Surface Passivation of Silicon Using HfO2 Thin Films Deposited by Remote Plasma Atomic Layer Deposition System

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ABSTRACT

Hafnium oxide (HfO2) thin films have attracted much attention owing to their usefulness in equivalent oxide thickness scaling in microelectronics, which arises from their high dielectric constant and thermodynamic stability with silicon. However, the surface passivation properties of such films, particularly on crystalline silicon (c-Si), have rarely been reported upon. In this study, the HfO2 thin films were deposited on c-Si substrates with and without oxygen plasma pretreatments, using a remote plasma atomic layer deposition system. Post-annealing was performed using a rapid thermal processing system at different temperatures in N2 ambient for 10 min. The effects of oxygen plasma pretreatment and post-annealing on the properties of the HfO2 thin films were investigated. They indicate that the in situ remote plasma pretreatment of Si substrate can result in the formation of better SiO2, resulting in a better chemical passivation. The deposited HfO2 thin films with oxygen plasma pretreatment and post-annealing at 500 °C for 10 min were effective in improving the lifetime of c-Si (original lifetime of 1 μs) to up to 67 μs.

Keywords: HfO2 thin films, Atomic layer deposition, O2 plasma pretreatment, Surface passivation

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