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Substrate Effects of Megnetostrictive Thin Film on Magnetostriction for Micro Actuator

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In this study, four kinds of substrates (Si, glass, Fe, polyimide) with the magnetostrictive thin film layers are investigated to characterize the magnetic and mechanical behaviors due to the substrates effects. Many research results show the potentials of these substrate materials in micro and nano world for bioengineering and industrial applications [1-2]. Magenetostrictive structures with the substrates can be used in wireless devices. To prove micro wireless behavior, magnetic and mechanical characteristics of each substrate with magnetostrictive thin film should be revealed.

To get the each substrate, micromachining techniques are used and presented in Fig. 1 The fabricated substrates have thicknesses of 50, 150 and 500 um with cantilever shape. And TbDyFe films are deposited by DC magnetron sputtering with 0.2 ~ 50 um thick. The deposited film thicknesses are measured using X-ray diffraction. The magnetostrictive film deposition technique has been previously studied [3] and TbDyFe deposition rate is shown in Fig. 2 The magnetization is examined using VSM (Vibrating Sample Magnetometer) and magnetostriction is measured using capacitance method to characterize magneto-mechanical behaviors. The magnetostriction results as deflections are compared in Fig.3

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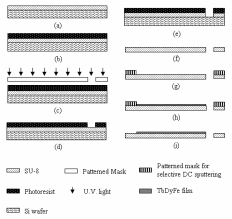

Fig. 1. Micromachning process.

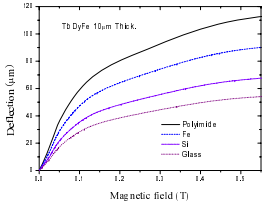

Fig. 2. TbDyFe deposition rate.

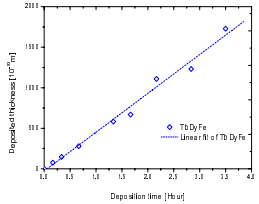

Fig. 3. Substrate effects on magnetos -trictive deflection.

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Optical Phonons in Finite One-Dimensional Spin ½ Cu-O Chain

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Low dimensional Cu-O based materials with 1D magnetic ordering are the promissing candidates for the quantum optical devices [1]. This paper shows how the optical excitation can induce various phonon modes in an ideal 1D string Cu-O at various length. The calculation was carried out at high level theory including CIS/DGDZVP2, MP2/DGDZVP, B2MPW91/LANL2DZ models which also incorporate the effect of strong electron correlation [2]. The phonon modes extensively depend on chain length but are limited to only two basic oscilations of oxygen, one is parallel and another is perpendicular to Cu-O chain direction. The charge distribution and therefore the force constants between the copper and oxygen varied for the boundary atoms. The boundary phonon modes increased as the chain length reduces and become dominated modes at length below 7. There is a difference between the phonon modes in the chains with singlet and doublet spin states.

Fig.1 shows a frequency diagram calculated using different level theories for a single unit Cu-O resonance. The differences reflect the depth of treatment of the electronic correlation in Cu-O.

A comparison is given to the 1D antiferromagnetic spin ½ chain system Ca_2CuO_3 which shows a series of the Raman-active forbidden phonon modes. As known, these modes varied according to chain length [3].

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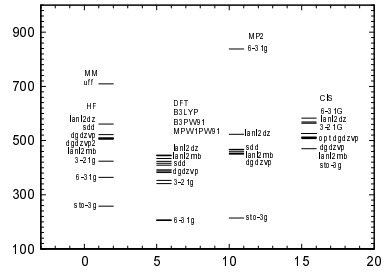

Fig. 1. The frequency diagram for a single unit Cu-O vibration as calculated by different level theories.

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