Proceedings
of
First International Congress on Trends and Advances in Global Research and Applications

TAGRA 2024

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Proceedings
of

1st International Congress on Trends and Advances in Global Research and Applications (TAGRA 2024)

21 - 22 December, 2024
Erzurum, Türkiye

Edited by
Muhammet Kaan YEŞİLYURT

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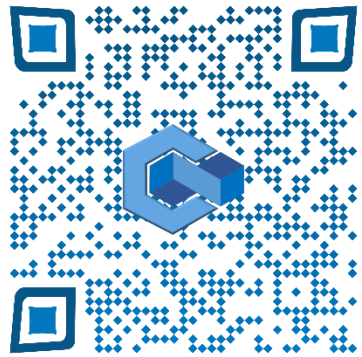

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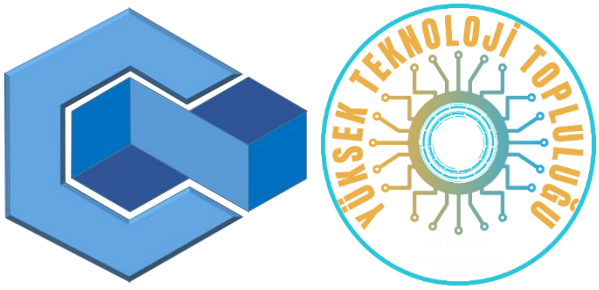

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PROCEEDINGS
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(TAGRA 2024)

21-22 DECEMBER 2024, ERZURUM, TÜRKİYE

Edited by
Muhammet Kaan YEŞİLYURT

Redacted by Hilal Kübra SAĞLAM
Reviewed by Hayrunnisa NADAROĞLU

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Message from the Organizing Committee

In a world where technology evolves at breakneck speed, how do we ensure our research keeps pace? Actually, academic events like this make us ensure we keep pace with the rest of the world. So, welcome to the International Congress on Trends and Advances in Global Research and Applications, TAGRA 2024. Aiming to bring together researchers and practitioners worldwide, the TAGRA events will be bringing together scientists, offering a unique platform to explore new developments in science and engineering and strengthen interdisciplinary collaboration as well as share innovative applications.

Organized with a multi-disciplinary approach, TAGRA also aims to bring together academics, researchers and industry professionals from all over the world in different fields to discuss the latest trends in science and technology and expand the global research vision. Offered with both face-to-face and online participation options, this flexible structure will increase the accessibility and enable us to reach a wider audience worldwide.

TAGRA is aimed to be not only a place for sharing academic knowledge, but also a meeting point where researchers can get inspired by each other and open doors to interdisciplinary collaboration and joint projects. In addition, participants will have the opportunity to access comprehensive information on the most up-to-date information and application techniques through oral and poster presentations, workshops and special sessions such as round-table talks, panel discussions, flash talks, and demonstrations/exhibits.

While the inaugural event this year, which was launched amidst several challenges in a very tight schedule, lacks many aspects of the conceptual framework. We eagerly look forward to seeing it come into reality in the coming events with your valuable contributions and spread of the word. Your presence here signifies our collective commitment to advancing scientific events. We do not want to become yet another event. We aim high, we aim for quality, we aim for yield, we aim for innovation, we aim for pure science, for all of us. Be the brick, be the cement, be the mold. Help us in making our way into it. As we embark on this journey together, do not just witness, be active contributors.

While we once again welcome you all the very first contributors of TAGRA, we would like to extend our sincere thanks and gratitude to everybody who made possible this event come into existence before we mark the new year, with special recognition to:

- our honorary chair, the chancellor of Ataturk University, Prof. Dr. Ahmet Hacımüftüoğlu,
- our congress chair and host Prof. Dr. Hayrunnisa Nadaroğlu,
- our organizing committee and secretariat for their priceless effort,
- our Keynote Speakers, esteemed professors Saravanan Muthupandian, Ahmad Ali, Zainab Yunusa, Hirofumi Tanaka, Ashok Nadda, Faiz Arith, Intan Helina Hasan, Abdulaziz Atabani, and Prathap Singh, who spared their valuable time to take part in this event despite their busy schedule.

Have a fruitful congress.

Happy to have you all here...

Chair's Opening Speech

My dear professors, colleagues, dear students,

I respectfully greet you all,

Welcome to the International Congress on Trends and Developments in Global Research and Applications (TAGRA) 2024. It is an absolute honor for me to stand before such a distinguished audience today, representing a truly global gathering of scientific minds and innovators, both face-to-face in Erzurum and online.

On behalf of the organizing committee, I would like to express my sincere gratitude for your presence.

Your participation, whether in person or virtually, underscores the importance of this event and the universal effort to share knowledge and advance the frontiers of science and engineering.

TAGRA 2024 is more than a congress. It is a platform; a bridge connecting ideas, disciplines and individuals from all corners of the world. This year, we are proud to host 64 participants from five countries, including Turkey, Malaysia, India, Iran, Taiwan and Bangladesh. This remarkable international representation is a testament to the universal impact of our shared mission: to advance knowledge, foster collaboration and find innovative solutions to global challenges.

Our participants come from a variety of backgrounds, including Professors, Doctors, Masters and Bachelors students and researchers, all united by a common passion for discovery and progress. Such interdisciplinary and intergenerational gathering reflects the essence of TAGRA 2024, a space where ideas are freely shared, perspectives are expanded and new collaborations are forged.

TAGRA 2024 will feature 2 plenary speeches, 9 keynote talks, 53 oral presentations, and oral and poster presentations presented by a mix of 40 in-person and 24 online participants. Through these presentations, our event will be both inclusive and accessible, allowing us to reach a broader audience while maintaining the depth of interaction that in-person interactions provide.

Each oral or poster presentation represents countless hours of research, experimentation and dedication. However, they form the heart of this congress, showcasing the latest developments in a wide range of fields.

Our TAGRA 2024 congress theme, “Discover the New Faces of Science”, is both timely and inspiring. Science and technology are evolving at an unprecedented pace, reshaping our understanding of industries, societies and even our world. TAGRA 2024 invites us not only to explore these transformative developments, but also to consider the challenges and opportunities they present.

Through plenary sessions, presentations and scientific discussions, we will delve into critical and groundbreaking topics, including:

- Energy systems and sustainable engineering practices, addressing the urgent need for clean and efficient energy solutions.
- Materials science and innovative materials, exploring the potential of advanced materials to revolutionize industries.
- Artificial intelligence, data science and industrial applications, examining how AI is transforming research and development.
- Environmental science and sustainable development strategies, tackling global environmental challenges with innovative approaches. Robotics, automation, and the internet of things are paving the way for smarter, more connected systems.

Genetic engineering and biotechnology applications are creating breakthroughs that have profound implications for health and agriculture.

Each of these topics is not just a field of study, but also a call to action, encouraging us to think creatively and work collaboratively to address the pressing issues of our time.

We live in a world of rapid transformation. Climate change, resource scarcity, and the need for sustainable development are challenges that require not only technological solutions but also interdisciplinary collaboration. At the same time, advances in artificial intelligence, robotics, and materials science offer unprecedented opportunities to reshape our future.

TAGRA 2024 serves as a forum to grapple with these dual realities. A place where ideas can be shared, theories can be tested, and the seeds of innovation can take root. Together, we can chart a path that is not only scientifically sound, but also socially and environmentally responsible.

As we gather in Erzurum, let’s take a moment to appreciate the unique setting of this congress. A city steeped in history and culture, Erzurum has long been a crossroads of civilizations. Its rich

heritage serves as a reminder of the enduring power of knowledge and exchange; values that deeply resonate with the mission of TAGRA 2024.

At this point, I would like to express my deepest gratitude to everyone who made TAGRA 2024 possible. First of all, to the organizing committee, Dr. Kaan YEŞİLYURT for his tireless efforts to bring this vision to life, Dr. Hilal Kübra SAĞLAM for his secretarial duties, and I thank Dr. Aynur BABAGİL. I thank all our distinguished speakers; your input will undoubtedly enrich our discussions. And I thank each and every participant for your commitment to advancing science and engineering.

Whether you are here in person or online, TAGRA 2024 is a truly global platform for innovation and collaboration.

Over the next two days, I encourage you to make the most of this opportunity. Join the presentations, participate in the discussions, and connect with other participants. Let’s use this time to learn from each other, challenge conventional thinking, and explore new possibilities.

Let this congress be a reminder of what we can achieve when we come together for a common purpose. The future of science is built not by individuals working in isolation, but by communities of researchers, practitioners, and innovators working hand in hand.

As we embark on this exciting journey, I invite each and every one of you to embrace the spirit of science, collaboration, and discovery that defines TAGRA 2024. Together, let’s make this a truly extraordinary event; an event that inspires new ideas, develops lasting partnerships and leaves a lasting impact on the global research community.

With great enthusiasm and optimism, I officially announce the opening of TAGRA 2024!

Thank you and I wish you all a productive and inspiring congress.

Congress Program

Saturday, December 21, 2024

Gathering and Acquaintance Session - C/Ground-2 - Main Hall (9:30 AM - 10:00 AM)

This is a gathering, warm-up and acquaintance session. Participation is optional

-Session Chair: YEŞİLYURT, Muhammet Kaan (Ataturk University)

Opening Session: Plenary Session - C/Ground-2 - Main Hall (10:00 AM - 1:30 PM)

-Session Chair: NADAROĞLU, Hayrunnisa (Ataturk University)

10:00 AM	[60] Opening Speech: About TAGRA (5 minutes)	YEŞILYURT, Kaan (Syntagra)
10:05 AM	[67] Chair's Speech (10 minutes)	Prof. NADAROĞLU, Hayrunnisa (Ataturk University)
10:15 AM	[64] Design of a Decision Support System for Evaluating Students' Learning Outcomes and Program Outcomes Acquisition Levels in the Education and Training Process (15 minutes)	YEŞILYURT, Mahmut (İzmir Kavram Meslek Yüksekokulu)
10:30 AM	[6] Emerging Polymer-based 3-D Bioprinted Nanomaterials for Chronic Wound Healing (20 minutes)	MUTHUPANDIAN, Saravanan (Prince Fahad bin Sultan Chair for Biomedical Research, Faculty of Applied Medical Sciences, University of Tabuk, Tabuk, Saudi Arabia)
10:50 AM	[61] Hydrogen Energy & Economy: Paving the Path to a Sustainable and Low-Carbon Future (20 minutes)	ATABANI, Abdulaziz (Yuan Ze University, Taiwan)
11:10 AM	[62] Nanobiocatalysis for Environmental Sustainability and Commercial Products Synthesis (20 minutes)	NADDA, Ashok Kumar (Jaypee University of Information Technology)
11:30 AM	[36] Fabrication and Characterization of Functionally Graded A356 Alloy and Its Composite (20 minutes)	S, Prathap Singh (Department of Mechanical Engineering, St. Joseph's Institute of Technology, CHennai, India.)
11:50 AM	[30] Silicon Carbide MOSFETs: From Devices to Advanced Packaging (20 minutes)	ARITH, Faiz (Technical University of Malaysia Malacca)
12:10 PM	[34] Revolutionizing the Electronics Industry Using Nanotechnology (20 minutes)	YUNUSA, Zainab (University of Hafr Al Batin)
12:30 PM	[43] CNT-ferrite Nanohybrid Materials for Electromagnetic Wave Applications (20 minutes)	HASAN, Intan Helina (Universiti Putra Malaysia)
12:50 PM	[46] Anti-inflammatory Potential of Some Commonly Used Plants in Unani Medicine (20 minutes)	ALI, Ahmad (University of Mumbai)

Break - Venue TBA (1:30 PM - 2:00 PM)

Architectural and Civil - d/1-10 - Hall 4 (2:00 PM - 3:00 PM)

-Session Chair: ÇAKICI, Fatma Zehra (Ataturk University)

2:00 PM	[20] Evaluation of Traditional Erzurum Houses in The Context of Climate-Responsible Design (15 minutes)	BAŞARAN, Şehriban (Graduate Student)
2:15 PM	[23] Investigation of Mechanical Properties of Fiber Reinforced Concrete After Exposure to Elevated Temperature (15 minutes)	URTEKIN, Yunus
2:30 PM	[19] Assessment of the Effects of Infrastructure Projects in The Context of Cultural Heritage (15 minutes)	KAÇDI, Rabia (Graduate Student)

Marine Sciences: Session for Marine Sciences - D/1-2 - Hall 2 (2:00 PM - 3:30 PM)

-Session Chair: ÖZTÜRK, Rafet Çağrı (Karadeniz Technical University)

2:00 PM	[10] Preliminary Investigation of Microplastic Occurrence in Pinfish (Lagodon rhomboides) from the Grand Isle, Louisiana, USA (15 minutes)	TERZI, Yahya (Karadeniz Technical University)
2:15 PM	[17] Bacteriophage Therapy Approach in Fish Disease Treatment (15 minutes)	USTAOĞLU, DİLEK
2:30 PM	[50] Comprehensive Assessment of Pilot Boat Emissions in Turkey's Eastern Black Sea Ports: A 2023 Case Study Using the Emission Factor Approach (15 minutes)	KÖSE, Süleyman (Karadeniz Technical University)
2:45 PM	[32] What is the Lifespan of a Vessel? (15 minutes)	ALTINPINAR, İshak
3:00 PM	[24] Importance of Understanding Marine Functional Connectivity in Marine Ecosystems (15 minutes)	ÖZTÜRK, Rafet Çağrı (Karadeniz Technical University)

Mechanical Engineering: Energy and Thermodynamics - D/1-1 - Hall 1 (2:00 PM - 3:30 PM)

-Session Chair: ÖNER, İlhan Volkan (Ataturk University, Faculty of Engineering)

2:00 PM	[38] Experimental Investigation of the Effects of Triple Mixtures of Waste Plastic Oil, Waste Transformer Oil and Diesel Fuel on Engine Performance and Exhaust Emissions (15 minutes)	YAZICI, Uğurcan (Atatürk University, Department of Mechanical Engineering)
2:15 PM	[8] Numerical Investigation of Heat Transfer of Nanofluid in a Square Channel (15 minutes)	MUSTAFAOGLU, Mansur (Atatürk University)
2:30 PM	[28] Strategy for Enhancing Heat Transfer in Electronics: Keeping Devices Cool and Efficient (15 minutes)	GHALY, Hassen
2:45 PM	[1] Assessment of Different Solar Cell Technologies for Sustainability Indicators (15 minutes)	YEŞILYURT, Muhammet Kaan (Ataturk University)
3:00 PM	[68] Powder Characteristics and Mechanical Properties of AlCrCo Middle Entropy Alloy Synthesized via Mechanical Alloying (15 minutes)	ÖZKAYA, SERDAR (Karadeniz Technical University, Metallurgy and Materials Science Engineering)

Telecommunications - D/1-8 - Hall 3 (2:00 PM - 3:05 PM)

-Session Chair: SAĞLAM, Hilal Kübra (ATATÜRK UNIVERSITY)

2:05 PM	[65] Comparison of Power Consumption in Data Transmission at Different Distances in Edge Computing Systems of Wireless IoT Technology (15 minutes)	KURT, Ahmet Ekmel
2:20 PM	[66] RConvLSTM4AD: Residual Convolutional LSTM Model for Anomaly Detection on 3D Printer (15 minutes)	KARADAŞ, Fadime
2:35 PM	[31] Structural, Optical and Morphological Properties of α-Fe2O3:Ag Thin Films Grown on Different Substrates (15 minutes)	SAĞLAM, Hilal Kübra (ATATÜRK UNIVERSITY)
2:50 PM	[69] Synthesis of Carbon Dots from Plants for Biosensor Applications (15 minutes)	YÜNCÜ, Hatice (Ataturk University, Erzurum)

Break - Venue TBA (3:30 PM - 4:00 PM)

Biology Biochemistry and Pharmacology - D/1-2 - Hall 2 (4:00 PM - 5:15 PM)

-Session Chair: MAZLUMOĞLU, Hayrunnisa

4:00 PM	[13] Assessment of Plant Development of Bean (Phaseolus Vulgaris L.) Under Deficit Irrigation Conditions (15 minutes)	GÜRBULAK, MUHAMMET GÖKHAN
4:15 PM	[5] Effect of Temperature and Agitation Speed on Adsorption Activity of TiO2/PLDOPA/Fe3O4 Nanocomposite for Lead Removal (15 minutes)	Mrs BINICI, Şule (Ataturk University)
4:30 PM	[52] Determination of Laccase Enzyme Activity in Culture Medium of Caldibacillus Pasinlerensis Using Medlar and Hawkshort Seed (15 minutes)	YEŞİLYURT, Fatma Melike (Atatürk Üniversitesi)
4:45 PM	[54] Production and Optimisation of Peroxidase, Catalase and Polyphenol Oxidase Enzyme from Caldibacillus pasinlerensis Using Eribotrya Japonica Seeds (15 minutes)	VIRDIL, Melisa (Ataturk University, Erzurum)
5:00 PM	[53] Isolation of Lactic Acid Bacteria Showing the Best Probiotic Properties from Wine Samples Obtained from Different Regions of Azerbaijan (15 minutes)	KARİMOVA, Narmin (Ataturk University, Erzurum)

Mechanical Engineering: Energy and Thermodynamics - D/1-10 - Hall 4 (4:00 PM - 5:30 PM)

-Session Chair: ÖZAKIN, Ahmet Numan (Atatürk University)

4:00 PM	[58] Evaluation of the Effects of Geometric Parameters on Thermal Performance in an Air Duct with an S-shaped Turbulator Using Numerical Methods (15 minutes)	YILDIRIM, Orhan (Atatürk Üniversitesi)
4:15 PM	[63] Experimental and Numerical Investigation of the Effect of Open Cell Aluminum Foams in Air Channel on Heat Transfer (15 minutes)	TOPRAK, Beytullah İsmet (Ataturk University, Faculty of Engineering)
4:30 PM	[56] Utilization of Geothermal Water Source Heat Pump in Space Heating in Cold Climate Regions (15 minutes)	AKMEŞE, Sedat (Erzurum Technical University)
4:45 PM	[55] Impact of Rectangular Flow Components and Different Fluids on the Efficiency of Solar Collectors: An Experimental Analysis (15 minutes)	KABAKUŞ, Abdussamet (Artvin University)
5:00 PM	[57] Investigation of Heat Transfer and Dynamic Instabilities in an Empty Tube with Boiling Two-Phase Flow (15 minutes)	GÜVEN, Hasan (Ataturk University, Faculty of Engineering)
5:15 PM	[18] Investigating the Weldability of Microalloyed Steel by Friction Stir Welding (15 minutes)	AKTARER, Semih Mahmut (Recep Tayyip Erdogan University)

Mechanical Engineering: Energy and Thermodynamics: Session for Mechanical Engineering - D/1-8 - Hall 3 (4:00 PM - 5:15 PM)

-Session Chair: ÇİLOĞLU, Doğan

4:00 PM	[35] Numerical Evaluation of Aerosol Deposition in Respiratory Tract Based on Chemical Properties and Size (15 minutes)	ÜÇÜNCÜ, Hacer (Ataturk University, Erzurum)
4:15 PM	[40] Experimental Investigation of the Effects of Adding Fe2O3 Nanoparticles to the Triple Mixtures of Pyrolytic Oil From Waste Tires, Waste Transformer Oil and Diesel Fuel on Engine Performance and Exhaust Emissions in a Diesel Engine (15 minutes)	ERTEKIN, Veysel (Ataturk University, Faculty of Engineering)
4:30 PM	[39] Investigation of Engine Performance and Exhaust Emissions of a Diesel Engine Using a Mixture of Waste Transformer Oil, Pyrolytic Oil Obtained from Waste Tires and Diesel Fuel (15 minutes)	Mr İNCE, Mustafa Köksal (Atatürk University, Department of Mechanical Engineering)
4:45 PM	[51] Occupational Health and Safety in Medium-Scale Hydroelectric Power Plants (15 minutes)	SİNCAR, Selçuk (Ataturk University, Vocational School of Technical Sciences)
5:00 PM	[47] The Importance of Periodic Control in Safe Production (15 minutes)	SINCAR, Selçuk

Nano Frontiers: Materials and Applications: Session for Nano Frontiers - D/1-1 - Hall 1 (4:00 PM - 5:40 PM)

-Session Chair: NADAROĞLU, Hayrunnisa (Ataturk University)

