3 - 29 Temporal Information of Incident Ions for Volumetric Charge Collection Model

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The limitation of accurately tracking the temporal imformation of incident ions prevents the study for the micro-mechanism of single event effects. Therefore, the approximation of treating incident ions have been presented in previous. For instance, the classical radiation strike model[1-3] for charge depostied is simplifiedgiven by,

$$Q_{\mathrm{deposited}} = 0.01036\ Ld$$

Where L is the linear energy transfer and d is the depth of the collection volume.

However, it is argued that the previous classical model is not adequate due to the assumption of linear energy transfer as constant and simply multiplying the depth of the collection volume to get deposited energy. One object of this section is to argue this classic method. With the integration of Monte Carlo simulation and mathematical analysis, the provided approach has the capability of estimating the current and accumulated energy.

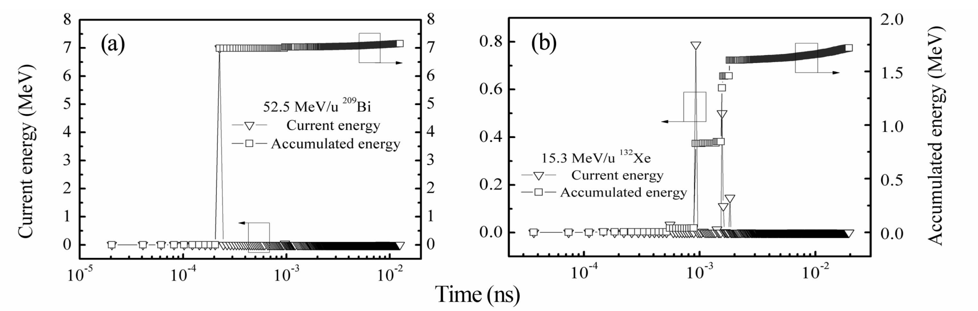

Fig. 1 The temporal time and energy profile are plotted under the environment that incident ions strikes 45 nm SOI SRAM.

As depicted in Fig. 1, the current energy and accumulated energy induced by 52.5 MeV/u ^{209}Bi and 15.3 MeV/u ^{132}Xeare obtained as a function of time, but it is the worst case among the events of 10^3 primary incident ions strike. Comparing the results in Fig. 1(a) to those shown in Fig. 1(b), the terminal time of incident ion transporting decreases by about 7 ps. This decrement is consistent with the ion-velocity characterization, such as the relative ion-velocity of 52.5 MeV/u ^{209}Bi and 15.3 MeV/u ^{132}Xe are respectively 0.32 and 0.18. Additionally, it is clearly presented that the difference of the saturation of accumulated energy induced by 52.5 MeV/u ^{209}Bi and 15.3 MeV/u ^{132}Xe mainly depends on the feature of incident ions, and the saturated energy (7.2 MeV) induced by 52.5 MeV/u ^{209}Bi is about four times larger than 15.3 MeV/u ^{132}Xe generated. To the transporting process, the current energy as a function of time seems to be irregular and this result is probably attributed to the randomized simulation as the principle of Monte Carlo. Finally, the analysis of the response to the incident ions requires the time characterization, especially the current energy and accumulated energy. Therefore, the approach proposed in this section gives a deeply compliment for the volumetric charge collection model and aids in the understanding of the temporal profile of incident ions.

References

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