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Editorial: Special Issue on Microsensors, Semiconductors, Integrated Circuits and Materials

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This special issue of the Romanian Journal of Information Science and Technology (ROMJIST) presents a selection of seven extended contributions of best papers from the International Semiconductor Conference – CAS 2025, IEEE Event, as proposed by the conference chairmen. The CAS Conference (https://www.imt.ro/cas) serves as a comprehensive platform for scientific exchange, facilitating the sharing of front-line research in nanoscience and nanoengineering, microsensors, microwaves, photonics, modelling, semiconductor devices and integrated circuits. The 48th edition of the event - CAS 2025, took place from 7 to 11 October 2025, at Sinaia, Romania. The conference was organized by the National Institute for Research and Development in Microtechnologies – IMT Bucharest, Romania, with support of the Romanian Authority for Research and under the aegis of IEEE Electron Devices Society (EDS). By bringing together distinguish scientists, industry experts, and students, the CAS 2025 conference created a robust environment for networking and the exchange of last research in nanoscience and semiconductor physics, acting as a prestigious international platform and a catalyst for innovation in micro- and nanoelectronics. The conference gathered 240 participants from 79 organizations in 22 countries: Austria, Belgium, Bulgaria, Czech Republic, France, Germany, Greece, Hungary, India, Jordan, Ireland, Iceland, Israel, Italy, The Netherlands, Poland, Portugal, Republic of Korea, Romania, Serbia, Turkey, UK. The programme included 4 plenary sessions, 14 sessions of oral presentations and 5 poster sessions, supplemented with 4 workshops, an industry exhibition and vibrant networking events. The technical programme comprised 127 research papers, with 14 invited papers, 63 oral presentations and 50 posters, including 32 student papers. In order to guarantee the originality and high quality of research, the papers accepted at CAS conference are subjected to a peer-review procedure performed by an international Paper Review Board. An industry Exhibition showcasing services, technologies, products, and R & D projects took place for the whole conference duration, with relevant companies in the domain and national and international projects participating. The Exhibition facilitated an open dialogue between academia and industry, fostering collaboration and knowledge exchange, in the same time aiming to a better collaboration and exploitation of results. The conference program included four workshops

demonstrating the innovation and responsibility in research and proving that semiconductors and microtechnology are not only about technical performance, but also about their real-world impact and contributions to society: NerveRepack Workshop "Pushing the boundaries of neuroprosthetics and bioelectronic medicine"; Net4Air Workshop "Smart sensor technologies for next-level air quality monitoring"; Net4Air Workshop "Awareness into Action: Ideas for an Inclusive Scientific Culture"; and Workshop "From Awareness to Implementation: Research Security for Future Partnerships co-organized by IMT Bucharest and the Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI), Romania.

A brief review of the papers is presented as follows:

The first paper, "Electrochemical synthesis of silver nanostructures-carbon based composites from deep eutectic solvents for bisphenol A detection", is authored by Sabrina State et al., and was presented at the NANOSCIENCE & NANOENGINEERING Session. This paper refers to the development of sustainable electrochemical sensing platforms. The authors investigated the green electrochemical synthesis of carbon-based nanocomposites, obtained by decorating SWCNTs and graphene oxide (GO) with AgNPs using Deep Eutectic Solvents (DES) electrolytes, and evaluates their electrochemical performance toward BPA (Bisphenol A) detection. The paper describes the materials and experimental procedures used for the green synthesis of Ag-based nanocomposites, followed by the design of the electrochemical sensor. The morphological, structural, and electrochemical characterization results are presented and discussed together with the analytical performance of the developed platform for BPA detection. The AgNPs–GO composite deposited onto a Screen-Printed Carbon Electrode (SPCE), enhanced their electrochemical performance, characterized by improved electron-transfer kinetics and increased active surface area.

The second paper is "Automotive Capacitor-Less Linear Regulators with Active Capacitance Multiplier Frequency Compensations and AI-Assisted Sizing", authored by Paul Coste et al. (within the INTEGRATED CIRCUITS – STUDENT PAPERS Session). The authors present a solution for implementing frequency-compensation of low-power automotive output-capacitor-less linear regulators able to operate over a wide supply voltage range. Automotive voltage regulators must maintain their output voltage level and stability across wide supply and environmental variations while meeting stringent limits on quiescent current and transient response. These requirements are especially difficult to meet in low-power regulators with small load capacitance, where the limited Operational Transconductance Amplifier (OTA) bias current constrains both loop bandwidth and slew rate. The authors introduced A novel Active-Capacitive-Multiplier (ACM) that emulates the passive, R-series-C, frequency compensation network of a conventional NMOS regulator. Two design examples are proposed that follow the same approach and their performance is compared: the conventional NMOS regulator with RC compensation is sized to meet a set of real-life requirements; next, the RC network is replaced by the proposed ACM, sized so the resulting regulator has loop gain frequency characteristics similar to the conventional one. Also an effective way of scaling up the load current of such regulators is presented: starting from the NMOS ACM-based regulator, with a maximum load current of 100 mA, an AI-assisted optimized sizing procedure was developed to re-size the pass-device and key ACM elements, so that the resulting regulator can handle loads up to 200 mA. The main contributions of the work include: a Widlar-based biasing scheme that reduces the sensitivity to PVT variations of the ACM-based NMOS regulator, and an AI-assisted automatic design procedure to scale the current capability of the NMOS ACM regulator from 100 mA to 200 mA while preserving low-frequency loop gain, stability, transient performance, and current consumption.

