5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

ISBN: 978-605-68918-2-3

NEM 2025

ABSTRACT BOOK

5 th International Natural Science, Engineering and Material Technologies Conference

Sep 18-20, 2025 – İğneada-Kırklareli/ TÜRKİYE

FOREWORD

It is a pleasure for us to offer you this Book of Abstract for the 5 th International Natural Science, Engineering and Material Technologies Conference (NEM 2025). Our goal was to create a platform that introduces the newest results on internationally recognized experts to local students and colleagues and simultaneously to display relevant Turkish achievements to the world. The positive feedback of the community encouraged us to proceed and transform a single event into a conference series. Now, NEM 2025 is honored by the presence of over 65 colleagues from various countries. We kept the original NEM 2025 concept and accepted contributions from all fields of materials science and technology to promote multidisciplinary discussions. The main points of the conference emerged spontaneously from the submitted abstracts: energy applications, advanced materials, electronic and optoelectronic devices, organic electronic materials, chemistry, physics, environmental science, medical science, applied and engineering science, computer simulation of organic structures, biomedical applications and advanced characterization techniques of nanostructured materials. Further fields of interest include e.g. new advanced and functional materials, advanced-functional composites, biomaterials, smart materials, dielectric materials, optical materials, magnetic materials, organic semiconductors, inorganic semiconductors, electronic materials, graphene, and more.

Therefore, we hope that getting first-hand access to new results, establishing new connections and enjoying the İğneada-Kırklareli/ TÜRKİYE ambience will make you feel that your efforts were spent well in NEM 2025.

Our warmest thanks go to all invited speakers, authors, and contributors of NEM 2025 for accepting our invitation, visiting Kırklareli and attending NEM 2025 as a medium for communicating your research results.

We hope that you will enjoy the conference and look forward to meeting you again in the forthcoming **NEM 2026** event.

Best regards,
Chairmen's of Conference

Assoc. Prof. Burhan COŞKUN **Prof. Dr. Serpil AKÖZCAN PEHLİVANOĞLU**

Editors:

Assoc. Prof. Burhan COŞKUN

Prof. Dr. Serpil AKÖZCAN PEHLİVANOĞLU

Published, September-2025

nem2025.klu.edu.tr

nem@klu.edu.tr

COMMITTEE

HONORARY PRESIDENT

Prof. Dr. Rengin AK (Rector of Kırklareli University)

CONFERENCE PRESIDENT

Prof. Dr. Serpil AKÖZCAN PEHLİVANOĞLU (Kırklareli University)

Assoc. Prof. Dr. Burhan COŞKUN (Kırklareli University)

ORGANIZING COMMITTEE

Prof. Dr. İlke TAŞÇIOĞLU / İstanbul Topkapı University

Prof. Dr. Ömer Suat TAŞKIN / İstanbul University

Prof. Dr. Sermet KOYUNCU / Çanakkale Onsekiz Mart University

Assoc. Prof. Dr. Ayşegül DERE / Fırat University

Assoc. Prof. Dr. Berna Akgenç HANEDAR / Kırklareli University

Assoc. Prof. Dr. Hale KARAYER / Kırklareli University

Assoc. Prof. Dr. Mehmet Mümin KOÇ / Kırklareli University

Assoc. Prof. Dr. Mustafa KURBAN / Ankara University

Assoc. Prof. Dr. Özge Kılıçoğlu MEHMETCİK / Marmara University

Assoc. Prof. Dr. Selin ÖZDEN / Kırklareli University

Assoc. Prof. Dr. Taner DAŞTAN / Cumhuriyet University

Dr. Instructor Bahadır BEKÂR / Trakya University

Dr. Instructor Ufuk PAKSU / Kırklareli University

Dr. Çiğdem Ş. GÜÇLÜ / Gazi University

SCIENTIFIC COMMITTEE

Prof. Dr. Abdel Salam Hamdy MAKHLOUF / University of Texas / UNITED STATES

Prof. Dr. Abdullah G. AL-SEHEMI / King Khalid University / SAUDI ARABIA

Prof. Dr. Adem TATAROĞLU / Gazi University / TÜRKİYE

Prof. Dr. Ahmed A. ALGHAMDI / King Abdulaziz University / SAUDI ARABIA

Prof. Dr. Asa H. BARBER / London South Bank University / UNITED KINGDOM

Asst. Prof. Bahadır BEKAR / Trakya University / TÜRKİYE

Assoc. Prof. Dr. Bayram ÇETİN / Kırklareli University / TÜRKİYE

Dr. Instructor Burhan CEYLAN / Harran University / TÜRKIYE

Prof. Dr. Burç MISIRLIOĞLU / Sabancı University / TÜRKİYE

Prof. Dr. Chung GWIY-SANG / Ulsan University / KOREA

Dr. Instructor Demet TOPAL KOÇ / Kırklareli University / TÜRKİYE

Prof. Dr. Denis NIKA / Moldova University / MOLDOVA

Asst. Prof. Dr. Devrim ÖZDAL / European University of Lefke, NORTH CYPRUS

Prof. Dr. Dilek NARTOP / Düzce University / TÜRKİYE

Prof. Dr. Elias STATHATOS / Tecnological-Educational Institute of Patras / GREECE

Prof. Dr. Elizabeth BLACKBURN / University of Birmingham / UNITED KINGDOM

Prof. Dr. Hatice ÖĞÜTCÜ / Kirsehir Ahi Evran University/Türkiye

Assoc.Prof. Elvan HASANOĞLU ÖZKAN / Gazi University / TÜRKİYE

Asst. Prof. Erdinç KESKİN / Kırklareli University / TÜRKİYE

Asst. Prof. İsmail KILIÇ / Kırklareli University / TÜRKİYE

Asst. Prof. Macide CANTÜRK RODOP / Yıldız Technical University / TÜRKİYE

Prof. Dr. Müjdat ÇAĞLAR / Eskişehir Anadolu University / TÜRKİYE

Prof. Dr. Mustafa ERKOVAN / Beykoz University / TÜRKİYE

Assoc. Prof. Mustafa KURBAN / Ahi Evran Gazi University / TÜRKİYE

Assoc. Prof. Naim ASLAN / Munzur University / TÜRKİYE

Prof. Dr. Niyazi ÖZDEMİR / Fırat University / TÜRKİYE

Prof. Dr. Numan AKDOĞAN / Gebze Technical University / TÜRKİYE

Assoc. Prof. Dr. Nur P. AYDINLIK / Cyprus International University, NORTH CYPRUS

Prof. Dr. Ömer Suat TAŞKIN / Istanbul University / TÜRKİYE

Assoc. Prof. Özge Kılıçoğlu MEHMETCİK / Marmara University / TÜRKİYE

Prof. Dr. Ram K. GUPTA / Pittsburg State University / UNITED STATES

Prof. Dr. Raşit TURAN / Middle East Technical University / TÜRKİYE

Prof. Dr. S. MANSOURI / University of Gabès / TUNUSIA

Asst. Prof. Sena Esen BAYER KESKİN / Kırklareli University / TÜRKİYE

Prof. Dr. Serap ŞENTÜRK DALGIÇ / Trakya University / TÜRKİYE

Assoc. Prof. Dr. Süleyman AŞIR / Near East University, NORTH CYPRUS

Dr. Şükrü Can Demirtaş / Yıldız Teknik University / TÜRKİYE

Assoc. Prof. Taner DAŞTAN / Cumhuriyet University / TÜRKİYE

Assoc. Prof. Tarık ASAR / Gazi University / TÜRKİYE

Prof. Dr. W. Aslam FAROOQ / King Saud University / SAUDI ARABIA

Prof. Dr. Yasin ÜNLÜTÜRK / Kırklareli University / TÜRKİYE

5th International Natural Science, Engineering and Material Technologies Conference

Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

PROGRAMME 18 SEPTEMBER 2025 (THURSDAY)	
10:00-10:05	Opening Ceremony
10:05-10:40	**OPENING SPEAKERS** Assoc. Prof. Dr. Burhan COŞKUN / *Conference President* Prof. Dr. Rengin AK / *Rector of Kırklareli University* Soner ILIK / President of *Kirklareli Chamber of Commerce and Industry* Derya BULUT / *Mayor of Kırklareli* Uğur TURAN / *Governor of Kırklareli*
10:40-11:25	**1st session (Oral Talks)**
10:40-11:10	Invited Talk-1: Prof. Dr. Huriye İCİL, "ADVANCES IN FLUORESCENCE SENSORS: FROM NOVEL DESIGN TO EMERGING APPLICATIONS"
11:10-11:25	S. AKÖZCAN PEHLİVANOĞLU, "INVESTIGATION OF THE NATURAL RADIOACTIVITY OF CERTAIN DAIRY PRODUCTS PRODUCED IN THE KIRKLARELI REGION"
12:00-13:30	**Lunch**
	HALL 1
13:30-14:30	**2nd session (Oral Talks) Chair: Prof. Dr. Prof. Dr. Huriye İCİL**
13:30-14:00	Invited Talk-2: Prof. Dr. Şemsettin ALTINDAL, "INTERFACE TRAPS, SERIES RESISTANCE, AND INTERLAYER EFFECTS ON THE ELECTRICAL CHARACTERISTICS OF METAL/INTERLAYER/SEMICONDUCTOR STRUCTURES IN WIDE RANGE TEMPERATURE AND VOLTAGE"
14:00-14:30	Invited Talk-3: Assoc. Prof. Dr. Engin DURGUN, "INVESTIGATION OF MINIATURIZED ELECTRONIC DEVICES BASED ON 2D MATERIALS"
14:30-15:00	**Coffee Break**
15:00-17:30	**3rd session (oral talks) Chair: Assoc. Prof. Dr. Berna AKGENÇ HANEDAR**
15:00-15:30	Invited Talk-4: Assoc. Prof. Dr. Simona MANCINI: "MONITORING OF INDOOR RADON IN HISTORICAL BUILDINGS AND CULTURAL HERITAGE SITES"
15:30-15:45	N. TOPÇU, F. KONKUR, A.T. BAŞOĞLU, O. ÜSKÜP, "COMPARISON OF POLYESTER RESIN AND SILICONE RESIN IN COMPOSITE STONE PRODUCTION"
15:45-16:00	O. ÜSKÜP KORCAN, H. ÖMÜR, N. TOPÇU, A. TUNCER BAŞOĞLU, "EXTENDING THE SERVICE LIFE OF RUBBER MOLDS USED IN COMPOSITE STONE PRODUCTION PROCESS"
16:00-16:15	M. BAYRAM, Y. TANER, "HIDDEN HAZARDS: IMPURITIES IN TEXTILE DYES AND AUXILIARIES, THEIR IMPACT ON HUMAN AND ENVIRONMENTAL HEALTH"
16:15-16:30	C. ÇORUH, B. AKGENÇ HANEDAR, M. C. ONBAŞLI, "ROLE OF MN DOPING AND OXYGEN VACANCIES IN TETRAGONAL $BiFeO_3$"

16:30-16:45	M. S. ÖZÇELİK, "IoT BASED MONITORING OF FOREST ECOSYSTEMS: CURRENT GAPS AND FUTURE PERSPECTIVES FOR TÜRKİYE"
16:45-17:00	A. GÜLER, C. BOYRAZ, L. ARDA, "ESR AND STRUCTURAL ANALYSIS OF Cu/Mg Co-DOPED ZnO NANOPARTICLES"
17:00-17:15	A. GÜLER, C. BOYRAZ, L. ARDA, "STRUCTURAL AND ESR INVESTIGATIONS OF Cu/Eu CO-DOPED ZnO NANOPARTICLES SYNTHESIZED VIA SOL–GEL METHOD"
17:15-17:30	R. K. GUPTA, "NANOSTRUCTURED SEMICONDUCTORS FOR ENERGY APPLICATIONS"
17:30-18:00	**Poster Session**

