The Impact of Soft Error on C-Elements Due to Process Corner Variation and Temperature

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Abstract

This paper presents current injection resemble single event upset (SEU) current at the vulnerable nodes on different configurations of C-elements under two different scenarios: process corner and temperature. The objectives are to identify the vulnerable nodes due to SEU and to find the critical charges needed to flip the output from low to high (0-1) and high to low (1-0) on different configurations of C-elements. The comparisons of C-elements in term of the resistivity toward soft error are presented.

Keywords: *Soft Error,Process Variation, Temperature.*

1. Introduction

Advancement in silicon technology has resulted in transistors becoming smaller which has in turn lowered operating voltage and capacitance [1]. Therefore, these transistors are more sensitive toward radiation-induced errors. As the demand for low power applications for digital electronics devices with high density continues to increase, the radiation effect on such electronic devices is becoming significant. Even though soft error due to radiation is not a permanent error, this type of error can cause data to be corrupted.

In this paper, the current pulse causing SEU is injected into different nodes of different C-elements. The amplitude of the current is increased until the output of the C-element is changed. Different configurations of C-elements are compared in terms of the charges needed to flip the output from 0-1 change or 1-0 change. The minimum charge needed to cause state change is known as the critical charge.

2. Single Event Upset

The drain of an off PMOS and drain of an off NMOS transistor are more vulnerable toward soft error due to SEU. Figure 1 shows the single SEU produced [2]. A neutron from the atmosphere strikes the silicon causing a collision between the nucleus and the neutron within the substrate. The density of electron-hole pairs is produced by particles, as shown in Figure 1(a). The carriers are swept to diffusion junction by an electric field and cause the charge collection to expand due to drift current (Figure 1(b)), resulting in the sudden current pulse. Then, the diffusion current dominates until all the excess carriers have been collected, recombined or diffused away from the junction area (Figure 1(c)). The size of the funnel, as shown in Figure 1(b), and collecting time are very much inversely proportional to the substrate doping. The collection time is usually completed within picoseconds and the diffusion current begins to dominate until all the excess carriers have been collected [3].

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