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Dynamic Magneto-mechanical Behavior of a Fe-Ni-based Constant-elasticity Alloy

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Magnetostriction can be described most generally as the deformation of a body in response to a change in magnetization [1]. Because Terfenol-D ($Tb_xDy_{1-x}Fe_y$) features with giant magnetostrictive property, it has received sufficient internets over the past few decades. However, it is difficult to machine the Terfenol-D material into small sizes due to its brittleness. Moreover, the mechanical quality factor (Q-factor) of Terfenol-D is very small (ranging from 3 to 20) [2]. In this manner, it is difficult to realize a high Q-factor micro-resonator with Terfenol-D.

In this paper, we discuss the magneto-mechanical behaviors of a Fe-Ni-based precipitation hardening type constant-elasticity alloy which features with high mechanical Q-factor, *e.g.* Q > 9000. In experiment, a number of rectangular samples are prepared. The dynamic magneto-mechanical behaviors of the samples are investigated by Laser Doppler Vibrometry (Polytec MSV-400, Germany). The magnetostrictive strains are investigated as a function of frequency under different bias magnetic fields. The magnetically-induced strain coefficients over frequency (strain coefficient spectra) show that the coefficients at resonance are significant notable due to the high effective mechanical Q-factor of the alloy, *e.g.,* some resonant magnetically-induced strain coefficients achieve 557.07 nm/A while the effective mechanical Q-factor is greater than 2000. Actually, the material Q-factor of the constant-elasticity alloy is greater than 9000, however, the effective mechanical Q-factor is much lower because of air damping and anchor losses. The resonant strain coefficients and the corresponding mechanical resonance frequencies of the samples are also investigated as functions of bias DC field H_{dc}. The results show that the resonant strain coefficients are strongly dependent on H_{dc} due to the high mechanical Q-factor. This also indicates that it is promising to design a high Q-factor micro-resonator by using the Fe-Ni-based constant-elasticity alloy for DC to quasistatic magnetic field sensing with high sensitivity.

This work was supported by the National High Technology Research and Development Program of China (863 Program) (No. 2006AA04Z337, 2007AA12Z132), and the National Natural Science Foundation of China (No. 10776039, 60774055).

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Synthesis and Magnetic Properties of Bi-doped $Y_3Fe_5O_{12}$ Nanopowders Prepared by Aloe Vera Solution Route

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Bismuth-doped yttrium iron garnet ($Bi_xY_{3-x}Fe_5O_{12}$, x = 0, 0.6, 1.2) nanopowders were synthesized by a simple, cost effective and environmental friendly method using metal nitrates of Y, Fe, Bi and aloe vera plant-extracted solution. The precursors were calcined at different temperatures of 800, 900, 1000 and 1100 ^{o}C, for 3 h to obtain $Bi_xY_{3-x}Fe_5O_{12}$ nanopowders. The prepared samples were characterized by XRD, FT-IR and SEM. The particle sizes estimated from XRD were in the range of 23-63 nm. The study of magnetic properties by VSM at room temperature showed that the saturation magnetizations of the samples calcined at 800 and 900 ^{o}C increased with increasing the content of Bi ions, while those of the samples calcined at 1000 and 1100 ^{o}C decreased with increasing the content of Bi ions. The effects of Bi doping on the magnetic properties of $Y_3Fe_5O_{12}$ are discussed in details.