Preparation and Electrical Properties of PZT Thin Film Capacitors for Ferroelectric Random Access Memory

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Abstract

Ferroelectric thin films of $Pb(Zr, Ti)O_3$ (PZT) are prepared on platinum (Pt) and $SrRuO_3$ (SRO) thin film electrodes by a laser ablation technique. Temperature and voltage dependence of the PZT thin film capacitors are investigated. As the results, it is confirmed that the distribution of remanent polarization (Pr) and coercive field is strongly affected by homogeneity of the grain size of PZT thin film and is estimated by differentiating Pr(E) curves with respect to an applied electric field (dP(E)/dE).

Keywords: PZT thin film, D-E hysteresis, $SrRuO_3$ film, polarization switching, inprint, degredation

INTRODUCTION

Ferroelectric thin films have recently attracted great interest as new dielectric materials for Gbit-scale ferroelectric random access memories (FRAMs) [1]. Many studies on synthesis of ferroelectric thin films have been made by using a laser ablation technique so far [2].

Degradation properties of the ferroelectric thin film have also been investigated. They have been explained by pinning and in-print effects associated with electronic-charge trapping and oxygen vacancies [3]. The ferroelectric degradation restricts lifetime and reliability of the devices. In order to overcome these problems, ferroelectric thin films have been grown on the oxide electrode, such as RuO_2, IrO_2 [4], $SrRuO_3$ (SRO) [5] and cubic LSCO as the buffer layer. The degradation properties of the ferroelecric thin films can be improved by using oxide buffer electrodes. However, the effect of the crystalinity of the buffer layer on the ferroelectricity of the ferroelectric films is not fully understood.

In this study, PZT thin film capacitors are fabricated using $Pt/SiO_2/Si$ and SRO/MgO substrates by laser ablation technique. The temperature and voltage dependence in the PZT thin film capacitors are investigated to discuss the effects of the buffer layer on the ferroelectric properties of the PZT thin film.

EXPERIMENTAL

A pulsed YAG laser ($\lambda = 1{,}064$ nm, SL805: Spectron Laser System) was used as a light source of the laser ablation, and the fourth harmonic wave ($\lambda = 266$ nm) was generated using a

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