Newsletter #5

June 2021 – December 2021

ELICSIR: Enhancement of Scientific Excellence and Innovation Potential in Electronic Instrumentation for Ionizing Radiation Environments

Welcome to the fifth ELICSIR project newsletter!

This period in the project implementation was marked by the presentation of research results at scientific events and publication of papers.

Project website: elicsir-project.eu

Type of action: Coordination and Support
Topic: H2020-WIDESPREAD-2018-2020
Call: WIDESPREAD-3-2018-TWINNING

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857558.

ELICISR project promoted at RAD 2021 Conference

Prof. Goran Ristic, the ELICISR project coordinator and the president of the RAD Conference, promoted the ELICISR project during the Ninth International Conference on Radiation in Various Fields of Research (RAD 2021 Conference) held from June 14–18, 2021, in Herceg Novi, Montenegro. This was one of the first scientific events after the coronavirus pandemic held in-person. The participants were very interested to hear about project realization, since it covers similar topics as the conference, especially having in mind the situation in the world due to the pandemic. Prof. Ristic used the opportunity to participate in the local TV show where he talked about the importance of radiation. In addition, some members of the project team presented the results of a research conducted within the ELICISR project.

NINTH INTERNATIONAL CONFERENCE ON RADIATION IN VARIOUS FIELDS OF RESEARCH
June 14-18, 2021 | Herceg Novi | Montenegro
rad-conference.org | Book of Abstracts

Temperature compensation in dose-rate measurements based on commercial photodiodes using a modified reader unit

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https://doi.org/10.21175/rad.abstr.book.2021.26.9

Introduction. The main application of photodiodes is to measure visible, ultraviolet or infrared light intensity. However, some authors have reported their use as dose rate sensor for X-ray photon beams (M. Andjelkovic et al., Radiation Measurements 75, 2015). Our research group previously developed a reader unit for MOSFET dosimeters that used the parasitic diode of DMOS transistors to apply a thermal compensation (M.A. Carvajal et al., Sensors and Actuators A 249, 2016). This compensation method measures the silicon temperature, not the room temperature, without external temperature sensors.

Due to the strong dependence of the photocurrent produced by photodiodes with temperature, base line will be strongly affected by the temperature in dose rate and absorbed dose measurements. Consequently, a thermal compensation during dose reading should be mandatory for accurate dose measurement by photodiodes as affordable skin dosimeter. In the present work, a thermal characterization of the photodiode BPW34S (Vishay Siliconix, USA) has been carried out. In addition, a new reader unit has been designed to implement this additional thermal compensation technique.

Experimental setup. A preliminary study has been done with five samples of the BPW34S photodiode. The semiconductor analyser B1500 (Agilent Technologies, Santa Clara, CA, USA) was used for devices biasing at V_R = 10 V and to measure the dark current. Temperature sweeps from 10 to 50 °C were conducted with a climatic chamber VCL4006 (Vötsch Industrietechnik, Balingen-Frommern, Germany).

System design. In order to measure the internal temperature of the photodiode, a sink current source with a LM334 (Texas Instruments, Dallas, TX, USA) has been added to the reader unit. The working principle for thermal compensation is as follows: after dose measurement, the photodiode used as sensor is disconnected from both bias voltage source and current to voltage converter and connected between ground and sink current source. Then, the forward biased photodiode has a direct voltage drop proportional to temperature, typical of p-n junctions.

Results and conclusions. In the preliminary study, an exponential dependence was found, resulting in an average dark current at 25 °C of (17 ± 3) nA. The designed reader unit will be tested to measure the temperature of the photodiode used as dose measurement sensor during an irradiation session. This would allow applying the temperature compensation algorithm to obtain an accurate dose rate and absorbed dose measurements minimizing the thermal uncertainty without requiring additional temperature sensors.

Acknowledgments: This work has been partially supported by the Junta de Andalucía with projects PI-0505-2017 and FQM387, the Spanish Government (FPA2015-67694-P) the European Regional Development Fund and FEDER/Junta de Andalucía Project B-TIC-468-UGR18. This work was also conducted in the framework of ELICSIR project funded by the European Union with grant No. 857558.

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Two joint scientific papers published in journals

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Recharging process of commercial floating-gate MOS transistor in dosimetry application

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ARTICLE INFO

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ABSTRACT

We investigated the recharging process of commercial floating gate device (EPAD) during the six different dose rates and ten irradiation cycles with the highest dose rate. Dose rate dependence of the floating gate dosimeter was observed from 1 Gy/h to 26 Gy/h (H_2O). There is no change of the dosimetric characteristic with a constant dose rate of 26 Gy/h for ten cycles. The absorbed dose does not affect the drift of the threshold voltage readings after the irradiation steps. The reprogramming characteristic is not degrading with the absorbed dose for the ten irradiation cycles, giving the promising potential in the application for dosimetric purposes.

