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Dielectric Characteristics of Al_2O_3 Thin Films Deposited by Reactive Sputtering

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Aluminium oxide (Al_2O_3) films have been investigated for many applications such as insulating materials, hard coatings, and diffusion barriers due to their attractive electrical and mechanical properties[1-6]. In recent years, application of Al_2O_3 films for dielectric materials in integrated circuits as gates and capacitors has attracted much attention[1].

Various deposition techniques such as sol-gel, metalorganic decomposition (MOD), sputtering, evaporation, metalorganic chemical vapor deposition (MOCVD), and pulsed laser ablation have been used to fabricate Al_2O_3 thin films[1-6]. Among these techniques, reactive sputtering has been widely used due to its high deposition rate and easy control of film composition. It has been also reported that the sputtered Al_2O_3 films exhibit superior chemical stability and mechanical strength compared to the films fabricated by other processes[2].

In this study, Al_2O_3 thin films were deposited on $Pt/Ti/SiO_2/Si$ and Si substrates by DC reactive sputtering at room temperature with variation of the Ar/O_2 ratio in sputtering ambient. Crystalline phase of the reactively sputtered films was characterized using X-ray diffractometry and the surface morphology of the films was observed with Scanning electron microscopy. Effects of the Ar/O_2 ratio in sputtering ambient on the dielectric constant (ε_r), loss factor ($\tan\delta$), and leakage current characteristics of Al_2O_3 films were investigated with emphasis on the thickness dependence of the dielectric properties. Correlation between the dielectric properties and the microstructure was also studied.

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