4:00 PM	[41] Investigation of Antioxidant and Antibacterial Activities of Nanoemulsions Obtained from Tarragon (Artemisia dracunculus) Essential Oil and Their Effects on Various Cancer Cells (15 minutes)	PINARBAŞI, Fatma Nur
4:15 PM	[37] A Photocatalytic Application of Modified Fe3O4 Nanoparticles (15 minutes)	DASDEMIR, Feyzanur Hilal (Ataturk University)
4:30 PM	[4] Bimetallic ZIF (Zeolitic Imidazolate Framework) Synthesis, Characterization and Removal of Some Azo Dyes from Wastewater by Photocatalytic Method (15 minutes)	SÜVARİ, Nur Aybüke
4:45 PM	[59] Development of Nano-Sensors for Detecting Carcinogenic Food Color Additives (15 minutes)	OKCİ, Sümeyra
5:00 PM	[45] Purification Characteristics of Montmorillonite Nano-clay for Pharmaceutical Uses (15 minutes)	RAZMI, Abbas
5:15 PM	[22] In-Materio Physical Reservoir Devices based on Random Network of Nanomaterials for Future Autonomous Systems (20 minutes)	TANAKA, Hirofumi (Kyushu Institute of Technology, Research Center for Neuromorphic AI Hardware)

Sunday, December 22, 2024

Electronics and Devices - D/1-1 - Hall 1 (11:00 AM - 1:00 PM)

-Session Chair: ÇEPNİ, Emir (Ataturk University, Faculty of Engineering)

11:00 AM	[27] A Novel Binder in Titanıum Dioxide Thick Film Gas Sensor for Carbon Dioxide Detection (15 minutes)	MOHD CHACHULI, Siti amaniah (Universiti Teknikal Malaysia Melaka)
11:15 AM	[42] Design and Synthesis of MoO3 as HTL in Improving The Power Conversion Efficiency of Lead-Free All Tandem Perovskite Solar Cell (15 minutes)	ABDUL WAHAB, ZULFANIZAM
11:30 AM	[48] Numerical Insights into Defect-Induced Performance Limitations in Doped PANI/GO-Based Perovskite Solar Cells (15 minutes)	Ms AHMAD JALALUDIN, Nabilah (Universiti Teknikal Malaysia Melaka)
11:45 AM	[33] La-doped CUSCN Strategy for Bandgap Tuning in Enhancing Hole Transport Mechanism for Inorganic Perovskite Solar Cell (15 minutes)	RAHIM, FARAH LIYANA
12:00 PM	[44] Copper Iodide as Hole Transporting Layer for Perovskite Solar Cell (15 minutes)	ALIYASELVAM, Omsri Vinasha (Universiti Teknikal Malaysia Melaka)
12:15 PM	[25] Investigation on Quality of Service (QoS) Parameters for 5G Network using OMNeT++ (15 minutes)	MOHD SULTAN, Juwita
12:30 PM	[26] Quality of Service (QoS) Performance of Cellular-Vehicle-to-Everything (C-V2X) Communication in the 5G Network Using OMNeT++ (15 minutes)	AFIQAH, Fitria
12:45 PM	[16] Investigation of Graphene Dopant Concentration on Eu□O□ Thick Film For Co□ Gas Sensing (15 minutes)	SANMUGAVELAN, Kuberahventhan

Nano Frontiers: Materials and Applications - D/1-2 - Hall 2 (11:00 AM - 1:40 PM)

-Session Chair: BAYRAM, Cemil

11:00 AM	[11] Using Nano-clays to Improve the Antibacterial Properties of Sanitary Products (20 minutes)	KARIMDOUST, SHAHRIYAR (PAYAM NOOR UNIVERSITY)
11:20 AM	[12] Application of Clay Minerals in Environmental Cleaning (20 minutes)	NAMI, Parisa (PAYAM NOOR UNIVERSITY)
11:40 AM	[29] Geochemistry of Minerals and Their Vital Role in Medical Geology (20 minutes)	MOUSAVI, Shahdad
12:00 PM	[15] A Study on the Green Synthesis of Carbon Quantum Dots: Characterization and Its Application in the Detection of Heavy Metal Ion (20 minutes)	FARJAMINEZHAD, Manoochehr (Department of Chemistry, Ardabil Branch, Islamic Azad University, Ardabil, Iran)
12:20 PM	[2] Cytotoxicity of Zirconium Oxide Nanoparticles on Diabetic Rabbit Tooth Gum Cells (15 minutes)	NASERZADEH, Parvaneh (Endocrine Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran)
12:35 PM	[14] A Study on Synthesis of Carbon Quantum Dots and Its Application in the Detection of Pb 2+ Metal Ions (20 minutes)	FARJAMINEZHAD, Manoochehr (Department of Chemistry, Ardabil Branch, Islamic Azad University, Ardabil, Iran)
12:55 PM	[7] Removal of Ni²□ and Cr□□, Complexed with 1,5-diphenylcarbazide (DPC), Using a Graphene Oxide/MnO□ Quantum Dot (GO/MnO□-QDs) Nanocomposite (20 minutes)	BABAEI, Maryam (Islamic Azad University, Ardabil, Iran)
1:15 PM	[3] Investigating the Oxidative Stress Mechanism of Carbon Dot Nanoparticles Exposed to Cells Isolated from Human Pituitary Cancer Tissue (15 minutes)	NASERZADEH, Parvaneh (Endocrine Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran)

KEYNOTE SPEAKERS

Hirofumi TANAKA

Director at Research Centre for Neuromorphic AI Hardware

Professor at Department of Human Intelligence Systems

Kyushu Institute of Technology
Japan

Prof. Tanaka completed his doctorate in materials science by studying the structural and magnetic properties of ferromagnetic nanoalloys at Osaka University in 1999. Then, moved to a national laboratory, RIKEN, to study the conductivity of metallic nanowires with double-probe scanning tunneling microscopy as a special postdoctoral researcher. After that, he advanced the molecular-ruler method in which precise multilayers of self-assembled molecular monolayers are used as lithographic resists to yield nanostructures with precise nanometer-scale spacings as a postdoctoral researcher at the Pennsylvania State University under Prof. Paul Weiss (presently UCLA, former chief editor of ACS Nano). Prof. Tanaka then joined the Research Center for Molecular-Scale Nanoscience at the Institute for Molecular Science in 2003 as an assistant professor, where he directed research in molecular electronics using carbon nanotube electrodes. He found that gold nanoparticles can switch from metallic conduction of SWNTs to semiconducting simply by nanoparticle adsorption. He has also focused on the development of atomic switches, exploring the ultimate miniaturization of electrical switches, and controlled by photo irradiation 2004-2008 in a key technology project of the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) and receive an excellent journal award from Japan Society of Applied Physics in 2012. He moved to the Department of Human Intelligence Systems, Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology (Kyutech) as a full professor in 2014 and is focusing on bio-mimic and/or neuromorphic AI electric nanodevices such as material reservoir devices. He concurrently became a director of the Research Center for Neuromorphic AI Hardware, Kyutech, in 2020. He was awarded an honorary degree from Suranaree University of Technology, Thailand, in 2021 (see photo),and received the degree certificate from Thai HRH Princess Sirindhorn. He obtained a national project as a PI, ALCA-NEXT, during 2023-2026 supported by Japan Science and Technology Agency, focused on carbon neutral and green computing. His broad knowledge of materials, from metals and inorganic materials to organic materials, and techniques for measurement and fabrication helped lead efforts in molecular electronics and in combining nanocarbon and nanoparticles to realize a new world of materials intelligence in nanosystems.

Ahmad ALI

Senior Assistant Professor in the Department of Life Sciences

Head of the Molecular Biochemistry Laboratory at University of Mumbai

University of Mumbai
India

Dr. Ahmad Ali is currently working as Assistant Professor (Senior) in the Department of Life Sciences, University of Mumbai, Mumbai, India. Earlier he worked in the National Institute of Pharmaceutical Education and Research (NIPER). He studied at Jamia Hamdard, New Delhi for MSc Biochemistry and at University of Mumbai for PhD degree in Life Sciences. He has over 18 years of teaching and research experience. Presently he is heading the Molecular Biochemistry Laboratory in the Department where he is supervising MSc and PhD students. His areas of research are Protein and DNA Biochemistry with special contributions on Glycation of biomolecules, DNA damage, antiglycating and anti-aggregating properties of natural products. He has also made significant contributions in the area of traditional medicines and their therapeutic applications especially antidiabetic and anti-inflammatory potentials. Cyanobacterial systems are another thrust area in his lab where researchers are exploring various applications of these organisms in the field of bioremediation, cosmetics and health benefits. He has received several extramural grants from Government and private funding agencies. He has collaborators from National and International laboratories. He is also a recipient of EMBO Travel Grant to attend European Molecular Biology Organization (EMBO) Research Course and CSIR Travel grant to attend International conference. Recently he was invited for Erasmus Mobility program by the University of Agricultural Science and Veterinary Medicine at Cluj-Napoca, Romania. He is serving as the Reviewer and member of Editorial board of various international journals like Chemosphere, Frontiers in Plant Sciences and Microbiology, Glycobiology, International Journal of Biological Macromolecules, and other journals of Elsevier, Frontiers, Springer etc. He has contributed more than 75 research articles in peer-reviewed national and international journals. He is also author of one book and more than 30 book chapters from Springer, Taylor & Francis and Elsevier publishing houses. He has presented his work in many international and national conferences as Invited Speakers and Resource persons. He has also worked as a Member of the organizing committee for many of these conferences. Recently he was invited by the University of Debrecen, Debrecen, Hungary as a visiting Faculty to interact with the researchers from the University.

Faiz ARITH

Manager at the Centre of Telecommunication Research and Innovation (CETRI)

Senior Lecturer and Head of the Micro and Nano Electronic Research Group at UTeM

Universiti Teknikal Malaysia Melaka
Malaysia

Dr Faiz Arith received the B. Eng. in Electrical & Electronic Engineering from the University of Fukui, Japan. Then, he obtained an M.Sc in Microelectronic from the National University of Malaysia and subsequently a Ph.D. in Semiconductor Materials and Devices from Newcastle University, United Kingdom. Currently, he is the Manager of the Centre of Telecommunication Research and Innovation and the Head of the Micro and Nano Electronic Research Group at Universiti Teknikal Malaysia, Melaka, Malaysia. His main research interest is semiconductor materials and devices including silicon carbide power semiconductor devices, solar cells, advanced packaging and optoelectronics devices. He has authored three book chapters, and more than 50 articles, and has won several international innovation competitions. To date, more than 20 research grants with a total value of more than USD 900,000 have been successfully secured as a researcher. Of these, 3 grants are from international agencies, Semiconductor Components Industries LLC (USA) and the Royal Society of Chemistry (UK) where he is the lead researcher. In addition, he also serves on the Editorial Board of Engineering Research Express (ERX), IOP UK Publisher and the Journal of Telecommunication, Electronic and Computer Engineering (JTEC). Apart from that, he has been awarded the Senior Member level in IEEE. Dr Faiz Arith is the recipient of the Excellent Service Award in 2013 and 2021 and several academic prestigious awards

Prathap SINGH S

Assistant Professor at Department of Mechanical Engineering

St. Joseph's Institute of Technology
India

Dr. S. Prathap Singh is an accomplished researcher and educator specializing in mechanical engineering, with a strong focus on additive manufacturing, functionally graded materials, tribology, machining, and mathematical optimization. He is currently serving as an Assistant Professor in the Department of Mechanical Engineering at St. Joseph's Institute of Technology, Chennai.

With a Ph.D. from Anna University, his research revolves around the mechanical testing, characterization, tribological, and machining studies of functionally graded aluminum alloy A356 reinforced with silicon nitride. He has published 40 Scopus and Web of Science, and 9 Book Chapters extensively in high-impact international indexed journals and has a notable citation record.

Dr. Prathap Singh has guided several student research projects on advanced materials and manufacturing processes. He is an active reviewer for reputed journals and has delivered keynote lectures at international conferences. Additionally, he holds multiple patents and has contributed to consultancy projects. His professional memberships include ISTE and IAENG

Abdulaziz ATABANI

Research Associate at Green Technology Research Centre

Rising Star of Science Award Holder (2024)

Yuan Ze University
Taiwan

Dr. Abdulaziz Atabani is an accomplished researcher in the field of clean energy, recycling, and biofuels, with a proven track record of scholarly contributions and leadership. Born on May 22, 1983, in Jeddah, Saudi Arabia, Dr. Atabani holds Sudanese nationality and possesses an extensive academic and professional background. Dr. Atabani earned his PhD through the prestigious Bright Spark Scholarship at the University of Malaya, where he was engaged in innovative research for three years, contributing to the institution's recognition as a top global university. Over the past nine years, he has held a position as Assistant Professor in the Energy Division at Erciyes University, Türkiye, and is currently serving as a Research Associate Professor at Yuan Ze University's Green Technology Research Centre in Taiwan. His research focuses primarily on clean energy solutions, waste valorization, and the hydrogen economy. Dr. Atabani has published over 100 research papers in high-impact journals and has accumulated more than 18,477 citations, resulting in an H-index of 59 and an i10-index of 109. He has received accolades, including the Rising Star of Science Award in 2024 and recognition as a Highly Cited Researcher by Clarivate in multiple years. In addition to his extensive research portfolio, Dr. Atabani has significant teaching experience in thermodynamics and advanced energy technologies at both graduate and undergraduate levels. He has successfully supervised the completion of seven master's and two PhD students. His editorial roles include serving as an associate editor for the Process Safety and Environmental Protection journal and reviewing for various prestigious publications. With a vision for sustainable energy development, Dr. Atabani is a prominent figure in the academic community, dedicated to advancing knowledge and innovation in energy technologies.

Intan Helina HASAN

Co-founder at SPTech Sdn. Bhd

Researcher at Institute of Nanoscience and Nanotechnology

University of Putra Malaysia
Malaysia

She received bachelor's degree in electrical and computer engineering from Yokohama National University, Japan in 2005. She later obtained MSc. degree in Intelligent Systems and Robotics Engineering in 2014 and Ph.D. degree in Sensor Technology in 2018, both from Universiti Putra Malaysia (UPM), Malaysia.

She was a software engineer at Alps Electric (M) Sdn. Bhd., Negeri Sembilan, Malaysia from 2005 to 2009. In 2009, she has been appointed as a research officer with the Institute of Nanoscience and Nanotechnology (ION2), UPM. Her research interests include thick film technology in electron devices, which includes printed electronics, gas sensors and patch antennas. She is also passionate about commercialization of the research work, having co-founded a start-up company named SPTech Sdn. Bhd. alongside her mentor, Prof. Dr. Mohd. Nizar Hamidon.

Saravanan MUTHUPANDIAN

Professor at Saveetha Institute of Medical and Technical Sciences, India

Professor at Prince Fahad bin Sultan Chair for Biomedical Research

University of Tabuk / Saveetha University
Saudi Arabia / India

Dr. Saravanan Muthupandian has over 21 years of teaching and research experience, and he is ranked in the top 2% of scientists worldwide by Stanford University five consecutive years (2020-2024). Currently, he is a Professor at Prince Fahad bin Sultan Chair for Biomedical Research, Faculty of Applied Medical Sciences, University of Tabuk, Saudi Arabia & Department of Pharmacology, Saveetha University, SIMATS, Chennai, India since January 2021. He has Graduated in Microbiology, from Madurai Kamaraj University and Doctorate with Specialization in Medical Microbiology and Nanomedicine from Sathyabama University, India. Thereafter, He worked as a Post-Doctoral Researcher, Institute of drug Research, Hebrew University of Jerusalem Israel (2011-2012) focusing his research on Nano-biomaterials & their Biomedical Applications. Prior to his postdoc, he worked as an Assistant Professor (SG), SRM University, and Department of Biotechnology for six Years, from 2005 -2011. and After his post-doctoral research, he worked as Associate Professor, under the United nation development Program, Department of Medical Microbiology and Immunology, School of Medicine, Mekelle University, Ethiopia till January 2021. His Research Specialization: Antimicrobial Resistance (AMR) and Development of Novel biomaterials for Antimicrobial Resistance (AMR) & Cancer therapeutics. He has published more than 270 research papers including high impact Journal: The Lancet and Nature and Nature Medicine with more than 40000 citations and h-index of 76 and i10 index of 193. He has published Nine books and 35 book chapters. He has participated in more than 100 National and International conferences and Reviewers of more than 100 international peer-reviewed journals. Guest editor/ Editors for various reputed PubMed and Scopus indexed journals, in particular, He has an Associate editor in Frontiers in Pharmacology, Frontiers in Oncology and MDPI Functional Biomaterials and Medicinea. He was received many national and international funded projects. In particular, he has secured recently two funded projects Sanctioned totalling 1.5 Crore from the ICMR and DST, Government of India in 2023. He has received many fellowships and Awards notably, IET- Nanobiotechnology premium Awards two-times consecutively in the years 2019 and 2020, Indian Dental Association, Best Researcher Awards 2024, International Fellowship “Advanced Course on Diagnostics” Sponsored by LSH&TM & Fondation Mérieux, in France 2013, International Fellowship “Pertussis: biology, epidemiology and prevention” meeting Sponsored by Fondation Mérieux & WHO in France 2014, International Union of Microbiological Societies (IUMS) travel grant in 2015 to Canada, International Fellowship "Advanced Course on Antibiotics” (AdCAb) Sponsored by Institute of Pasteur and Fondation Mérieux France, 2016.

Zainab YUNUSA

Assistant Professor at Department of Electrical Engineering

University of Hafr Al Batin
Saudi Arabia

Zainab Yunusa has completed her PhD from Universiti Putra Malaysia, Malaysia. She has been working in the Department of Electrical Engineering, Bayero University Kano as a Senior Lecturer. She is currently an Assistant Professor in the Department of Electrical Engineering University of Hafr Al Batin Saudi Arabia. She has published many ISI indexed journals and presented papers in international conferences. Her research interests include Nanomaterials for electronics application and R.F microwave devices and applications.

Ashok Kumar NADDA

Assistant Professor at Department of Biotechnology and Bioinformatics

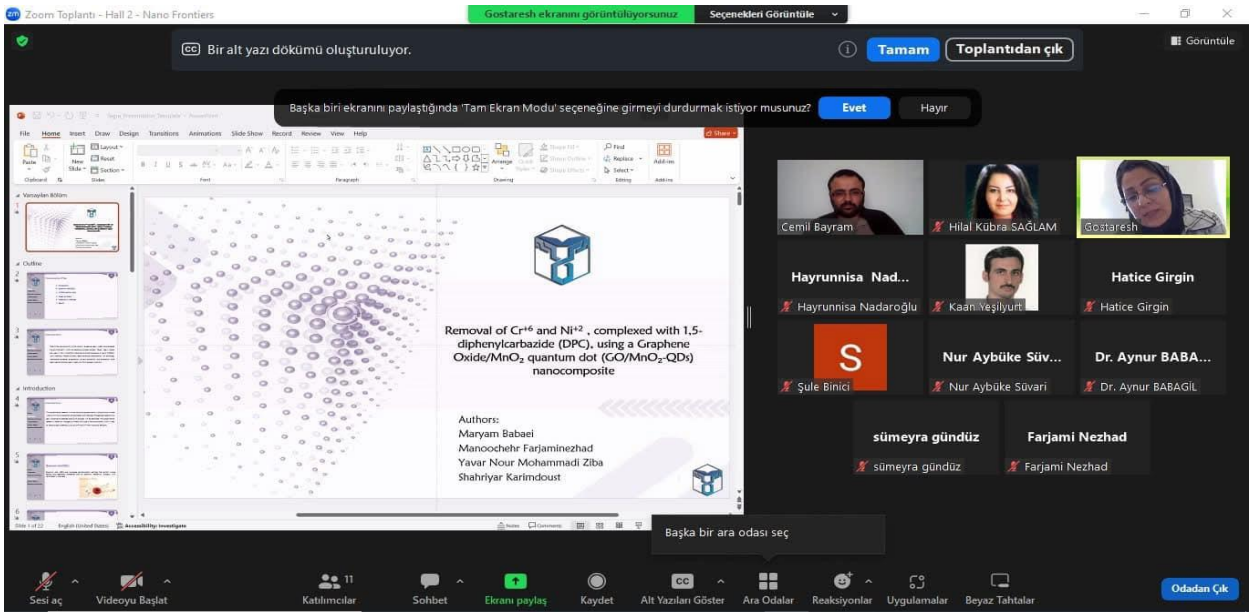
Jaypee University of Information Technology
India

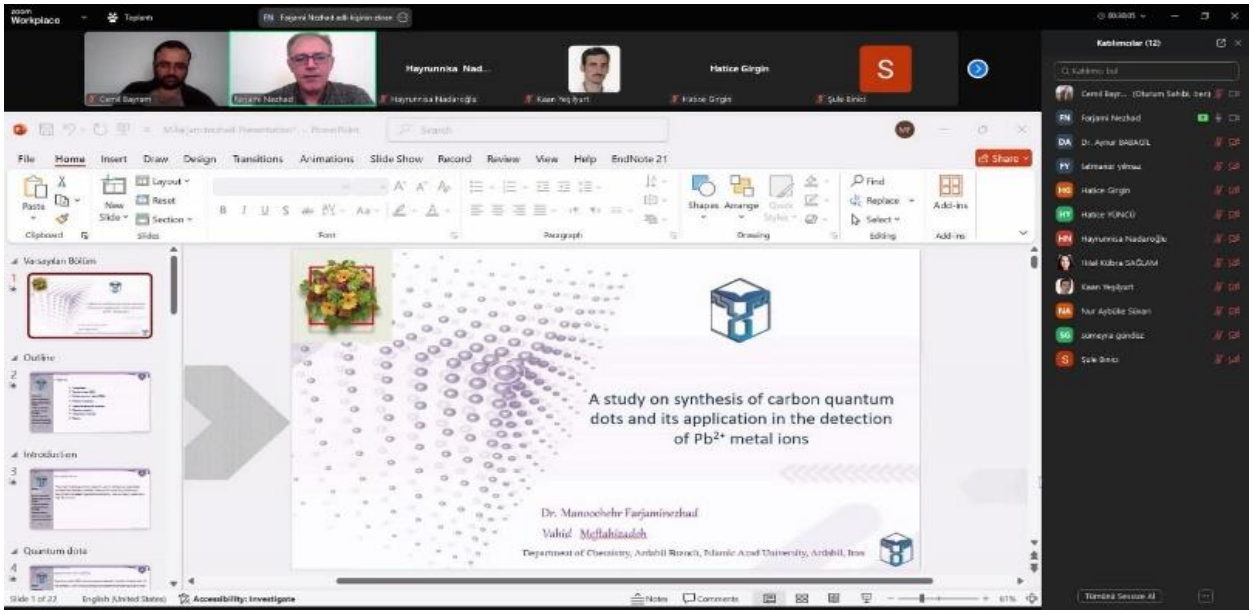
Dr. Ashok Kumar Nadda is working as an Assistant Professor in the Department of Biotechnology and Bioinformatics, Jaypee University of Information Technology, Waknaghat, Solan, Himachal Pradesh, India. He holds an extensive 'Research and Teaching' experience of more than 10 years in the field of microbial biotechnology, with research expertise focusing on various issues pertaining to 'nano-biocatalysis, microbial enzymes, biomass, bioenergy' and 'climate change. He holds International work experiences in South Korea, India, Malaysia, and People's Republic of China. He worked as a post-doctoral fellow in the State Key Laboratory of Agricultural Microbiology, Huazhong Agricultural University, Wuhan China. He also worked as a Brain Pool researcher/ Assistant Professor at Konkuk University, Seoul, South Korea. Dr. Ashok has published more than 215 scientific contributions in the form of research, review articles, books, book chapters and others at several platforms in various journals of international repute. The research output includes 140 research articles, 55 book chapters and 31 books. He is the main series editor of "Microbial Biotechnology for environment, energy and health" that publishing the books under Taylor and Francis, CRC Press USA. He is also a member of the editorial board and reviewer committee of the various journals of international repute. He has presented his research findings in more than 40 national/international conferences. He has attended more than 50 conferences/ workshops/colloquia/ seminars etc. in India and abroad. Dr. Ashok is also an active reviewer for many high-impact journals published by Elsevier, Springer Nature, ASC, RSC, and Nature Publishers. Currently, Dr. Ashok has h-index 44, i10 index 136 and 6000+ citation in Google scholar profile. His research works have gained broad interest through his highly-cited research publications, book chapters, conference presentations, and invited lectures.