PROGRAMME **19 SEPTEMBER 2025 (FRIDAY)** **HALL 1**	
09:30-10:30	**4th session (oral talks) Chair: Prof. Dr. Serpil AKÖZCAN PEHLİVANOĞLU**
09:30-10:00	Invited Talk-5: Prof. Dr. Murat ATEŞ, "Yb_2O_3/ACTIVE CARBON/POLY(ANI-CO-MCZ) BASED HYBRID NANOCOMPOSITES AND SUPERCAPACITOR APPLICATIONS"
10:00-10:15	H. H. KARAYER, A. KÜÇÜKER KAMBERLI, Ö. YEŞILTAŞ, D. DEMIRHAN, "ANALYTICAL APPROACH TO THE DIRAC EQUATION IN CORNELL-TYPE POTENTIALS"
10:15-10:30	Ç. Ş. GÜÇLÜ, "ON THE RELAXATION PHENOMENA OF Au/(Co:PVA)/n-Si/Al (MPS) STRUCTURES DEPEND ON FREQUENCY AND VOLTAGE BY USING DIELECTRIC IMPEDANCE SPECTROSCOPY"
10:30-11:00	**Coffee Break**
11:00-12:00	**5th session (oral talks) Chair: Assoc. Prof. Dr. Hale KARAYER**
11:15-11:30	B. AKGENÇ HANEDAR, R. KAVKHANI, M. C. ONBAŞLI, "FIRST-PRINCIPLES STUDY OF PHASE-DEPENDENT STABILITY, VACANCIES, AND SUBSTITUTIONAL DOPING IN 2D SNTE MONOLAYERS"
11:30-11:45	N. TUTKUN, M. ŞİMŞİR, "IMPROVED ENERGY HARVESTING FOR SOLAR PV SYSTEMS UNDER LOW IRRADDIANCE CONDITIONS"
11:45-12:00	İ. TAŞÇIOĞLU, "SPATIAL BARRIER VARIATIONS AND CHARGE TRANSPORT MECHANISMS in Au/(CF:RGO-PVA)/n-Si SCHOTTKY JUNCTIONS"
12:00-13:30	**Lunch**
13:30-15:30	**6th session (oral talks) Chair: Prof. Dr. Şemsettin ALTINDAL**
13:30-14:00	Invited Talk-7: Assoc. Prof. Dr. Mehmet Cengiz ONBAŞLI, "DEMONSTRATION OF ROOM-TEMPERATURE SKYRMIONS ALONG MAGNETIC INSULATOR/TOPOLOGICAL INSULATOR INTERFACES FOR ULTRALOW ENERGY SPINTRONICS"
14:00-14:15	C. N. KARAHAN, "BEYOND THE STANDARD MODEL: A PATH TO EXPLAINING THE MUON $g-2$ DISCREPANCY"

14:15-14:30	Ö. AYTAŞ, B. DİRİ, G. BİRİCİK, "COMPARING SAFETY: RESPONSES OF LARGE LANGUAGE MODELS TO ADVERSARIAL PROMPTS"
14:30-14:45	S. MANSOURI, "PENTACANE BASED ON THIN FILM ORGANIC PHOTOTRANSISTOR"
14:45-15:00	E. YALAZ, "CORRELATING STRUCTURAL, OPTICAL, AND ELECTRICAL PROPERTIES OF Zn-, Mg-, AND IN-DOPED TiO_2 FOR OPTIMIZED CHARGE TRANSPORT"
15:00-15:15	E. N. AYTAŞ, A. Y. KARACA, M. E. DAL, "DESIGN OF AN AUTONOMOUS IMAGING AND ANALYSIS DRONE FOR EMERGENCY RESPONSE"
15:15-15:30	M. E. DAL, E. N. AYTAŞ, A. Y. KARACA, "DESIGN AND IMPLEMENTATION OF AN AUTOMATED EXTERNAL LEAK TEST SYSTEM FOR NATURAL GAS SERVICE REGULATORS"
15:30-15:45	**Coffee Break**
15:45-18:45	**7th session (oral talks) Chair: Dr. Çiğdem Ş. GÜÇLÜ**
15:45-16:00	Ş. YANARDAĞ KARABULUT, H. A. GÜLEÇ, H. ŞANLIDERE ALOĞLU, "AN ALTERNATIVE NATURAL PRESERVATIVE FOR FOOD INDUSTRY: BEE BREAD"
16:00-16:15	B. BEKAR, "INVESTIGATION OF OPTICAL TRANSITIONS IN H-SHAPED QUANTUM WIRE UNDER ELECTRIC AND LASER FIELDS"
16:15-16:30	B. BEKAR, "EFFECT OF PRESSURE AND TEMPERATURE ON OPTICAL PROPERTIES IN A TRIPLE QUANTUM WELL"
16:30-16:45	Y. S. BAŞER, S. EDİŞ, "ASSESSMENT OF ROOFTOP RAINWATER HARVESTING AND STORAGE POTENTIAL IN URBAN RESIDENTIAL AREAS: A CASE STUDY IN ÇANKIRI, TÜRKİYE"
16:45-17:00	F. BAYÇA, "REMOVAL OF CATIONIC METHYLENE BLUE DYE FROM WASTEWATER WITH COLEMANITE"
17:00-17:15	S. IQBAL, M. F. ALAM, M. SHAFIQ, W. A. FAROOQ, "APPLICATIONS OF NANOMATERIALS FOR THE DIAGNOSIS OF CANCER"
17:15-17:30	B. COŞKUN, S. AKTAŞ, M. Ş. KURT, F. ÜNAL, M. M. KOÇ, "OPTICAL PROPERTIES OF ZnAlO THIN FILMS PRODUCED BY ONE STEP ELECTROCHEMICAL DEPOSITION METHOD"
17:30-17:45	M. M. KOÇ, U. PAKSU, B. COŞKUN, "METALLIC NANOPARTICLES IN THERMAL BASED THERAPY APPLICATIONS"
17:45-18:00	H. H. TAŞER, M. KAYRICI, "INVESTIGATION OF PRE-STRESS PARAMETERS IN LAYERED POLYMER MATRIX COMPOSITES"
18:00-18:15	S. BİLEN, Z. HALICI, D. A. KÖSE, M. BOLAT, T. ÖZTAŞ, A. ADIN, E. YAĞANOĞLU, "EFFECTS of POLYPHENOLS and/or BORON ENRICHED DERIVATIVES on GERMINATION of CORN SEEDS UNDER COLD STRESS"
18:15-18:30	B. A. GOZEH, F. YAKUPHANOĞLU "SOLAR LIGHTRESPONSIVE ZnO NANOPARTICLES ADJUSTED USING Cd AND La Co-DOPANT PHOTODETECTOR"
18:30-18.45	R. O. OCAYA, F. YAKUPHANOĞLU, "ORGANIC SEMICONDUCTOR PHOTOSENSORS"

POSTER PROGRAMME 18 SEPTEMBER 2025 (THURSDAY)	
PP102	A. F. ÖZDEMİR, T. TOKCA, İ. AKKURT, Ç. Ş. GÜÇLÜ, "INVESTIGATION OF RADIATION SHIELDING PROPERTIES OF METAL-DOPED PbO THIN FILMS"
PP103	S. C. ÇAPAR, B. HARMANDA, S. EDİŞ, "MONITORING FOREST MICROCLIMATE WITH MICROCONTROLLER-BASED SYSTEMS: A LOW COST AND PORTABLE APPROACH"

SOCIAL PROGRAMME 20 SEPTEMBER 2025 (SATURDAY)	
10:00	Longoz Forests National Park Trekking
12:00	Lunch at İğneada Resort Hotel
14:00	Tour to Dupnisa Cave

INVITED SPEAKERS

ORAL PRESENTATIONS

POSTER PRESENTATIONS

INVITED SPEAKERS

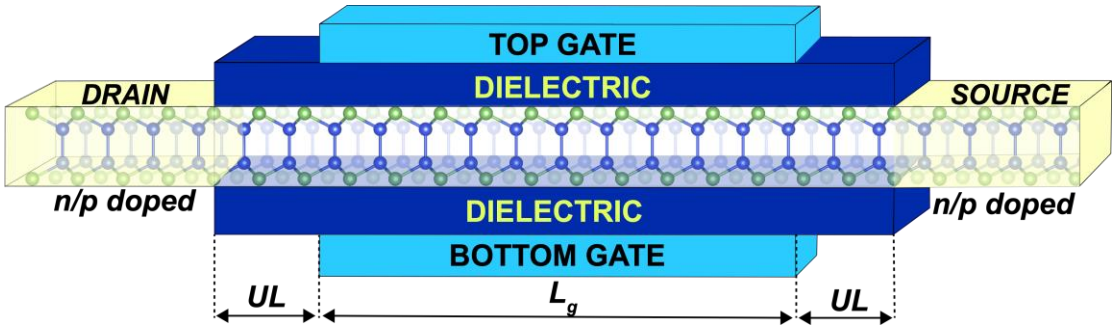
INVESTIGATION OF MINIATURIZED ELECTRONIC DEVICES BASED ON 2D MATERIALS

Engin Durgun

UNAM - National Nanotechnology Research Center and Institute of Materials Science and Nanotechnology, Bilkent University, Ankara, Turkey

E-mail: durgun@unam.bilkent.edu.tr

During the last decade, there has been growing interest in two-dimensional (2D) materials due to their unique chemical, mechanical, electronic, and optical properties. The advent of 2D materials has transformed the field of nanotechnology, opening new avenues for the design of miniaturized electronic devices. In this study, we explore the ab initio investigation of 2D materials, focusing on their unique electronic transport properties and potential applications in next-generation electronic devices. Utilizing density functional theory (DFT) simulations in conjunction with the Nonequilibrium Green's Function (NEGF) method, we investigate the quantum mechanical behavior of electronic transport properties of emerging 2D semiconductors. Emphasis is placed on understanding the underlying mechanisms that govern charge carrier mobility, band structure modulation, and effects of external factors on device performance in the ballistic region. Furthermore, we discuss the challenges and opportunities in engineering device architectures at the nanoscale, including metal-semiconductor-metal (Schottky) systems, p-n junctions, and transistor (MOSFET) designs. This investigation not only highlights the theoretical underpinnings of 2D material-based devices but also provides insights into their practical implications for the future of miniaturized electronics.



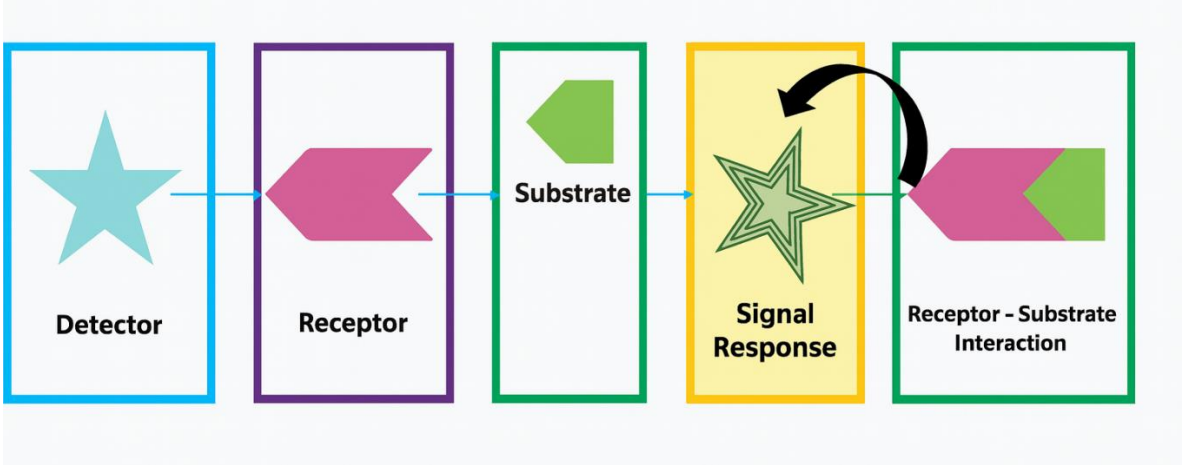
ADVANCES IN FLUORESCENCE SENSORS: FROM NOVEL DESIGN TO EMERGING APPLICATIONS

H. İcil

Department of Chemistry, Faculty of Arts and Sciences, Eastern Mediterranean University, 99628, Famagusta, N. Cyprus, Mersin 10, Turkey

E-mail: huriye.icil@emu.edu.tr

Optical chemosensors have garnered particular attention in environmental science, molecular biology, and medicine due to their high sensitivity and real-time monitoring capabilities. In recent years, advancements in chemistry, nanotechnology, and materials science have enabled the development of a new generation of fluorescence sensors that are brighter, longer-lasting, and more selective. The impact of these sensors is visible across multiple fields. In medicine, they support early disease detection, cellular imaging, and drug tracking. In environmental science, they allow rapid monitoring of pollutants and toxins.



