

Predictive tools and “Radiation Hardening By Design” (RHBD) – SEL and Temperature Effects

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Abstract :

Single Event Latchup (SEL) is an important reliability issue for semiconductor components. However, only a few works have been dedicated in recent literature to the accurate prediction of the SEL rate in a given environment. The goal of this PhD work is to precisely address this lack of predictive tool for SEL. In this work, a full methodology will be developed, based on a multi-scale and multi-physics simulation chain, efficiently coupling the physical and electrical responses of the device subjected to irradiation. Two TCAD (Technology Computer Aided Design) tools will be used for that. One is ECORCE^[1], a 2D tool, which has been developed by Université de Montpellier. Then, Sentaurus by Synopsys^[2], a 2D and 3D tool. The SEL modeling will take primarily into account the temperature, the most important physical parameter for SEL. The temperature dependence of all the mechanisms along the simulation chain will be rigorously evaluated (particle interaction, charge deposition, transport and collection). So far, 2D simulations have been performed on Sentaurus^[3]. Temperature effects but also doping profiles and anode to cathode spacing effects have been studied in order to understand the importance of these parameters on SEL sensitivity. A PNP structure formed by a PMOS source and an NMOS source has been used in order to perform simulations with this tool. This is the basic structure that SEL requires in order to be investigated. The structure is based on a 65 nm CMOS inverter. A comparison between the effects on SEL sensitivity from these different parameters has been made. Cross sections for each parameter have been calculated using 2D TCAD simulations. This approach allows to perform fast simulations and to calculate an important value to estimate SEL sensitivity as the cross section. Next step will be to perform 3D simulations using a full CMOS inverter structure and to compare results with 2D simulations.

References

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