PN.4 Study of Radiation Effects on Low Voltage Memories

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Etude de l'effet des radiations sur les mémoires basse tension

Des caractérisations aux effets de la dose cumulée et aux événements singuliers induits par les ions lourds et les protons ont été effectuées sur cinq types de mémoires (deux SRAM 1M, deux DRAM 16M, une flash EPROM 8M) basse tension et leurs équivalents en 5V. L'objectif de l'étude était d'étudier l'effet de la tension d'alimentation sur la sensibilité aux radiations.

I Introduction

A wide range of low voltage memories have performances (low power dissipation, high density) which make them quite attractive for space applications. As device geometry shrinks, power supply voltage must be reduced and new circuit design approaches must be used in order to maximize performance benefits from scaling. As usually expected, the general trends of scaling down the supply voltage would be a lower total ionizing dose tolerance, a lower SEU tolerance, and a better Latch-up tolerance. But, as low power devices are more integrated, it is difficult to distinguish the effect of low supply voltage from the effect of scaling down. Furthermore, very little data exist on low voltage device radiation ([1] to [8]).

This paper presents results of total dose, heavy ion and proton tests performed on five types of low voltage memories (two 1 Mbit SRAMs, two 16 Mbit DRAMs, one 8 Mbit Flash memory) and their 5V equivalent device, in order to evidence the effect of low voltage on their sensitivity to irradiations.

II Presentation of the tested devices.

A. SRAMs

The tested SRAM devices are presentedd in Table 1. The Toshiba SRAM is a 5 V device which stays functional at 3V supply voltage. The Sony SRAM is a dual memory, designed to operate either at 5V or at 3V.

Manufacturer.	Reference	Supply voltage (V)
Toshiba	TC551001BPL-70L	2.7-5.5
Sony	CXK581000A	2.7-5.5

Table 1 : references of tested SRAMs

B. DRAMs

The tested DRAM devices are presented in Table 2. The IBM and Micron DRAM are 3.3V devices, but both types stay functional up to 4.6V.

Manufacturer	Reference	Supply voltage (V)
IBM	Luna ES/3	3-5.5
Micron	MT4LC4M4B1(S)	3-4.6

Table 2 : references of tested DRAMs

C. Flash memories

The tested flash EPROM devices is presented in Table 3. The low voltage device (LV) and the 5V one (F) are twin devices : the technology and the memory cells are identical.

Manufacturer	Reference	Supply voltage (V)
AMD	AM29(LV)800B	2.7-3.6
AMD	AM29(F)800B	4.5-5.5

Table 3 : references of flash EPROM device

III. Tests results

A. Heavy ion test results

Figure 1 shows the heavy ion SEU cross-section curves of Sony SRAMs. These results exhibit a stronger sensitivity when devices are biased under 3.3V. The effects are more important in the LET threshold region than near the saturated cross-section region.

