Inductively Coupled Plasma Etching of $SrBi_2Ta_2O_9$ Thin Films

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$SrBi_2Ta_2O_9$ 박막의 ICP 식각 특성

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The layered $SrBi_2Ta_2O_9$ (SBT) is known as a promising candidate for FRAM device due to its excellent properties such as a high fatigue resistance against polarization switching up to 10^{12} cycles. However, little work has been done on a high density plasma etching of SBT films, especially in terms of plasma chemistry and plasma parameters. SBT films were prepared on Pt(1500 Å)/Ti(500 Å)/SiO_2/Si substrates using a radio frequency (rf) sputtering system equipped with a planar magnetron sputtering source. The SBT thin films were etched in a planar type inductively coupled plasma (ICP) etcher with different chemistries of Cl_2/Ar, Cl_2/NF_3/Ar and Cl_2/NF_3/O_2/Ar. Etch rates were obtained from stylus profilometry measurements. The surface morphology and crystalline structure were analyzed using atomic force microscope (AFM) and X-ray diffraction (XRD) patterns, respectively. Electrical characterization of the films was carried out using a Pt/SBT/Pt capacitor structure. The etch rate was a strong function of gas concentration, ICP source power, and rf chcuk power. Cl_2/NF_3/Ar and Cl_2/NF_3/O_2/Ar plasmas showed maximum etch rates of ~1600 Å/min at 5 mTorr, 700 W ICP power and 150 W rf chuck power. Electrical properties of the SBT films were quite dependent of plasma chemistries: Cl_2/NF_3/O_2/Ar showed a least damage in the films and resulted in overall the best P-E hysteresis loop compared to other chemistries.

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