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Editorial: Special Issue on Electronics, Microtechnologies and Materials Science

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This special issue presents a selection of extended contributions of best papers, proposed by the chairmen of the International Semiconductor Conference (CAS 2021). One of the oldest annual scientific events in Europe, at its 44th edition in 2021, the CAS conference is a prestigious forum for sharing high level scientific and innovative research results in the field of electronics and micro- and nanotechnologies. Since 1978 the conference was organized by ICCE Bucharest as an Annual Semiconductor Conference. In 1991, CAS became international and changed its name to International Semiconductor Conference. Starting with 1995, the conference is an IEEE (Institute of Electrical and Electronic Engineers) event, being sponsored by the IEEE EDS (Electron Devices Society). Since 1997, the organizer of CAS has been the National Institute for Research and Development in Microtechnologies - IMT Bucharest (www.imt.ro) and the conference profile was extended from semiconductor device physics and technology (including semiconductor materials and microelectronics) to micro- and nanotechnologies, micro-nanoelectronics. Nanostructures and nanostructured materials are also considered.

The program of the 2021 edition included 82 selected and invited presentations, 77 regular papers grouped in 15 conference sessions, presented by specialists from 20 counties (Algeria, Austria, Belgium, China, France, Germany, Greece, Iceland, India, Iran, Ireland, Italy, Japan, Korea, Moldova, Romania, Serbia, Taiwan, Ukraine, United States) facilitating a real multinational exchange of experiences and ideas. The program also included 5 sessions dedicated to students.

In the first paper, *Compact Implementation of an RFID Tag with Electromagnetic Wave Polarization Diversity*, with the conference paper presented in the Microwave and Millimeter Wave Circuits and Systems Session, the authors Dan Neculoiu, Alina-Cristina Bunea and Ovidiu George Profirescu propose a backscattering RFID system with reduced interference of incident and reflected electromagnetic waves. The tag system was designed for 5 GHz operating frequency and used two microstrip patch antennas with linear polarization in perpendicular directions. Between the tag antennas a block including a Schottky diode is used for amplitude modulation of the received signal with tag information. All the blocks were fabricated using

microstrip technology and were integrated on the same FR4 substrate. Design, fabrication and measurements results are given. The proposed technology can take advantage of existing 5 GHz WiFi, infrastructure for IoT implementation and has the potential to be scaled up to millimeter wave frequencies for high density RFID systems.

In the second paper, *High Power Supply Rejection Capacitor-less Low Dropout Regulators Based on High Slew Rate Symmetrical Operational Transconductance Amplifiers*, with the conference paper presented in the Integrated Circuits – Student Papers Session 1, I. Sularea *et al.* introduce a power supply rejection (PSR) enhancement technique for capacitor-less low dropout (LDO) voltage regulators with PMOS pass transistor. For a conventional LDO variations of the supply line cause variation of the output voltage due to unwanted signal paths created mainly by parasitic capacitors associated with the pass transistor and by finite drain-source resistances of PMOS transistors connected to the supply. The main idea for enhancing the PSR is to create a feed forward signal path, so that variations of the supply line result in a current injected directly into the node at the gate of the pass transistor, which cancels the effect of the unwanted signal paths mentioned above. Circuit implementation is based on an additional OTA that senses the supply variations by using a high pass filter and generates the cancelling signal current. Simulations results performed for both proposed LDOs demonstrates the capability of the circuits and validates the theoretical analysis.

The third paper, Methods for Assessing the Stability of Conditionally Stable Circuits by Using Small-signal Simulations, with the conference paper presented in the Integrated Circuits– Student Papers Session 2, V. Beleca *et al.* address some of the issues faced by designers that use small-signal analysis to assess the stability of feedback systems based on the Bode and Nyquist stability criteria. The popular Bode stability criterion is not suitable for assessing the stability of feedback systems for which the phase characteristic of their loop gain, T(s), crosses the –180° horizontal more than once. This fact is illustrated by four simple examples of such circuits, that also help to demonstrate an extension of the Bode criterion proposed in this paper: the stability of a sub-class of conditionally stable circuits - whose T(s) comprises neither RHP poles nor poles in the origin, and the module frequency characteristic of their T(s) crosses the 0 dB horizontal only once - can be assessed by analyzing the phase characteristic of their loop gain. The relationship between the phase margin of these circuits and their frequency and step response is also analyzed. Finally, the paper introduces a three-step method for assessing the stability of all feedback systems, including the conditionally stable ones, by using small-signal analysis. It involves extracting the poles and zeros of T(s), then plotting the corresponding Nyquist contour by using Matlab scripts developed for this purpose.