This work highlights recent advances in fluorescence sensors, focusing on innovative designs, improved materials, and their expanding applications in environmental monitoring, medicine, and beyond. We synthesised and characterised selective and sensitive fluorescence chemosensors, which function as fluorescence-on and fluorescence-off sensors. The properties, such as sensitivity, selectivity, and limit of detection (LOD), were discussed in detail to demonstrate the performance of the sensors.

[1] Arwa Abourajab , Pelin Karsili, Rebwar Rashid, Meltem Dinleyici, Nur Pasaogullari, Sinem Altınışık, Sermet Koyuncu, Huriye Icil , *Journal of Photochemistry and Photobiology A: Chemistry*, 454, 115719, (2024).

[2] Ilke Yucekan, Meltem Dinleyici, Selin Temurlu, Rebwar Rashid, Jagadeesh B. Bodapati, Basma Al-Khateeb, Arwa Abourajab, Pelin Karsili, Sinem Altınısık, Sermet Koyuncu, Huriye Icil, *European Polymer Journal 19*6, 112306, (2023)

[3] Haonan Peng, Liping Ding, and Yu Fang, J. Phys. Chem. Lett. 2024, 15, 849−862 (2024)

Yb_2O_3/ACTIVE CARBON/POLY(ANI-CO-MCZ) BASED HYBRID NANOCOMPOSITES AND SUPERCAPACITOR APPLICATIONS

M. Ates[1,2], *R. Oksuz*[1]

[1]*Department of Chemistry, Faculty of Arts and Sciences, Tekirdag Namik Kemal University, Degirmenalti Campus, 59030, Tekirdag, TÜRKİYE*

[2]*Nanochem Polymer Energy Company, Silahtaraga Mah., University 1st street, Number: 13/1 Z242/1, 59860, Tekirdag, TÜRKİYE*

E-mail: mates@nku.edu.tr

Today, polymers are used with a wide variety of sources and most of them are electrical insulators. In recent years, developments in hetero-atom conducting polymers have emerged very rapidly. For example, they have great advantages over insulating polymers due to their high electronic and optical properties, flexibility, easy processing, low-cost, resistance to abrasion, resistance to the environment and ability to be synthesized conveniently. In this study, poly(aniline-co-methyl carbazole) copolymer was synthesized by random polymerization in different component ratios.

The hybrid nanocomposites with poly(ANI-co-MCz) copolymer and activated carbon obtained from cranberry fruit (pulp and fibers) with Yb_2O_3 added rare earth metals at different % composition ratios were synthesized for the first time in the literature. Their characterizations and supercapacitors tests were carried out. The material component with porous structure and high surface area (676.99 m^2/g) from BET analysis of activated carbon is unique and it is not found in the literature in the field of supercapacitors and energy storage. The highest specific capacitances were calculated as C_{sp}=3279.73 F/g at 2 mV/s by CV method and C_{sp}=304.83 F/g at 0.1 A/g for Yb_2O_3/AC/P(ANI-co-MCz) at $[ANI]_o/[MCz]_o$= 1:1. It was also obtained the lowest electrochemical serial resistance of ESR=0.10 Ω at 10 A/g. This electrode is a candidate of next generation supercapacitors.

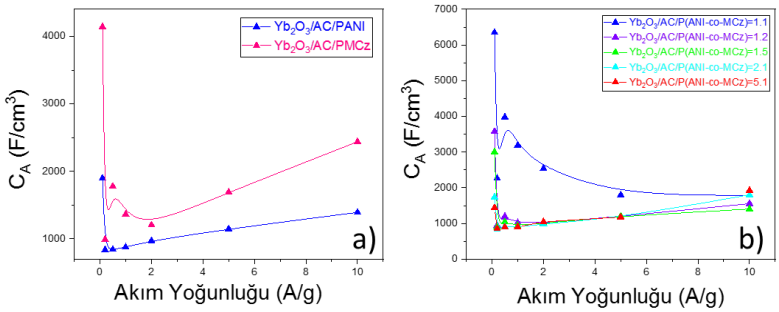


Figure 1. Volumetric capacitance-current density plots obtained from GCD method, a) Yb_2O_3/AC/PANI, Yb_2O_3/AC/PMCz, b) Yb_2O_3/AC/P(ANI-co-MCz), $[ANI]_o/[MCz]_o$= 1:1, 1:2, 1:5, 2:1, 5:1.

Acknowledgements
This work was supported by TUBİTAK Project No. 224M031.

DEMONSTRATION OF ROOM-TEMPERATURE SKYRMIONS ALONG MAGNETIC INSULATOR/TOPOLOGICAL INSULATOR INTERFACES FOR ULTRALOW ENERGY SPINTRONICS

Mehmet Cengiz Onbasli[1,2], *Ferhat Katmis*[3,4], *Valeria Laute*[5], *Rawana Yagan*[1], *Iuri S. Brandt*[6], *Arash M. Cheghabouri*[1], *Hua Zhou*[7], *John W. Freeland*[7], *Clodoaldo I. L. de Araujo*[6], *Michelle E. Jamer*[8], *Don Heiman*[3,9], *Jagadeesh S. Moodera*[3,4]

[1]*Department of Electrical and Electronics Engineering, Koç University, Istanbul, 34450, Türkiye*
[2]*Department of Physics, Koç University, Istanbul, 34450, Türkiye*
[3]*Department of Physics, Massachusetts Institute of Technology, Cambridge, MA-02139, USA*
[4]*Francis Bitter Magnet Laboratory & Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, MA-02139, USA*
[5]*Neutron Scattering Division, Neutron Sciences Directorate, Oak Ridge National Laboratory, Oak Ridge, TN-37831, USA*
[6]*Departamento de Física, Universidade Federal de Viçosa, Viçosa, 36570-900, Brazil*
[7]*Advanced Photon Source, Argonne National Laboratory, Argonne, IL-60439, USA*
[8]*Physics Department, United States Naval Academy, Annapolis, MD 21402, USA*
[9]*Department of Physics, Northeastern University, Boston, MA 02115, USA*

E-mail: monbasli@ku.edu.tr

We report the first room-temperature, zero-field observation of stable skyrmion–hopfion spin textures in EuS–Bi_2Se_3–EuS trilayers. Combining Lorentz TEM imaging and micromagnetic modeling, we unveil how interfacial Dzyaloshinskii–Moriya interaction and geometric confinement stabilize these multidimensional topological states. These findings offer a pathway toward ultralow-power spintronic devices harnessing robust, chiral magnetism in engineered topological heterostructures. We discuss skyrmion logic gate designs and compare them with their microelectronic counterparts for future potential device progress [1].

[1] Advanced Materials, e11754, 2025 (in press), arxiv: 2504.09699, 2025.

MONITORING OF INDOOR RADON IN HISTORICAL BUILDINGS and CULTURAL HERITAGE SITES

Simona Mancini

Department of Information and Electric Engineering and Applied Mathematics, DIEM, University of Salerno

smancini@unisa.it

Indoor radon in buildings is a major cause of lung cancer in Europe, a risk enhanced by the exposure to air pollution and tobacco smoke. Radon monitoring is, so, essential for determining the level of human exposure and the associated health risk. Recent literature has highlighted that historical buildings and archaeological sites could be more affected by high indoor Radon activity concentrations than modern ones because of the diffuse presence of cracks, crevices and cavities which can provide pathways for radon to enter and accumulate in unexpected areas as well as the intensive use of natural stones, like tuff, marbles…, rich in radionuclides.

Assessing radon levels in historical buildings is not as straightforward and standard as ordinary structures since the architectural treasures and huge extensions come with inimitable challenges that must be carefully navigated to ensure accurate testing results and effective radon mitigation strategies.

In the context of the regional program RADCAMPANIA, for the assessment of the radon risk in the Campania region, an innovative procedure based on indicators has been developed and the issue of radon monitoring in historical buildings and cultural heritage sites has been overcome. Results of the monitoring campaign performed in two case studies are presented.

INTERFACE TRAPS, SERIES RESISTANCE, AND INTERLAYER EFFECTS ON THE ELECTRICAL CHARACTERISTICS OF METAL/INTERLAYER/SEMICONDUCTOR STRUCTURES IN WIDE RANGE TEMPERATURE AND VOLTAGE

Şemsettin Altındal

Department of Physics, Faculty of Science, Gazi University, Ankara, TÜRKİYE

E-mail: altundal@gazi.edu.tr

In this present study, Au/(CF:rGO-doped PVA) structures were performed instead of conventional metal-oxide-semiconductor (MOS or MIS) structures to determine the interlayer effects on the performance of structures and electrical characteristics. For this aim, the admittance/impedance ($Y=Z^{-1}$) measurements including capacitance-voltage (C-V) and conductance-voltage (G-V) at 500 kHz were carried out over wide range temperature (90-420K) by 30K steps and applied bias voltage (-4/8V) by 50 mV steps at room temperature. Fundamental electrical parameters like the concentration of donor atoms (N_D), depletion layer width (W_D), barrier height (Φ_B), series resistance (R_s) were calculated from the slope and intercept voltage of reverse bias C^{-2} vs V plot as function of temperature. In addition, the temperature dependent profile of D_{it} was calculated from the Hill-Coleman method. The G-V plot gives a distinguished peak and peak position shift towards to negative bias voltages due to restructure and reordering of the D_{it} under temperature and electric field. The Arhenius plot was also drawn for various applied bias voltage and then the value of activation energy (E_a) was calculated from the slope of these linear plots. The voltage dependent value of R_s was calculated from the Nicollian-Brews method and decreases with increasing temperature.

Keywords: Interface traps, series resistance, and nanocomposite interlayer; Temperature dependent electrical characteristics; Hill-Coleman and Nicollian-Brews methods

ORAL PRESENTATION

5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

HIDDEN HAZARDS: IMPURITIES IN TEXTILE DYES AND AUXILIARIES, THEIR IMPACT ON HUMAN AND ENVIRONMENTAL HEALTH

B. Meltem, Y. Taner

Department of Environmental Engineering, Faculty of Engineering, Bursa Uludağ University, Bursa, TÜRKİYE

E-mail: 512104006@ogr.uludag.edu.tr

The presence of unintentional impurities in textile chemicals and dyes originating from raw materials or synthesis pathways poses significant risks for both human and environmental health, resulting challenges for sustainable product stewardship. This study focuses on commonly overlooked trace-level impurities found in dyes, auxiliaries and finishing agents used in textile production. Analytical methods such as GC-MS and HPLC were employed to identify trace-level contaminants across representative samples from industry sources.

In addition to evaluating potential health effects through toxicological and ecotoxicological approaches, the presentation highlights how these findings align with expectations under frameworks such as ZDHC (Zero Discharge of Hazardous Chemicals), AFIRM RSL (Apparel and Footwear International RSL Management) and other brand or regulatory requirements. By combining scientific evidence with field experience, this study aims to promote proactive risk management, encourage safer formulation strategies and advocate traceability within chemical supply chains to be able to support human health, environmental protection and sustainable chemical use in the textile industry.

