

Investigation of Factors Affecting the Total Ionizing Dose Threshold of Electrically Erasable Read Only Memories for Use in Dose Rate Measurement

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Abstract : The dose rate present in a seriously contaminated area can be indirectly determined by monitoring radiation damage to inexpensive commercial electronics, instead of deploying expensive radiation hardened sensors. EEPROMs (Electrically Erasable Read Only Memories) are a good candidate for this purpose because they are inexpensive and are sensitive to radiation exposure. When the total ionizing dose threshold is reached, an EEPROM chip will show signs of damage that can be monitored and transmitted by less susceptible electronics. The dose rate can then be determined from the known threshold dose and the exposure time, assuming the radiation field remains constant with time. Therefore, the threshold dose needs to be well understood before this method can be used. There are many factors affecting the threshold dose, such as the gamma ray energy spectrum, the operating voltage, etc. The purpose of this study was to experimentally determine how the threshold dose depends on dose rate, temperature, voltage, and duty factor. It was found that the duty factor has the strongest effect on the total ionizing dose threshold, while the effect of the other three factors that were investigated is less significant. The effect of temperature was found to be opposite to that expected to result from annealing and is yet to be understood.

Keywords : EEPROM, ionizing radiation, radiation effects on electronics, total ionizing dose, wireless sensor networks

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