Ferroelectric Probe Data Storage Using HfO_2-Based Thin-Film Recording Media

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Ferroelectric probe data storage is a novel data storage method, which is expected to bring a considerable improvement in recording density. An areal recording density of 4 Tbit/inch^2 has been achieved with single-crystal recording media in our previous demonstrative study. Development of thin-film recording media manufactured by a deposition method is one of the most important issues from the viewpoint of practical applications. In this study, we focused on HfO_2-based ferroelectric thin films, because these films have advantageous characteristics that ultimately thin film shows excellent ferroelectricity.

Yttrium-doped HfO_2 (Y:HfO_2) films with a thickness of 11-14 nm were deposited on ITO/YSZ substrate using pulsed laser deposition method. Several measurement samples including (111)- and {100}-oriented films were prepared with different process conditions. Nanoscale domain switching behaviors of these films were observed using scanning nonlinear dielectric microscopy. The experimental results showed that clear domain patterns could be formed on the films with DC voltage poling. Especially, the {100} epitaxial film showed the highest contrast pattern, and was expected to possess advantageous properties for data storage application. Multiple number of domain dots with an average diameter of 40 nm were written on the same film with relatively good reproducibility.

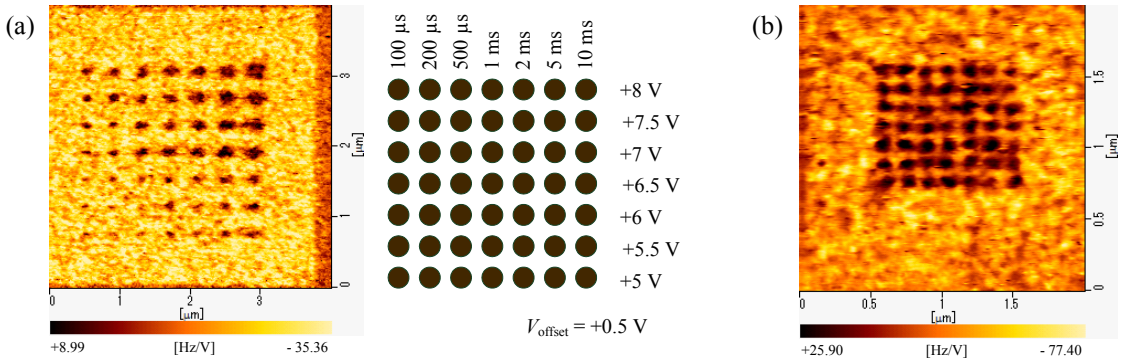

Figure 1. Domain dot array written on Y:HfO_2 film with (a) various voltage pulses and (b) constant voltage pulses.

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