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Improved Giant Stress-impedance Effect in Complex annealed $Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ Ribbons

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The stress-impedance (SI) effect has been recently discovered in magnetically soft amorphous wires.[1] Shortly afterwards, observation of this phenomenon has been reported for amorphous and nanocrystalline ribbons. [2] From a practical point of view, this property can be exploited for various applications in micro-miniature stress sensors. It has been established that the induced transverse anisotropy determined the magnitude of transverse permeability, which is responsible for the SI effect in magnetically soft nanocrystalline ribbons.[3] Nevertheless, the induced anisotropy is composed of the strength and direction of anisotropic field, thus, either change of them results in the variation of induced anisotropy.

In the present paper, the influence of direction and strength of the induced anisotropy on SI effect has been studied. Experimentally it is found the magnetic anisotropy of stress Joule heated $Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ nanocrystalline ribbons is determined by direction and strength of the induced anisotropy. Theoretical calculations of direction and strength of induced magnetic anisotropy suggests that transverse anisotropy and small anisotropic field result in the increase of SI effect. To decrease anisotropic field and increase transverse anisotropy simultaneously, a complex annealing is applied to $Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ ribbons, and it is found that the SI effect is drastically improved. A maximum change of 286% in the SI ratio of the complex annealed nanocrystalline $Fe_{73.5}Cu_1Nb_3Si_{13.5}B_9$ ribbon was observed around 10 MHz frequencies.

[1] L. P. Shen, T. Uchiyama, K. Mohri, E. Kita, and K. Bushida, IEEE Trans. Magn., **33**, 3355 (1997).

[2] Deren Li, Zhichao Lu and Shaoxiong Zhou, Sensors and Actuators A, **109**, 68 (2003).

[3] D. R. Li, Z. C. Lu, and S. X. Zhou, J. Appl. Phys., **95**, 204 (2004).