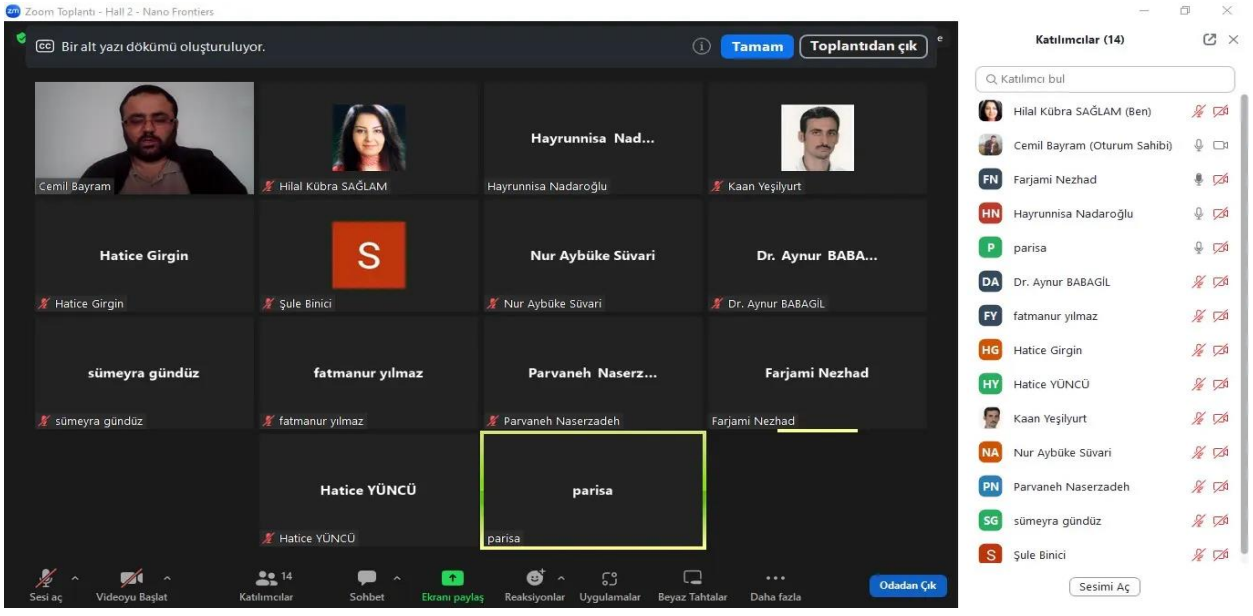
PHOTOGRAPHS FROM THE CONGRESS


TEKNİK BİLİMLER MESLEK YÜKSEKOKULU
Vocational College of Technical Sciences


BİLİMLER MESLEK YÜKSEKOKUL
nal College of Technical Sciences


Zoom Toplantı - Hall 2 - Nano Frontiers
Gostaresh ekranını görüntülüyorsunuz
Seçenekleri Görüntüle
Bir alt yazı dökümü oluşturuluyor.
Tamam
Toplantıdan çık
Görüntüle
Başka biri ekranını paylaştığında 'Tam Ekran Modu' seçeneğine girmeyi durdurmak istiyor musunuz?
Evet
Hayır
Removal of Cr+6 and Ni+2 , complexed with 1,5-diphenylcarbazide (DPC), using a Graphene Oxide/MnO2 quantum dot (GO/MnO2-QDs) nanocomposite
Authors:
Maryam Babaei
Manoochehr Farjaminezhad
Yavar Nour Mohammadi Ziba
Shahriyar Karimdoust
Cemil Bayram
Hilal Kübra SAĞLAM
Gostaresh
Hayrunnisa Nad...
Hayrunnisa Nadaroğlu
Kaan Yeşilyurt
Hatice Girgin
Hatice Girgin
Şule Binici
Nur Aybüke Süv...
Nur Aybüke Süvari
Dr. Aynur BABA...
Dr. Aynur BABAGİL
sümeyra gündüz
sümeyra gündüz
Farjami Nezhad
Farjami Nezhad
Başka bir ara odası seç
Sesi aç
Videoyu Başlat
Katılımcılar
Sohbet
Ekranı paylaş
Kaydet
Alt Yazıları Göster
Ara Odalar
Reaksiyonlar
Uygulamalar
Beyaz Tahtalar
Odadan Çık


A study on synthesis of carbon quantum dots and its application in the detection of Pb2+ metal ions
Dr. Manoochehr Farjaminezhad
Vahid Mollahizadeh
Katılımcılar (12)


Zoom Toplantı - Hall 2 - Nano Frontiers
Bir alt yazı dökümü oluşturuluyor.
Tamam
Toplantıdan çık
Katılımcılar (14)
Katılımcı bul
Hilal Kübra SAĞLAM (Ben)
Cemil Bayram (Oturum Sahibi)
Farjami Nezhad
Hayrunnisa Nadaroğlu
parisa
Dr. Aynur BABAGİL
fatmanur yılmaz
Hatice Girgin
Hatice YÜNCÜ
Kaan Yeşilyurt
Nur Aybüke Süvari
Parvaneh Naserzadeh
sümeyra gündüz
Şule Binici
Sesimi Aç
Cemil Bayram
Hilal Kübra SAĞLAM
Hayrunnisa Nad...
Hayrunnisa Nadaroğlu
Kaan Yeşilyurt
Hatice Girgin
Hatice Girgin
Şule Binici
Nur Aybüke Süvari
Nur Aybüke Süvari
Dr. Aynur BABA...
Dr. Aynur BABAGİL
sümeyra gündüz
sümeyra gündüz
fatmanur yılmaz
fatmanur yılmaz
Parvaneh Naserz...
Parvaneh Naserzadeh
Farjami Nezhad
Farjami Nezhad
Hatice YÜNCÜ
Hatice YÜNCÜ
parisa
parisa
Sesi aç
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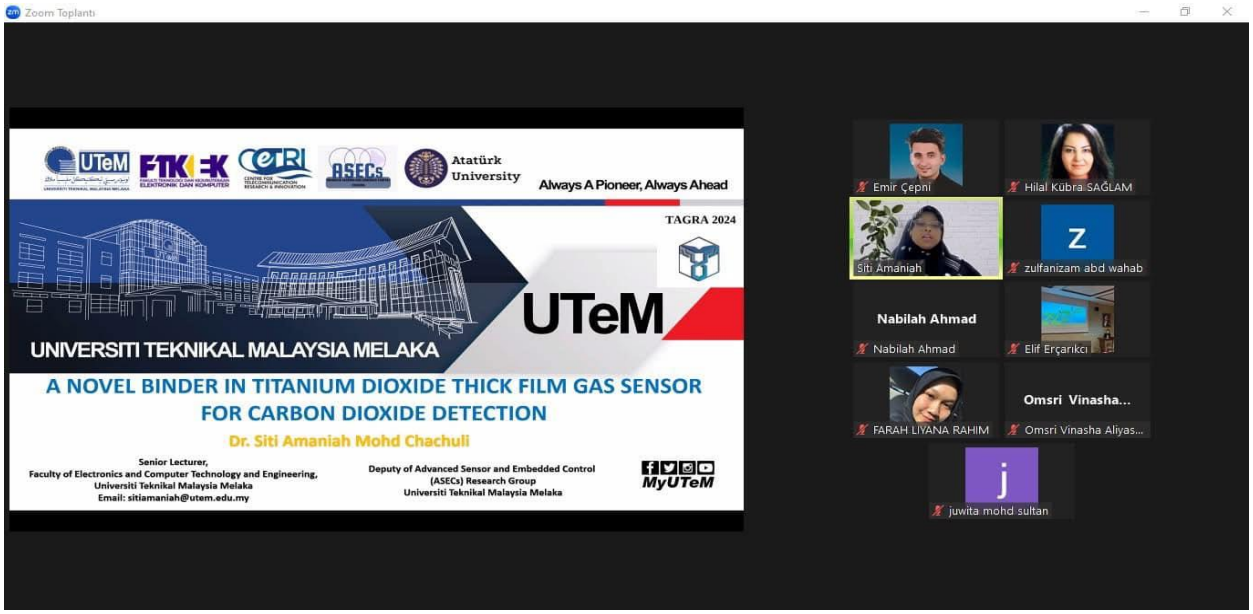
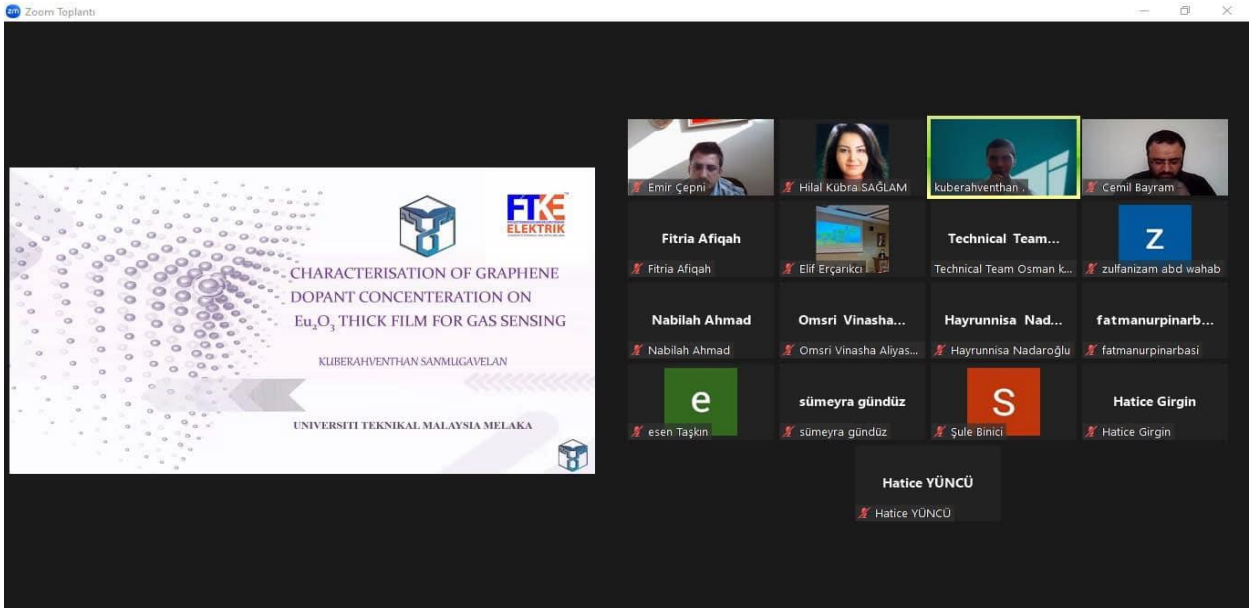
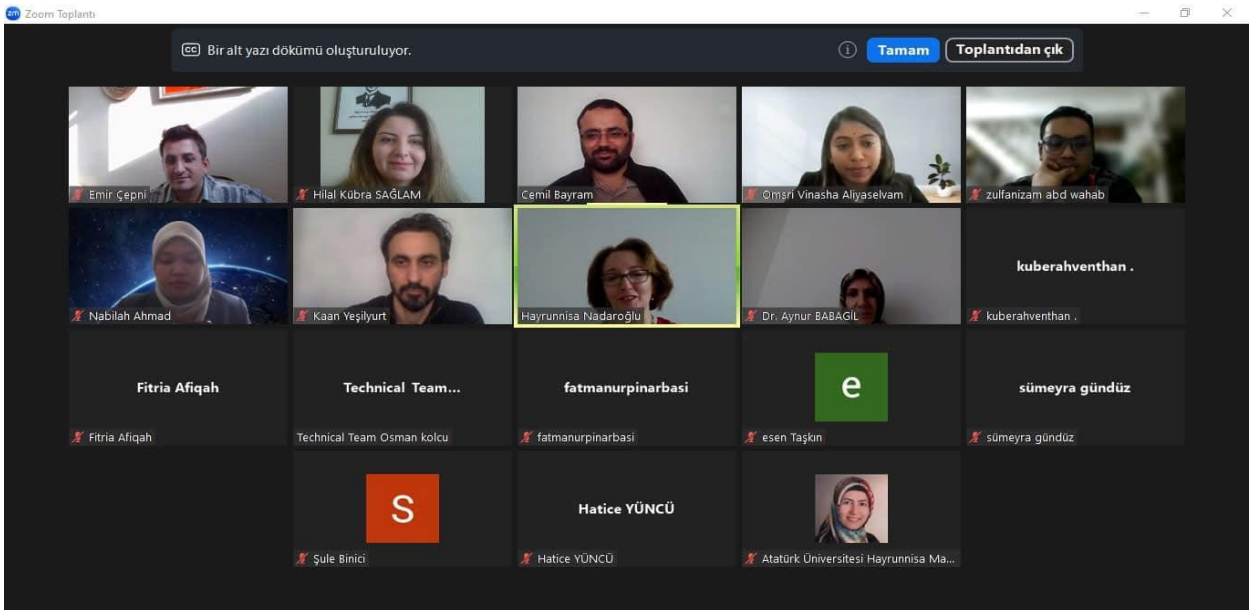
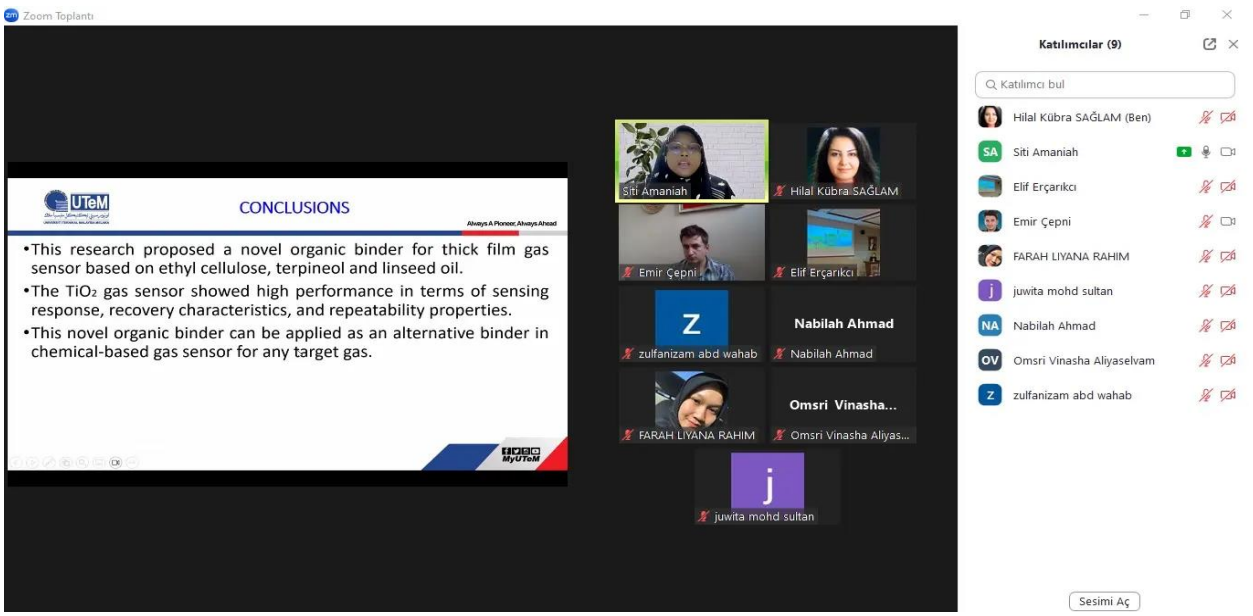
Reaksiyonlar
Uygulamalar
Beyaz Tahtalar
Daha fazla
Odadan Çık

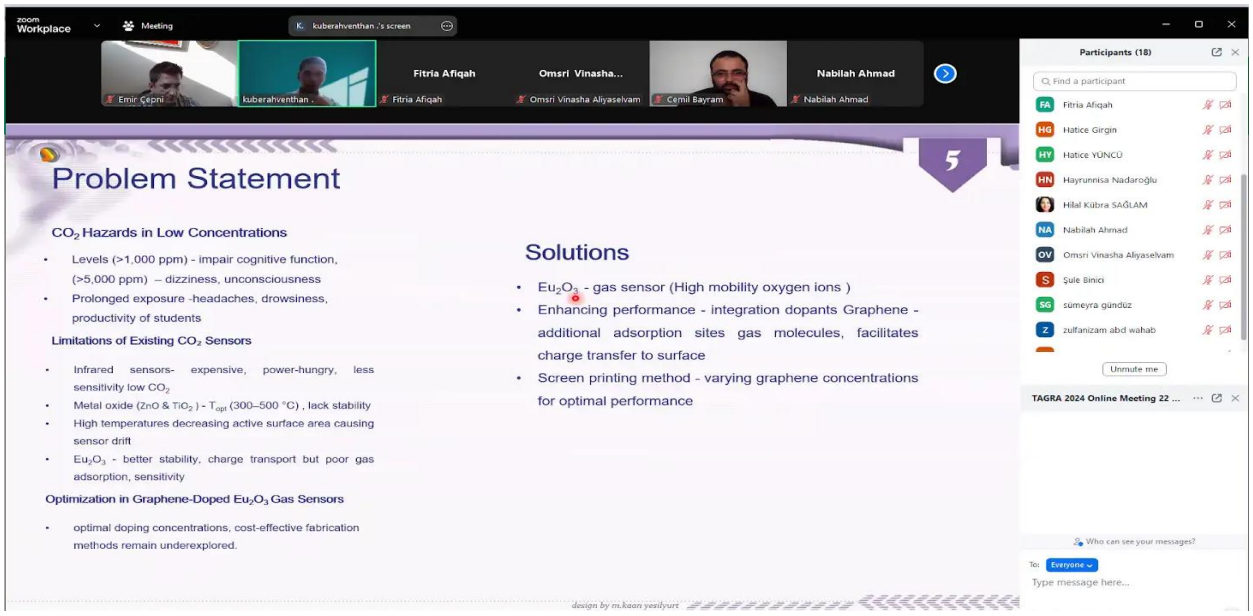

Zoom Toplantı
Atatürk University
Always A Pioneer, Always Ahead
TAGRA 2024
UTeM
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
A NOVEL BINDER IN TITANIUM DIOXIDE THICK FILM GAS SENSOR FOR CARBON DIOXIDE DETECTION
Dr. Siti Amaniah Mohd Chachuli
Senior Lecturer,
Faculty of Electronics and Computer Technology and Engineering,
Universiti Teknikal Malaysia Melaka
Email: sitiamaniah@utem.edu.my
Deputy of Advanced Sensor and Embedded Control (ASECs) Research Group
Universiti Teknikal Malaysia Melaka
MyUTeM
Emir Çepni
Hilal Kübra SAĞLAM
Siti Amaniah
zulfanizam abd wahab
Nabilah Ahmad
Elif Erçarıkcı
FARAH LIYANA RAHIM
Omsri Vinasha...
Omsri Vinasha Aliyas...
juwita mohd sultan


Zoom Toplantı
CHARACTERISATION OF GRAPHENE DOPANT CONCENTERATION ON Eu_2O_3 THICK FILM FOR GAS SENSING
KUBERAHVENTHAN SANMUGAVELAN
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
Emir Çepni
Hilal Kübra SAĞLAM
kuberahventhan .
Cemil Bayram
Fitria Afiqah
Elif Erçarıkcı
Technical Team...
Technical Team Osman k...
zulfanizam abd wahab
Nabilah Ahmad
Omsri Vinasha...
Omsri Vinasha Aliyas...
Hayrunnisa Nad...
Hayrunnisa Nadaroğlu
fatmanurpinarb...
fatmanurpinarbasi
esen Taşkın
sümeyra gündüz
Şule Binici
Hatice Girgin
Hatice YÜNCÜ


Zoom Toplantı
Bir alt yazı dökümü oluşturuluyor.
Tamam
Toplantıdan çık
Emir Çepni
Hilal Kübra SAĞLAM
Cemil Bayram
Omsri Vinasha Aliyaselvam
zulfanizam abd wahab
Nabilah Ahmad
Kaan Yeşilyurt
Hayrunnisa Nadaroğlu
Dr. Aynur BABAGİL
kuberahventhan .
Fitria Afiqah
Technical Team...
Technical Team Osman kolcu
fatmanurpinarbasi
esen Taşkın
sümeyra gündüz
Şule Binici
Hatice YÜNCÜ
Atatürk Üniversitesi Hayrunnisa Ma...