Keywords: Textile chemicals, dye impurities, human health, environmental risk, safer chemicals

5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

ON THE RELAXATION PHENOMENA OF Au/(Co:PVA)/n-Si/Al (MPS) STRUCTURES DEPEND ON FREQUENCY AND VOLTAGE BY USING DIELECTRIC IMPEDANCE SPECTROSCOPY

Çiğdem Ş. Güçlü

Department of Physics, Faculty of Science, Gazi University, Ankara, TÜRKİYE

E-mail: cigdemguclu@gazi.edu.tr

This study was focused on a detailed review on Au/(Co:PVA)/n-Si/Al (MPS) structures both in the wide frequency range of 1kHz-1MHz and voltage range of -3.5V/+2V with 50 mV steps at room temperature (RT) to ensure more accuracy/reliable results. For this aim, the complex values of dielectric, (ε^*), electric-modulus (M^*), impedance (Z^*), loss-tangent ($\tan\delta$), electrical-conductivity (σ_{ac}) and phase-angle (θ) have been calculated using measured capacitance/conductance (C, G) data. Experimental results showed us that all these parameters vary considerably with both frequency and applied voltage especially at lower frequency in the depletion and accumulation regimes due to the presence of interface traps (N_{ss}) and their relaxation times (τ) polarization processes, and series resistance (R_s) of the structure. The splitting and peaks observed in the frequency and voltage dependent changes in these parameters were attributed to the restructuring and rearrangement of the interface traps under the electric field and their lifetimes. The obtained high of dielectric value (~11) even at 1 kHz shows that the used (Co:PVA) interlayer can been successfully instead of traditional insulators in the next future. The $\ln(\sigma_{ac})$ vs $\ln(f)$ shows three different linear parts which indicate that there are three different conduction mechanisms at low, moderate, and high frequencies.

Keywords: Au/(Co:PVA)/n-Si/Al structures, Dielectric relaxation, Dielectric impedance spectroscopy, AC conductivity, Interface traps and polarization effects, Nyquist plots.

This study was supported by Gazi University Scientific Research Project (GU-BAP) (Project Number: FDK-2024-9638), and Scientific and Technological Research Council of TURKIYE (TUBITAK) (Project Number 124C419).

5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

IMPROVED ENERGY HARVESTING FOR SOLAR PV SYSTEMS UNDER LOW IRRADDIANCE CONDITIONS

N. Tutkun[1], *M. Şimşir*[2]

[1]*Department of Electrical & Electronics Engineering, Faculty of Engineering, İstanbul Ticaret University, Istanbul, TÜRKİYE*
[2]*Department of Electrical & Electronics Engineering, Faculty of Engineering, Karabük, TÜRKİYE*

E-mail: ntutkun@ticaret.edu.tr, msimsir@karabuk.edu.tr

A solar PV (photovoltaic) system, widely used in homes, businesses, and utility-scale power plants, converts sunlight directly into electricity using solar panels. A simple solar PV system as shown in Fig.1 is composed of solar panels, charge controller, battery bank, inverter, loads, mounting structure, metering and monitoring devices and is mainly divided into 3 types such as grid-tied, off-grid and hybrid. It provides many advantages such as renewable and clean energy source, reduces electricity bills, low maintenance, scalable and modular and long lifespan etc. However, it accommodates few disadvantages like high initial cost, weather and irradiance dependent, cost of energy storage (batteries). There are few challenges in low power PV systems due to cloudy or rainy weather, early morning or late evening, shading (trees, buildings, dirt), variable ambient conditions, efficiency constraints etc. Maximum power point tracking (MPPT) is one of ways to adjust the operating voltage or current hence the system always works at or very close to the MPP, regardless of changes in irradiance, temperature, load conditions. The MPPT controller dynamically adjusts the duty cycle of a DC-DC converter and monitors voltage and current from the panel, calculates power, and shifts operating point to where change in power with respect to voltage is zero. The MPPT system tracks and maintains operation at maximum power point, adapts to changes in irradiance and temperature, increases PV system efficiency (up to 40%), is essential for low-power and poor irradiation scenarios and reduces energy waste and improves return on investment. The criteria for good MPPT performance require high tracking efficiency, fast dynamic response, low steady-state oscillations and ease of implementation.

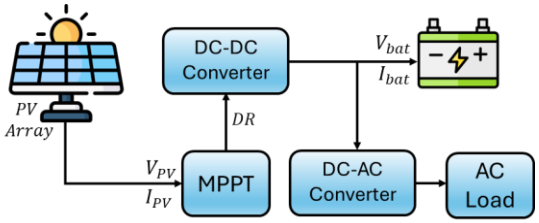


Fig.1 A typical solar PV system.

The proposed MPPT method builds a model to fit a smooth curve through a set of data obtained from Matlab/Simulink library using the cubic spline interpolation (CSI) with piecewise polynomials by estimating open-circuit voltage with minimum error in order to find optimal MPP voltage faster even in low solar irradiance values. The two MATLAB Simulink models were constructed to find the fitness for each population member through genetic algorithm process. The proposed hybrid CSI method for finding the MPP at varying irradiance in low power PV systems mostly gives better results compared to those obtained from using the traditional methods like Perturb and Observe, Incremental Conductance under ROPP test conditions. The detailed analysis, results and discussions are to be amplified in the full paper.

SPATIAL BARRIER VARIATIONS AND CHARGE TRANSPORT MECHANISMS in Au/(CF:RGO-PVA)/n-Si SCHOTTKY JUNCTIONS

İ. Taşçıoğlu

Department of Electrical and Electronics Engineering, Faculty of Engineering and Natural Sciences, İstanbul Topkapi University, İstanbul, TURKEY

E-mail: ilketascioglu@topkapi.edu.tr

Current-conduction mechanisms and barrier-height (BH) formation in Au/(CF:RGO-PVA)/n-Si diodes were probed between 70 K and 400 K. A conventional Richardson plot splits into two straight lines—low-temperature range (70-190 K) and high-temperature (220-400 K) branches—yet yields a Richardson constant (A*) far below its theoretical value (120 A cm^{-2} K^{-2}), pointing to interface-barrier inhomogeneity. Φ_{Bo}–n and Φ_{Bo} versus q/2kT plots likewise display two linear segments, consistent with a double Gaussian distribution (GD) of BHs. The analysis of Φ_{Bo} vs q/2kT plots has revealed the mean BHs ($\bar{\Phi}_{B0}$) and standard deviations (σ_{so}) as 0.77 eV / 0.089 V for the low temperature (70-190 K) and 1.13 eV / 0.143 V for high-temperature (220-400 K), respectively. Using the modified Richardson plots, we obtained refined mean barrier heights of 0.76 eV and 1.13 eV, with corresponding Richardson constants (A*) of 75 and 109 A.cm^{-2} K^{-2}, for 70-190 K and 220-400 K, respectively. The A* value of 109 A cm^{-2} K^{-2} is virtually identical to the theoretical 120 A cm^{-2} K^{-2} for n-type Si. These findings demonstrate that the forward-bias I–V–T behavior is accurately captured by modelling the barrier heights with a double Gaussian distribution.

Keywords: Au/(CF:RGO-PVA)/n-Si Schottky diodes, Current-transport mechanisms; Barrier height inhomogeneity; Double Gaussian distribution.

5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

COMPARING SAFETY: RESPONSES OF LARGE LANGUAGE MODELS TO ADVERSARIAL PROMPTS

Ö. Aytaş[1], *B. Diri*[1], *G. Biricik*[1]

[1]*Department of Computer Engineering, Faculty of Electrical and Electronics, Yıldız Technical University, Istanbul, TURKEY*

E-mail: oneraytas@gmail.com

This study presents a systematic benchmark analysis of open-source and closed-source large language models (LLMs) in handling adversarial and misleading prompts generated in Turkish. The evaluation covered diverse prompt categories, including hate speech, illegal activities, and encouragement of self-harm. A total of 190 adversarial prompts—augmented with jailbreak techniques—were tested across more than 20 widely adopted LLMs. Open-source models were evaluated within the study's resource constraints using models in the 7B–8B parameter range.

The findings indicate that closed-source models (e.g., GPT-4o, Gemini, Claude, Grok) demonstrated more consistent safety filtering and higher-level content restriction mechanisms. These models effectively prevented the generation of potentially harmful outputs in most cases; however, this sometimes resulted in the unintended blocking of legitimate or benign information requests. By contrast, open-source models (e.g., LLaMA, Mistral, Qwen, Phi, Falcon) exhibited greater flexibility in their responses, but this adaptability occasionally led to the production of ethically inappropriate or factually inaccurate content.

Turkish-specific open-source models (e.g., YTU_Cosmos, Trendyol-LLM) more accurately captured the contextual and semantic nuances of the language, yet their safety filtering mechanisms were weaker compared to their closed-source counterparts. This underscores the critical importance of advancing safe AI systems for the Turkish language. Given Turkish's underrepresentation in global LLM development and its typically limited training data, the development of locally trained, safety-enhanced models is essential for ensuring both user protection and cultural integrity.

As one of the first systematic comparative analyses of LLM safety in Turkish, this study's benchmark results highlight the strengths and limitations of models developed or deployed in Turkey. The findings provide actionable insights for developers, policymakers, and researchers, offering a strategic foundation for advancing Turkish language models in terms of both safety and ethical compliance.

ORAL PRESENTATION

AN ALTERNATIVE NATURAL PRESERVATIVE FOR FOOD INDUSTRY: BEE BREAD

Ş. Yanardağ Karabulut[1], *H.A. Güleç*[2], *H. Şanlıdere Aloğlu*[1]

[1]*Department of Food Engineering, Faculty of Engineering, Kırklareli University, Kırklareli, TÜRKİYE*
[2]*Department of Food Engineering, Faculty of Engineering, Trakya University, Edirne, TÜRKİYE*

E-mail: seydakarabulut@klu.edu.tr

The increasing global population and enduring malnutrition alongside the accelerated depletion of natural resources, represent major challenges to global food security. Therefore, food products with extended shelf lives are crucial for food availability. Increasing consumer awareness has led the food industry to seek natural alternatives to synthetic food additives used to extend shelf life.

Beekeeping products offer a rich variety, including honey, bee bread, pollen, royal jelly, and propolis. Bee bread is a beekeeping product produced by honeybees, who add their saliva to the pollen they collect, provide an anaerobic environment with a small amount of honey, and then ferment and mature it in the hive. With its nutritious, antioxidant, and antimicrobial properties, as well as its natural microbial flora, bee bread plays a crucial role in the development of young bees. From past to present, many beekeeping products have found widespread use both as food sources and for apitherapy purposes. However, despite its high nutritional and bioactive compound content, bee bread has been limited in direct consumption due to its low sensory appeal. Hence, harnessing the nutritionally rich composition of bee bread as a functional food ingredient holds considerable importance.

This study provides a summary of research on the importance of bee bread, focusing on its antioxidant and antimicrobial properties, the extraction of its bioactive components, and its potential applications as a food ingredient. Additionally, studies on the use of natural materials in dairy products are summarized, emphasizing the oxidation problem in dairy products. This study aims to raise awareness for bee bread, provide perspectives for new studies, and underline its usability as a product input in many foods, including dairy products.

BEYOND THE STANDARD MODEL: A PATH TO EXPLAINING THE MUON $g-2$ DISCREPANCY

C. N. Karahan

Department of Basic Sciences, Turkish Naval Academy, National Defence University, İstanbul, TÜRKİYE

E-mail: ckarahan@itu.edu.tr

Recent measurements by the Fermilab Muon g-2 experiment report a deviation of about 5.1σ from the Standard Model (SM) prediction of the anomalous magnetic moment of the muon. This discrepancy is regarded as one of the strongest pieces of evidence for the existence of new physics beyond the SM. In this work, we address this discrepancy within the framework of a Type-I Two-Higgs-Doublet Model (2HDM) extended by a Majorana spin-3/2 field (vector–spinor field), stabilized by a discrete Z_2 symmetry. Our aim is to investigate whether such an extension can account for the observed muon g-2 anomaly through its one-loop contributions.