https://doi.org/10.1080/16878507.2021.1970921

Radiation sensitive MOSFETs irradiated with various positive gate biases

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ABSTRACT

The RADiation sensitive metal-oxide-semiconductor field-effect-transistors (RADFETs) were irradiated with gamma rays up to absorbed dose of 110 Gy(H_2O). The results of threshold voltage, V_T, during irradiation with various positive gate biases showed the increase in V_T with gate bias. The threshold voltage shift, ΔV_T, during irradiation was fitted very well. The contributions of both the fixed traps (FTs) and switching traps (STs) during radiation on ΔV_T were analyzed. The results show the significantly higher contribution of FTs than STs. A function that describes the dependence of threshold voltage shift and its components on gate bias was proposed, which fitted the experimental values very well. The annealing at the room temperature without gate bias of irradiated RADFETs was investigated. The recovery of threshold voltage, known as fading, slightly increase with the gate bias applied during radiation. The ΔV_T shows the same changes as the threshold voltage component due to fixed states, ΔV_{ft}, while there is no change in the threshold voltage component due to switching traps, ΔV_{st}.

ARTICLE HISTORY
Received 18 January 2021
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KEYWORDS
pMOS dosimeters; RADFETs; sensitivity; fading; radiation defects

Participation in conferences

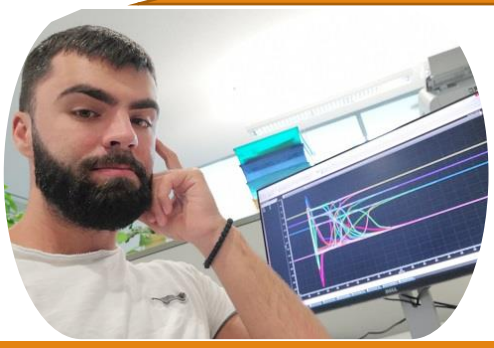
Participation in the 32nd International Conference on Microelectronics

ELICSIR Project members participated in the virtual 2021 IEEE 32nd International Conference on Microelectronics organized in the period from September 12 to September 14, 2021. Four papers of PhD and MSc students created within the project were included in the Conference Programme and presented online.

Joint research paper presented at 32nd ESREF

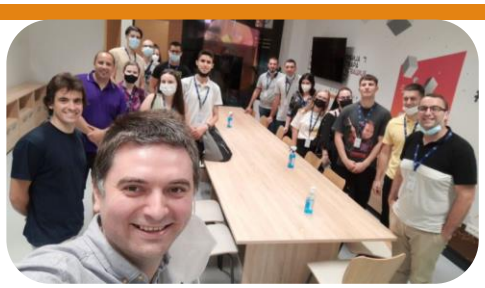
Stefan Ilić presented a joint research paper *"S. D. Ilić, M. S. Andjelković, R. Duane, A. J. Palma, M. Sarajlić, S. Stanković, G. S. Ristić, Recharging Process of Commercial Floating-Gate MOS Transistor in Dosimetry Application"* which was prepared as part of ELICISR project activities. The 32nd European Symposium on Reliability of Electron Devices, Failure Physics and Analysis was held online, and the paper was presented in real-time, in one of oral sessions.

Project staff mobility



Bojan Draško, a PhD student at the Faculty of Electronic Engineering, University of Niš, spent a month at the IHP, Germany. He used this mobility period from August 21 to September 20 to further expand his knowledge through the training activities he attended. He was also included in some research activities, which was very helpful for the preparation of various scientific publications.

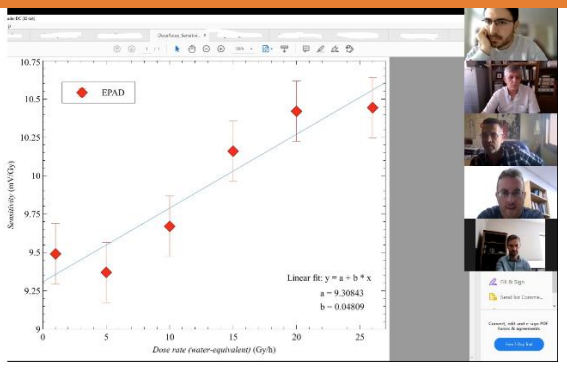
Miloš Marjanović visited the start-up company BeeHold



The start-up company BeeHold, which operates within the Science and Technology Park Niš, was visited by Miloš Marjanović on September 25. During the visit, he was promoting the ELICISR project and its activities, and talked about the importance of cooperation with companies and the exchange of good practice and solutions.

Online consultations with project partners

A regular session of online consultations among project team members was held on October 1. One of the PhD students involved in the project, Stefan Ilić, had a meeting with the partners from the Tyndall National Institute and the University of Granada where they discussed some of the scientific issues that appeared during the research, data processing and data analysis. Online consultations such as this have been very helpful not only for the creation of scientific papers, but also for project implementation.