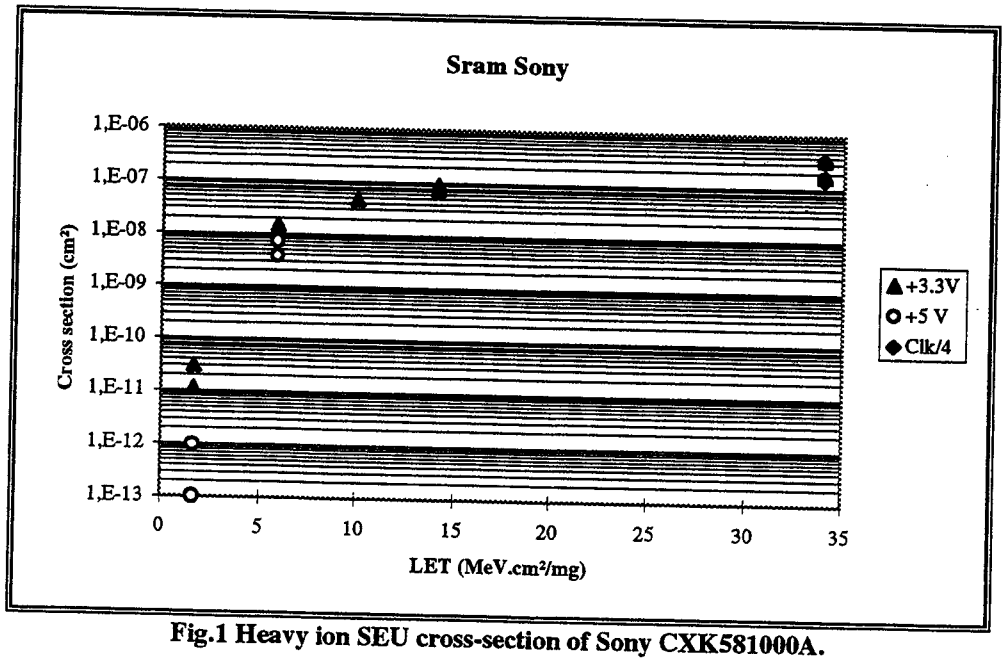

Fig.1 Heavy ion SEU cross-section of Sony CXK581000A.

Heavy ion test results on the other device types will be presented in the final paper.

B. Proton test results

Fig.2 shows the proton SEU cross-section curves of Sony SRAMs. The effect of power supply on the cross section is stronger with protons than with heavy ion irradiations.

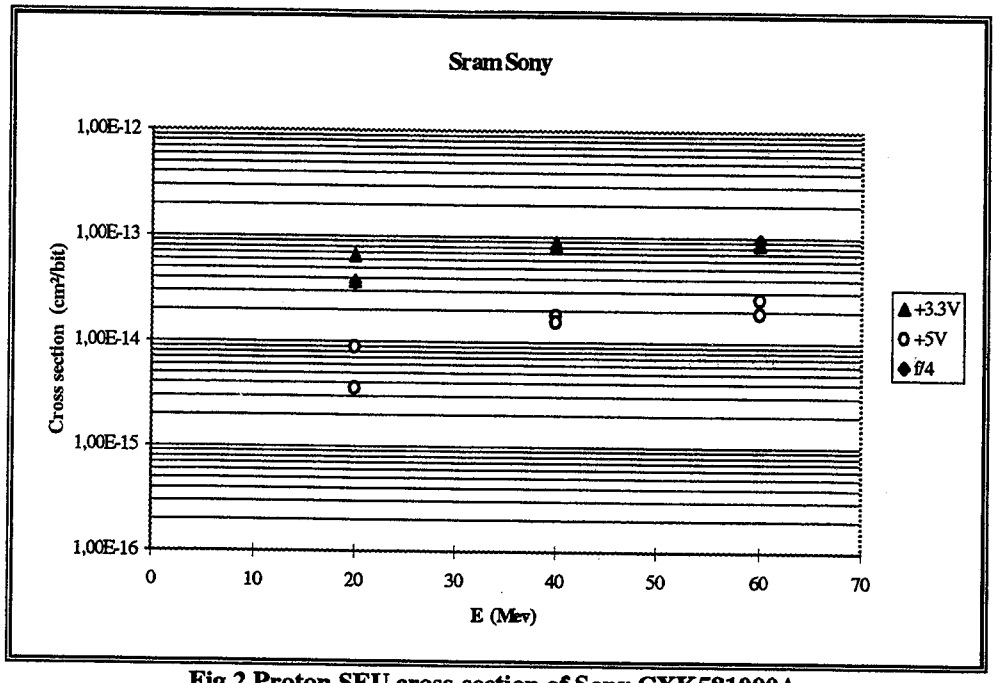

Fig.2 Proton SEU cross-section of Sony CXK581000A.

Proton test results on the other device types will be presented in the final paper.

C. Total dose test results

Total dose tests are still in progress. Tests results will be presented in the final paper.

IV References

[1] "Radiation effects in Five Volt and Advanced Lower Voltage DRAMs", D.C. Shaw, G. M. Swift, D. J. Padgett, A. H. Jonhson, IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL 41, N0 6, Dec. 94

[2] "Radiation evaluation on an advanced 64 Mbits 3.3V DRAM, and Insights into effects of scaling on Radiation Hardness", D.C. Shaw, G. M. Swift, A. H. Jonhson, IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL 42, N0 6, Dec. 95

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[5] "Heavy Ion test report on 16 Mbit DRAM from Texas Instruments, IBM, Hitachi", C.Poivey, P. Garnier, DOF/SIC/CP/RP4.442

[6] "Total Steady State Irradiation of DRAM 4Mx4-bit, from IBM", A. Gach, DASC/SIC/TC4.214

[7] "Total Steady State Irradiation of DRAM 4Mx4-bit, HM5116400AS6 from Hitachi", A. Gach, DASC/SIC/TC4.216

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