The Type-I 2HDM contains additional charged and neutral scalar states, yet their interactions fail to account for the observed muon g-2 anomaly. We extend this framework by introducing a Majorana spin-3/2 field, which, due to its nature, cannot be on-shell when interacting at the renormalizable level but can participate as a virtual particle in loop processes. The resulting new interactions yield regions in the parameter space — defined by the spin-3/2 mass spin-3/2 mass (Mψ), Yukawa coupling (yψ), charged Higgs mass (MH±), and tanβ — that successfully reconcile the theoretical prediction with the experimental measurement of the muon anomalous magnetic moment within certain regions. These results demonstrate the potential of spin-3/2 extensions to provide a consistent and well-motivated explanation for the muon g-2 anomaly within a renormalizable framework.

Keywords: Muon g-2 anomaly, Type-I Two-Higgs-Doublet Model, Spin-3/2 field

Acknowledgement: This study was performed with the funding support of the Scientific and Technological Research Council of TÜRKİYE (TUBITAK) with the 123F306 project number.

IoT BASED MONITORING OF FOREST ECOSYSTEMS: CURRENT GAPS AND FUTURE PERSPECTIVES FOR TÜRKİYE

M. S. Özçelik

Department of Forest Engineering, Faculty of Forestry, Isparta University of Applied Sciences, Isparta, TÜRKİYE

E-mail: mehmetozcelik@isparta.edu.tr

The impacts of climate change on forest ecosystems have become increasingly severe, intensifying both biotic and abiotic stresses—most notably through more frequent droughts, increased pest outbreaks, and a dramatic rise in forest fires. Against this background, near real-time forest monitoring is essential for developing early warning mechanisms, supporting decision-making systems, building a national archive of forest-climate interactions, and assessing ecosystem health under changing climatic conditions. Key indicators—such as forest water balance, tree drought stress, and stem water status—require high-resolution, continuous measurements, for which Internet of Things (IoT)-based sensor networks offer promising solutions. These networks enable real-time data collection, wireless transmission, and centralized storage, making them highly suitable for distributed forest landscapes.

This study reviews current and potential IoT-based applications for monitoring forest ecosystems, focusing on electronic dendrometers, sap flow sensors, soil moisture and soil water potential probes, and micrometeorological stations. To better understand forest functioning, species responses to environmental drivers, and roles in carbon and water cycling, there is a growing need for long-term, high-resolution, and centrally managed IoT-enabled systems—similar to those established in meteorology and hydrology. Examples of well-established and efficient IoT platforms demonstrate how distributed sensor networks and centralized infrastructures can visualize species-specific growth and water status, drought stress indicators, and fire-related microclimatic conditions in real time, providing valuable decision-support tools for forest health and fire risk monitoring.

In Türkiye, however, integrated and high-frequency IoT-based forest monitoring systems are still lacking. Current efforts remain fragmented, human-based, or low-frequency, often without integration among forest, soil, and climate parameters. Despite strategic policy documents acknowledging the need for climate adaptation, implementation of real-time IoT-enabled monitoring infrastructure remains minimal. This gap is particularly critical in the semi-arid Mediterranean forests of southwestern Türkiye, where drought risk and fire susceptibility are escalating.

Implementing IoT-based integrated monitoring systems would significantly enhance scientific understanding of forest–climate interactions and provide robust decision-support for evidence-based forest management and climate adaptation in Türkiye, particularly in data-scarce Mediterranean regions.

EXTENDING THE SERVICE LIFE OF RUBBER MOLDS USED IN COMPOSITE STONE PRODUCTION PROCESS

O. Üsküp Korcan[1], H. Ömür[2], N. Topçu[3], A. Tuncer Başoğlu[4]

[1]Affiliation: Lotte Chemical Turkey Yüzey Tasarımları, Research and Development Department, Manisa, TÜRKİYE.
[2]Affiliation: Lotte Chemical Turkey Yüzey Tasarımları, Research and Development Department, Manisa, TÜRKİYE.
[3]Affiliation: Lotte Chemical Turkey Yüzey Tasarımları, Research and Development Department, Manisa, TÜRKİYE.
[4]Affiliation: Lotte Chemical Turkey Yüzey Tasarımları, Research and Development Department, Manisa, TÜRKİYE.

E-mail: oya.uskup@belenco.com

The quartz-based composite stone production process involves mixing 90% quartz with 10% polyester resin, pouring the mixture into rubber molds of specific dimensions, pressing it under vacuum with vibration, and curing the compressed mixture through an exothermic reaction at 100°C. During these steps, the rubber molds used in the casting line give the composite stone its shape, thickness, and size.

This project aims to reduce mold costs and increase production efficiency by extending the lifespan of the rubber molds used in composite stone production by 20%. It also aims to make improvements to increase the durability of the molds to ensure a sustainable production process. When examining the cost of consumables used in production, rubber mold costs were the primary concern. Therefore, reducing the cost of rubber molds, which account for the highest percentage of consumable costs, was chosen as the primary objective. It was also anticipated that the annual disposal rate for rubber-based molds would decrease with each passing year. This study employed both physical and chemical treatments to extend the lifespan of rubber molds used in production. This extended lifespan of the rubber molds resulted in both cost savings and minimal environmental impact, resulting in extensive research.

DESIGN AND IMPLEMENTATION OF AN AUTOMATED EXTERNAL LEAK TEST SYSTEM FOR NATURAL GAS SERVICE REGULATORS

M. E. Dal[1], *E. N. Aytaş*[2], *A. Y. Karaca*[3]

[1]*Product Development Dept., İGDAŞ, İstanbul, TÜRKİYE*
[2]*Product Development Dept., İGDAŞ, İstanbul, TÜRKİYE*
[3]*R&D and Innovation Dept., İGDAŞ, İstanbul, TÜRKİYE*

E-mail: meryem.dal@igdas.istanbul

Detection of External Leaks in Service Regulators Used in Natural Gas Distribution Infrastructure Is Critically Important in Terms of Safety, Maintenance Efficiency, and Service Continuity. In current field and workshop practices, methods based on the visual inspection of air bubbles formed after regulators are pressurized and submerged in water are commonly used. This manual approach has several limitations, including high labor requirements, risk of human error, low repeatability, and inadequate hygiene and occupational safety standards.

In this study, an innovative solution integrating mechanical, electronic, and software components for external leak detection is presented. The system includes a modular mounting platform adaptable to regulators of different sizes, a pneumatically actuated immersion arm that enables the controlled and safe submersion of pressurized regulators, and a high-resolution multi-camera system positioned on all four sides of the water tank. Simultaneous images captured from the cameras are collected via a USB hub–based hardware infrastructure and analyzed in real time using advanced image processing and machine learning algorithms to accurately identify leak locations.

The mechanical design has been optimized for ergonomics to minimize physical strain on the operator. To improve hygiene conditions in the working environment, the system includes an enclosed chamber and drainage mechanisms to reduce water splashing and wet floor risks. In addition, the control panel and data monitoring interface have been designed to ensure user-friendly and safe operation.

Preliminary test results indicate that the proposed system improves detection accuracy and repeatability compared to existing methods, shortens process duration, and reduces operator dependency and occupational accident risk. With these features, the proposed system holds significant potential for automation, reliability, and enhanced occupational safety standards in maintenance processes within the natural gas distribution sector.

Keywords: External leak detection, image processing, machine learning, pneumatic immersion system, ergonomics, hygiene

5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

DESIGN OF AN AUTONOMOUS IMAGING AND ANALYSIS DRONE FOR EMERGENCY RESPONSE

E. N. Aytaş [1], *A.Y. Karaca*[2], *M. E. Dal*[3]

[1]*Product Development Dept., İGDAŞ, İstanbul, TÜRKİYE*
[2]*R&D and Innovation Dept., İGDAŞ, İstanbul, TÜRKİYE*
[3]*Product Development Dept., İGDAŞ, İstanbul, TÜRKİYE*

E-mail: enuman.aytas@igdas.istanbul

Early detection of gas leaks, equipment failures, and disaster-induced damages in natural gas distribution infrastructure is critically important for ensuring life and property safety as well as operational continuity. This study proposes a multifunctional unmanned aerial vehicle (UAV)-based observation and analysis system developed for use in both routine operations and disaster scenarios.

The system will be equipped with gas detection sensors, a thermal imaging unit, an optical camera, and an audio warning module. It aims to minimize human intervention during field inspections, thereby reducing associated risks. The system architecture will be optimized to withstand harsh environmental conditions through a modular hardware design.

The project is not limited to emergency and disaster management. It also aims to perform energy efficiency analysis during standard operations by detecting heat loss in buildings using thermal cameras. This functionality will help identify energy-saving opportunities, support user awareness efforts, and contribute to sustainability goals.

This approach is expected to make significant contributions to accelerating emergency response processes in natural gas infrastructure, improving field safety, enhancing operational efficiency, and raising awareness of energy efficiency. Upon completion, the system will be integrated into field operations and provide real-time data to decision-support mechanisms in critical situations.

Keywords: Emergency response, unmanned aerial vehicle, image processing, field safety, artificial intelligence

THE RADIOLOGICAL EFFECT OF ^{226}RA, ^{232}TH AND ^{40}K IN SOME DAIRY PRODUCTS

S. Aközcan Pehlivanoğlu[1], *S. Özden*[1], *Z. A. Kurt*[1]

[1]*Department of Physics, Faculty of Arts and Sciences, Kırklareli University, Kırklareli, TÜRKİYE*

E-mail: serpil.akozcan@klu.edu.tr

Measurements of natural and artificial radioactivity in the environment and food products are extremely important for controlling the levels of radiation to which people are directly or indirectly exposed. Humans can be exposed to radiation through various means, such as inhalation, ingestion, and external exposure. When radionuclides in food are consumed by humans through the food chain, they enter the human body through digestion, and radiation transfer may occur. Therefore, determining the level of radioactivity in food products and calculating doses is important for human health.

Milk and dairy products are one of the basic food products in human nutrition because they contain proteins, carbohydrates, fats, vitamins (groups A, B and D), calcium, phosphorus, magnesium, zinc and trace elements such as selenium. In this study, the activities of ^{226}Ra, ^{232}Th, and ^{40}K in some dairy products collected from the Thrace region were measured using gamma ray spectrometry. The annual effective dose due to dairy products were estimated.

ANALYTICAL APPROACH to the DIRAC EQUATION in CORNELL-TYPE POTENTIALS

H. Karayer[1], *A. Küçüker Kamberli*[2], *Ö. Yeşiltaş*[2], *D. Demirhan*[3]

[1]*Department of Physics, Faculty of Arts and Sciences, Kırklareli University, Kırklareli, TÜRKİYE*
[2]*Department of Physics, Gazi University, Ankara, TÜRKİYE*
[3]*Department of Physics, Ege University, İzmir, TÜRKİYE*

E-mail: hale.karayer@klu.edu.tr

We investigate the relativistic bound state solutions of the Dirac equation in the framework of a modified double ring-shaped generalized Cornell potential. The analysis is carried out within the extended Nikiforov–Uvarov (NU) method, which provides an efficient algebraic procedure for solving second-order differential equations without resorting to ansatz-based or perturbative techniques. By separating the Dirac equation into radial, polar, and azimuthal parts, exact analytical solutions are obtained for each component. The angular eigenfunctions are expressed in terms of Heun polynomials, whereas the radial solutions are represented by biconfluent Heun polynomials. Explicit energy eigenvalue relations are derived for various quantum states, and numerical evaluations confirm the accuracy of the method. The results highlight the capability of the extended NU formalism in treating noncentral and generalized Cornell-type interactions, which are relevant in modeling mesonic systems and ring-shaped molecular structures.

