ROMANIAN JOURNAL OF INFORMATION SCIENCE AND TECHNOLOGY
Volume **26**, Number 2, 2023, 163–166

Editorial: Special Issue on Topics in Electronics, Microtechnologies and Materials Science

Raluca MÜLLER[1,*] and Miron Adrian DINESCU[1]

[1]National Institute for Research and Development in Microtechnologies - IMT Bucharest,
Str. Erou Iancu Nicolae 126A, 077190 Voluntari, Ilfov, Romania
E-mails: raluca.muller@imt.ro*, adrian.dinescu@imt.ro
* Corresponding author

This special issue presents a selection of extended contributions of best papers, proposed by the chairmen of the International Semiconductor Conference – CAS 2022. The conference, International Semiconductor Conference – CAS 2022 at its 45th edition, a reference event, was organized, as every year, by the National Institute for Research and Development in Microtechnologies – IMT Bucharest, with the support of the Ministry of Research, Innovation and Digitalization, under IEEE-EDS aegis. CAS is the only conference organized in Romania in the field of semiconductors.

The CAS 2022 edition was organized in a moment when the fundamental, enormous role of semiconductors industry in global economy became evident for the entire word. Interesting discussions on semiconductors and their future in EU and all over the world took place. After a period when it was organized online, due to the COVID-19 pandemic, the conference took place onside at Hotel Alpin, Poiana Brasov, between 12 – 14 October 2022, and enjoyed a real success thanks to the large number of foreign and Romanian participants, https://www.imt.ro/cas.

CAS conference has a long tradition, being annually organized since 1978, in the form of a national conference, and since 1991 it has become an international conference. Since 1995, the CAS conference is an IEEE event – Institute of Electrical and Electronic Engineering, the largest international professional association in the world, which aims to stimulate technological innovation and excellence for the benefit of humanity. The conference is organized under IEEE-EDS (Electron Devices Society) aegis and is included in the IEEE-EDS conferences calendar.

The main objective of the conference is to promote direct interactions between specialists with a common interest in the field of semiconductors, micro- and nanotechnologies, material science from various countries, ensuring the possibility of presentation and information exchange focusing on the latest achievements in fields such as: micro- and nanoelectronics, photonics, microprocessed circuits of very high frequency, microsystems, physics of semiconductor devices, integrated circuits. CAS 2022 edition offered the participants the opportunity to disseminate the latest research regarding scientific achievements and latest technological developments in the field of micro- and nanotechnologies, as well as to identify the most important aspects for the near future development of fileds of interest. A wide range of topics were covered, from

the physics of semiconductor devices and integrated circuits to micro- and nanotechnologies, inclusive micro-nanoelectronics, micro- and nanosystems technologies.

CAS 2022 joined 138 participants: 105 Romanian and 33 from 17 different countries: Saudi Arabia (1), Austria (2), Belgium (1), Canada (1), France (5), Germany (2), Greece (2), Island (4), India (2), Italy (1), Moldova (1), Poland (6), Serbia (1), Spain (2), The Netherlands (1), UK (1), USA (1). The participants belonged to 39 organizations: 21 universities, 9 research institutes, 9 companies / 20 organizations from Romania and 21 from abroad.

The CAS 2022 conference program included 4 sessions of invited papers, 11 sessions of oral presentations, among which 4 sessions dedicated to the papers presented by students, 2 poster sessions and 1 networking and brokerage event within an European H2020 project. During the conference, 89 papers were presented: 13 invited papers; 52 current works within the oral sessions; 24 papers at the poster sessions. The original papers presented at the conference, were accepted after a peer review selection made by the International Program Committee.

