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Effect of Non-lattice Oxygen Concentration and Micro-structure on Resistance Switching Characteristics in Nb-doped HfO2 by DC Magnetron Co-Sputtering

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In this study, we investigated that the resistance switching characteristics of Nb-doped HfO2 films with increasing Nb doping concentration. The Nb-doped HfO2 based ReRAM devices with a TiN/Nb-doped HfO2/Pt/Ti/SiO2 were fabricated on Si substrates. The Nb-doped HfO2 films were deposited by reactive dc magnetron co-sputtering at 300°C and oxygen partial ratio of 60% (Ar: 16sccm, O2: 24sccm). Micro-structure of Nb-doped HfO2 films and atomic concentration were investigated by XRD, TEM, and XPS, respectively. The Nb-doped HfO2 films showed set/reset resistance switching behavior at various Nb doping concentrations. The process voltage of forming/set is decreased and whereas the initial current level is increased in doped HfO2 films. However, the switching properties of Nb-doped HfO2 were changed above the specific doping concentration of Nb. The change of resistance switching behavior depending on doping concentration was discussed in terms of concentration of non-lattice oxygen and micro-structure of Nb-doped HfO2.

Keywords: resistance switching, Nb doping concentration, non-lattice oxygen, micro-structure

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Optical Characteristics of $Ge_{0.99}Sn_{0.01}$/Si and Ge/Si Using Photoreflectance Spectroscopy

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We have investigated optical characteristics of p-$Ge_{0.99}Sn_{0.01}$ and Ge films grown on Si substrates using photoreflectance (PR) spectroscopy. The $Ge_{0.99}Sn_{0.01}$ and Ge films were grown by using an ultra-high vacuum chemical vapor deposition and molecular beam epitaxy methods, respectively. PR spectra were measured at 25 K and an extended InGaAs detector was used. By comparing $Ge_{0.99}Sn_{0.01}$/Si and Ge/Si spectra, we observed the signals related to direct transition and split-off band of $Ge_{0.99}Sn_{0.01}$. The transition energies of $Ge_{0.99}Sn_{0.01}$ and Ge films were approximately 0.74 and 0.84 eV, respectively. Considering the shift of split- off band transition of $Ge_{0.99}Sn_{0.01}$, we suppose that the transition at 0.74 eV is attributed to direct transition between Γ band and valence band. The temperature- and excitation power-dependent PR spectra were also measured.

Keywords: Ge, GeSn, PR