

R2RAM PROJECT: DEVELOPMENT AND CHARACTERIZATION OF A RADIATION-HARD RESISTIVE RANDOM-ACCESS MEMORY

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Over the past decades, the constant miniaturization of electronic components, and in particular electronic memories, has enabled a steady improvement in their performance, power consumption and storage density. However, a major drawback of this miniaturization is that current technologies are sensitive to radiation, and data corruption and/or device failure may result from individual particle strikes (Single-Event Effects, SEE) or long-term dose accumulation (Total Ionising Dose, TID) generating parasitic charge in the memory component.

In recent years, a considerable effort from the semiconductor industry, has been dedicated to the development of new technologies to produce enduring, low-power, rad-hard and non-volatile memories, all of which are critical qualities for space applications. However, most technological improvements have focused on the storage elements, while the control circuitry in these devices is still designed and fabricated with legacy technologies, which are inherently vulnerable to radiation. Consequently, most of these new technologies are not truly radiation-hard when their control circuitry is active.

This presentation aims at presenting the R2RAM project, which aims at filling this technological gap by designing, manufacturing and characterizing a new type of memory. The storage elements will be based on Resistive Random-Access Memory technology (RRAM), whose operating principle is based on chemical redox reactions and has proven to be immune to SEE and TID effects [1]. The memory control circuitry will implement innovative designs and algorithms to ensure a reliable operation in a radiation environment [2].

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[1] A. Grossi, C. Calligaro, E. Perez, J. Schmidt, F. Teply, T. Mausolf, C. Zambelli, P. Olivo and C. Wenger, "Radiation hard design of HfO₂ based 1T1R cells and memory arrays," in *Proc. 2015 Int. Conf. on Memristive Systems (MEMRISYS)*, Nov. 2015

[2] C. Zambelli, A. Grossi, P. Olivo, C. Walczyk and C. Wenger, "RRAM Reliability/Performance Characterization through Array Architectures Investigations," in *Proc. 2015 IEEE Computer Society Annual Symposium on VLSI*, 8-10 July 2015