In the third paper, "The potential of electrospun carbon allotrope nanofiber coatings in antimicrobial bandages", the authors Maria-Roxana Marinescu et al. (within the BRIDGING ELECTRONICS, AI, and BIOMEDICAL APPLICATIONS Session) propose a versatile method for the fabrication of uniform nanofiber coatings incorporating carbon-based nanomaterials directly onto textile gauze substrates. Advanced wound dressings are expected to provide biocompatibility, mechanical stability, moisture balance and antimicrobial activity in a single platform. In this paper, electrospun Polyvinylpyrrolidone (PVP) nanofiber coatings incorporating carbon allotropes were directly deposited onto commercial gauze substrates under identical fabrication conditions. This design enables a controlled comparative evaluation of how carbon allotrope type influences nanofiber diameter, crystalline behavior, vibrational signatures, and antibacterial performance. The authors try to clarify the role of carbon allotrope geometry and bonding configuration in determining the functional behavior of electrospun textile coatings. The authors also provide a systematic comparative analysis under identical conditions and includes a detailed correlation between structural features and antimicrobial performance. The used materials, preparation methods, and electrospinning process used to fabricate the nanofiber coatings are presented. Morphological (SEM), structural (XRD), and vibrational (Raman) analyses consistently confirmed the successful incorporation of the carbon allotropes while preserving the crystalline structure of the cellulose substrate. The electrospun architecture provides effective immobilization of the nanofillers within the polymer network, which is advantageous in reducing the risk of nanoparticle detachment during handling or potential wound application. The main findings and highlights the potential of these materials for antimicrobial wound dressing applications are addressed.

The fourth paper, presented at the INTEGRATED CIRCUITS Session, and entitled "A Novel Current-Mode Capacitor Multiplier for Improved Noise Filter", authored by Ionuț-Alin Ilie et al., deals with a novel current-mode capacitor multiplier that offers a superior alternative to existing solution. By adding a resistor, the proposed circuit achieves multiplied equivalent capacitance, outperforming state-of-the-art implementations. The new design proposed excels in both power supply rejection ratio and noise performance, making it an attractive solution for low-power, high-precision applications. After a presentation of the state of art follows a detailed description of the proposed innovative capacitance multiplier circuit. The novelty consists in the introduction of a resistor placed between the gates. Under DC operation, the resistor has no influence due to zero gate current, in the AC regime, the mirroring ratio is effectively enhanced. Another purpose is the developing of an area-efficient low-pass noise filter tailored for a generic voltage reference. The selected architecture is a Kujik voltage reference. Simulated results include PSRR for the unfiltered reference and for three specific filtering variants, plus noise density and transient noise simulations to demonstrate performance gains. Different analysis and simulations were performed. The novel current-mode capacitor multiplier offers a superior alternative to the state of the art, obtaining the multiplied equivalent capacitance in a simple manner.

The next paper, "Real-Time Spectrum Monitoring for UAV RF Signature Using a Multi-Channel SDR Architecture", authored by Mirela Șorecău et al. (within the MICROWAVE & MILLIMETER WAVE CIRCUITS & SYSTEMS Session), presents the design and experimental validation of a wideband, real-time spectrum monitoring system implemented on a multi-channel software-defined radio (SDR) architecture. A real-time wideband observation is required in order to capture transient emissions, accurately track occupancy and interference, and eliminate the blind intervals inherent to sequential scanning. The platform utilizes an USRP X310 equipped with dual TwinRX daughterboards to provide four independent receive chains. It has