Giriş yapın
Görüntüle
Emir Çepni
Hayrunnisa Nadaroğlu
Cemil Bayram
Omsri Vinasha Aliyaselvam
zulfanizam abd wahab
Nabilah Ahmad
Kaan Yeşilyurt
Hilal Kübra SAĞLAM
Dr. Aynur BABAGİL


Zoom Toplantı
CONCLUSIONS
Always A Pioneer, Always Ahead
•This research proposed a novel organic binder for thick film gas sensor based on ethyl cellulose, terpineol and linseed oil.
•The TiO2 gas sensor showed high performance in terms of sensing response, recovery characteristics, and repeatability properties.
•This novel organic binder can be applied as an alternative binder in chemical-based gas sensor for any target gas.
Siti Amaniah
Hilal Kübra SAĞLAM
Emir Çepni
Elif Erçarıkcı
Nabilah Ahmad
zulfanizam abd wahab
Omsri Vinasha...
FARAH LIYANA RAHIM
juwita mohd sultan
Katılımcılar (9)
Katılımcı bul
Hilal Kübra SAĞLAM (Ben)
Siti Amaniah
Elif Erçarıkcı
Emir Çepni
FARAH LIYANA RAHIM
juwita mohd sultan
Nabilah Ahmad
Omsri Vinasha Aliyaselvam
zulfanizam abd wahab
Sesimi Aç


Meeting
Fitria Afiqah
Omsri Vinasha...
Nabilah Ahmad
Participants (18)
Problem Statement
5
CO2 Hazards in Low Concentrations
Levels (>1,000 ppm) - impair cognitive function, (>5,000 ppm) – dizziness, unconsciousness
Prolonged exposure -headaches, drowsiness, productivity of students
Limitations of Existing CO2 Sensors
Infrared sensors- expensive, power-hungry, less sensitivity low CO2
Metal oxide (ZnO & TiO2) - Topt (300–500 °C) , lack stability
High temperatures decreasing active surface area causing sensor drift
Eu2O3 - better stability, charge transport but poor gas adsorption, sensitivity
Optimization in Graphene-Doped Eu2O3 Gas Sensors
optimal doping concentrations, cost-effective fabrication methods remain underexplored.
Solutions
Eu2O3 - gas sensor (High mobility oxygen ions)
Enhancing performance - integration dopants Graphene - additional adsorption sites gas molecules, facilitates charge transfer to surface
Screen printing method - varying graphene concentrations for optimal performance
TAGRA 2024 Online Meeting 22 ...
Unmute me
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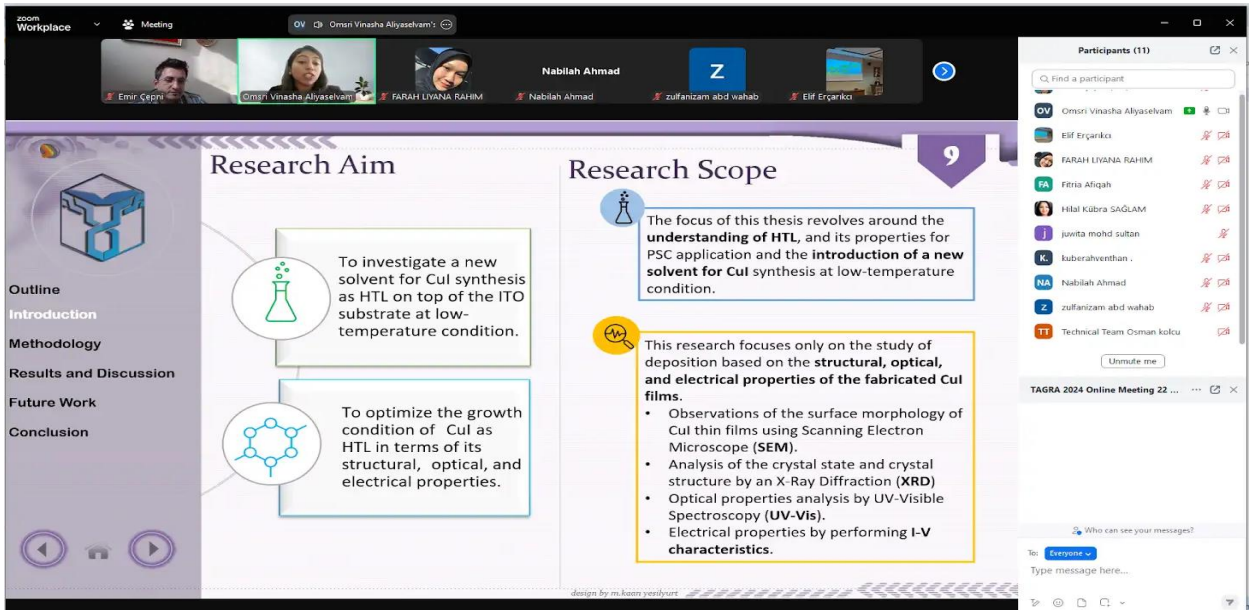
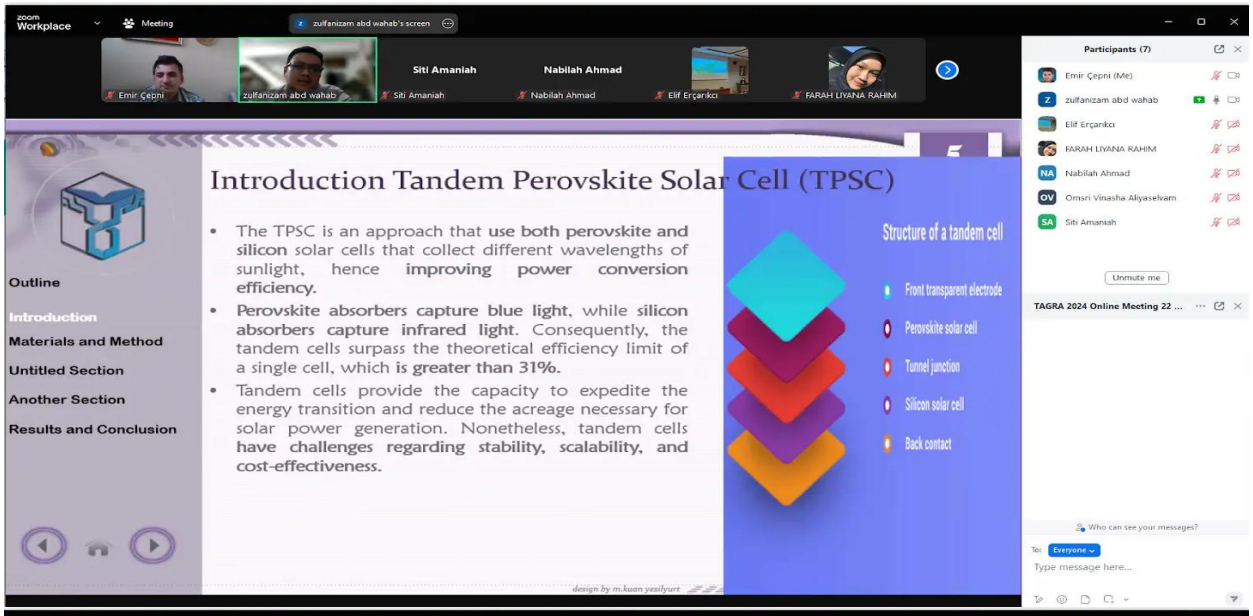
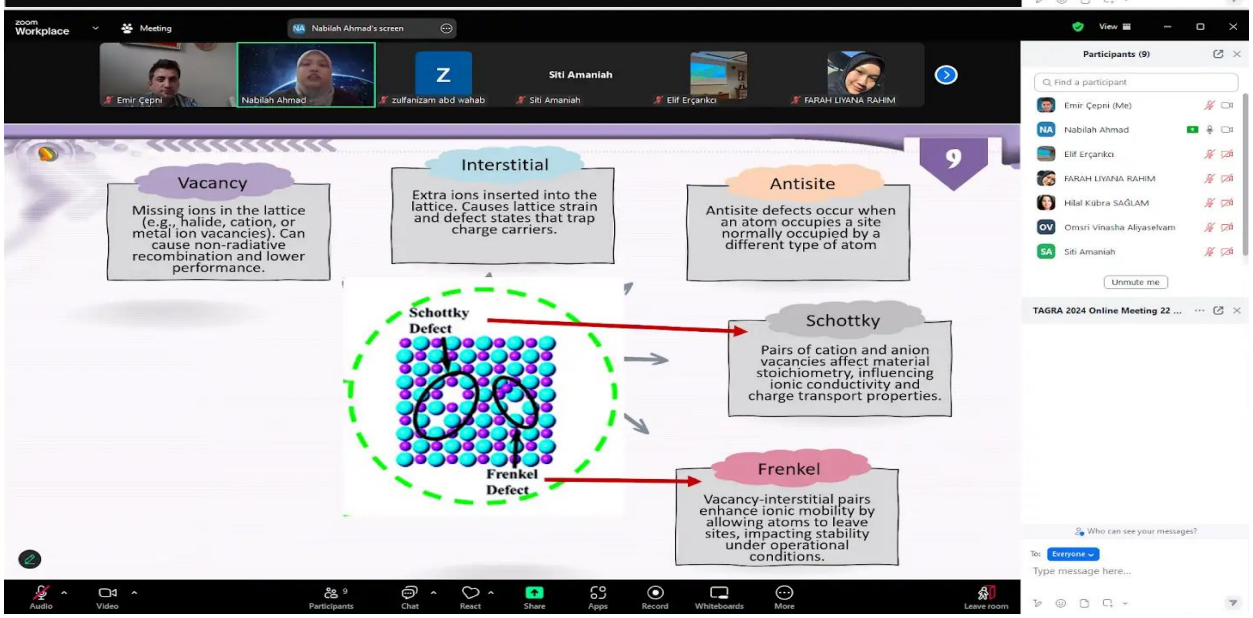
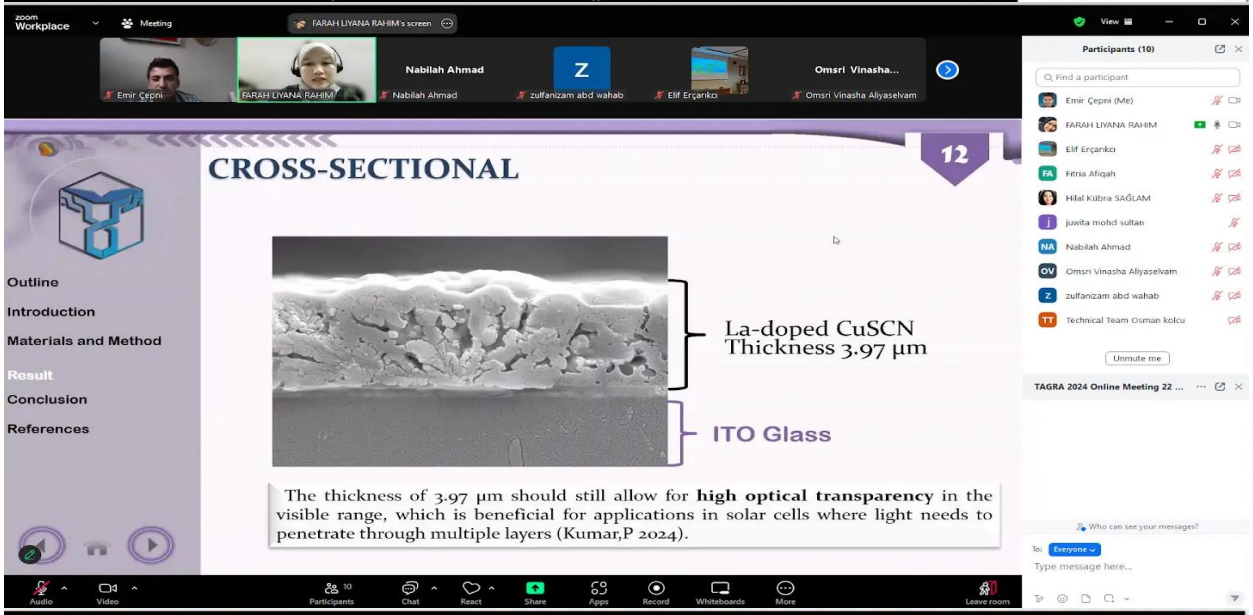
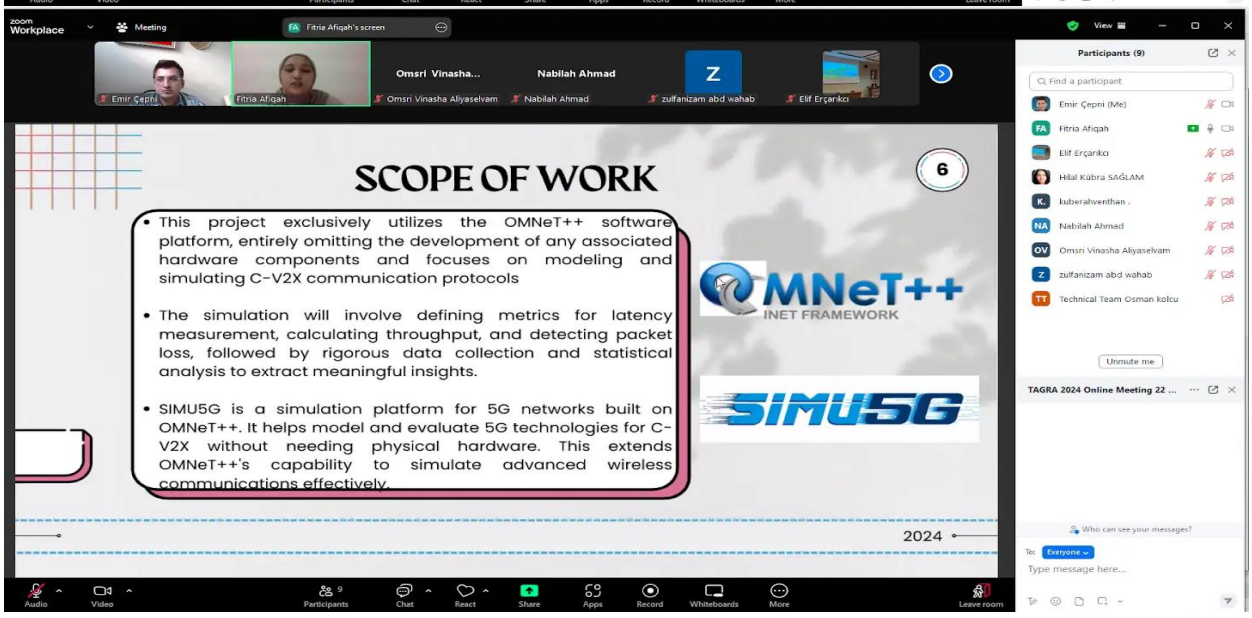

Research Aim
To investigate a new solvent for CuI synthesis as HTL on top of the ITO substrate at low-temperature condition.
To optimize the growth condition of CuI as HTL in terms of its structural, optical, and electrical properties.
Research Scope
The focus of this thesis revolves around the understanding of HTL, and its properties for PSC application and the introduction of a new solvent for CuI synthesis at low-temperature condition.
This research focuses only on the study of deposition based on the structural, optical, and electrical properties of the fabricated CuI films.
Observations of the surface morphology of CuI thin films using Scanning Electron Microscope (SEM).
Analysis of the crystal state and crystal structure by an X-Ray Diffraction (XRD)
Optical properties analysis by UV-Visible Spectroscopy (UV-Vis).
Electrical properties by performing I-V characteristics.
Outline
Introduction
Methodology
Results and Discussion
Future Work
Conclusion


Introduction Tandem Perovskite Solar Cell (TPSC)
The TPSC is an approach that use both perovskite and silicon solar cells that collect different wavelengths of sunlight, hence improving power conversion efficiency.
Perovskite absorbers capture blue light, while silicon absorbers capture infrared light. Consequently, the tandem cells surpass the theoretical efficiency limit of a single cell, which is greater than 31%.
Tandem cells provide the capacity to expedite the energy transition and reduce the acreage necessary for solar power generation. Nonetheless, tandem cells have challenges regarding stability, scalability, and cost-effectiveness.
Structure of a tandem cell
Front transparent electrode
Perovskite solar cell
Tunnel junction
Silicon solar cell
Back contact
Outline
Introduction
Materials and Method
Untitled Section
Another Section
Results and Conclusion


Vacancy
Missing ions in the lattice (e.g., halide, cation, or metal ion vacancies). Can cause non-radiative recombination and lower performance.
Interstitial
Extra ions inserted into the lattice. Causes lattice strain and defect states that trap charge carriers.
Antisite
Antisite defects occur when an atom occupies a site normally occupied by a different type of atom
Schottky Defect
Frenkel Defect
Schottky
Pairs of cation and anion vacancies affect material stoichiometry, influencing ionic conductivity and charge transport properties.
Frenkel
Vacancy-interstitial pairs enhance ionic mobility by allowing atoms to leave sites, impacting stability under operational conditions.


OBJECTIVE
01
To investigate and determine the Quality of Service (QoS) in 5G
02
To analyze the QoS parameters (throughput, delay and packet loss) in 5G network using Simu5G OMNeT++


CROSS-SECTIONAL
12
Outline
Introduction
Materials and Method
Result
Conclusion
References
La-doped CuSCN
Thickness 3.97 µm
ITO Glass
The thickness of 3.97 µm should still allow for high optical transparency in the visible range, which is beneficial for applications in solar cells where light needs to penetrate through multiple layers (Kumar,P 2024).


SCOPE OF WORK
6
This project exclusively utilizes the OMNeT++ software platform, entirely omitting the development of any associated hardware components and focuses on modeling and simulating C-V2X communication protocols
The simulation will involve defining metrics for latency measurement, calculating throughput, and detecting packet loss, followed by rigorous data collection and statistical analysis to extract meaningful insights.
SIMU5G is a simulation platform for 5G networks built on OMNeT++. It helps model and evaluate 5G technologies for C-V2X without needing physical hardware. This extends OMNeT++'s capability to simulate advanced wireless communications effectively.
OMNeT++
INET FRAMEWORK
SIMU5G
2024

ABSTRACTS

KEYNOTE SPEECHES

Emerging Polymer-based 3-D Bioprinted Nanomaterials for Chronic Wound Healing

Saravanan MUTHUPANDIAN[1]

1 Prince Fahad bin Sultan Chair for Biomedical Research, Faculty of Applied Medical Sciences, University of Tabuk, Tabuk, Saudi Arabia

Corresponding *saravananm.sdc@saveetha.com*

Chronic wounds are a serious issue in modern healthcare, frequently resulting in prolonged patient suffering and increased healthcare expenses. Recent advances in 3D bioprinting technology have created new opportunities for development of novel therapeutic techniques. This talk addresses the potential of polymer-based drug-loaded nanoparticles developed via 3D bioprinting for chronic wound healing applications. We hope to construct scaffolds that provide structural support as well as controlled delivery of therapeutic drugs by combining biocompatible polymers and nanomaterials. The distinct features of polymer-based nanoparticles improve treatment loading capacity and release patterns, facilitating localized treatment while reducing systemic side effects. This study emphasizes 3D bioprinting's transformational significance in regenerative medicine, as well as its potential for resolving the challenges of chronic wound management. Future research will concentrate on improving the formulation and determining the in vivo efficacy of these drug-loaded nanomaterials in clinical settings.

