and spin-flip transitions

There are two types of metamagnetic transitions[1], the spin-flop transition and spin-flip transition as shown in Fig. S2. For the spin-flop transition, at a critical magnetic field H_{critic}, M_a and M_b rotate suddenly to a direction perpendicular to the easy magnetization direction, consequently perpendicular to the applied magnetic field. Then a continuous rotation of the magnetic moment occurs upon increasing H. For the spin-flip transition as shown in Fig. S2b, M_a and M_b remain parallel to the easy magnetization axis up to a critical field. At H_{critic} a sudden rotation occurs of M_a, towards the field direction resulting to a parallel arrangement of both magnetic moments, and the saturation state is obtained. At present study, the steep response around an original point of Fig. 2a in the horizontal direction includes the spin-flip transition behavior, and the H_{critic} is very small, so formed the S-shaped curve in Fig. 2a. In Fig. 2b, at 300 K in the horizontal direction which ranges in the paramagnetic phase, initially the M is proportional to the applied magnetic field H. When the value of applied magnetic field H increases, and reaches the saturation magnetization point H_s, it can be in saturation state, and formed the S-shaped curve. As there is super exchange interaction[2] at 2 K, the applied magnetic field strength H_s to reach the saturation magnetization point is a little bigger than that at 300 K in the horizontal direction (see Table I).

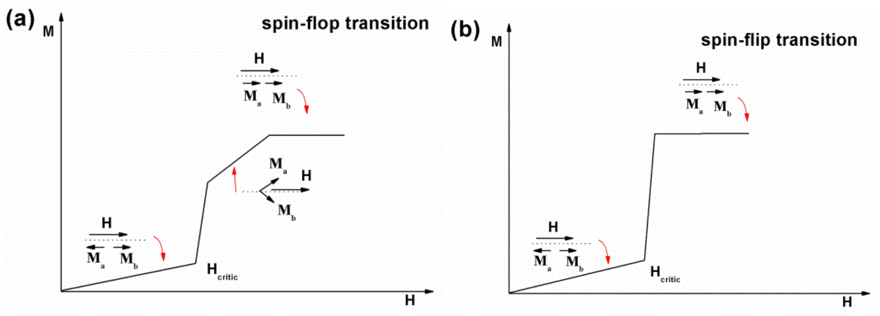

Fig. S2 Schematic illustration of the spin-flop transition (a) and spin-flip transition (b).

References

1 S. Blundell, Magnetism in condensed matter, Oxford University Press, 2001.

2 J. Kanamori, *Journal of physics and chemistry of solids*, 1959, **10**, 87.