been demonstrated that a RFNoC-based acquisition chain performs FPGA rate reduction, while host-side processing in GNU Radio applies high-resolution FFT-based spectrum estimation and real-time visualization. Signal acquisition in the 2.4 GHz and 5.8 GHz Industrial, Scientific and Medical (ISM) bands was performed using a custom-designed dual-band microstrip parasitic patch antenna (MPPA) intended for resonant operation at 2.4 GHz and 5.8 GHz. The antenna's output was distributed to the four receiver inputs using a passive RF distribution network based on power splitters. Signal acquisition, real-time processing and visualization were implemented using GNU Radio with Python-generated flow graphs (Fig. 1). Low-level hardware control, synchronization configuration and high-rate streaming from the X310/TwinRX front end were performed via the UHD RFNoC interface. A spectrogram graphical user interface (GUI) is presented, incorporating percentile- driven auto-leveling with smoothing and display-domain frequency pooling to enhance wide- band readability. A concatenation and trim method facilitate stitched wideband observation in the 5.8 GHz band. Controlled laboratory measurements in the 2.4 and 5.8 GHz ISM bands, including sweep injection and multi-UAV scenarios under Wi-Fi congestion, confirm stable real-time operation, continuity across the stitching boundary, and clear visibility of dominant drone downlink activity.

The sixth paper, selected from the MICROSENSORS & MICROSYSTEMS Session, "Sensing Performance of Dual-Mode SAW HumiditySensors on ScAlN/Si using HfO_2 and SiO_2 Functionalization Layers", authored by Monica Nedelcu et al., gives a comparative study of surface acoustic wave (SAW) humidity sensors fabricated on the emerging piezoelectric layered structure ScAlN/Si, functionalised with HfO_2 and SiO_2 thin films, operating in both Rayleigh and Sezawa propagation modes. After an introduction regarding the applications of SAW devices, highlighting the SAW humidity sensors, the paper describes the fabrication process of the SAW sensors. On-wafer characterization, revealing the dual-mode operation of the SAW sensors, and the experimental setup are presented. The results and frequency responses in the humidity range are analysed. The structures were characterized in the humidity range from 20 to 90% RH, at constant temperature, 30ºC and a comparative experimental study was presented. The results demonstrate a strong dependence of the sensors behavior on the type of functionalization layer. The sensitivity determinations for the SAW structures covered with SiO_2 showed a nonlinear variation of the resonance frequency vs. RH and the resonance frequency decreases with the increase of the relative humidity. An interesting behavior of the SAW humidity sensors with HfO_2 functionalization layer is noted: the main sensing mechanism is the stiffening effect, and the resonance frequency increases when the humidity increases. This is in contrast to the behavior exhibited by the SAW structures covered with SiO_2 as well as to the most reported humidity sensors, where the mass loading effect is the dominant sensing mechanism. This might be explained by adsorbed water molecules that lead to local stiffening at the surface of the sensitive layer generating an increase in the effective Young's modulus of the HfO_2 layer. The experimentally observed higher sensitivity for smaller IDTs area can be attributed to a more favourable balance between elastic stiffening and geometry-dependent mass loading effects.

The seventh paper, with the authors Iulia Antohe et al. and the title "Plasmonic Optical Fiber-based Sensor for Monitoring Toxic Nitrophenolic Compounds" (within the MICROPHOTONICS & MICROSYSTEMS Session), deals with a sensitive and selective approach based on a polyaniline (PANI)-coated fiber optic-surface plasmon resonance (FO-SPR) sensor for real-time monitoring of these pollutants in aqueous environments. This study explores the development of the PANI-functionalized FO-SPR sensor for the detection of 4-NP and 2,4-DNP in aqueous environments. Surface Plasmon Resonance (SPR) has attracted considerable attention for its ability

to detect changes in refractive index at a metal–dielectric interface with high sensitivity. If coupled with fiber-optic (FO) configurations, FO-SPR sensors offer additional advantages, including compactness, flexibility, and remote sensing capability, making FO-SPR systems very suitable for in situ applications, where continuous, real-time measurements are necessary. The work is focused on the description of the used materials, the fabrication process of the FO-SPR sensors, the methods employed for surface characterization, and the procedures for detecting the nitrophenols compounds. The PANI layer was fabricated directly onto the gold-coated sensing region of an unclad optical fiber via chemical oxidative polymerization, ensuring uniform coverage and strong adhesion. The PANI layer was characterized using Scanning Electron Microscopy (SEM) and X-ray Photoelectron Spectroscopy (XPS), in order to obtain information on its morphological features and chemical composition. The main experimental results, investigations and data obtained for nitrophenol detection using the prepared FO-SPR sensors are analyzed, the original results were highlighted. The proposed method is label-free, highly sensitive and selective, and enables real-time monitoring. The sensor is very suitable to be integrated into a portable device.

We hope that the readers will enjoy the publications and find interesting the scientific contributions of this special issue in the fields of microsensors, semiconductors, integrated circuits and materials.

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