Keywords:

Chronic wounds healing, 3D Bioprinting, Nanomaterials, Polymer

Hydrogen Energy & Economy: Paving the Path to a Sustainable and Low-Carbon Future

Abdulaziz ATABANI[1]

[1] Yuan Ze University, Taiwan

Corresponding *aeatabani@gmail.com*

In the context of achieving carbon neutrality, the call for clean fuel alternatives to support the decarbonization of various energy sectors has been growing steadily. Among many potential alternatives, Hydrogen (H2) energy is expected to play a vital role in the energy transition. This is attributed to its potential to reduce the harmful emissions besides its high energy content (Gravimetric). The H2 economy is rapidly becoming a vital component of global efforts to transition to cleaner and more sustainable energy systems. Economic data show how quickly the markets for Green Hydrogen (GH2) are growing. The global market for GH2 was estimated to be worth 0.3*billionin*2020*andisexpectedtoreach*10.2 billion by 2027, growing at a Compound Annual Growth Rate (CAGR) of 54.7%. In this talk, the advantages of H2, H2 production technologies, H2 storage, challenges of the H2 energy and economy, GH2, applications of H2 and overview of fuel cells and types will be presented.

Keywords:

Hydrogen energy, Hydrogen production technologies, Hydrogen storages, Fuel cells

Nanobiocatalysis for Environmental Sustainability and Commercial Products Synthesis

Ashok Kumar NADDA[1]

[1] Jaypee University of Information Technology

Corresponding *ashok.nadda09@gmail.com*

One of the major problems brought on by excessive carbon dioxide (CO2) emissions into the atmosphere is global warming. Many governmental and non-governmental organizations support the transition from fossil fuels to clean energy sources in order to lower CO2 emissions and shield the planet from the catastrophic consequences of global warming. Additionally, research is being conducted globally to identify a powerful and environmentally benign process that directly transforms CO2 released by industries and automobiles into useful products. Therefore, some microorganism including bacteria and algae are being utilized to reduce the rising CO2 levels by enzyme catalysis. One of the well known biocatalysts, carbonic anhydrase (CA) contributes to the sequestration of CO2. The enzyme is present in bacteria, human beings and also in algae. This is one of the metallozyme containing zinc in its active center. CA transforms the CO2 into bicarbonates, which, when calcium ions are present, can be further transformed into CaCO3. There are various benefits of using CA to transform CO2 from flue gas into environmentally safe, thermodynamically stable calcium carbonate. Various nonmaterial and solvents have also been used to absorb the CO2 and convert the same into various useful products. Thus the amalgamation of nonmaterial and enzyme to prepare a nanobiocatlyst would prove to be more effective method to sequester and convert the CO2 into commercial products. In addition, algae using Calvin Benson cycle fix almost double its weight of CO2. It contains ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco), the enzyme responsible for catalyzing the entry of CO2. Algae are able to grow in varied type of climate and are rich in metabolites which further enhance its use as potential candidate for CO2 sequestration.

Keywords:

Biocatalyst, nanomaterials, algae, enzymes, carbondioxide, climate change, sustainability

Fabrication and Characterization of Functionally Graded A356 Alloy and Its Composite

Prathap SINGH S[1]

[1] Department of Mechanical Engineering, St. Joseph's Institute of Technology, Chennai, India.

Corresponding *prathap.singh50@gmail.com*

The primary goal of the study is to create an Aluminium A356 Functionally Graded alloy (A356 FG alloy) by vertical centrifugal casting after stir casting. After T6 heat treatment at various aging temperatures, the optimal aging temperature was determined to be 165℃. Using Vickers' microhardness instrument, the hardness was determined to be 50% greater in the higher hardness zone (Outer zone) for the sample aged at 165℃ compared to the as-cast Aluminum functionally graded alloy. Also, the tensile strength evaluation showed the highest tensile strength of 101.487 N/mm² in the 165℃ aged higher hardness zone. The microstructure was analyzed, and it was discovered that the heat-treated condition contained spheroidized eutectic silicon and magnesium silicide particles. The secondary investigation spatially dispersed high-hardness silicon nitride particles with Aluminium A356 alloy via vertical centrifugal casting to reinforce A356 with 10 wt.% Si_3N_4 Functionally Graded Composite (A356-10 wt.% Si_3N_4 FG Composite). On the fabricated FG composite, the optimal T6 heat treatment conditions obtained from the A356 FG alloy were implemented. Using Vicker's microhardness instrument, the hardness behavior was assessed. It was determined that the exterior surface exhibited a superior microhardness of 182 HV, which constituted a 73% increase compared to the interior surface. Also, the tensile strength evaluation showed the highest tensile strength of N/mm² in the wealthy ceramic zone. The phase analysis and particle dissemination of the gradient were validated in the radial direction.

Keywords:

Aluminium functionally graded composites, Centrifugal Casting technique, Vicker's microhardness

Silicon Carbide MOSFETs: From Devices to Advanced Packaging

Faiz ARITH[1]

1 Technical University of Malaysia Malacca

Corresponding *faiz.arith@utem.edu.my*

Silicon Carbide (SiC) Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs) have emerged as a key technology for high-power, high-efficiency applications, particularly in electric vehicles, renewable energy systems, and industrial motor drives. SiC's superior material properties, such as wide bandgap, high thermal conductivity, and high breakdown voltage, allow it ideal for operating in harsh conditions and enabling faster-switching speeds, higher efficiencies, and reduced system size compared to traditional silicon-based devices. This paper explores the development of SiC MOSFETs, focusing on their device physics, performance characteristics, and advancements in fabrication technologies. It further examines the challenges and innovations in advanced packaging solutions, essential for maximizing the potential of SiC MOSFETs in practical applications. Integrating advanced packaging techniques such as power modules, thermal management strategies, and high-density interconnects is critical for ensuring optimal performance, reliability, and cost-effectiveness of SiC power devices in next-generation power electronic systems. This work provides a detailed outlook on the role of SiC MOSFETs and advanced packaging in transforming power electronics for a wide range of industries through a comprehensive review of the current state and future trends.

Keywords:

Silicon Carbide MOSFET, Advanced Packaging, Electric Vehicle, Power Modules

Revolutionizing the Electronics Industry Using Nanotechnology

Zainab YUNUSA[1]

1 University of Hafr Al Batin

Corresponding *zee2yunusa@gmail.com*

Nanotechnology involves the manipulation of materials in the nanometer scale from 1 to 100 nm. Due to its numerous advantages which includes miniaturization and enhanced energy efficiency it has been deployed in many industrial applications including electronics, medicine, energy, environment, materials and consumer products. In this paper, our focus will be deployment of nanotechnology to revolutionize the electronics industry. The miniaturization of electronic devices and advances in nanomaterial research and production has made the application of functional nanomaterials at the forefront of scientific and industrial attention. Recent advances in carbon nanomaterials such as carbon nanotubes, graphene, graphene nanoribbons (GNRs) and other green carbon nanomaterials from organic sources such as rice husk and carbon charcoal have shown excellent results when deployed in electronics, bioelectronics, optoelectronics and photonic applications. In this paper we will present some case studies when these materials were used in gas sensor and microstrip patch antenna applications that proved to show excellent results with improved performance.

Keywords:

Nanomaterials, nanoelectronics, sensors, antennas

CNT-ferrite Nanohybrid Materials for Electromagnetic Wave Applications

Intan Helina HASAN[1], Ismayadi ISMAIL[1], Mohd Nizar HAMIDON[1]

[1] University of Putra Malaysia

Corresponding *i_helina@upm.edu.my*

The development of advanced materials for electromagnetic wave applications, including microstrip patch antennas and electromagnetic wave absorbers, has become pivotal in addressing the growing demand for efficient and compact devices. Carbon nanotube (CNT)-ferrite nanohybrids have emerged as promising candidates, offering unique synergies between the high conductivity of CNTs and the excellent magnetic properties of ferrites. This talk delves into the synthesis, characterization, and application of CNT-ferrite nanohybrid materials, with a focus on their performance in electromagnetic wave technologies. Drawing insights from recent advancements, such as the use of Yttrium Iron Garnet (YIG) and Nickel-Zinc Ferrite (NZF) thick films as substrates for microstrip patch antennas, we explore how these hybrid materials enhance bandwidth, resonance frequency, and absorption capabilities. Innovative techniques, including chemical vapor deposition and utilization of eco-friendly precursors like waste cooking oil and linseed oil, have facilitated the scalable production of these materials while maintaining optimal rheological properties for thick film pastes. Furthermore, hybridization strategies, such as integrating coiled CNTs with ferrites, have demonstrated significant improvements in radar absorption and natural resonance frequencies. By bridging material science and microwave engineering, CNT-ferrite nanohybrids are positioned to revolutionize electromagnetic wave applications, offering lightweight, flexible, and highly efficient solutions. This presentation aims to provide a comprehensive overview of current research trends, highlighting key challenges and future directions in the development of CNT-ferrite nanohybrids for next-generation electromagnetic technologies.

Keywords:

Carbon nanotube, Ferrite, Nanohybrid, Patch antenna, Radar absorber

Anti-inflammatory Potential of Some Commonly Used Plants in Unani Medicine

Ahmad ALI[1]

[1] University of Mumbai

Corresponding *ahmadali@mu.ac.in*

Osteoarthritis affects millions of people globally. There are multiple factors contributing towards the onset and progression of this condition. Anti-inflammatory drugs prove to be beneficial in providing relief to the patients. However these drugs have their own side effects and cause adverse effects. Alternative and traditional medicines have provided some breakthrough as therapeutic approach for these chronic conditions. Unani system of medicine is based on the traditional medicines approach brought to India by Arabs who developed this system of medicine adapting the knowledge from Greek literature. This medicine system has evolved as a reliable approach and accepted since centuries. In this study we have characterized the health promoting benefits of several plants which have been used for treatment of osteoarthritis. We have analyzed the phytochemical composition, antioxidant properties and anti-inflammatory potential of different extracts of these plants. Some plants showed the presence of high amount of phenolics and flavonoids. A few of them had very high antioxidant potential. A formulation was prepared using a prescribed mixture of these plants and its toxicity was analyzed using wistar rats as per the OECD guidelines. The anti-inflammatory potential was also analyzed for the aqueous formulation which showed suppression of pro-inflammatory cytokines and increased amount of anti-inflammatory cytokines in the serum sample of rats. Further characterization will reveal the generation expression of these cytokines.

Keywords:

Anti-inflammatory, Antioxidant, Cytokines, Unani medicine, Toxicity

In-Materio Physical Reservoir Devices based on Random Network of Nanomaterials for Future Autonomous Systems

Hirofumi TANAKA[1]

[1] Kyushu Institute of Technology, Research Center for Neuromorphic AI Hardware

Corresponding *tanaka@brain.kyutech.ac.jp*

In recent years, the superior computational power of deep learning based on software has been widely recognized, and the practical applications of artificial intelligence are rapidly expanding. On the other hand, the hardware for replacing to such artificial intelligence (AI) algorithms is facing the physical limits of scaling in silicon CMOS technology, and performance improvement is expected to hit the ceiling. For this reason, there is a growing interest in hardware technologies that physically implement artificial neural networks (ANNs), neuromorphic or brainmorphic information processing systems, and the applications (hereafter referred as AI systems in this paper), as well as new materials and devices. A critical difference between the presently required device functionality and that in conventional computational systems is the use of dynamics. By cleverly using nanomaterials' nonlinearity and network structure, devices that spontaneously generate pulses, noise, and other physical phenomena are expected to be realized to utilize for the AI hardware. These devices will enable drastically lower power consumption and higher integration of AI systems. In the learning process of ANNs, it is necessary to constantly change and store the weights of the weighted sum (sum-of-products) part. In our research center, we have been working on materials that can complement CMOS for AI systems by using molecules and nanocarbon materials, and further, we are trying to apply them to autonomous AI robots. This paper introduces these nanomaterials and networks' formation as AI devices, the key points of the devices' functionalization, application to robots, and other recent research results.

Keywords:

Network of Nanomaterials, AI hardware

ORAL PRESENTATIONS

Assessment of Different Solar Cell Technologies for Sustainability Indicators

Muhammet Kaan YEŞILYURT[1]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *kaan.yesilyurt@atauni.edu.tr*

Although solar energy is one of the most promising renewable energy sources, and is considered infinite when compared to human needs, many factors such as low efficiency, large area requirements and high costs limit solar energy systems from being a suitable option to meet energy needs. In the last half century, new approaches have been developed and new research has been conducted on methods of generating electricity from solar energy. As a result of research conducted during this period, the efficiency of existing solar cell technologies has been increased two to three times and new solar cell technologies have been developed. Scientific studies on hybrid systems where solar energy systems are integrated into various systems and new methods and approaches for improving solar energy systems in various aspects continue at full speed. However, as in all renewable energy sources, sustainability is the top priority for solar energy systems. Therefore, solar cell technologies should be evaluated from a perspective that prioritizes sustainability rather than an approach focused solely on efficiency. In the study; Various sustainability indicators consisting of critical elements such as energy efficiency, carbon footprint, production and usage costs, material recycling and environmental impact parameters have been defined and various solar cell technologies have been evaluated in terms of these sustainability indicators in order to make the most appropriate and sustainable solution choices for different needs in the light of these indicators.

Keywords:

Renewable energy, solar cells, sustainability

Cytotoxicity of Zirconium Oxide Nanoparticles on Diabetic Rabbit Tooth Gum Cells

Parvaneh NASERZADEH[1]

1 Endocrine Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran

Corresponding *pnnew2011@yahoo.com*

In recent years, advances in nano-scale technology have led to the use of nanoparticles in almost all areas of life. Nanoparticles have been acknowledged as one of the emerging environmental threats; however, studies in different components of environment are limited. Among the available nanoparticles, zirconium oxide nanoparticles (ZrO2-NPs) are widely used in tooth coating and cosmetic products The cytotoxicity mechanism of ZrO2-NPs has not been clarified to date. Nevertheless, generation of reactive oxygen species (ROS) by ZrO2-NPs has been considered as an important mechanism in some in vivo studies. The present study was conducted to identify the potential effects of ZrO2-NPs on diabetic rabbit tooth gum cells as well as the mechanisms of their cytotoxicity. ZrO2-NPs were characterized using scanning electron microscopy (SEM) and dynamic light scattering (DLS). Cell viability, ROS level, lipid peroxidation (MDA), mitochondrial membrane potential (MMP), glutathione count (GSH/GSSG), lysosome damage and apoptosis/ necrosis were evaluated. Biodistribution were conducted on tooth gum, liver, kidney, heart and brain tissues in the diabetic rabbit using the inductively coupled plasma optical emission spectrometry (ICP/OES). ZrO2-NPs increasedROS, MMP collapse and MDA. In contrast, GSH/GSSG and apoptosis/ necrosis were found to be changed. The ZrO2-NPs accumulated significantly more on diabetic rabbit tooth gum tissues compared with other organs. The study provided evidence that ZrO2-NPs cannot be considered completely biocompatible in the gum cell tissues of the diabetic rabbit. Before these nanoparticles can be used for human dental applications, further investigations on a wide range of cell death signaling should be performed.

Keywords:

Cytotoxicity; Diabetic Rabbit; Reactive oxygen species; Tooth gum; Zirconium oxide nanoparticles

Investigating the Oxidative Stress Mechanism of Carbon Dot Nanoparticles Exposed to Cells Isolated from Human Pituitary Cancer Tissue

Parvaneh NASERZADEH[1]

[1] Endocrine Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran

Corresponding *pnnew2011@yahoo.com*

Pituitary adenomas constitute the most frequent neuroendocrine pathology, comprising up to 15% of primary intracranial tumors. Current therapies for pituitary tumors include surgery and radiotherapy, as well as pharmacological approaches for some types. Although all of these approaches have shown a significant degree of success, they are not devoid of unwanted side effects, and in most cases do not offer a permanent cure. Nanoparticle-based therapeutic systems often have added layers of complexity when compared to chemical systems because of their varying structural, chemical, mechanical, and biological makeup. However, each nanoparticle formulation is unique and possesses distinct physiochemical properties, which require individual investigation into their theragnostic potential. Carbon dots (CDs) are an emerging class of fluorescent nanoparticles which have, in recent times, gained attention for their biocompatibility and versatility for cancer therapeutic and diagnostic (theragnostic) applications. Carbon dots (CDs) are an emerging class of fluorescent nanoparticles which have, in recent times, gained attention for their biocompatibility and versatility for cancer therapeutic and diagnostic. The enzymatic effects of the CDs on the stress oxidative pathway human pituitary cancer cells in further generation of reactive oxygen species(ROS), resulting in mitochondrial and lysosome damage. The lipid peroxidation causing cytochrome-c release along with significant reduction in adenosine triphosphate (ATP) and glutathione (GSH) levels were observed. The oxidative stress-induced interruption in the mitochondrial electron transport chain has been suggested as the mechanism describing the cellular toxicity pathway resulting in the cell death (apoptosis and necrosis) signaling. These results strongly suggest preclinical applications of CDs-based membranes in upcoming nanotechnology-based strategies of human pituitary cancer treatments.

Keywords:

Nanomaterials, Cytotoxicity, Cell death signaling, Oxidative stress, Blood cancer treatment

Bimetallic ZIF (Zeolitic Imidazolate Framework) Synthesis, Characterization and Removal of Some Azo Dyes from Wastewater by Photocatalytic Method

Nur Aybüke SÜVARİ[1], Hayrunnisa NADAROĞLU[1]

[1] Institute of Science, Department of Nano-science and Nano-Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *nuraybuke.suvari19@ogr.atauni.edu.tr*

Water is one of the basic elements for living and has an important role in terms of the sustainability of ecosystems and human health. Water, which is involved in the stages of biological, physiological, and chemical processes of living things, is also used in many sectors, such as industry and energy production. The availability of clean and adequate water is important for food security and health well-being. Global climate change and increasing population density are making the management of water resources even more difficult. Considering the limited nature of water resources, it has paved the way for the research of different water treatment techniques. Organic organisms that arise as a result of industrial events cause damage to ecosystems and create negative effects on human health. Especially hard-to-break down organic substances such as azo-dyes, which are widely used in different industries, form a permanent layer on the water surface. In this context, the development of effective and sustainable treatment methods for the removal of azo-dyes is of great importance. In this study, a new Cu/Zn bimetallic ZIF (Zeolitic Imidazolate Framework) synthesis and characterization was performed for the removal of azo dyes from wastewater using the green hydrothermal method, and the removal of some azo dyes used as food dyes from wastewater by photocatalytic method using the obtained Cu/Zn bimetallic ZIF was investigated. For this purpose, the characterization of the Cu/Zn bimetallic ZIF structure was performed using analytical techniques such as scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FT-IR) before and after dye removal. The results showed that the Cu/Zn bimetallic ZIF structures exhibited high photocatalytic performance in the removal of azo-dyes and could provide an environmentally friendly solution for the remediation of wastewater resources.

Keywords:

Wastewater treatment, Photocatalytic reaction, Remediation, Azo-dye, Cu/Zn bimetallic ZIF-8.

