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Modulation of Defect States in Co- and Fe-implanted Silicon by Rapid Thermal Annealing

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The dilute magnetic semiconductors (DMS) have been developed to multi-functional electro-magnetic devices. Specially, the Si based DMS formed by ion implantation have strong advantages to improve magnetic properties because of the controllable effects of carrier concentration on ferromagnetism. In this study, we investigated the deep level states of Fe- and Co-ions implanted Si wafer during rapid thermal annealing (RTA) process. The p-type Si (100) wafers with hole concentration of 1×10^{16} cm^{-3} were uniformly implanted by Fe and Co ions at a dose of 1×10^{16} cm^{-2} with an energy of 60 keV. After RTA process at temperature ranges of 500~900^{o}C for 5 min in nitrogen ambient, the Au electrodes with thickness of 100 nm were deposited to fabricate a Schottky contact by thermal evaporator. The surface morphology, the crystal structure, and the defect state for Fe- and Co- ion implanted p-type Si wafers were investigated by an atomic force microscopy, a x-ray diffraction, and a deep level transient spectroscopy, respectively. Finally, we will discuss the physical relationship between the electrical properties and the variation of defect states for Fe- and Co-ions implanted Si wafer after RTA.

Keywords: Dilute magnetic semiconductors, Defect, Si, Co, Fe