3 - 28 Impact of High-*Z* Material in Vertical Direction on Single Event Upset Occurrence

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To deepen the understanding of how high-*Z* materials affecting single event upset (SEU) cross section by the contribution of nuclear reaction, the over-layer position, as an investigated object, may probably affect radiation-induced charge collection. Thus, it is likely that to isolate and identify the contributions of high-*Z* material layers on charge collection is a proper solution to studyon the influence of high-*Z* material on the SEU cross section.

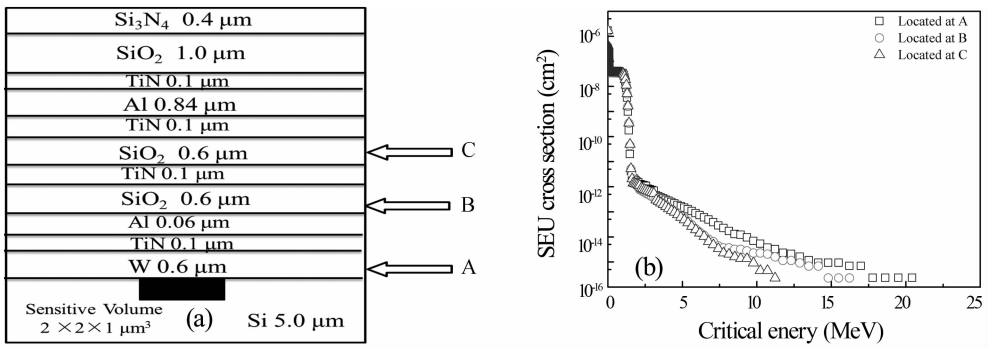

Fig. 1 (a) Schematic of tungsten layer's position varied in the vertical direction, and each layer replaced (A, B, C) is filled with same scale thickness of silicon. Not drawn to scale. (b) Integral SEU calculated when distance varied from position of tungsten in the vertical direction toupper surface of the sensitive volume.

In this section, the distance from High-*Z* material, tungsten to sensitive volume in the vertical direction is studied as an investigatedfactor. The location of tungsten is shown schematically in Fig. 1(a). To keep the property of incident ions consistent withthe above described, mono-energetic beam of 25 MeV/u ^{40}Ar has been simulated to randomly travel the structures. As illustrated in Fig. 1(b), SEU cross section was calculated in the case of the location at A, B, C, respectively. The results show thatthe location A, tungsten nearest the sensitive volume leads to the largest critical energy. In addition, the discrepancy of placement A, B, C clearly implies that the closer tungsten to the active silicon, the more SEU cross section was observed. According to this result, it is probable that fragments of nuclear reaction occurring at the location A might be capable of easily contributing secondary particles to the sensitive volume on more energy deposition, because of the secondary particles' longer path length. Similarly, if the tungsten's location is arranged at the further distance, insufficient range of secondary particles may be happened. As previous analysis, if defining the critical energymore than 17.5 MeV, then the SEU cross section wouldonlyhappenat the location A, but if the value of E_{crit} is less than 17.5 MeV, the location A, B, C all have the capability of inducing SEU occurrences.

In fact, these results have beenpreviously proved by experimental data and Monte Carlo simulation[1]. Therefore, it is concluded that the presence of high-*Z* materials, like tungsten, can significantly increase the charge collection. The detailed description is that, it is probably interpreted by the increased distribution of secondary ions, when the location of the high-*Z* material is nearer to sensitive volume, and it will inducemore charge deposition.

Reference

[1] M. A. Clemens, N. C. Hooten, Vishwa. Ramachandran, et al., IEEE Trans. Nuc. Sci., 3212(2010)3218.