The fourth paper, *On the Reverse Breakdown Behavior of GaAs PIN Diodes for High Power Applications*, with the conference paper presented in the Modelling Session, P. Scharf *et al.* present the fabrication of a device based on gallium arsenide, for use in power electronics with comparable or better properties to devices realized on compound semiconductors as gallium nitride and silicon carbide, but at lower costs. The authors propose the first GaAs PIN diode for 900 V operation, which is fabricated and characterized. For applications in power electronics, it must be ensured that the reverse biased diodes have a very low leakage current and high breakdown voltages. The diode have to be functional over a wide temperature range for use in electric vehicles. In the paper the temperature-dependent reverse breakdown behavior was investigated with the help of TCAD (Technology Computer Aided Design) simulations and high-voltage measurements. Based on these results from simulations and measurements, an analytical model was developed, which describes the temperature-dependent behavior of a reverse biased GaAs PIN

diode. The model was parameterized by fitting the breakdown voltage VBD and the saturation current IS in a wide temperature range from –40 °C to 150 °C. This enables further optimization of the GaAs PIN diode to optimally meet customer's needs.

In the fifth paper, *Battery Connected Linear Voltage Regulator for Very Low Current Consumption Automotive Applications*, with the conference paper presented in the Integrated Circuits – Student Papers Session 2, I.-A. Ilie *et al.* describe a very low quiescent current linear voltage regulator for automotive applications. They proposed a battery connected linear voltage regulator suitable for always-on automotive applications (keyless entry, car monitoring, anti-theft system). The regulator is designed as a simple 3 pins device and it is always connected to the battery, even when the car's engine is off; therefore, a very low quiescent current of the regulator is mandatory. The regulator has a fixed 5 V output voltage and can deliver up to 0.5 A to the load. The total quiescent current of the proposed regulator is 3.8 μA at no load and due to an adaptive biasing technique a value of 75 μA is achieved at 500 mA load current. The architecture include a buffer to bias the gate of pMOS pass device and so a PSRR value of 65 dB at 100 Hz is obtained. Moreover, being supplied directly from the automotive battery, this regulator can withstand the very harsh environment in terms of temperature, line disturbances, EMC. The proposed regulator was implemented on silicon in a 0.8 μm BiCMOS technology and its characteristics were simulated and measured.

In the sixth paper, *Motion Algorithms for a Neuroprosthesis Equipped with Velostat Sensors*, with the conference paper presented in the Microsensors & Modelling Session, M.-I. Gheorghe *et al.* describe new motion algorithms tested on a neural prosthesis prototype that is equipped with manually fabricated Velostat sensors used for providing tactile feedback to the patient. This neural prosthesis was developed in order to capture biological signals with the help of implants at the level of the median nerve and ulnar nerve. The signals can be processed with various techniques to be suitable for triggering the movement of the prosthesis. Such a prosthetic device is intended to help the large number of patients who suffer from upper limb amputation. The implemented motion algorithms are based on how the motors, that are part of the mechatronics structure, rotate in one direction or another, with a certain speed, to achieve a specific movement. The implemented algorithms were functional and have been successfully tested on the experimental assembly containing the mechatronics structure and the command-and-control block. The presented and tested device, with the signals received from pressure sensors with Velostat, is versatile and sophisticated. It allows the realization of various types of movements starting from those that involve the use of a computer, to those in which objects of various shapes and sizes can be used in daily activities.

I. Tismanar *et al.* propose in the seventh paper, *Vis-active TiO_2 rGO Photocatalysts for Advanced Wastewater Treatment*, with the conference paper presented in the Nanoscience & Nanoengineering Session 2, the implementation of efficient Vis-active photocatalysts, targeting water re-use, which represents a priority considering that the up-scaling and possible feasible candidates are the composites with metal oxide matrix and graphene derivative(s) fillers. The most efficient metal oxide matrix is titanium dioxide and coupled with the reduced graphene oxide it can develop Vis-active photocatalytic composites. The paper analyzes the performance of these composites as potential photocatalysts to be implemented at industrial scale. The properties of the TiO_2 - rGO composite thin films are discussed along with the efficiencies in degrading the methylene blue standard pollutant; moreover, the stability of these thin films during the photodegradation processes is outlined correlated with the rGO filler content in the composites. Experimental work and microphysical investigations are presented and discussed.

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We hope that the readers you will find interesting the scientific contributions of this special issue in the fields of electronics, microtechnologies and materials science.

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Dr. Raluca Müller - IMT Bucharest and Dr. Miron Adrian Dinescu - IMT Bucharest, Guest Editors