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Modified rf magnetron sputtering에 의해 $Pt/SiO_2/Si$ 기판위에 제조된 강유전체 $SrBi_2Ta_2O_9$ 박막의 특성 및 전기적 성질에 미치는 Tantalum의 영향

(Effect of Tantalum on Ferroelectric $SrBi_2Ta_2O_9$ Thin Films Deposited on $Pt/SiO_2/Si$ by a Modified rf Magnetron Sputtering Techique)

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Ferroelectric thin films have been widely investigated for non-volatile memory device applications. The recent interest in the layered-perovskite ferroelectric $SrBi_2Ta_2O_9$ from its characteristic low fatigue with polarization switching. This material has demonstrated the capability of undergoing 10^{12} cycles without a degradation in the remanent polarization. The low fatigue properties of this material make it attractive for non-volatile memory device applications.

Over the years various deposition techniques have been applied to deposit ferroelectric $SrBi_2Ta_2O_9$ thin films, including sputtering, CVD, spin-on, and liquid source misted deposition. Since the ferroelectric $SrBi_2Ta_2O_9$ thin films are milti-component oxides, there are difficulties in compositional control of the films. A modified rf sputtering can easily control composition of the $SrBi_2Ta_2O_9$ films.

Pt (150 nm)/SiO_2/Si (001) substrates were prepared at 400°C by DC sputtering. The composition of the target was a $Sr_{1.2}Bi_{2.4}Ta_{2.0}O_9$ ceramic with 20 and 20 mole % excess $SrCO_3$ and Bi_2O_3 to compensate for the lack of Sr and Bi in SBT films, respectively. Ta target was used to control composition of films. which yield higer P_r values than films stoichiometric Sr/Ta atomic ratio. The SBT thin films deposited with the various tantalum powers of 10, 20, and 30 W keeping the rf power of 100W and the bismuth power of 10 W in deposition pressure of 10 mtorr (Ar : O_2 = 1 : 1).

The SBT films were deposited using the SBT, Bi, and Ta targets at 500°C and then annealed at 800°C for 10 min in an oxygen ambient.

Bi-layered ferroelectric $SrBi_2Ta_2O_9$ films were successfully deposited on $Pt/SiO_2/Si$ substrates using a sintered $Sr_{1.2}Bi_{2.4}Ta_{2.0}O_9$ ceramic target, Bi and Ta targets by a modified rf magnetron sputtering technique. The 250 nm thick SBT films deposited under the conditions of rf power of 100 W, Bi power of 25 W, and Ta power of 10 W showed a dense and uniform microstructure, the remanent polarization (P_r) of 7.51 $\mu C/cm^2$ and the coercive field (E_c) of 27.96 kV/cm at excitation voltage of 5 V. The SBT films show practically no polarzation fatigue after the films were switched up to 7.0×10^{10} cycles. The retention characteristics of the SBT films looks very promising up to 10^5 s.

The SBT films deposited on $Pt/SiO_2/Si$ substrates by a modifited rf magntron sputtering are the most attractive for the application to nonvolatile memory devices.