3 - 30 Theoretical Method for Estimating Profile of Single Event Transient Current

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The single event transient (SET) currents, the peak and collected charge saturation in particular, are vital to characterizing the single event upset. The section provides a physics-based method for estimating the SET current and charge collection. The detailed information of SET current is extracted from the physical model within technology computer aided design (TCAD).

This theoretical method utilizing the amount of charge collection, transporting time of the incident ion, and the ion track[1-3] established time, are applied to determine a reasonably accurate SET pulse in reverse biased p-n junction. In addition, the results of charge collection (through drift and diffusion) at the drain node and SET current are obtained by mathematical integration and Monte Carlo simulation without using the TCAD.

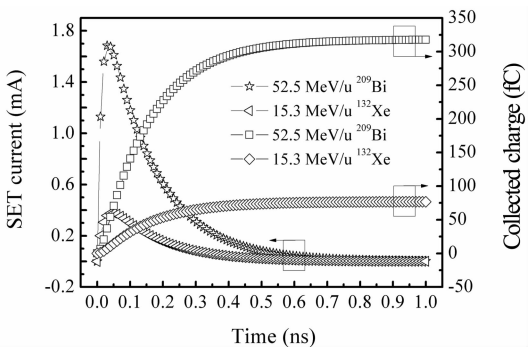

Fig. 1 The SET current and charge collection output from incident ion strikes at the drain node with the incident ion of 52.5 MeV/u ^{209}Bi and 15.3 MeV/u ^{132}Xe, respectively.

The SET current pulse illustrated in Fig. 1 are calculated from the outputted data by Monte Carlo simulation. The worst case depicted by Fig. 1 is extracted from the results of 10^3 ions at the primary incidence. The transients can be characterized by the metric of width and magnitude. Thus, the SET current presented in Fig. 1 in both of two kinds of incident ions reveals the charge collection process. It is interesting noted that the simulated SET current pulses are so different in spite of the same LET value of incident ions. For instance, the discrepancy of the peak of SET current is about 1.3 mA, and in contrast to 15.3 MeV/u ^{132}Xe, the SET current induced by 52.5 MeV/u ^{209}Bi falls sharp after the peak. In addition, the saturation of collected charge is 0.32 pC from 52.5 MeV/u ^{209}Bi and 0.08 pC from 15.3 MeV/u ^{132}Xe, respectively. To summarize, the radiation feature (e.g. ion species, ion energy) play an indispensable part in the radiation environment for analyzing the radiation effects on the semiconductor device, thus this section gives the SET current pulse induced by two kinds of ions with different energy, and it is concluded that utilizing the SET current pulse and collected charge to elucidate the charge collection process is necessary and reasonable. Therefore, with the integration of the amount of collected charge and the ion track establishment from Monte Carlo simulation, the SET current and saturation of charge collection can be accurately characterized and identified for the space radiation application.

References

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3 - 31 Raman Spectroscopic Study of Irradiation Effects on Monolayer Graphene

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Graphene, composed by a hexagonal two-dimensional network of carbon atoms, is a unique material with exotic electronic properties. Its electron transport is described by the Dirac equation and this allows access to quantum electrodynamics in a simple condensed matter experiment. Many aspects of ion irradiation induced damage on graphene have been the subject of much interest recently. Most investigations deal