Removal of Ni^{2+} and Cr^{6+}, Complexed with 1,5-diphenylcarbazide (DPC), Using a Graphene Oxide/MnO_2 Quantum Dot (GO/MnO_2-QDs) Nanocomposite

Maryam BABAEI[1]; Manoochehr FARJAMINEZHAD[1]; Yavar Nour Mohammadi ZIBA[1]; Shahriyar KARIMDOUST[2]

[1] Department of Chemistry, Ardabil Branch, Islamic Azad University, Ardabil, Iran.
[2] Payame Noor University, Ardebil, Iran

Corresponding *ma.babaei@iau.ac.ir*

In this research, a graphene oxide/MnO_2 quantum dot (GO/MnO_2-QDs) nanocomposite was utilized as a solid-phase adsorbent to remove Ni^{2+} and Cr^{6+} metal ions from water and wastewater samples. This approach leverages the adsorption capabilities of the nanocomposite to effectively capture and eliminate these heavy metal contaminants, offering a potential solution for purifying water sources. All measurements of Ni^{2+} and Cr^{6+} were conducted through their complexation with 1,5-diphenylcarbazide (DPC) at their maximum absorbance wavelengths of 284 nm and 540 nm, respectively. 1,5-Diphenylcarbazide is an organic compound commonly used as a chemical reagent, particularly in analytical chemistry. This compound is a derivative of carbazide with two phenyl groups attached to its molecular structure. MnO_2 quantum dots (MnO_2-QDs) were synthesized via the reduction of potassium permanganate in the presence of wheat extract, and Graphite powder was used for the synthesis of graphene oxide. The synthesized nanocomposite was characterized using UV-Vis spectrophotometry, flourier-transform infrared (FTIR) spectroscopy, Raman spectroscopy and X-ray diffraction (XRD). The surface morphology and particle size of the nanocomposite were analyzed using. High-resolution transmission electron microscopy (HR-TEM) and field-emission scanning electron microscopy (FE-SEM). The influence of parameters such as temperature, time of removal, pH values, dosage of the analyte and adsorbent, and initial metal ion concentration was investigated and optimized. The present approach was successfully applied to solid-phase extraction (SPE) for the removal of heavy metal ions from real samples, and under optimal conditions, the removal percentage was 98% to 99%.

Keywords:

Green synthesis, Nanocomposite, Quantum dots, Graphene Oxide, 1-5 diphenylcarbazid (DPC), Solid-phase extraction.

Numerical Investigation of Heat Transfer of Nanofluid in a Square Channel

Mansur MUSTAFAOĞLU[1], İlhan Volkan ÖNER[1]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *mansour@atauni.edu.tr*

Heat transfer plays an important role in industrial and engineering applications. In this research, the effect of aluminum oxide nanoparticles on the forced heat transfer rate in laminar flow in a square cross-section channel is investigated. The governing equations are discretized by the finite difference method on the shifted grid. Nanofluid flow is simulated using single-phase and mixed models. Simulation results show that the average Nusselt number increases with the increase in Reynolds number. In addition, the average Nusselt number and consequently the heat transfer rate increase with the increase in volume fraction. The results of the mixed model are closer to the laboratory results than the single-phase model.

Keywords:

nanofluid, single-phase model, convective heat transfer, square channel, aluminum oxide

Preliminary Investigation of Microplastic Occurrence in Pinfish (Lagodon rhomboides) from the Grand Isle, Louisiana, USA

Yahya TERZİ[1]

1 Karadeniz Technical University

Corresponding *yhyterzi@gmail.com*

Microplastic pollution has become a global concern, and studies focusing on their fate in aquatic environments give insight on possible transportation routes and environmental impacts. The suspected microplastic occurrence in the gastrointestinal tract (GIT) of pinfish (Lagodon rhomboides) was studied. Pinfish is a benthic carnivore species and prey to piscivorous birds the most popular game fishes. The fish samples (n = 25) were taken in September 2022 from Grand Isle, Louisiana, USA, which is described as "sport fisherman's paradise". The average length of the fish was 13.15±2.8 cm. The GIT of fish was extracted and digested using H2O2 (30%) at 65°C in separate beakers. The digested material was filtered and suspected microplastics were examined under microscope. All analyzed fish had suspected microplastics in their GITs. No correlation was determined between the fish length and abundance. The average number per fish was 5.12±0.36 (mean ± SE). The shapes of the particles were dominated by fiber (42.14%), followed by fragment (34.73%), pellet (14.96%) and film (8.17%). The average size was 1232.18±73.45 µm. The colors were black (48.43%), blue (18.38%), transparent (11.63%), red (7.32%), brown (6.92%), multicolor (5.33%), orange (1.99%). The result demonstrates a preliminary insight to possible microplastic ingestion by pinfish from Grand Isle. Since it is a prey for other species in upper trophic level, comprehensive studies using spectrometric methods are crucial for understanding the abundance and polymers ingested by the species.

Keywords:

microplastic, pollution, ingestion, forage fish

Using Nano-clays to Improve the Antibacterial Properties of Sanitary Products

Shahriyar KARIMDOUST[1], Ekrem KALKAN[2], Hayrunnisa NADAROGLU[2], Yalçın Kemal BAYHAN[2], Yousef VASIGH[3]

1 Payam Noor University, Ardebil, Iran
2 Ataturk University, Erzurum, Türkiye
3 Islamic Azad University, Tehran, Iran

Corresponding *karimdoust_sh@yahoo.com*

Nano-clays are hydrous silicate minerals with a sheet structure that have a special place in various industries, especially in the field of health and treatment, due to their nano-metric dimensions (at least in one dimension) and unique structural properties. The presence of a negative surface charge with strong physical adsorption capacity is one of the valuable structural features of these inexpensive minerals, which has placed them among the organic nanostructures that absorb water and pathogens. Adding homogenized raw nano-clays to the composition of health products (especially cellulose) due to their increased water and bacteria absorption properties is a significant advance in the preparation and production of environmentally friendly anti-pathogenic products that are compatible with the body's biological system. Optimizing the composition of health products with modified nano-clays by efficient methods of modern nanotechnology is a fundamental and valuable step in the synthesis of safe mineral antibacterial products with minimal side effects (unlike chemical materials). Homogeneous and modified sodium nano-clays (bentonite) due to the increase in specific surface area and adsorption of health products, in addition to water absorption in improving the antibacterial properties of these products, are a great step in the synthesis of environmentally friendly health products and low side effects for human health. Sanitary products treated with nano-clay as a filler have better antibacterial properties and pose the least environmental and organic risks compared to non-clay products.

Keywords:

Nano-clay, Bentonite, Antibacterial, Sanitary products.

Application of Clay Minerals in Environmental Cleaning

Parisa NAMI[1], Günay KAYA[2], Shahriyar KARIMDOUST[1], Zeki KODAY[2]

1 Payam Noor University, Ardebil, Iran
2 Ataturk University, Erzurum, Türkiye

Corresponding *parisanamii@gmail.com*

Clay minerals are hydrous silicate sheets with a layered structure of the phyllosilicate type, which are composed of oxygen (O) and hydroxide (OH) layers. Generally, they are product of chemical weathering of other silicate minerals on the Earth's surface, and are considered to be among the most abundant substances in nature. In mineralogy, particles smaller than 4 microns (0.004 mm) are referred to as clays, regardless of their chemical composition. The placement of oxygen (O) and hydroxide (OH) layers creates spaces where cations can settle. Clays have many applications in various industries. The properties and applications of clays depend on their internal structure and composition. The surface activities of clays depend on the chemical composition, the nature of the surface atoms (Mainly oxygen and hydrogen), the type and number of adsorption sites, the surface charge, and the type of exchangeable cations. Large surface area, high cation exchange capacity, mechanical and chemical stability, sheet structure, abundance, and easy modification are effective factors for selecting clays as a cleaning agent in environmental applications. The most important environmental applications of clay minerals include controlling waste landfills, absorbing pollutants, reducing the use of pesticides and fertilizers, etc. One of the important characteristics of clay minerals in relation to their application in the environment is their absorption capacity, which is increased by various methods such as acid, alkali, surfactant and salt treatments and is used as a cheap and effective adsorbent in removing environmental pollutants. The environmental applications of clays are growing and developing, and their modification by various methods improves their efficiency, but it should be borne in mind that excessive exploitation of clay resources will cause environmental effects such as land degradation, destruction of wildlife habitats, soil pollution, air pollution, and water pollution. Therefore, one must be cautious and use these resources properly. The unplanned, uncontrolled use and recovery of clay minerals can cause many problems for the environment.

Keywords:
Clay minerals- Environment- Pollution.

A Study on Synthesis of Carbon Quantum Dots and Its Application in the Detection of Pb 2+ Metal Ions

Manoochehr FARJAMINEZHAD[1], Vahid MEFTAHIZADEH[1]

1 Department of Chemistry, Ardabil Branch, Islamic Azad University, Ardabil, Iran

Corresponding *manoochehr.farjaminezhad@iau.ac.ir*

Carbon Quantum Dots (CQDs), a new generation of carbon-based nanomaterials, have attracted significant attention in scientific research due to their unique optical properties, high biocompatibility, low toxicity, and excellent chemical stability. Their low production cost and versatility in applications such as bioimaging, biosensors, drug delivery, and energy storage, especially compared to conventional quantum dots, make them highly valuable. Given that hen nails are rich in organic compounds such as proteins and polysaccharides, they are an excellent and sustainable carbon biomass source for CQD synthesis. The nail's organic content was converted into CQDs with desirable optical and structural properties using the solvothermal method. This method not only aids in waste reduction but also aligns with the principles of green chemistry, leveraging a natural, abundant, and biodegradable resource. Photoluminescence (PL) analysis of the synthesized CQDs showed an excitation wavelength of 330 nm and an emission wavelength of 430 nm. Key parameters affecting synthesis, including solvent selection, synthesis temperature, reaction time, pH, and carbon source concentration, were studied and optimized. Ethanol as a solvent, 160 ◦C as synthesis temperature, pH=12, and nail solution 500 ppm were selected. Additionally, the CQDs were doped with nitrogen, sulfur, and fluorine to enhance their properties. The synthesized CQDs were successfully employed as fluorescent sensors for detecting heavy metals such as lead (Pb) and cadmium (Cd) in water samples. Structural and functional characterization was performed using FTIR, PL, and UV-Vis spectroscopy, to analyze the size distribution DLS technique and CHNS for elemental analysis.

Keywords:

carbon quantum dots, solvothermal synthesis, fluorescence, characterization, metal ions sensing, biomass

A Study on the Green Synthesis of Carbon Quantum Dots: Characterization and Its Application in the Detection of Heavy Metal Ion

Manoochehr FARJAMINEZHAD[1], Yavar Nour Mohammadi ZIBA[1], Maryam BABAEI[2], Shahriyar KARIMDOUST[3]

[1] Department of Chemistry, Ardabil Branch, Islamic Azad University, Ardabil, Iran
[2] Department of chemistry, Khalkhal Branch, Islamic Azad University, Khalkhal, Iran
[3] Payam Noor University, Department of Geology, Ardabil, Iran

Corresponding *manoochehr.farjaminezhad@iau.ac.ir*

Abstract: The properties of synthesized carbon quantum dots (CQDs) depend on the precursor type and synthesis method. Therefore, selecting an appropriate precursor is the first step in the controlled production of CQDs. The synthesis method should be simple, environmentally friendly, and utilize materials that can replace conventional toxic substances. For this purpose, a green approach is employed to produce carbon dots using naturally occurring precursors. In this study, the precursors include Jasminum polyanthum flower extract, rich in secondary metabolites, and chicken nails as a source of keratin. The ethanolic extract of Jasminum polyanthum flower was prepared via maceration, and the chicken nail solution was obtained through acidic digestion. CQDs, due to their properties such as excellent water solubility, photostability, and chemical stability, have been employed as sensors for detecting Pb^{2+} metal ions in solutions. In this method, fluorescence quenching occurs as a result of complex formation between lead ions and the carbon quantum dots. Photoluminescence (PL) analysis of the synthesized CQDs showed an excitation wavelength of 330 nm and an emission wavelength of 430 nm. Key parameters affecting synthesis, including solvent selection, synthesis temperature, synthesis time, pH, and carbon source concentration. Jasminum polyanthum flower extract was studied and optimized. Between water and ethanol, ethanol was selected as a solvent, 160 ◦C as synthesis temperature, pH=12, nail solution 500 ppm, and Jasminum polyanthum flower extract 300 ppm were selected. The surface of CQDs is modified with nitrogen, sulfur and fluorine to enhance the detection limit. GC-MS analysis was performed to separate and identify the secondary metabolites present in the ethanolic extract of Jasminum polyanthum. Structural and functional characterization was performed using FTIR, PL, and UV-Vis spectroscopy, to analyze the size distribution DLS technique and CHNSO for elemental analysis.

Keywords:

green synthesis, carbon quantum dots, solvothermal synthesis, photoluminescence, characterization, metal ions sensing, biomass

Investigation of Graphene Dopant Concentration on Eu_2O_3 Thick Film for Co_2 Gas Sensing

Kuberahventhan SANMUGAVELAN[1], Siti Amaniah Mohd CHACHULI[1], Mohd Hafiz Bin JALI[1]

1 Technical University of Malaysia Malacca

Corresponding *m112310007@student.utem.edu.my*

The development of novel gas sensing materials that operate effectively at room temperature is crucial for improving environmental monitoring systems, particularly the sensitive detection of carbon dioxide (CO_2). Europium oxide (Eu_2O_3) has potential as a sensing material but lacks sufficient sensitivity, stability, and response time at room temperature, making it insufficient for real world application. The objective of this research is to improve CO_2 detection capabilities in ambient circumstances by systematically incorporating graphene dopants into Eu_2O_3 thick films. In addition to an undoped Eu_2O_3 gas sensor and thick film sensors with different graphene concentrations of 0.1%, 0.5%, 1%, 2%, and 5% by weight were fabricated by the screen-printing method on Kapton substrates. The gas sensors were characterized using Field Emission Scanning Electron Microscopy (FESEM) for morphological assessment, Energy Dispersive X-ray EDX for compositional analysis, Raman spectroscopy laser for structural evaluation, and X-ray Diffraction (XRD) for crystallographic analysis. The gas sensors performances were evaluated in a controlled environment laboratory, with CO_2 detection performed at concentration of 30, 50, and 70 sccm under conventional room temperature. The purpose of this study is to determine the best graphene concentration that maximizes sensors reaction time, recovery characteristics, detection sensitivity, repeatability, hysteresis and stability. The 2% Eu_2O_3/Gr gas sensor exhibited the best performance, with a low resistance of 0.0874 GΩ and improved responsiveness to CO_2 at 30, 50 and 70 sccm CO_2 concentrations with values of 2.40, 2.37 and 2.34. The 2% Eu_2O_3/Gr sensor demonstrated a 2.1-fold gain in sensitivity, a 4.5-fold improvement in resolution, and a 2.2-fold decrease in standard deviation with linearity 98.04% compared to undoped Eu_2O_3 sensors. Graphene large surface area and high conductivity facilitate CO_2 adsorption and charge transfer between Eu_2O_3 and CO_2 molecules, resulting in enhanced production of carbonate species through redox reactions with Eu^{3+} ions. The ideal graphene doping level was found to be 2%, which balanced the structural integrity of the Eu_2O_3 gas sensors with conductivity increase. In a nutshell, this research demonstrates that graphene doped Eu_2O_3 thick films provide a viable method for room temperature CO_2 gas detection, with increased stability, sensitivity, and response times. Further research into graphene concentration and fabrication methods will give quantitative insights into the link between dopant concentration and sensing performance, assisting in the development of effective, room-temperature CO_2 sensors for industrial and environmental applications.

Keywords:

CO_2 Gas Sensing, Dopant Concentration, Europium oxide (Eu_2O_3), Graphene, Screen-printing method

Bacteriophage Therapy Approach in Fish Disease Treatment

Dilek USTAOĞLU[1], Rafet Çağrı ÖZTÜRK[1], İlhan ALTINOK[1]

1 Karadeniz Technical University

Corresponding *dilekustaogluu@gmail.com*

One of the biggest problems of the aquaculture sector is fish diseases. Bacterial fish diseases are an important factor that causes serious financial losses in aquaculture. Antibiotics are used in the treatment of fish diseases. However, excessive antibiotics cause the development of antimicrobial resistance in bacteria in the environment. Antibiotic resistance spreads among bacteria, which makes it difficult to treat bacterial diseases and endangers public health. For this reason, studies on alternative treatment methods to antibiotics are important. Bacteriophages are viruses that infect bacteria. Bacteriophage therapy is the use of bacteriophages in the fight against bacteria. Bacteriophage therapy stands out as an environmentally friendly and biological method compared to other treatment methods. In this study, the effect of bacteriophage therapy in the treatment of important bacterial fish diseases such as Vibriosis, Yersiniosis and Lactococcosis was examined, and its usability against antibiotics and other chemical treatments was also discussed. Studies show that bacteriophage therapy is promising as a good alternative in the treatment of fish diseases with its important advantages such as being host specific and environmentally friendly.

Keywords:

Aquaculture, Fish Diseases, Bacteriophage, Phage Therapy

Investigating the Weldability of Microalloyed Steel by Friction Stir Welding

Semih Mahmut AKTARER[1]

1 Recep Tayyip Erdogan University

Corresponding *aktarer@hotmail.com*

Microalloyed steels are widely used in many industries due to their high strength, light weight and weldability. These steels, which are preferred for components such as chassis and body structures in automotive manufacturing, require welding joining methods to adapt to complex designs. For these steels, which are generally joined by methods such as fusion, laser and resistance welding, fusion and laser welding in particular can cause problems such as grain growth, cracking and weakening of mechanical properties in the weld zone due to high heat input. This situation results in loss of performance after welding, especially in thin sections and high strength materials. Friction stir welding (FSW), one of the solid-state welding methods, can largely avoid such problems as it is a process performed without melting. In this study, the weldability of microalloyed steels by FSW, the microstructure and the mechanical properties of the welded zone were investigated. The microalloyed steel sheets with 1.5 mm thick and 200x50 mm were butt welded by FSW method using a tungsten carbide (WC) tool. The shoulder diameter of the tool was 14 mm, the pin diameter was 4 mm, the pin length was 1.3 mm and the conical angle was 30°. During the FSW process, the tool speed was set at 800 rpm, the trverse rate was set at 65 mm/min and the tool down force was set at 5 kN. Microstructural analysis of the weld zone was carried out by optical microscope and scanning electron microscope. Mechanical properties were evaluated by Vickers microhardness test and tensile test. The results showed that the initial ferrite-carbide microstructure of the microalloyed steel was significantly refined and the grain size was reduced after the FSW process. This refined microstructure resulted in a significant increase in both hardness and strength values in the weld zone. While the initial microhardness of the microalloyed steel was 180 HV0.3, this value increased to avarege 240 HV0.3 in the FSW zone. Furthermore, no loss of hardness was observed the heat affected zone. The strength of the weld zone increased compared to the base material, while the total elongation value decreased. These results show that microalloyed steels can be successfully welded by the FSW method and that the weld performance is acceptable.

Keywords:

FSW, Mikroalloyed steel, Microstructure, Mechanical properties.

Assessment of the Effects of Infrastructure Projects in The Context of Cultural Heritage

Rabia KAÇDİ[1], Fatma Zehra ÇAKICI[1]

1 Faculty or Architecture, Ataturk University

Corresponding *rabiakacdii@gmail.com*

Modern life needs and expectations have increased in line with the rapid population growth and urbanization in the world. In this context, it has become a necessity for states to make investments in order both to maintain their existence and to respond to increasing needs. These investments, which ensure social and economic development, include comprehensive infrastructure projects in areas such as transportation, communication, water and energy. However, the works carried out to meet the needs in different fields have caused negative situations on tangible and intangible cultural heritage assets. Conservation activities have been carried out to eliminate or minimize the damage to historical values. With the studies carried out under the leadership of European countries, conservation projects have started to be implemented for historical values that will be damaged in infrastructure project areas. Infrastructure projects and conservation activities are handled holistically. In this context, reports such as Environmental Impact Assessment (EIA) and Environmental and Social Impact Assessment (ESIA) were prepared for environmental planning and protection of tangible and intangible historical values. In line with the results of the report studies, projects have been prepared for the protection of movable and immovable cultural heritage that may be affected by the project. Within the scope of this study, cultural heritage assets affected by infrastructure projects around the world and in Türkiye were analyzed and their protection status and methods were determined.

Keywords:

Infrastructure investments, infrastructure projects, cultural heritage, historical values, conservation

Evaluation of Traditional Erzurum Houses in The Context of Climate-Respon Design

Şehriban BAŞARAN[1], Fatma Zehra ÇAKICI[1]

1 Faculty or Architecture, Ataturk University

Corresponding *sehribanbasaran@gmail.com*

Traditional houses have created unique characteristics with the influence of the climate conditions, site conditions, socio-economic factors, traditions and customs of the region where they are located, and have developed sustainable design strategies that are compatible with the environment. The most important factor affecting building design is the climate factor. The climate factor has greatly affected the design and formation of traditional houses, as in all buildings. Traditional houses were created with a plan, material selection and construction technique appropriate to the climatic conditions of the region in which they are located. The hypothesis of this study is that traditional Erzurum houses are sustainable traditional houses suitable for the climatic conditions of the region where they are located. Erzurum is located in a region under the influence of continental climate. Winters in this region are long and quite harsh. Summers are rainy and mild. The main purpose of this study is to examine the effects of harsh continental climatic conditions on the design and formation of traditional Erzurum houses in the context of climate-sensitive design criteria. Within the scope of the study, 19 registered traditional Erzurum houses located in Erzurum city center were evaluated in terms of land use and orientation, building form, building envelope, walls, windows, doors, foundations, flooring, roof, building materials and construction techniques. As a result of this evaluation, the effect of climate on the design of the architectural elements considered was examined. In this context, it has been determined that the effect of harsh continental climate conditions is tried to be minimized in traditional Erzurum houses. As a result of the study, it was concluded that traditional Erzurum houses developed a sustainable design approach that is suitable for the climatic conditions of the region and reflects its unique characteristics.