3rd ELICSIR ONLINE WORKSHOP

The 3rd ELICSIR Online Workshop "Fault-tolerant Electronics for Radiation Environments" was held on November 17 and 18, 2021. Organized by the IHP, the workshop gathered more than 120 participants who had a chance to hear eight invited talks and have interesting discussions with the presenting authors.

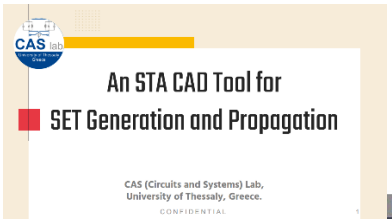

Talk 1

Felipe Augusto Kuentzer (IHP, Germany)

Title: *MORAL - Export-free Rad-hard Microcontroller for Space Applications*

Abstract: The space segment of modern applications, opens a wide spectrum of possibilities compared to the current traditional approach. Small satellites now perform new tasks, especially on the constellation and swarm formations, and push forward cluster satellites formation that will replace large satellites. This market segment is one of the major targets of the EU Horizon 2020 MORAL project. This presentation shows an overview of the MORAL project and the different aspects involved in its development.

Biography: Felipe A. Kuentzer received a bachelor degree in Computer Engineering from the University of Santa Cruz do Sul (UNISC) in 2009. In 2014 he received his M.Sc. degree in Computer Science from the Pontifical Catholic University of Rio Grande do Sul (PUCRS) and later in 2018 the Ph.D. degree in Computer Science also from PUCRS. Since 2018 he has been with the University of Potsdam, Germany, where he is a Postdoc, and also with the IHP Microelectronics, Frankfurt (Oder), Germany, as a Guest Scientist.



Day 1, November 17, 2021

- Felipe Augusto Kuentzer (IHP, Germany), MORAL – Export-free Rad-hard Microcontroller for Space Applications
- Sergio Montenegro (University of Würzburg, Germany), Design to Survive
- Junchao Chen (IHP, Germany), Self-adaptive Single-Event Upset Resilience in Reconfigurable Systems for Space Applications
- Tatjana Nikolic (University of Nis, Serbia), Fault-tolerant Systems Based on Coding Techniques

Day 2, November 18, 2021

- Zoran Stamenkovic (IHP, Germany), Characterization of Single Event Transient Effects in Electronic Integrated Circuits and Systems
- Mladen Berekovic (University of Lübeck, Germany), Fault Analysis in Early Design Steps for AI Applications
- Christos Sotiriou (University of Thessaly, Greece), An STA CAD Tool for SET Generation and Propagation Christos Sotiriou
- Thomas Lange (IROC Technologies, France), Machine Learning Techniques to Estimate the Functional Failure Rate of Complex Circuits

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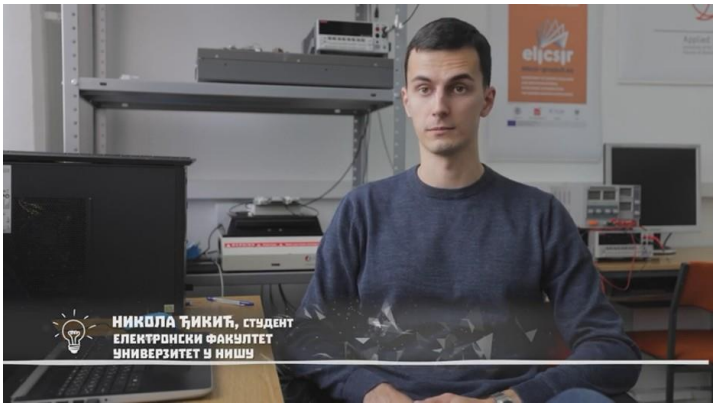
Nikola Đikić spoke for the Serbian National Television (RTS)

Nikola Đikić, a student at the Faculty of Electronic Engineering, University of Niš, and a member of the ELICSIR team, gave an interview to the Radio Television of Serbia (RTS) on December 18 about his engagement at CERN. We are proud to see a member of the ELICSIR team contribute to the largest project in our field. His interview was a part of the TV show New Serbian Minds, which is a part of the RTS educational and scientific program.



Another experiment at Vinča Institute of Nuclear Sciences

25 December 2021 – Vinča Institute for Nuclear Sciences in Belgrade, Serbia, was the host of another experiment conducted within the ELICSIR Project. Although the realization of this experiment was planned with colleagues from the University of Granada, COVID restrictions prevented their participation. Serbian project team members were assisted by Dr. Srboljub Stanković from the Vinča to ensure the success of the experiment and the validity of results.

ELICISR project at a science fair *Nauk nije bauk 13*

27 December 2021 – The popularization of science and scientific findings to the general public is very important, especially in the area of radiation. Therefore, ELICSIR project members participated in the science fair *Nauk nije bauk 13* with a presentation about ionizing radiation and its measurement, which they also used to promote the project.