The Effects of the Oxygen Concentration of (Ba0.7,Sr0.3)(Ti0.9,Zr0.1)O3 thin films Grown by RF Sputtering

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Abstract

Recently, the Giga-bytes Dynamic Random Access Memory (DRAM) devices requiring the high dielectric constants and low leakage current density in the form of thin film has been developed. The new thin film materials such as (Ba,Sr)TiO3 (BST) and Ba(Ti,Zr)O3 (BTZ) are expected to replace the conventional SiO2 or Ta2O5 because of their higher dielectric constants and lower leakage current density than those of BaTiO3 itself. In this study, the (Ba0.7Sr0.3)(Ti0.9Zr0.1)O3 thin film were successfully deposited on Pt/SiO2/Si(100) substrate by rf magnetron sputtering. From the experiment results, the optimal deposited parameters of the films were chamber pressure of 10mtorr, oxygen concentration of 25%, substrate temperature of 5800C and rf power of 180W. From the capacitances-voltages (C-V) and the leakage current density with electric field (J-E) measurement, the dielectric constant and leakage current density were about 130 and 510-7 A/cm2 under the electrical field of 0.1MV/cm, respectively. The dielectric constant roll-down and leakage current density decreased by increasing the oxygen concentration. The oxygen ion vacancy should be filled by increasing oxygen-rich. Finally, from the electrical simulation results, the leakage current transmission mechanisms of the films were Schottky emission mechanism in the lower electric field and the Poole-Frankel mechanism in the high electric field.

Keywords: Dielectric constant, Leakage current, thin film, rf sputtering, Ferro electricity. References

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