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Multilayered TbFe/Ni/TbFe Thin Film Multi Body Actuator for Micromachined Magnetostrictive Transducer

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In this paper, we have developed a comb type micromachined multi body actuator system and investigated the magneto-mechanical characteristics of TbFe/Ni/TbFe layered thin film deposited on the actuator systemwith different thickness ratios for the application. Many studies show much interest in the design and fabrication of thin film structures using magnetic materials [1, 2]. Since their magnetostriction amounts in low magnetic field are too small to be adapted to the micro actuator system, they could not find the potential use as wireless magnetostrictive MEMS transducers. However, in this paper, we could deflect the driver by 53μm max under 0.5T which, compared to single layer, indicated the multilayer of 3~5% lower coercive force and 10~15% enhancement of magnetostriction under low magnetic field below 0.5T. The developed actuator of this study operates under magnetic field applied along with the direction of each branch (Fig.1). The magnetostriction of magnetized thin film, a transducer, makes branches deflected. The multilayered film on the Si based frame is fabricated by micromachining process and selective DC magnetron sputtering techniques. The fabrication process starts on the thick Si wafer followed by dry etching thickness up to 101~102μm. After the polishing process, thick photoresist is spun on the thin Si wafer and patterned to act as empty holes for the branches and frame shape. Then, the wafer is etched by DRIE to create holes for comb branch shape and frame structure. Finally, the multi films are sputter-deposited as thicknesses of 1/0.5/1, 1/0.5/0, 0.5/1/0.5, 1/0/0 μm on the branch using designed mask (500μm thick) for selective DC magnetron sputtering. The deposited film thicknesses are measured by XRD. To characterize the magneto-mechanical properties of the structure, the magnetization is observed using VSM and the magnetostriction of the actuator and is determined by measuring the differences of the curvature of the branch using the optical method (Fig. 2 and Fig. 3).

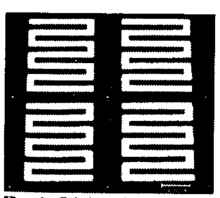

Fig. 1. Fabricated multi body mangetostrictive transducer.

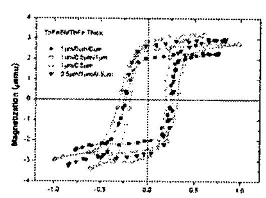

Fig. 2. Results of magnetization at each deposition rate.

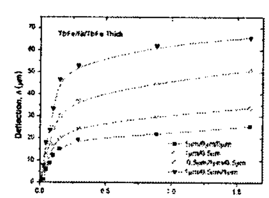

Fig. 3. Results of magnetostriction at each deposition rate.

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