In the first paper, presented at the Integrated Circuits Session, by Raul Onet *et al.*, the authors presented a HELP kit for electronic instrumentation and measurements that gave the same interface as a laboratory-based experience, a kit which is low-cost, portable which helps students to take more control over managing their learning, as the laboratory activity is no longer time-limited. The HELP kit electronic board developed by the authors comprises not only the usual breadboard and the required wires and cables, but also several functional blocks that greatly expand the range of experiments students can perform. The HELP kit equipment offers the chance to students to have a portable laboratory kit at home where they can experience hands-on activities using the equipment encountered in professional settings to observe, manipulate, and understand complex physical processes.

In the second paper, held at the Semiconductor Devices Session, Razvan Pascu et al. presented the fabrication and electrical characterization of Ti/Si and Mo/Si Schottky barrier diodes for a wide temperature domain (15 – 500 K). The effect of PMA treatment (post-metallization annealing) performed in forming gas atmosphere (FGA), in order to improve the electrical performances, is discussed for each fabricated sample. X-ray diffraction measurements show the presence of different metal silicides after the annealing. The Schottky diodes were fabricated starting from heavily doped (10^{19} cm^{-3}) n-type Si wafers with a 10 μm epitaxial layer ($5 \cdot 10^{14}$ cm^{-3} doping). The Schottky contacts, have been obtained from two different metals, which were deposited on the wafers' frontside: Ti (100 nm) and Mo (100 nm). All diodes exhibit some form of exponential current-voltage dependence in forward bias, the I-V characteristics of annealed devices (Ti-FGA and Mo-FGA) have more uniform profiles. The better behaviour of these devices is also confirmed in the reverse bias region, where the leakage currents are much lower and more stable than those of their unannealed counterparts. Werner and Güttler's inhomogeneity model was used in order to explain the samples' electrical behavior, indicating the presence of at least two Gaussian distributions of barriers on the contact surface. The paper demonstrates that a complete characterization approach needs to be undertaken in order to fully explain Schottky diode electrical behavior over wide temperature ranges.

In the third paper, presented at the Microsystems & Semiconductor Devices-Student Session, Ali Ammar *et al.* describe the design of a 10 kV, 10 A SiC BJT (Silicon Carbide Bipolar Junction Transistor). The authors presented in details different fabrication steps and the analysis and optimization of the peripheral protection. Compared to Si-based component, for the same level of on conduction losses, SiC power components, enables a clear reduction of the switching losses; that enables a possible reduction of total losses or for embedded applications a clear reduction

of the size and mass of the converters. The paper carries out a comparison of SiC BJT, MOSFET transistors and bipolar devices such as thyristors, GTOs, BJTs and IGBTs related to I-V characteristics. The authors concentrated on the fabrication processes, design and techniques, technological flow. Electrical characterizations were performed. Reverse I-V characteristics, as shown, were completed using a high vacuum probe station at ISL A high-blocking voltage of 11 kV with a leakage current density of 0.1 mA/cm^2 was recorded, validating their model.

The fourth paper, presented by C. Romanitan *et al.* in the Nanoscience & Nanoengeneering 3 Section, is a study related to the morpho-structural properties of V_2O_5 samples obtained by spray pyrolysis technique (SPT) and radio-frequency magnetron sputtering (RF-MS) in correlation with their optical properties. Vanadium oxides compounds have received a constantly growing interest in materials science, due to their ability to tune the material properties according to the oxidation state (V^{2+}, V^{3+}, V^{4+}, and V^{5+}). The structural properties of V_2O_5 play a significant role in defining its optical properties, such as its absorption, reflectance, and transmission spectra. These properties are function of the synthesis method and processing conditions; that is the reason why the structural properties, as crystal structure, are of great interest. Different methods were used to obtain vanadium oxide, V_xO_y, thin films as: Spray pyrolysis technique, SPT, radio-frequency magnetron sputtering, RF-MS. The surface morphology was analyzed using scanning electron microscopy, SEM, and atomic force microscopy, AFM. The crystalline structure of the experimental samples was investigated by grazing incidence X-ray diffraction, XRD. Many interesting results related to V_2O_5 are presented and investigated.

