学位論文内容の要旨（英文）

Thesis Abstract (English)

Thesis Title

A Study to Evaluate and Project Soft Error Tolerance in Radiation-hardened Circuits Using Device and Physical Level Simulations

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Thesis Abstract

My thesis focuses on projection and evaluation for soft error tolerance in the radiation-hardened circuit by device and physics level simulations. The SERs of various circuit, layout and device structures are discussed. A high accurate Monte-Carlo based simulation methodology is also proposed in this thesis.

Firstly, the device and physical level simulations methodology for soft error are described in Chapter 2. In my thesis, the charge generation and collection mechanisms by direct ionization are simulated by TCAD simulator SENTAURUS, and the mechanisms by indirect ionization are simulated by Monte-Carlo based physical-level simulator PHITS. After that in Chapter 3, the parasitic bipolar effects are investigated to suppress MCUs on radiation-hardened dual-modular flip-flops in a 65-nm process. Device simulations reveal that a simultaneous flip of redundant latches is suppressed by storing opposite values instead of storing the same value due to its asymmetrical structure. Then, in Chapter 4, the contributions of layout structures to suppress MCU are analyzed by device-level simulations and neutron-beam tests. Device simulation and experimental results reveal that the ratio of MCU to SEU decreases by increasing the distance between 65-nm process redundant latches. MCU is suppressed effectively by increasing the density of well contacts. Furthermore, in Chapter 5, the SERs (Soft Error Rates) of FD-SOI processes depending on BOX (Buried OXide) regions and body bias are estimated by alpha, neutron-beam tests and a proposed Monte-Carlo based simulations. The simulated results are consistent with the alpha and neutron irradiation experimental results. Simulated results reveal that the SERs are decreased by increasing the thickness of BOX layer. By applying the reverse body bias the tolerance for soft error becomes stronger in SOTB while that in UTBB becomes weaker. Finally, Chapter 6 summarizes the contribution of my thesis.