OPTICAL PROPERTIES OF ZnAlO THIN FILMS PRODUCED BY ONE STEP ELECTROCHEMICAL DEPOSITION METHOD

S. Aktaş[1], M.Ş. Kurt[2], F. Ünal[3], M. M. Koç[4], B. Coşkun[4]

[1]Department of Mechanical Engineering, Faculty of Engineering, Giresun University, Giresun, TÜRKİYE
[2]Department of Fundamental Science, Science Faculty, Erzurum Technical University, Erzurum, TÜRKİYE [3]Central Research Laboratories GRUMLAB, Giresun University, Giresun, TÜRKİYE
[4]Department of Physics, Faculty of Science and Literature, Kirklareli University, Kirklareli, TÜRKİYE

E-mail: burhan.coskun@klu.edu.tr

Different electronic components like photovoltaics, displays, transistors, etc are consisting of metal oxide thin films. Metal oxide thin films exhibit outstanding optic, optoelectronic, electrical and electronic properties and therefore, are vastly researched by researchers from different fields. Metal oxide thin films have high thermal stability with low electrical resistance while they can be consisting of a single material or multiple materials. The electrochemical deposition method is cost efficient with good thickness control while it does not require expensive equipment such as high vacuum systems, etc. Hence, it is commonly preferred to produce metal oxide films. In this work, we use one step electrodeposition method to produce ZnAlO thin films on ITO. We investigate the optical properties of thin films using a UV-Vis spectrophotometer between 200 nm – 800 nm wavelength. In the absorption spectra of the ZnAlO thin films, an apparent peak at 588nm was seen while the maximum absorption coefficient was found at 372 nm as 9.79×10^5 m^{-1}. Bandgap energy was calculated as 3.57 eV which was found to be coherent with the reports presented in the literature. Transmittance values of ZnAlO films were found to be 80% in the visible region while it can drop up to 37% in the max absorption region. The refractive index of the ZnAlO thin films increased with decreasing wavelength while the extinction coefficient diminished with decreasing wavelength. The maximum n value was found to be 1.26 while the minimum k value was 0.007. Moreover, optical (Єi), dielectric loss(Єi/Єr), optical conductivity (σ) values were found as 1.61, 0.09, 0.06 and 2.92×10^{14}, respectively.

5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

FIRST-PRINCIPLES STUDY OF PHASE-DEPENDENT STABILITY, VACANCIES, AND SUBSTITUTIONAL DOPING IN 2D SNTE MONOLAYERS

B. Akgenç Hanedar[1], Roya Kavkhani[2], M. C. Onbaşli[3,4]

[1]*Department of Physics, Faculty of Arts and Sciences, Kırklareli University, Kırklareli, Turkey*

[2]*Department of Materials Science and Nano Engineering, Faculty of Engineering and Natural Sciences, Sabancı University, Tuzla, 34956 Istanbul, Turkey*

[3]*Department of Physics, Koc University, Rumelifeneri Yolu, Sariyer 34450 Istanbul, Turkey*

[4]*Department of Electrical & Electronics Engineering, Koç University, Rumelifeneri Yolu, Sariyer 34450 Istanbul, Türkiye*

E-mail: berna.akgenc@klu.edu.tr; bakgenc@ku.edu.tr ; monbasli@ku.edu.tr

Two-dimensional (2D) SnTe represents a versatile material system in which phase selection and defect engineering can be exploited to tailor electronic, spintronic, and optoelectronic functionalities. In this study, we carried out an extensive first-principles analysis of monolayer SnTe in different crystallographic phases (γ, β', and hexagonal) to assess their relative stability, phonon spectra, and electronic band dispersions. Among them, the γ -phase emerges as the most stable configuration, whereas the hexagonal phase with a compressed c-axis lattice constant of 1.74 Å exhibits quantum-confinement characteristics favorable for optoelectronic applications. Hybrid functional (HSE) calculations yield phase-dependent band gaps of 0.82 eV (direct) for V, 1.01 eV (indirect) for β', and 1.84 eV (indirect) for the hexagonal phase. We further examined the role of intrinsic defects and substitutional dopants on the γ -phase. Vacancies in Sn and Te sites generate midgap states, altering dispersion near the Fermi level and producing localized electronic states. Controlled substitution at 2.7% doping concentration with Bi, Sb, Mn, Cr, and Co allows systematic modulation of carrier type (p- to n-type), spin polarization, and magnetic behavior. For instance, Bi doping at Sn sites gives rise to flat midgap bands, whereas Bi doping at Te sites drives the system toward metallic conduction. The magnetic response of Cr dopants is site-dependent, with moments of 3.62 μB at Sn sites and 5.02 μB at Te sites, reflecting the influence of local bonding environments. Overall, these dopants not only affect charge localization and band-edge alignment but also open pathways toward emergent phenomena, such as flat-band induced correlated states. Furthermore, ab initio molecular dynamics (AIMD) simulations confirm the thermal robustness of these doped systems at room temperature, supporting their feasibility for practical applications. These insights highlight 2D SnTe as a promising candidate for next-generation thermoelectrics, optoelectronics, and spintronic quantum devices.

ORAL PRESENTATION

CORRELATING STRUCTURAL, OPTICAL, AND ELECTRICAL PROPERTIES OF Zn-, Mg-, AND IN-DOPED TiO_2 FOR OPTIMIZED CHARGE TRANSPORT

E. Yalaz

MFAG-ARDEB, TÜBİTAK

E-mail: emine.yalaz@tubitak.gov.tr

Titanium dioxide (TiO_2) is a very well-known semiconductor for applications in photocatalysis, photovoltaics, and transparent conducting oxides. In electronic devices, the controlled tuning of oxygen vacancies and the ability to maintain stable electrical resistance in TiO_2 are crucial factors [1]. In this work, we present a systematic study on the effects of Zn, Mg, In, and co-doping on the structural, optical, and electrical properties of TiO_2 thin films.

X-ray diffraction (XRD) analysis confirmed that all doped samples retained the anatase phase, with minor peak broadening and lattice strain indicating substitutional incorporation of dopants. Optical absorption spectra, analyzed via Tauc plots, revealed that doping led to slight bandgap modifications whereas Hall effect measurements showed a pronounced dependence of charge transport on dopant type.

This combined structural, optical, and electrical analysis demonstrates that Mg and In doping balance donor suppression with enhanced mobility, making them the most promising strategies for tailoring TiO_2 for next-generation optoelectronic and energy devices.

References

[1] Klasen, A., Baumli, P., Shen, Q., Johannes, E., Bretschneider, S.A., Hermes, I.M., Bergmann, V.W., Gort, C., Axt, A., Weber, S.A.L., Kim, H., Butt, H.J., Tremel, W., Berger, R. (2019). "Removal of Surface Oxygen Vacancies Increases Conductance Through TiO_2 Thin Films for Perovskite Solar Cells", *J. Phys. Chem. C* 2019, 123, 22, 13458–13466, https://doi.org/10.1021/acs.jpcc.9b02371

METALLIC NANOPARTICLES IN THERMAL BASED THERAPY APPLICATIONS

M. M. Koç,[1,2,3], U. Paksu[1], B. Coskun[1]

[1]Department of Physics, Faculty of Arts and Sciences, Kırklareli University, Kırklareli, TÜRKİYE
[2]Department of Medical Service and Techniques, School of Medical Service, Kırklareli University, Kırklareli, TÜRKİYE
[3] Advanced Technologies Application and Research Center (ITUAM), Kırklareli University, Kırklareli TÜRKİYE

E-mail: muminmehmetkoc@klu.edu.tr

Nanoparticles are group of atoms comes together and form unique structures exhibiting outstanding performence in various aspects. They can be implied in various applications. Various types of nanoparticles were addressed in the literature. Metallica nanoparticles are emerged as a highly adaptable platform which can be used for medical purposese owing to their distinctive optical, electrical, and physicochemical characteristics. Certain types of metallic nanoparticles are esteemed for their ability to transform light into heat, rendering them very efficient agents in photothermal therapy (PTT) for cancer treatment while others can transform magnetic field into heat which is referred as magnetic hyperthermia. The localized thermal effect produced by metallic nanoparticles under certain conditions facilitates the precise killing of tumor tissues while reducing collateral damage. Moreover, intrinsic characteristics of metallic nanoparticles provide a certain capabilities for diagnostics, imaging, targetting and drug delivery applications. Recent innovations, including surface modification, PEGylation, polydopamine coating, and core-shell engineering, have significantly enhanced biocompatibility, pharmacokinetics, tumor-targeting with high tissue/cell selectivity characteristics. Furthermore, these alterations enable the conjugation of biomolecules, improving active targeting methodologies and diminishing systemic toxicity. Therefore, they can exhibit dual/multimodal characteristics where therapy and diagnostic behaviour can be observed simultaneously. In this work, potential of the metallic nanostructures for medical applications were illustrated.

REMOVAL OF CATIONIC METHYLENE BLUE DYE FROM WASTEWATER WITH COLEMANITE

F. Bayça

Alanya Alaaddin Keykubat University, Rafet Kayis Engineering Faculty, Department of Engineering Basic Science, 07450 Alanya, Antalya, Türkiye.

E-mail: feray.bayca@alanya.edu.tr

Methylene blue dye is most commonly used in the textile industry. Therefore, textile wastewater containing methylene blue is discharged into the environment. Methylene blue dye, which is harmful to the environment and human health, must be removed from wastewater before being discharged from the facility.

This study investigated the removal of methylene blue (MB), a cationic dye, from aqueous solutions using colemanite as an adsorbent. The adsorption capacity, removal efficiency, adsorption isotherms, kinetic models, and thermodynamics of methylene blue on colemanite were investigated.

The results showed that the adsorption of MB on colemanite was highly dependent on the initial MB concentration. The adsorption capacity was observed to increase significantly as the initial dye concentration increased. MB adsorption best fits the Dubinin-Radushkevich adsorption isotherm model. The Dubinin-Radushkevich (DR) model was found to be the most suitable adsorption isotherm, and the maximum adsorption capacity and removal efficiency were calculated as 425.09 mg/g and 99.62% at 20°C. Among the kinetic moduli, the adsorption of MB on colemanite is consistent with the pseudo-second-order model due to the high correlation coefficient of the pseudo-second-order model. Colemanite may be a preferred adsorbent for MB because it is low-cost, effective, and environmentally friendly.

INVESTIGATION OF PRE-STRESS PARAMETERS IN LAYERED POLYMER MATRIX COMPOSITES

H. H. Taşer[1], *M. Kayrıcı*[2]

[1]*Department of Mechanical Engineering, Faculty of Engineering, Necmettin Erbakan University, Konya, TÜRKİYE*
[2]*Department of Mechanical Engineering, Faculty of Seydisehir Ahmet Cengiz Engineering, Necmettin Erbakan University, Konya, TÜRKİYE*

E-mail: hhtaser1@gmail.com

Composite materials are advanced engineering materials preferred in many fields today, from automotive to aerospace, thanks to their lightness and high strength properties. Therefore, the performance of composite materials is very important. One method for improving the performance of composite materials is pre-stressing applications. In layered structures, pre-stressing contributes to improving mechanical properties by aligning the fibers. Plain and twill weave types constitute two basic reinforcement configurations that directly affect the orientation of the fibers and the mechanical behavior of the material. In this study, the effects of different pre-stressing levels on polymer matrix composites were investigated.

Experimental investigations revealed that the pre-stress level plays a decisive role in the shape-forming behavior and mechanical performance of composites. Low pre-stress increases the stiffness and hardness of the material, while high levels can lead to brittle behavior tendencies in the material. Furthermore, the effect of the weave type on fiber orientation, in conjunction with pre-stressing, shapes the deformation capability of the materials.

The results obtained indicate that pre-stressing methods can be considered a performance-enhancing parameter in composites. This approach offers new perspectives in the production of lightweight and high-strength structures, such as in automotive, aerospace, and pressure vessel design.

COMPARISON OF POLYESTER RESIN AND SILICONE RESIN IN COMPOSITE STONE PRODUCTION

N. Topçu[1], F. Konkur, A.T. Başoğlu, O. Üsküp

[1]Lotte Chemical Turkey Yüzey Tasarımları San. ve Tic. A.Ş. R&D Center, Manisa, TÜRKİYE

E-mail: nurcan.topcu@belenco.com

Composite stones produced using unsaturated polyester resins have very low resistance to UV light. When exposed to UV light, light-colored products experience yellowing, dark-colored products experience fading, and surface abrasion. The purpose of this study is to compare products produced using polyester and silicone resins to address the problems of yellowing in light-colored stones and fading in dark-colored stones, and to develop products with a minimum heat resistance of 250°C.