Keywords:

Erzurum houses, traditional housing, climate-sensitive design, sustainability

Investigation of Mechanical Properties of Fiber Reinforced Concrete After Exposure to Elevated Temperature

Yunus URTEKIN[1]; ZİNNUR ÇELİK[1]

[1] Faculty of Engineering, Department of Civil Engineering, Atatürk University

Corresponding *yeurtknn@gmail.com*

Fire is one of the important durability problems that cause negativities in civil engineering structures. Irreversible problems occur in the physical, chemical and mechanical properties of concrete elements when structures are exposed to high temperatures during fire. In recent years, it is known that fiber-reinforced concretes have shown significant improvements in mechanical properties, especially flexural strength and toughness, compared to plain concrete. In addition, the use of fiber is also an important parameter in making concrete fire resistant. In this context, the performance of concrete mixtures prepared using steel and basalt fiber under the effect of high temperatures was investigated in the study. After the mixtures were exposed to temperatures of 400 ℃, 600 ℃ and 800 ℃, the mechanical properties of the samples such as ultrasonic pulse velocity (UPV), compressive and flexural strength were examined. In particular, the use of steel fibers caused increases in the compressive and flexural strength of the concrete at ambient temperature. On the contrary, replacing steel fiber with a certain amount of basalt fiber in the mixtures caused a decrease in the mechanical properties before elevated temperatures.The hybrid use of steel fibers with basalt fibers in the mixtures gave better results than the single steel fiber concrete in the relative residual strength values of the samples, especially after 600 ℃ and 800 ℃.

Keywords:

Steel fiber, basalt fiber, elevated temperature, mechanical properties, Fiber reinforced concrete

Importance of Understanding Marine Functional Connectivity in Marine Ecosystems

Rafet Çağrı ÖZTÜRK[1]; Yahya TERZİ[1]

[1] Karadeniz Technical University

Corresponding *rafetcagriozturk@gmail.com*

Marine functional connectivity plays an important role in the sustainability and resilience of marine ecosystems. It simply refers to the exchange of individuals, genes, and energy between marine habitats, which supports biodiversity, enhances fishery yields, and strengthens the adaptability of marine populations to environmental changes. This study provides an overview of the key methodologies used to estimate marine functional connectivity, offering insights into genetic, tagging, chemical markers, and modeling approaches. Genetic tools, such as analysis of protein variants, cytoplasmic and (mtDNA, cpDNA), nuclear markers, microsatellites, and single nucleotide polymorphisms (SNPs), enable researchers to trace lineage and identify population structure. Tagging and tracking methods provide direct evidence of species movement, while chemical markers, including stable isotope ratios and elemental concentrations, reveal environmental and physiological histories. Advances in modeling techniques, such as ecological niche models (ENMs), biophysical modeling, and meta-population models, further facilitate the prediction of connectivity patterns. These collaborative efforts aim to improve resource management and conservation strategies by providing comprehensive knowledge on marine connectivity. By understanding the mechanisms that drive marine connectivity, stakeholders can better design marine protected areas, support sustainable fisheries, and promote biodiversity conservation.

Keywords:

connectivitiy, MPA, resource management

Investigation on Quality of Service (QoS) Parameters for 5G Network using OMNeT++

Juwita Mohd SULTAN[1], Darmawaty Mohd ALI[1], Farahin HANAFI[1], Azdiana Md YUSOP[1], Wan Haszerila Wan HASSAN[1]

1 Technical University of Malaysia Malacca

Corresponding *juwita@utem.edu.my*

The field of wireless communication has seen significant growth during the past several years. The 5G network was intended to be developed to address the underlying issues with the quality of services in current networks. Based on the new modulation and transmission techniques of 5G technology, the efficiency of data transfer speeds will be improved by more than 10 Gb/s compared to 4G. This study aims to ensure the end-user has a good experience such as enabling higher data speeds, reducing end-to-end latency, using less energy, increasing traffic capacity, and maximizing end-user satisfaction. This research focuses on Quality of Service (QoS) for 5G networks specifically for VoIP applications. VoIP application is selected as it is considered crucial in telecommunication networks for real-time communication. Utilizing Simu5G OMNeT++ software, the Quality of Service (QoS) indicators selected which are throughput, delay, and packet loss are analyzed for various 5G service flow types. Therefore, the expected outcome of this research is to gain all the parameters measured in the range of threshold according to the literature review.

Keywords:

5G, QoS, VoIP, Simu5G, OMNeT++

Quality of Service (QoS) Performance of Cellular-Vehicle-to-Everything (C-V2X) Communication in the 5G Network Using OMNeT++

Fitria AFIQAH[1], Juwita Mohd SULTAN[1], Wan Haszerila Wan HASSAN[1], Siti Amaniah Mohd CHACHULI[1]

1 Technical University of Malaysia Malacca

Corresponding *b022120042@student.utem.edu.my*

Advanced communication technologies in 5G networks has the potential to transform the interaction of transportation system between vehicles, infrastructure and padestrians. This study focusses on developing a C-V2X communication model using OMNeT++ simulation tool and analyzing its performance based on key Quality of Service (QoS) factors such as latency, throughput and packet loss in 5G network. The results show that C-V2X in 5G network is suitable for real-time applications such as accident prevention and traffic management because it offers high data transfer speeds and low delays. However, better optimization is needed as the packet loss increases during network congestion. The research highlights the importance of building reliable C-V2X models to meet the needs of connected and autonomous vehicles, encouraging network designers to adopt strategies that ensure efficient communication. This study contributes to the development of safer, smarter and more efficient transportation systems.

Keywords:

C-V2X, 5G, QoS, latency, throughput, packet loss, OMNeT++

A Novel Binder in Titanıum Dioxide Thick Film Gas Sensor for Carbon Dioxide Detection

Siti Asma Che AZIZ[1]; Siti Amaniah Mohd CHACHULI[1]; Wong Hui YING[1]

1 Technical University of Malaysia Malacca

Corresponding *sitiamaniah@utem.edu.my*

Chemical-based gas sensors typically have good sensitivity to the target gas and can detect a variety of gases. However, after being exposed to the target gas, certain chemical-based gas sensors either did not recover at all or did not recover adequately. It is believed that the performance of a chemical-based gas sensor, notably its recovery characteristic, can be impacted by the binder utilized, according to the literature. Thus, this study proposes a novel organic binder for a chemical-based gas sensor, specifically for TiO2 gas sensors. The novel organic binder comprised three elements: terpineol, linseed oil, and ethyl cellulose. The novel binder has been tested in a TiO2 gas sensor and exposed to carbon dioxide at room temperature. The TiO2 gas sensor showed high performance in terms of sensing response, recovery characteristics, and repeatability properties. T1S1 is chosen as the most efficient fabricated gas sensor with sensing response, response time and recovery time were approximately 2.16, 119.238s and 32.064s respectively. This novel organic binder also can be applied in chemical-based gas sensors for any target gas.

Keywords:

thick film gas sensor, titanium dioxide, screen-printing, organic binder, interdigitated electrode

Strategy for Enhancing Heat Transfer in Electronics: Keeping Devices Cool and Efficient

Hassen GHALY[1], Kenan YAKUT[1], Muhammet Harun OSTA[1], Yüksel HANBEYİ[1]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *hassen.ghaly18@ogr.atauni.edu.tr*

The rise in component temperatures during operation represents one of the most significant challenges that electronic devices confront, as elevated temperatures can negatively impact their functionality and potentially lead to irreversible damage. In order to effectively tackle this problem, the utilization of synthetic jet cooling holds considerable promise for enhancing the efficiency of electronic devices while simultaneously reducing their operating temperatures. This study not only aims to reduce the thermal load on the components but also contributes to the overall reliability and longevity of the devices. To investigate the effectiveness of synthetic jet cooling in thermal applications, an experimental setup was meticulously developed, incorporating loudspeaker capable of generating synthetic jets. This setup aims to explore how these jets can facilitate enhanced heat transfer and improve cooling performance in various electronic components. By leveraging the unique properties of synthetic jets, which can create localized airflow without the need for moving parts, this research seeks to provide valuable insights into advanced cooling solutions that are essential for meeting the increasing thermal demands associated with modern high-performance electronics. As electronic devices continue to evolve toward greater integration and miniaturization, effective thermal management strategies become increasingly critical. The findings from this experimental investigation may pave the way for innovative cooling technologies that not only mitigate heat-related issues but also enhance device performance and reliability in a range of applications. This study demonstrates that a finned heat sink height of 1 mm enhanced heat transfer by 42.47%, effectively maintaining the heat sink temperature within an acceptable range.

Keywords:

Heat sink, Cooling, Synthetic jets, Heat transfer,Electronics

Geochemistry of Minerals and Their Vital Role in Medical Geology

Shahdad MOUSAVI[1], Ekrem KALKAN[1], Shahriyar KARIMDOUST[2], Yalçın Kemal BAYHAN[1]

1 Faculty of Engineering, Ataturk University, Erzurum, Türkiye
2 Payam Noor University, Ardebil, Iran

Corresponding *shahdadmousavi1@gmail.com*

The frequency of diseases in certain regions of the world and the use of various minerals to treat diseases throughout history, indicate that there is a direct and close relationship between geological processes and the health of living organisms. The effective relationship between geological indicators and human, animal and plant health, as well as understanding the impact of environmental factors on the geographical distribution of diseases, is the field of study in a new branch of earth sciences called medical geology. Study of the geochemical behavior of elements in minerals (as the smallest structural unit of the Earth's solid crust) is the most important case in medical geology. The presence of certain amounts of elements in the human body is necessary to maintain the stability of the biological system and metabolism of the body's organs. Increase or decrease in the amounts of some elements, geo-biological disorders and anomalies causes in the vital system of organisms, which in turn causes the emergence of the geogene diseases. Therefore, geochemical studies of elements in medical geology are of great importance from two perspectives: the necessity of elements to maintain the health of living organisms and biological functions on the one hand, and diseases caused by excess levels of various elements on the other.

Keywords:
Geochemistry – Minerals – Medical Geology – Elements.

What is the Lifespan of a Vessel?

İshak ALTINPINAR[1]

[1] Karadeniz Technical University

Corresponding *ishakaltinpinar@ktu.edu.tr*

The lifespan of a ship typically ends when it no longer remains safe, cost-effective, or practical to operate. Ship life varies depending on the quality of construction, maintenance, and specialized work performed, but ships generally remain in service for many years before being decommissioned. In this study, the factors affecting the ship dismantling age were determined by a literature review. Structural Integrity: The hull and key structural components may weaken over time due to wear, corrosion, or fatigue. This can make the ship unsafe to operate, especially in rough seas or heavy loads. Maintenance Costs: If the costs for repairs and maintenance exceed the ship's operational value or revenue, it might be more economical to retire the ship. Environmental Regulations: New regulations can make it impractical to continue operating older ships, which often require significant modifications to meet modern environmental standards, like emissions control, waste management, or fuel restrictions. Market Demand: Some ships, like cargo vessels or oil tankers, might become economically unviable if market demand drops or if shipping companies switch to a different type of vessel. Degradation of Machinery: Older engines, electrical systems, and other onboard machinery can degrade over time, becoming less efficient and more prone to breakdowns. Once a ship's operational value is no longer viable, it may be sold for parts, scrapped, or repurposed for a different use, such as being converted into an artificial reef. The age of ship dismantling, which is affected by all these factors, has been increasing in recent years. Between 2016 and 2022, the average age at which ships are dismantled increased from 23 to 29 years. Future studies can be conducted to investigate the reason for this increase.

Keywords:

Ship dismantling, Vessel obsolescence, Environmental regulations, Market demand, Maintenance costs.

La-doped CUSCN Strategy for Bandgap Tuning in Enhancing Hole Transport Mechanism for Inorganic Perovskite Solar Cell

Farah Liyana RAHIM[1]

[1] Technical University of Malaysia Malacca

Corresponding *m122310007@student.utem.edu.my*

Perovskite solar cells (PSCs) have emerged as a leading technology in photovoltaics, producing remarkable efficiency and cost-effective production methods. Copper(I) thiocyanate (CuSCN) has garnered attention as an effective hole transport layer (HTL) in PSCs due to its advantageous electronic properties, high stability, and excellent hole mobility. This study investigates the effects of lanthanum (La) doping on the optical and electronic properties of CuSCN. Various doping concentrations have been explored ranging from 1 to 5 mol% resulting in band gap values ranging from 3.6 eV to 3.72 eV. These findings confirm that La doping effectively tunes the band gap of CuSCN, which is crucial for optimizing charge transport and enhancing device performance in PSCs. In summary, La-doped CuSCN represents a promising HTL material for next-generation PSCs, contributing to enhanced efficiency and stability in photovoltaic applications. This research highlights the potential of tailored doping strategies to optimize material properties in pursuing high-performance solar technologies.

Keywords:

band gap, CuSCN, hole transport layer, lanthanum, perovskite solar cells

A Photocatalytic Application of Modified Fe3O4 Nanoparticles

Feyzanur Hilal DAŞDEMİR[1], Hayrunnisa NADAROĞLU [1]

[1] Ataturk University

Corresponding *feyzadasdemir@gmail.com*

Today, with the developing technology and industrialization, the wastewater brought by the rapid population growth parallel to industrial progress threatens the environment and ecosystems more and more every day. Synthetic dyes are seen as one of the biggest causes of environmental pollution. Synthetic dyes, especially azo-dyes, are used in many areas, especially in textiles, leather, construction, plastic, cosmetics, the pharmaceutical industry, and the plastic industry. Due to their large specific surface areas, high reactivity, and effective cleaning capacity in a short time, nano-sized sorbents have many advantages in removing heavy metal ions in the removal of azo dyes. Nano-sized magnetite (Fe3O4) particles are a method that can be used effectively in the removal of azo dyes due to their magnetic properties, large surface area, chemical stability, easy synthesis, and low toxicity. In this study, Fe3O4 NPs were synthesized, characterized using scanning electron microscopy (SEM), transmission electron microscopy (TEM), and Fourier transform infrared spectroscopy (FTIR) techniques, then modified with natural materials, and the feasibility of photocatalytic azo dye removal was investigated. For this purpose, some parameters such as contact time, pH, dye concentration, and photocatalyst concentration were investigated. The obtained findings determined the optimal conditions for the removal of azo dyes and showed that modified Fe3O4 NPs can be used effectively in the removal of azo dyes from wastewater.

Keywords:

Fe2O3 NPs, Azo dye, Photocatalytic removal, Remediation

Experimental Investigation of the Effects of Triple Mixtures of Waste Plastic Oil, Waste Transformer Oil and Diesel Fuel on Engine Performance and Exhaust Emissions

Uğurcan YAZICI[1], Muhammet Kaan YEŞİLYURT[2], İlhan Volkan ÖNER[3]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *ugurcanyazici07@gmail.com*

The rapidly increasing energy demand worldwide is directing countries towards sustainable and renewable energy sources. In this context, the evaluation of waste in energy production both reduces energy costs and contributes to environmental sustainability. Alternative fuels, especially oils obtained from waste plastics, are among the remarkable solutions in the energy sector. Recycling and recovery of wastes play a vital role in preventing environmental pollution and protecting natural resources. In this study, waste plastic oil obtained from waste plastics, waste transformer oil and diesel were mixed at different rates and tested in a single-cylinder diesel engine. Ternary fuel mixtures were prepared and a cetane number improver was added to them. The obtained fuel mixtures were examined in detail in terms of both engine performance and exhaust emissions. In experimental studies, the effects of different fuel mixtures on engine power, fuel consumption and combustion efficiency were analyzed. The results showed that the cetane improver additive positively affects the combustion process especially in low-quality fuel mixtures and provides a significant improvement in engine performance. In addition, when the exhaust emission values were examined, it was determined that certain mixtures were effective in reducing emissions. These findings reveal the potential of using waste-based fuels in internal combustion engines and are promising in terms of environmentally friendly energy production. The study yields significant findings relate to both reducing energy costs and increasing environmental sustainability.

Keywords:

Waste plastic oil, waste transformer oil, diesel engine, engine performance, exhaust emissions

Investigation of Engine Performance and Exhaust Emissions of a Diesel Engine Using a Mixture of Waste Transformer Oil, Pyrolytic Oil Obtained from Waste Tires and Diesel Fuel

Mustafa Köksal İNCE[1], İlhan Volkan ÖNER[1]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *mustafakoksalince@gmail.com*

Diesel engines, one of the biggest sources of global warming and harmful exhaust emissions, constitute an important research topic in terms of reducing dependency on fossil fuels and environmental damage. The limited life of fossil-based fuels and the increase in energy demand increase the need for sustainable energy solutions that require the evaluation of waste. In this context, the evaluation of pyrolytic oil obtained from waste tires and waste transformer oil that has completed its service life as alternative fuels has great importance both environmentally and economically. In this study, fuel mixtures were created by mixing pyrolytic oil obtained from waste tires, waste transformer oil and diesel fuel in different proportions. In addition, cetane number improver was added to the prepared mixtures and these mixtures were tested in a single-cylinder diesel engine. Mixing the components used in the blends in different proportions allowed a detailed examination of their effects on engine performance and exhaust emissions. Experimental results showed that changes in the ratios of pyrolytic oil and transformer oil directly affect the performance parameters of the engine such as power, fuel consumption and thermal efficiency. At the same time, it has been determined that certain mixtures provide reductions in emission values, especially the release of harmful gases such as CO and NOx is significantly reduced. These findings reveal that optimization of fuel mixture ratios is critical for both environmentally friendly fuel production and engine performance.

Keywords:

Waste pyrolytic oil, waste transformer oil, diesel engine, engine performance, exhaust emissions

Experimental Investigation of the Effects of Adding Fe2O3 Nanoparticles to the Triple Mixtures of Pyrolytic Oil from Waste Tires, Waste Transformer Oil and Diesel Fuel on Engine Performance and Exhaust Emissions in a Diesel Engine

Veysel ERTEKİN[1], Muhammet Kaan YEŞİLYURT[1]; İlhan Volkan ÖNER[1]

[1] Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *ertekinv@gmail.com*

The use of waste as an alternative fuel source is gaining increasing interest worldwide due to its dual benefits such as reducing energy costs and reducing environmental damage caused by improper waste disposal. It is very important to dispose of waste materials such as used tires that have reached the end of their service life and transformer oils that were once used as heat transfer fluids without posing an environmental hazard. Because these wastes not only cause pollution but also pose a risk to ecosystems and public health. Therefore, using such waste materials as an energy source is both an environmentally responsible and economically advantageous approach. In this context, in the study conducted, triple modified fuel mixtures containing used tire-derived oil, used transformer oil and diesel were prepared and the performance of these wastes as alternative fuels were investigated. In addition, these nanoparticles, which are known to increase combustion efficiency and stabilize fuel properties, make them a suitable option for alternative fuel applications. Therefore, Fe2O3 nanoparticles were included in the mixtures as a metal-based additive to increase the performance of fuel mixtures. In order to evaluate the effect of these nanoparticle-enhanced fuel blends on engine performance measures such as power output, fuel consumption and thermal efficiency, harmful pollutants such as CO, NOx and particulate matter in exhaust emissions were also systematically measured in experimental studies. The results showed that the addition of Fe2O3 nanoparticles significantly improved combustion characteristics, leading to better engine performance and reduced pollutant emissions. As a result, it was shown that waste-derived fuels enriched with nanoparticle additives have the potential to be used as an alternative to traditional fossil fuels. Such innovative applications that integrate waste management and energy production processes have significant potential to contribute significantly to both managing critical environmental problems and producing sustainable energy solutions.

Keywords:

Waste plastic oil, waste transformer oil, diesel engine, engine performance, exhaust emissions, Fe2O3 nanoparticle

Investigation of Antioxidant and Antibacterial Activities of Nanoemulsions Obtained from Tarragon (Artemisia dracunculus) Essential Oil and Their Effects on Various Cancer Cells

Fatma Nur PINARBAŞI[1], Esen TAŞĞIN[3], Hayrunnisa NADAROĞLU[1], Aynur BABAGİL[2]

1 Ataturk University

Corresponding *ylmzftmnrr@gmail.com*

The aim of this study was to develop a nanoemulsion formulation from tarragon (Artemisia dracunculus) essential oil and to investigate its antioxidant, antimicrobial, and anticancer properties. Tarragon essential oil was obtained using the hydrodistillation method, and nanoemulsions were produced via ultrasonic homogenization. The characterization of the nanoemulsions was performed using Fourier Transform Infrared Spectroscopy (FT-IR) and zeta potential measurements. The in vitro biological activity of the nanoemulsions was assessed using the MTT assay. The antimicrobial activity was evaluated by the agar well diffusion method, while the antioxidant capacity was determined by the Cupric Ion Reducing Antioxidant Capacity (CUPRAC) assay and the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging method. Cell viability studies were conducted on A549 (non-small cell lung cancer), Caco-2 (colon cancer), and HDF (healthy human dermal fibroblast) cell lines. The effects of different compound concentrations were analyzed in a dose- and time-dependent manner. The results confirmed that tarragon essential oil has strong free radical scavenging activity due to its high phenolic content. Microbiological analyses demonstrated the antimicrobial effects of tarragon extracts against various microorganisms. In conclusion, this study highlights the potential of nanoemulsions to enhance the bioactivity of natural products. These formulations may provide new approaches in targeted therapy, particularly in cancer treatment. The development of a safer and more effective therapeutic strategy underscores the significance of natural products in biotechnological applications.

