Demonstration of HDD type High Speed Data Readouts in Ferroelectric Probe Data Storage Using $Pb(Zr,Ti)O_3$ Recording Medium

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Data recording techniques have been collecting attention due to the saturation of areal recording densities of existing data storages. As an alternative, ferroelectric probe data storage realizes ultra-high recording densities of over 1 Tbit/in^2 with high stability domain. We have reported areal recording density of 4 Tbit/in^2 real data written on a $LiTaO_3$ single crystal ferroelectric material using a data storage system based on scanning nonlinear dielectric microscopy (SNDM) [1]. Moreover, we have developed a hard-disk-drive(HDD) type data storage test system based on SNDM. We have demonstrated high-speed readout tests with the use of this test system [2].

In this research, we focus on $Pb(Zr,Ti)O_3$ [PZT] thin film medium as an alternative recording medium because PZT has a higher nonlinear dielectric constant (ε_{333}) than conventional $LiTaO_3$. ε_{333} is the key factor to determine the readout speed because the readout signal of the SNDM-based technique is proportional to ε_{333}. For this purpose, epitaxial PZT thin films were prepared using RF magnetron sputtering technique on SRO coated STO substrates. Periodically-inverted domain stripe pattern was formed on PZT recording layer with a pitch width of 600 nm using an EB-lithography-based technique. Fig. 1 shows the formation of PZT domain structure observed using SNDM. Readout test was conducted using the test system at the spindle rotation of 20,000 rpm, and a readout waveform with a bit rate of 40 Mbps was clearly observed as shown in Fig. 2. The achieved readout speed surpassed the conventional one, and thus, introducing PZT thin film is advantageous to improve the readout speed.

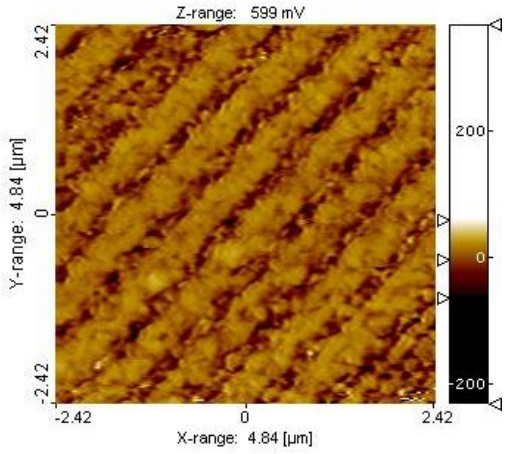

Fig. 1. PZT domain stripe pattern of pitch-of-600nm

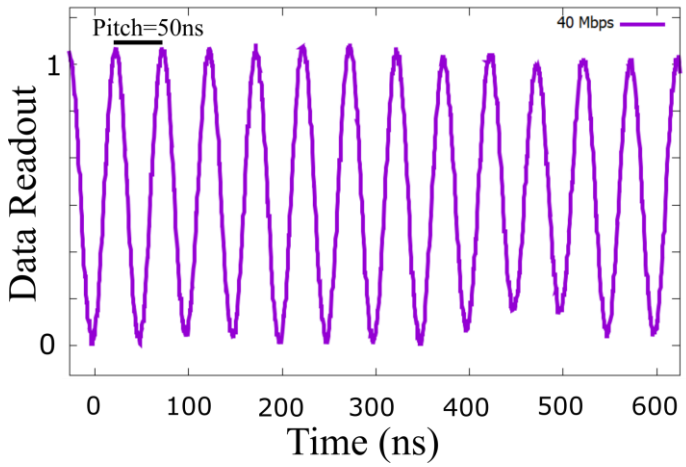

Fig. 2. High-speed readout waveform at a bit rate of 40 Mbps

Acknowledgement

This work was supported in part by a Grant-in-Aid for Scientific Research(16H06360) from the Japan Society for the Promotion of Science(JSPS).

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[2] T. Aoki, Y. Hiranaga and Y. Cho, J. Appl. Phys, Vol.119 (2016) 184101.