D. Vasilache *et al.* proposed in the fifth paper, presented at the Microsensors & Microsystems Session, the design, manufacturing and characterization of 0-level packaged dual SAW pressure and temperature sensors, GHz operation, developed on GaN/Si/Mo thin membranes and a method to embed it using solid silicon cap. The possibility to determine simultaneously the pressure and the temperature with the same SAW structure was demonstrated previously by the authors. The developed configuration enhanced the quality factor and the coupling coefficient. FEM mechanical simulations were carried out in order to determine the stress of the membrane and the deformation of the proposed package. The manufacturing of the dual sensor used nanolithography and micromachining techniques, assuring a high sensitivity and compatibility with wireless data transmission and battery-less operation, and advantage for harsh and environmental applications. A novel encapsulation method has been developed as well.

In the sixth paper (Section on Micro- & Nanophotonics & Optoelectronics, Microsensors & Microsystems, Modeling, Semiconductor Devices), Eugen Chiriac *et al.* reported the improvement of a sensitive electrochemical sensor capable of detecting the presence of the SARS-CoV-2 virus using graphene-modified interdigitated working electrodes functionalized with antibodies targeting the SARS-CoV-2 nucleocapsid protein (N protein). The authors chose an electrochemical sensor due to the advantages of high sensitivity, short time-consuming and specificity for a broad range of applications in biological detection. The authors describe the manufacturing and all technological steps, with details related to the operation of the electrochemical sensor with vertical graphene, modified interdigitated gold electrodes, which ensures the increasing of the sensor sensitivity, developed for the detection of SARS-CoV-2 viral nucleocapsid protein (N-protein or SARS-CoV-2 nucleoprotein). The gold interdigitated electrodes were decorated with AuNPs capable of detecting the N protein in the SARS-CoV-2 virus at very low concentrations. Structural characterization was carried out in terms of Atomic Force Microscopy (AFM) to analyze the material in terms of the shape of the layers, the size of the graphene domains and their operation, and Raman spectroscopy was performed in order to obtain information on the

shape and type of chemical bonds in the developed materials. The Electrochemical Impedance Spectroscopy method was used for detection. Through both tests, cyclic voltammetry and Electrochemical Impedance Spectroscopy (EIS), the N protein was detected for very low concentrations.

In the seventh paper, presented in the Semiconductor Devices Session, Nour Beydoun *et al.* describe advanced research on deep etching of Silicon Carbide (SiC) in order to achieve isolated deep trenches in the same thick SiC substrates. The technological work combines both plasma etching and electrochemical etching on p-type SiC above n-type SiC layers. Uniform and smooth plasma etched surfaces of SiC were obtained upon using Ni masks with significant thicknesses deposed by electroplating. Selective conductive electrochemical etching, by using p-type SiC as an inert layer, allowed a higher etched thickness of silicon carbide substrates, deep etching reaching around 80 μm, which opens the perspectives for fabrication of vertical power-integrated SiC devices. The technological processes involved: Aminopropyl Triethoxysilane (APTES) functionalization step; growth of Pd nanoparticles and Ni electroplating; Ni mask pattering and SiC etching; patterned of SiC substrates; etched using ICP/RIE Plassys MU400 reactor. Kinetic etching was performed and interesting morphology investigations were presented and analyzed. This paper opens a perspective for having integrated multi-terminal chip made from SiC by performing deep etching to isolate devices.

Acknowledgements. We would like to thank all the contributing authors, the reviewers and the Program Committee Members of CAS 2022 for their hard work, which contributed to the success of the conference. The Guest Editors would like to thank the Editor-in-Chief of the Romanian Journal of Information Science and Technology, Acad. Radu-Emil Precup, and Acad. Gheorghe Stefan, Honorary Co-Editor-in-Chief, for the publication of this special issue, which is very important for the visibility of the CAS conference.

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

June 2023

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