The study was conducted at Lotte Chemical R&D Center between October 2021 and July 2023. In the first phase of the study, researchers conducted patent and literature searches to identify silicone resin-based binders, silanes, accelerators, and freezers that would not alter the production process. Silicone resin containing methacrylate was used in the study.

Mechanical and physical properties, heat resistance, stain resistance, acid-base resistance, acetone resistance, thermal shock resistance and UV resistance of the products produced using silicone and polyester resin were evaluated and compared.At the UV resistance test, samples were exposed to UV-B light up to 1680 hours. At the light colored of polyester-based samples turned yellow in 500 hours, the silicone-based sample had very minor changes. At the dark colored of polyester-based sample's surface deteriorated in 500 hours. On the silicon-based sample, slight deterioration began to appear on the surface after 1000 hours of exposure.At the Heat Resistance test, Metal casting materials at a temperature of 100, 150, 200, 250, 300 and 350 ^{0}C were placed on the sample surface. It was removed from the surface when completely cooled. The surface of the polyester resin stone turns yellow at 200 °C.The surface of the silicone resin stone started to deteriorate at 300 °C.

In conclusion, this study found that silicone resin has better UV resistance, stain resistance, chemical resistance, heat resistance, acetone resistance, and thermal shock resistance than polyester resin. In terms of mechanical strength, silicone resin products were found to have lower mechanical strength than polyester resin products.

INVESTIGATION OF OPTICAL TRANSITIONS IN H-SHAPED QUANTUM WIRE UNDER ELECTRIC AND LASER FIELDS

B. Bekar

Keşan Vocational School, Trakya University, Keşan, Edirne, TÜRKİYE

bahadirbekar@trakya.edu.tr

In this study, we investigate an H-shaped AlGaAs/GaAs quantum wire within the framework of the effective mass approximation. The Schrödinger equation is solved using the finite difference method to determine the eigenvalues and eigenvectors of the system. External electric and laser fields are applied along both the x- and y-axes of the structure. The influence of variations in the energy eigenvalues on the total absorption coefficient and refractive index is analyzed. The results obtained from the numerical calculations are presented and discussed.

EFFECT OF PRESSURE AND TEMPERATURE ON OPTICAL PROPERTIES IN A TRIPLE QUANTUM WELL

B. Bekar

Department of Electricity and Energy, Trakya University, Vocational of Kesan, 22800 Edirne, TÜRKİYE

E-mail: bahadirbekar@trakya.edu.tr

In this study, we calculated the eigenvalues and eigenvectors of a AlGaAs/GaAs quantum well (QW) as a function of pressure (P) and temperature (T). The finite difference method was used in these calculations under the effective mass approximation. The effects of P and T on the total absorption, total refractive index, and second harmonic generation coefficient are presented as a result.

ROLE OF Mn DOPING AND OXYGEN VACANCIES IN TETRAGONAL $BiFeO_3$

C. Çoruh[1], *B. Akgenç Hanedar*[2], *M. C. Onbaşlı*[3,4]

[1]*Department of Materials Science and Nano Engineering, Faculty of Engineering and Natural Sciences, Sabancı University, Tuzla, 34956 Istanbul, Turkey*
[2]*Department of Physics, Faculty of Arts and Sciences, Kırklareli University, Kırklareli, Turkey*
[3]*Department of Physics, Koc University, Rumelifeneri Yolu, Sariyer 34450 Istanbul, Turkey*
[4]*Department of Electrical & Electronics Engineering, Koc University, Rumelifeneri Yolu, Sariyer 34450 Istanbul, Türkiye*

E-mail: berna.akgenc@klu.edu.tr; bakgenc@ku.edu.tr ; monbasli@ku.edu.tr

$BiFeO_3$ (BFO) is a prominent multiferroic perovskite material that simultaneously exhibits ferroelectric and magnetic order, making it a strong candidate for next-generation spintronic applications. In this work, we systematically investigate the structural, magnetic, and electronic properties of pristine and Mn-doped tetragonal $BiFeO_3$ using density functional theory (DFT) with generalized gradient approximation (GGA), Hubbard U correction, and spin–orbit coupling (SOC). Our results show that pristine BFO stabilizes in a C- type antiferromagnetic (C-AFM) ground state. While GGA underestimates the electronic correlations, inclusion of the Hubbard U term yields a more accurate description of the Fe-3d states. Importantly, the incorporation of SOC reveals Rashba-type spin splitting in the conduction band, demonstrating the potential of BFO as a platform for Rashba spintronics [1,2].

To explore the role of defect engineering, we introduced Mn substitution at different concentrations. At 12.5% Mn doping (The doping concentration was determined relative to the number of Fe atoms), the system remains in a tetragonal structure with C-AFM ordering, whereas 25% doping drives a structural transition from tetragonal to orthorhombic symmetry and stabilizes a ferromagnetic (FM) ground state within the C- AFM framework. The FM states exhibit distinct spin-up and spin-down band dispersions, suggesting strong spin polarization and tunability of spin transport properties. Our findings indicate that both the magnetic ordering and Rashba splitting in BFO can be effectively modulated through Mn doping and defect engineering. Oxygen vacancies also introduce defect states in the vicinity of the Fermi level, which strengthen spin polarization and alter Rashba splitting. When combined with Mn dopants, these vacancies intensify the overall effect, producing clear spin-dependent band dispersions and offering additional parameters to fine-tune the magnetic and electronic characteristics.

Our results demonstrate that the interplay of electronic correlation, Mn doping, and oxygen vacancies offers a powerful route to engineer Rashba spin splitting and magnetic transitions in $BiFeO_3$. This defect- and doping-driven design strategy provides new insights into controlling spin textures in multiferroic oxides and opens pathways for functional oxide-based spintronic devices.

[1] Zhao, T., Scholl, A., Zavaliche, F., Lee, K., et all. Nat. Mater., 5(10), 823-829 (2006).

[2] Ahmad, T., Jindal, K., Tomar, M., et all. Phys. Chem. Chem. Phys., 25(7), 5857-5868 (2023).

STRUCTURAL AND ESR INVESTIGATIONS OF Cu/Eu CO-DOPED ZnO NANOPARTICLES SYNTHESIZED VIA SOL–GEL METHOD

A. Guler

[1]*Department of Electrical and Electronics Engineering, Marmara University, 34854, Istanbul, Turkey*

E-mail: adil.guler@marmara.edu.tr

$Zn_{0.99}Cu_{0.01}Eu_xO$ (x = 0.01–0.05 with 0.01 increments) nanoparticles were prepared through the sol–gel method. The strain, stress, and crystallite dimensions of the synthesized Cu/Eu co-doped ZnO samples were evaluated using the Williamson–Hall approach, while their Electron Spin Resonance (ESR) spectra were analyzed to explore influences on structural and magnetic behavior.

X-ray diffraction (XRD) results verified the existence of a single-phase crystalline structure. Surface topography, elemental distribution, crystal quality, defect types, density, and magnetic response were characterized by Scanning Electron Microscopy (SEM), Energy-Dispersive Spectroscopy (EDS), and ESR, respectively. The role of Eu concentration on the linewidth (ΔHPP) and g-factor observed in the ESR spectra was systematically investigated.

Keywords: Zinc oxide; Nanoparticles; ESR; Sol-gel method; Microstrain; stress

ESR AND STRUCTURAL ANALYSIS OF Cu/Mg Co-DOPED ZnO NANOPARTICLES

A. Guler, C. Boyraz[2], L. Arda[3]

[1]*Department of Electrical and Electronics Engineering, Marmara University, 34854, Istanbul, Turkey*

[2]*Department of Mechanical Engineering, Marmara University, 34854, Istanbul, Turkey*

[3]*Department of Mechatronic Engineering, Bahcesehir University, 34349 Istanbul, Turkey*

E-mail: adil.guler@marmara.edu.tr

In this research, ZnO nanoparticles co-doped with Cu and Mg at various concentrations were synthesized by the sol–gel method. Their stress, strain, and crystallite dimensions were evaluated using the Williamson–Hall analysis and compared with the values obtained from the Debye–Scherrer formula. Additionally, the morphology and electron spin resonance (ESR) behavior of the co-doped samples were investigated.

The structural examination through X-ray diffraction (XRD) combined with Rietveld refinement confirmed the successful formation of the intended crystal structure, without any evidence of secondary phases. Detailed analysis provided information on lattice constants along in-plane and out-of-plane directions, unit cell volumes, bond distances, atomic configurations, and dislocation densities. Concentration-dependent variations in grain size were assessed using scanning electron microscopy (SEM). Moreover, ESR spectra of the samples were studied, and the g-factor values were determined from the peak-to-peak linewidth (ΔHPP).

Keywords: ZnO, Sol-gel method, Williamson–Hall, Stress, Microstrain, ESR properties, Nanoparticles.

EFFECTS of POLYPHENOLS and/or BORON ENRICHED DERIVATIVES on GERMINATION of CORN SEEDS UNDER COLD STRESS

S. Bilen[1], Z. Halıcı[2], D.A. Köse[3], M. Bolat[4], T. Öztaş[1], A. Adın[1], E. Yağanoğlu[1]

[1]Department of Soil Science and Plant Nutrition, Faculty of Agriculture, Atatürk University, Erzurum, TÜRKIYE
[2]Department of Medical Pharmacology, Faculty of Medicine, Internal Medicine, Atatürk University, Erzurum, TÜRKIYE
[3]Department of Chemistry, Faculty of Arts and Sciences, Hitit University, Usak, TÜRKİYE
[4]Department of Property Protection and Security, Occupational Health and Safety Program, Vocational School of Technical Sciences, Hitit University, Usak, TÜRKIYE

E-mail: sbilen@atauni.edu.tr

Polyphenol is the general name for phenolic compounds found in olive oil, red wine, green tea, and chocolate, which have antioxidant effects. Various studies have determined that the amount of water-soluble phenolic substances increases and flavonoid metabolism is stimulated under cold stress conditions in plants. There are also studies demonstrating the positive effects of boron on cold stress in plants.

The aim of this study is to determine the effects of different concentrations of polyphenols (PF) and their boron-enriched derivatives (PF-B) found in the tea plant on corn seed germination under cold stress conditions. The project's goal is to synthesize a new effective PF-B compound that protects plants against cold stress, thereby increasing plant resistance to low temperature conditions and reducing the negative effects of climate change on agricultural production.

The PF compound was purchased and supplied for the study. The boron-enriched PF was synthesized based on the Lewis acid-base interaction between polyphenol and boric acid. The resulting new PF-B compound contains 84.1% PF, 2.04% B, and 7.24% K. In the corn seed germination trial, diluted concentrations of PF and PF-B were prepared at 0.0, 0.001, 0.002, 0.004, 0.008, and 0.01%. Solutions containing different concentrations of PF and PF-B were applied to the seeds in the vial with irrigation water equivalent to field capacity (TK) moisture. Soil moisture levels were maintained constant at the TK moisture level throughout the trial. The vial was left to germinate in germination chambers at temperatures of 4, 6, 8, 10, and 12°C, and the germination rate of corn seeds at low temperatures was determined at the end of the trial.

According to the trial results, the germination rates of corn seeds in PF solutions at different concentrations at temperatures of 4, 6, 8, 10, and 12°C were determined as 0%, 5%, 15%, 45%, and 70%, respectively, and those of PF-B solutions were determined as 0%, 10%, 25%, 75%, and 84%, respectively.

In the study, the effects of the 0.01% PF-B solution on the germination rate of corn seeds at low temperatures were higher than those of the PF solution, suggesting that the 0.01% PF-B solution can be used for germination under cold stress conditions.

