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Abstract
In this research, TaOx thin films were deposited onto (100) p+-Si wafers by radio frequency magnetron sputtering. We changed deposition power and oxygen mixture ratio to find out the optimum sputtering conditions at ambient temperature. After that, the in-situ annealing and postannealing were implemented to investigate the effects of annealing on the current-voltage (I-V) characteristics and film structure. The result shows that the optimum sputtering conditions for the films deposited at ambient temperature are under oxygen mixture ration（OMR）of 60% and power of 100W. For in-situ annealing, we found that the film density increases with increasing substrate temperature. The I-V characteristics, however, show that the leakage current density in the TaOx thin films increases with increasing deposition substrate temperature. The AES and XRD analyses reveal that the oxygen deficiency and crystallization are the causes of higher leakage current density in the TaOx thin films with in-situ annealing. When the thin flims were annealed after deposition, we found that the I-V characteristics of the TaOx thin films were affected by the methods of postannealing. The lowest leakage current density was obtained by using two-step annealing. The dielectric constant of the tantalum oxide ranges from 16.6 to 21.6 depending on the different annealing methods. From the results of leakage current and dielectric constant, it proves that nitrous oxide plasma annealing improves properties of the TaOx thin films better than oxygen plasma annealing.
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