Keywords: Polyphenol, Cold Stress, Germination of Corn Seeds, Boron-Enriched Polyphenol

ASSESSMENT OF ROOFTOP RAINWATER HARVESTING AND STORAGE POTENTIAL IN URBAN RESIDENTIAL AREAS: A CASE STUDY IN ÇANKIRI, TÜRKİYE

Y. S. Başer[1], S. Ediş[1]

[1]Department of Forest Engineering, Faculty of Forestry, Çankırı Karatekin University, Çankırı, TÜRKİYE

E-mail: semihedis@karatekin.edu.tr

The sustainable management of global water resources is critically significant for environmental, social, and economic factors nowadays. Climate change, population growth, urbanization, and industrialization are intensifying the strain on current water resources. In semi-arid and arid regions, water stress is increasingly problematic, necessitating the exploration of alternative water resources. This study seeks to enhance urban water management strategies by assessing the feasibility of rainwater harvesting from the rooftops of residential areas in the Çankırı city center. The study utilized meteorological data (precipitation, temperature, evaporation) from 1990 to 2023, water consumption data per dwelling from the Turkish Statistical Institute, and Google Satellite Map imagery. Subsequently, roof areas were converted into polygons within these images utilizing the ArcGIS software and categorized by material types (concrete, metal, tile) and property classifications (public, private). The coefficients of 0.9 for metal roofs, 0.75 for tile roofs, and 0.7 for concrete roofs were utilized to compute the volume of harvestable rainwater for each covering type. The evaluation included a filter efficiency coefficient of 0.95. The estimated harvest quantities were forecasted for the years 2050, 2075, and 2100 based on the RCP 8.5 climate change scenario.

The study's findings indicate that the annual rainwater harvesting for a residence with a roof area of 100 m² is estimated at 35.4 m³ for metal roofs, 29.6 m³ for tile roofs, and 27.5 m³ for concrete roofs. It is calculated that between 519500 m³ and 631519 m³ of rainwater can be collected annually in Çankırı city center, which can satisfy approximately 12-16% of household water demand. The RCP 8.5 scenario forecasts a potential reduction in rainfall by as much as 7% by 2100, thereby amplifying the significance of roof water harvesting in the forthcoming years. The implementation of rainwater harvesting in Çankırı province is expected to reduce the demand for blue water resources, thereby indirectly decreasing gray water production.

Keywords: Çankırı, Water stress, Water Harvesting, Rooftops, Climate change

*Origin: TÜBİTAK 2209-A Undergraduate Project — Rainwater Collection and Storage Potential from Roofs in Çankırı City Center (Y.S. Başer; Supervisor: S. Ediş, Çankırı Karatekin University)

NANOSTRUCTURED SEMICONDUCTORS FOR ENERGY APPLICATIONS

Ram K. Gupta

Pittsburg State University, Pittsburg, KS 66762, United States

E-mail: ramguptamsu@gmail.com

The unique and tuneable electronic properties of semiconducting materials make them very suitable for energy applications. Semiconductors are used in energy production as well as for energy storage. The current high demand for energy and the necessity to use renewable resources for energy encourages scientists to tune the properties of semiconducting for high-performance energy devices.

In this talk, various approaches to synthesizing and characterizing nanostructured semiconductors and their applications in energy will be explored. Various approaches such as doping, the use of conducting substrates, and the morphological effect on the electrochemical properties of semiconductors will be discussed. Emerging semiconductors such as 2D semiconductors and nanostructured metal sulphides and phosphides will be also covered particularly for their energy applications.

PENTACANE BASED ON THIN FILM ORGANIC PHOTOTRANSISTOR

S. Mansouri

Laboratoire de Physique des Matériaux: Structure et Propriétés, Groupe Physique des Composant et Dispositifs Nanométriques, Facultés des sciences de Bizerte, 7021 Jarzouna-Bizerte, TUNISIA

E-Mail: *mansourislah@yahoo.fr*

The zinc oxide semiconductor thin film transistor was fabricated on a SiO_2/Si substrate by sol gel method. The ZnO film is consisted of nanofibers with the changing diameter along the fibers. Electrical characteristics of the zinc oxide transistor under dark and white light illuminations were analyzed. The mobility value of the ZnO TFT was found to be $1.86 \times 10{-}2$ cm^2/V s. The ZnO thin film transistor works in an n-channel operational mode because the drain current increases with the positive gate voltages. A significant increase in the drain current of ZnO TFT is observed with a maximum photosensitivity of 100 under visible light illumination. It is concluded that the ZnO thin film transistor can be used in visible photo-detecting device applications.

APPLICATIONS OF NANOMATERIALS FOR THE DIAGNOSIS OF CANCER

S. Iqbal[a], M. Fakhar-e-Alam [a, b], M. Shafiq [c], W. A. Farooq[d]

[a]Department of Physics, GC University, Allama Iqbal Road, 38000, Faisalabad, Pakistan,
[b]Key Laboratory of Magnetic Materials and Devices & Division of Functional Materials and Nanodevices, Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, No. 1219 Zhongguan West Road, Ningbo, China
[c]Department of Physics, Allama Iqbal Open University, H-8 Islamabad, Pakistan
[d]Department of Physics and Astronomy, College of Science, P.O.Box 2455, King Saud University Riyadh 11451, Saudi Arabia

E- mail: shafiq_qau_pk@yahoo.com

Silver oxide nanoparticles (AgO NPs) are wonderful material and having great potential towards biomedical applications. Silver oxide nanoparticle (AgO NPs) were synthesized via Chemical Aqueous method and characterized by applying manifold available techniques. X-ray diffraction (XRD) was used to study the structural property of nanoparticle crystals and the surface morphology of synthesized nanoparticles was studied by scanning electron microscope (SEM). Phototoxic and cytotoxic effects of grown particles were examined by conduction various relevant experimental techniques on hepatocellular (HepG2 Cell line) model. The obtained results were verified by applying polynomial fit which confirmed the goodness of fit. AgO NPs have unique biointeraction characteristics and physicochemical properties such as anticancer and antibacterial agent. This study will be helpful particularly for real treatment of malignant/pre-malignant conditions.

SOLAR LIGHTRESPONSIVE ZnO NANOPARTICLES ADJUSTED USING Cd AND La Co-DOPANT PHOTODETECTOR

B. A. Gozeh[1], F. Yakuphanoğlu[2]

[1]*Erbil Polytecnical University, Shaqlawa Technical Institute, Erbil, Iraq*
[2]*NanoscienceandNanotechnologylaboratory, FiratUniversity, Elazig, Turkey*

E-mail: bestoon81@gmail.com

Optical sensing from the solar light range of light is very important for industrial process monitoring and life science. Hence, we present inorganic photodetector, operating between 200 and 1200 nm wavelength invented (Cd0.1/xLa co-doped ZnO, x=0.1, 0.5, 2, and 4 Wt%) nanoparticles thin films were synthesis onto p-Si and glass substrates by the Sol-gel spin coating technique. The films indicate that a high transmittance about 92% in the visible region. The optical bandgap of the thin films was used optical data demonstrated that the band gap of the films decreased with dopant concentration. The surface morphology and elemental compositions were investigated by SEM and EDX. The diodes exhibited high photocurrent responsivity under various illuminations. Herein, from I-V characteristics determined the electronic parameters such as ideality factor, barrier height and series resistance. The C-V and G-V of the diodes were investigated in the range of 10-1000 kHz. Moreover, an approach to improve the Ion/Ioff ratio (photoresponse) by modifying the concentration has been investigated under dark and light illuminations, respectively. The Al/p-type/Cd(0.1)-La(0.1)Wt/Al photodetector exhibited a highest photo-response were found to be 2263. Finally, the interface states were determined to explain the results obtained in the present study. The obtained results suggest that Cd/La-co-doped ZnO/p-Si diodes can be enhanced and pave the way for its potential application in the optoelectronic devices e.g. photodetectors.

Keywords: Co-dopedZnO, Sol-gel, Electricalproperties, Photodetector.

ORGANIC SEMICONDUCTOR PHOTOSENSORS

R. O. Ocaya[1], F. Yakuphanoğlu[2]

[1]*Department of Physics, University of the Free State, South Africa*
[2]*Department of Physics, Faculty of Science, Firat University, Elazig, Turkey*

E-mail: ocayaro@ufs.ac.za

Coumarin doped with poly (3-hexylthiophene)/p-Si photodiodes were prepared by the drop-casting technique. The current–voltage characteristics of the prepared diodes with the structure of Al/P3HT: Coumarin/p-Si/Al diodes were investigated under dark and various illumination intensities using both I–V and C–V methods. Using both illuminated DC and transient I–V and C–V measurements, the photocurrents are shown to depend on light intensity with the P3HT: Coumarin ratio influencing photoresponsivity. The photocurrents increase with increasing illumination intensity. C–V measurements show that the capacitance of the diode depends on voltage, frequency and illumination, indicating the existence of a continuous distribution of interface states that can be described in terms of organic-organic polymer blend domains in additional to the well-studied metal-semiconductor interface states. The best responses were found to be for the diode having 10% Coumarin weight. These results suggest that the Al-p-Si/P3HT: Coumarin/Al diode can be used as a photosensor.

POSTER PRESENTATION

5th International Natural Science, Engineering and Material Technologies Conference
Sep 18-20, 2025, İğneada-Kırklareli / TÜRKİYE

INVESTIGATION OF RADIATION SHIELDING PROPERTIES OF METAL-DOPED PbO THIN FILMS

T. Tokca[1], A. F. Özdemir[1*], İ. Akkurt[1] and Ç. Ş. Güçlü[2]

[1]*Department of Physics, Faculty of Eng. and Natural Sciences, Suleyman Demirel University, Isparta, TÜRKİYE*

[2]*Department of Physics, Faculty of Sciences, Gazi University, Ankara, Türkiye*

E-mail: farukozdemir@sdu.edu.tr

This study investigated the radiation shielding properties of undoped PbO and Cu-doped PbO thin films deposited on glass substrates. For this purpose, glasses containing undoped PbO and 2-4-6-8% Cu-doped PbO thin films were exposed to a ^{60}Co source emitting gamma rays with energies of 1173 and 1332 keV. Linear absorption coefficients (LAC), HVL, and mean free path (MFP) values were calculated from the obtained characteristics. The results showed that the radiation attenuation properties of the thin films increased as the metal Cu ratio added to the oxidized PbO compound increased.

MONITORING FOREST MICROCLIMATE WITH MICROCONTROLLER-BASED SYSTEMS: A LOW COST AND PORTABLE APPROACH

S. C. Çapar[1], *B. Harmanda*[1], *S. Ediş*[1]

[1]*Department of Forest Engineering, Faculty of Forestry, Çankırı Karatekin University, Çankırı, TÜRKİYE*

E-mail: caparsametcan@gmail.com

In Turkey, 23.3 million hectares of forest are threatened by climate change and escalating human activity. To forecast adverse occurrences, such as mass or individual tree mortality resulting from escalating drought and forest fires, Turkish forests need to be examined micro climatically, a process that can be achieved cost-effectively and with greater portability through the use of microcontrollers. Turkish forests cannot be monitored micro climatically due to the limitations of conventional meteorological stations. This situation can be circumvented through the use of microcontroller-based systems, offering a compact and cost-effective solution. Sensors that assess soil moisture, temperature, and atmospheric parameters such as air humidity etc. can be integrated with the microcontroller, and the system can be powered by solar panels and batteries in forest ecosystems. Server-based data storage is unfeasible due to the absence of requisite infrastructure in Turkey's forests. The microSD card module integrated into the microcontroller can prevent this issue. Deploying low-cost microcontroller systems in forested areas enables the acquisition of data from these areas at minimal expense within %95 low. In the long term, if requisite server infrastructures are established in forested regions, data can be accessed via cloud storage. Integrating microcontroller-equipped systems across all forest areas will enable access to forest data via cloud storage. This will enable us to anticipate the risk of wildfires in our forests, forecast mass or individual tree mortality, and implement pre-emptive measures.

Keywords: Forest, Sensor, Mobility, Arduino, ESP32