Keywords:

tarragon, nanoemulsion, cancer cell, antioxidant

Design and Synthesis of MoO3 as HTL in Improving The Power Conversion Efficiency of Lead-Free All Tandem Perovskite Solar Cell

Faiz ARITH[1], Fauziyah SALEHUDDIN[1], Zulfanizam ABDUL WAHAB[1]

[1] Technical University of Malaysia Malacca

Corresponding *p022210003@student.utem.edu.my*

The development of efficient, lead-free tandem perovskite solar cells (TPSCs) has become a vital area of study in the quest for sustainable and high-performance photovoltaic technology. An essential challenge in enhancing the power conversion efficiency (PCE) of these devices is the optimization of the hole transport layer (HTL), which is vital for charge collection and device stability. In this paper, the findings of simulation-based investigations carried out on the perovskite tandem (top and bottom subcells consisting of perovskites and silicone layer) are presented in the current research study. This study examines the design and fabrication of molybdenum trioxide (MoO3) as an effective hole transport layer (HTL) for lead-free all-tandem perovskite solar cells for top layer subcells. The MoO3 is chosen for its favorable electrical properties, transparency, and chemical stability, making it an ideal choice for improving the overall efficiency of TPSCs and serving as the top cell. The lower cell utilized silicone. The maximum cell efficiency achieved is 23.59%, while the minimum cell efficiency is 17.48%, both under the illumination of the AM 1.5 G spectrum for the simulations. The synthesized MoO3-based hole transport layers are incorporated into lead-free perovskite solar cells, and their performance is evaluated for structural, optical, and electrical properties. Our research demonstrates a significant enhancement in the power conversion efficiency of lead-free tandem devices, highlighting the potential of MoO3 as a beneficial HTL material for the advancement of sustainable solar cell technology. This study advances the growing body of research aimed at creating efficient, lead-free, and sustainable perovskite-based solar cells with improved power conversion efficiency (PCE).

Keywords:

TPSC, MoO3, HTL, Voc, PCE, Jsc, FF

Copper Iodide as Hole Transporting Layer for Perovskite Solar Cell

Omsri Vinasha ALIYASELVAM[1], Faiz ARITH[1]; Mohd Asyadi AZAM[1]

1 Technical University of Malaysia Malacca

Corresponding *p122310011@student.utem.edu.my*

Highly transparent and uniform planar surfaced Copper Iodide (CuI) film exhibits intriguing morphological properties by presenting Monoethanolamine (MEA) as the green solvent for CuI, thus yielding a comparable outcome of the hole transport layer (HTL) for perovskite solar cell (PSC) applications. The γ-CuI with a zinc-blende structure can be successfully synthesized at a relatively low temperature of 350 ℃ using a green solvent-based method without additives. This approach significantly reduces fabrication costs by eliminating the need for high-temperature processes, making it a more economical and sustainable option. CuI films are fabricated on top of Indium-doped Tin Oxide (ITO) glass substrates via a simple solution-processable spin coating technique at room temperature conditions and lastly, completed with an annealing process that ranges from 60 ℃, 80 ℃, 100 ℃ and 120 ℃. The CuI films' structural properties are characterized by scanning electron microscopy and X-ray diffraction to study the growth of grains and epitaxial growth at the preferred crystallographic orientation, respectively. The pristine, sharp-edged nanoflower-like CuI structure annealed at an optimal temperature of 80 ℃ exhibited excellent conductivity and comparable band gap energy, making it highly suitable for PSC applications. Compared to conventional JCPDS data (00-006-0246), the γ-CuI reveals changes in its crystallographic planes and X-ray diffraction patterns as the annealing temperature increases. Herein, the annealing temperature plays a critical role in influencing the epitaxial growth and structural parameters of CuI, including crystallite size, lattice constant, lattice strain, and dislocation density. Hence, the optimization of annealing temperature is essential to achieve desirable structural properties, making CuI an effective solid-state thin film and a promising hole transport layer for PSC applications.

Keywords:

perovskite solar cell, hole transporting layer, copper iodide

Purification Characteristics of Montmorillonite Nano-clay for Pharmaceutical Uses

Abbas RAZMI[1]

[1] Independent Researcher

Corresponding *abbasrazmi@hotmail.com*

By using nanotechnology, it is possible to achieve properties of materials that are not visible in larger-sized. Bentonite is a mineral from the group of sheet phyllosilicates, which is mainly composed of the mineral montmorillonite. Pure montmorillonite (nano-clay) is the most widely used clay mineral in various industries, especially the medical and pharmaceutical industries. Since montmorillonite with a purity of over 95% is required for the production of nano-clay, it is essential to remove the impurities associated with bentonite to the desired extent and requires special purification processes. Common methods of purification and extraction of nano-clay are generally chemical and expensive, and the chemicals used for purification can have a negative impact on the process and properties of nano-clay. Therefore, safe and non-chemical methods (physical and mechanical methods) should be used in the separation and extraction of montmorillonite nano-clay for pharmaceutical purposes. Due to the fineness of montmorillonite crystals compared to associated impurities, the purification and extraction process of montmorillonite nanoclay from bentonite can be based on particle size separation by mechanical separation. To assess the quality and effectiveness of the purification and extraction method of the produced nanoclay, a laser particle size analysis (PSA) device can be used. Based on the research results, purification and extraction of montmorillonite nanoclay from bentonite by using a mechanical method based on particle size fractionation and separation is a safe, efficient, and side-effect-free method for purifying nanoclay for pharmaceutical use.

Keywords:

Nanoclay, Montmorillonite, Bentonite, Purification, Particle size analyzer (PSA).

The Importance of Periodic Control in Safe Production

Hüseyin GÜLLÜCE[1]; Selçuk SİNCAR[1]

1 Ataturk University, Vocational School of Technical Sciences

Corresponding *ssincar@atauni.edu.tr*

Periodic control in safe production is critical to ensure the health and safety of employees in workplaces, to ensure the smooth operation of equipment and to maintain the sustainability of production processes. Thanks to periodic controls, potential risks are identified in advance and necessary precautions are taken. Regular control of machinery and equipment used in the workplace ensures that accidents caused by wear or malfunction are prevented, regular maintenance and control contribute to the uninterrupted continuation of production processes and increase efficiency. It is ensured that minor malfunctions detected during the controls are eliminated before they turn into very large malfunctions that may occur in the future. In this way, the life of the equipment is extended and costly repairs are prevented. In addition, these controls help to minimize the environmental impacts that may arise from the equipment. Well-maintained and trouble-free equipment increases operational efficiency by preventing interruptions in the production process. Since unplanned malfunctions cause production to stop, periodic maintenance minimizes these stoppages and saves time and cost. According to the Occupational Health and Safety Law No. 6331, the occupational health and safety regulations that must be followed in the workplaces necessitate periodic checks that must be carried out at regular intervals. Performing these checks regularly prevents businesses from facing criminal sanctions. Controls to be carried out are not only limited to the fulfillment of legal requirements, but also a necessity for employee health and operational efficiency. Periodic control is a critical process not only in terms of occupational safety, but also in terms of business sustainability, environmental compliance and cost-effectiveness. Regular and professional inspections are the cornerstone of safe production. Therefore, every business should see periodic inspections as an investment in sustainability and safety, not a necessity. In this study, the responsibilities imposed on the enterprises by the Regulation on Health and Safety Conditions in the Use of Work Equipment were investigated and the issues that the enterprises should pay attention to were determined.

Keywords:

OHS, periodic control, machine and man safety

Numerical Insights into Defect-Induced Performance Limitations in Doped PANI/GO-Based Perovskite Solar Cells

Nabilah Ahmad JALALUDIN[1], Faiz ARITH[1]; Fauziyah SALEHUDDIN[1]

1 Technical University of Malaysia Malacca

Corresponding *p022220006@student.utem.edu.my*

This research investigates the critical role of defects in the absorber and interface layers of organic-inorganic lead halide perovskite solar cells (PSCs), with a specific emphasis on methylammonium lead triiodide (MAPbI3) PSCs that utilize doped polyaniline/graphene oxide (PANI/GO) as the hole transport layer (HTL). The study employs numerical simulations to comprehensively analyse experimental data, facilitating a robust comparison between simulated results and empirical findings. It reveals the detrimental impact of defects on the overall performance of these devices, particularly highlighting that interface defects at the absorber/hole transport layer (Abs/HTL) interface significantly impair power conversion efficiency (PCE). Notably, a decline in PCE to 7.65% is observed at a defect density of 1×1014 cm-2, compared to 11.25% at the electron transport layer/absorber (ETL/Abs) interface. These findings underscore the necessity for targeted control measures at the Abs/HTL interface to mitigate these adverse effects. Furthermore, the study explores the effects of defects on device performance to determine defect tolerance for enhanced overall efficiency. It identifies the density of defect tolerance in the absorber layer, revealing that both interfaces (ETL/Abs and Abs/HTL) exhibit tolerances of 1016 cm-2, 1013 cm-2, and 1010 cm-2, respectively. Despite these challenges, the simulations demonstrate a PCE of 15.37%, representing a 40% improvement over experimental data. This enhancement highlights the potential of doped PANI/GO materials in addressing defects that typically hinder performance. Ultimately, insights from this research contribute to advancing both the efficiency and stability of PSCs by addressing defect-related challenges inherent in their architecture.

Keywords:

Interface Defect, Doped PANI/GO, Hole Transport Layer, Perovskite Solar Cell

Comprehensive Assessment of Pilot Boat Emissions in Turkey's Eastern Black Sea Ports: A 2023 Case Study Using the Emission Factor Approach

Süleyman KÖSE[1]

1 Karadeniz Technical University

Corresponding *s.kose@ktu.edu.tr*

This study focuses on the estimation of emissions produced by pilot boats operating in the ports of Ordu, Giresun, Trabzon, Rize, and Hopa, located in Turkey's Eastern Black Sea region, over the course of 2023. Pilot boats play a critical role in ensuring the safe navigation, docking, and undocking of vessels within port boundaries, making their operational activities a significant component of port-related emissions. The Emission Factor Methodology, a standardized approach widely recognized in maritime emission studies, was utilized to perform the calculations. The methodology involves key parameters such as engine power (converted to kilowatts), annual activity hours, engine load factors, emission factors specific to marine engines (g/kW-hr), and fuel correction factors that account for the properties of fuel used by pilot boats. To ensure accuracy, the annual operating hours of pilot boats at each port were meticulously recorded and analyzed. The movement patterns of these vessels within port waters, which include routine maneuvers for guiding larger ships, were also integrated into the assessment. The results provide a detailed quantification of total emissions, including major pollutants such as nitrogen oxides (NOx), carbon dioxide (CO2), and particulate matter (PM), emitted by pilot boat operations. This study highlights the environmental impact of pilot boat activities and underlines their contribution to the overall emission footprint of port operations in the region. The findings offer valuable data for policymakers and port authorities, enabling the development of strategies to mitigate emissions, promote cleaner technologies, and improve the environmental sustainability of maritime activities in the Eastern Black Sea ports.

Keywords:

Pilot Boats, Maritime Emissions, Eastern Black Sea Ports, Emission Factor Methodology

Occupational Health and Safety in Medium-Scale Hydroelectric Power Plants

Selçuk SİNCAR[1]; Hüseyin GÜLLÜCE[1]

1 Ataturk University, Vocational School of Technical Sciences

Corresponding *ssincar@atauni.edu.tr*

The increasing world population and the development of industry cause the need for energy to increase very rapidly. Renewable energy sources are used today to meet the increasing energy need and reduce foreign dependency. Hydroelectric Power Plants (HEPP) are being built in order to benefit from the water power of the rivers, which are renewable energy sources. The vast majority of hydroelectric power plants built in very different capacities are medium-sized power plants with the power to generate 1-10 MW of electricity. In this study, it was investigated how a proactive approach should be in order to operate medium-sized hydroelectric power plants safely and to prevent accidents. Hazards and risks that may arise in hydroelectric power plants start from the installation stage of the facility. The hazards that may be encountered at different stages of the facility such as construction, operation, maintenance and repair are determined. While taking general occupational safety measures in power plants, it is essential to take the necessary precautions by taking into account the Occupational Health and Safety (OHS) Law No. 6331 and the relevant laws and regulations. Employees should be given regular OHS trainings. These trainings cover awareness of hazards, safe working methods, and how to act in emergencies. Employees are required to use personal protective equipment (PPE). All hazards that may occur in the power plant such as falling from a height, fire, explosion, electricity, noise, flood, landslide, etc. should be detected and necessary precautions should be taken. In addition, contingency plans should be created and updated regularly. Emergency drills should be conducted to ensure that employees are prepared for these situations. Contingency plans should cover possible scenarios such as fire, explosion, power outage, and flooding. Occupational safety inspections should be carried out regularly at the power plant and possible risks should be constantly monitored. As a result, employers must take all necessary measures to protect the health and safety of employees. In addition, it has been determined that OHS boards should be established and these boards should hold regular meetings and evaluate the issues related to occupational safety.

Keywords:

Occupational Health and Safety, Hydroelectric Power Plants, Renewable Energy Sources

Determination of Laccase Enzyme Activity in Culture Medium of Caldibacillus Pasinlerensis Using Medlar and Hawkshort Seed

Fatma Melike YEŞİLYURT[1], Ahmet ADIGÜZEL[1]

1 Faculty of Science, Department of Molecular Biology and Genetics, Atatürk University, Erzurum, Türkiye

Corresponding *melikeyesilyurt08@gmail.com*

In this study, laccase enzyme production potentials of *Caldibacillus pasinlerensis* isolated within the borders of Pasinler district of Erzurum were investigated in the culture medium consisting of medlar and hawthorn seeds. Medlar (*Mespilus germanica*) and hawthorn (*Crataegus* sp.) seeds were used as natural substrates. These seeds are in terms of biologically active substances such as lignin, phenolic compounds, flavonoids and tannins and have the potential to stimulate laccase production thanks to their lignocellulose rich osic structures. Laccase enzyme has a wide range of use in biotechnology and applications with its capacity to degrade complex organic molecules such as lignin and phenolic fragments. In experimental study, medlar and hawthorn seeds were ground and divided into 1-2 mm cross-sectional size. The ground seeds were added to the culture medium at different densities (3 g of hawthorn seed and 5 g of medlar seed). In order to investigate the enzyme production potential of the test bacteria, various temperature conditions such as incubation time (72 hours), temperature (55 ℃) and pH (9) were optimized. Laccase activity was measured spectrophotometrically using ABTS substrate. The results showed that laccase production was significantly increased in both seed blocks, but the analyses containing the highest enzyme content was obtained from medlar seeds. When evaluated in terms of bioremediation, the utilization of medlar and hawthorn seeds, which have lignocellulosic structure, as agricultural waste offers an economical and sustainable alternative for reducing environmental pollution. The capacity of laccase enzyme to degrade phenolic and aromatic compounds stands out as a promising biocatalytic option especially in the treatment of agricultural and industrial wastewater. This study reveals an important potential for the use of renewable biological resources in industrial enzyme production and environmental remediation processes.

Keywords:

Laccase, optimization, medlar, hawthorn, Caldibacillus pasinlerensis

Isolation of Lactic Acid Bacteria Showing the Best Probiotic Properties from Wine Samples Obtained from Different Regions of Azerbaijan

Narmin KARİMOVA[1], Ahmet ADIGÜZEL[1]

1 Faculty of Science, Department of Molecular Biology and Genetics, Atatürk University, Erzurum, Türkiye

Corresponding *karimovanarmin4@gmail.com*

Fermented foods are formed by the action of various microorganisms and support our immune system. Examples of fermented foods are yoghurt, kimchi, pickles, kefir, beer and wine. Fermented foods contain probiotics, organic acids, ethanol or antimicrobial compounds that help balance the gut microbiome. Today, in the production of foods, great importance is attached to the use of microorganisms that support consumer health and strengthen the immune system by stimulating the immune system. It is known that lactic acid bacteria are important in terms of food safety and are therefore recognized as GRAS. In recent years, the fact that LAB regulate intestinal microflora homeostasis, prevent cancer development, produce antimicrobial substances, are resistant to antibiotics and do not form spores has caused scientists to pay attention to these bacteria. Researches are carried out to determine the most effective new or different strains of a known species that can be used especially in public health and industrial applications. The food industry also benefits from these properties. In this study, isolation and phenotypic characterization of lactic acid bacteria from wine samples were investigated. A total of 150 isolates were obtained from wine and as a result of phenotypic characterization, 52 Gram positive, catalase, oxidase negative isolates were determined. In the next stage, hemolytic activity of the isolates which were thought to be LAB and their resistance to low pH, gastrointestinal system, bile salt and ethanol were examined. 38 isolates were γ-hemolytic, 27 were resistant to gastrointestinal system, 12 to low pH and 10 to ethanol. With the data obtained as a result of the studies carried out, it is aimed to bring the most effective lactic acid bacteria isolates/isolates, which are important in terms of food safety and technology in wine content, to the food industry.

Keywords:

Wine, Lactic acid bacteria, Probiotic, Isolation, Identification

Production and Optimization of Peroxidase, Catalase and Polyphenol Oxidase Enzyme from Caldibacillus pasinlerensis Using Eribotrya Japonica Seeds

Melisa VIRDIL[1], Ahmet ADIGÜZEL[1]

1 Faculty of Science, Department of Molecular Biology and Genetics, Atatürk University, Erzurum, Türkiye

Corresponding *virdilmelisa@gmail.com*

Enzymes are stable and specific biocatalysts. In recent years, their use in environmentally-friendly biotechnological approaches for various industrial innovations has become increasingly common. For this reason, identifying enzymes and enzyme units with potential applications in different processes is of both economic and environmental significance. Among the biomass waste generated in the environment, lignin and its derivatives hold considerable importance. Some of the enzymes capable of degrading lignin include peroxidase, catalase, and polyphenol oxidase. In this study, a waste carbon source, Eriobotrya japonica seeds, was utilized for the production of peroxidase, catalase, and polyphenol oxidase enzymes, aiming to achieve a lower-cost and easily accessible enzyme production process. As a result, high-value antioxidant enzymes were produced from the environmental waste of Eriobotrya japonica seeds using a thermophilic bacterium. In this study, the bacterium *Caldibacillus pasinlerensis*, a newly identified species isolated from the hot springs of Pasinler district in Erzurum, was used. The activity of antioxidant enzymes such as peroxidase, catalase, and polyphenol oxidase was controlled using appropriate substrates. As a result of the optimization process, the highest enzyme activity was observed at 4g, pH 8, 55 ℃ for 24 hours for peroxidase and catalase, and at 4g, pH 9, 55 ℃ for 48 hours for polyphenol oxidase. Enzymes produced in plant waste-based media are frequently used in industries, clinical diagnostics, biosensor production, and organic synthesis reactions. Due to their free radical scavenging properties, these enzymes are intended for use in preparing pharmaceutical or cosmetic products, degrading pesticides and other toxic chemicals, paper bleaching, waste oil, and water treatment in industrial fields.

Keywords:

Peroxidase, Catalase, Polyphenol Oxidase, Eribotrya Japonica

Impact of Rectangular Flow Components and Different Fluids on the Efficiency of Solar Collectors: An Experimental Analysis

Fırat TUNA[1], Abdussamet KABAKUŞ[2], Ahmet Numan ÖZAKIN[1]

1 Faculty of Engineering, Mechanical Engineering Department, Ataturk University, Erzurum, Türkiye
2 Artvin Çoruh University

Corresponding *akabakus@artvin.edu.tr*

The adoption of solar water heating systems not only minimizes reliance on fossil fuels but also supports global sustainability efforts by mitigating environmental impacts and promoting energy security. As solar energy remains a cornerstone of renewable energy technologies, advancements in hybrid systems and FPSWH designs are crucial to sustainably address the rising global energy demand. This study experimentally examines the effects of turbulators (arranged in a spiral pattern with 1, 5, and 9 turbulators per tube) and advanced matte black coatings (Black 2.0 and Black 3.0) on the thermal performance of FPSWH systems. The experimental setup was complemented by a design optimization approach employing Response Surface Methodology (RSM) to maximize system efficiency. In this case; Experimental optimization was carried out with antifreeze added water, pure water and ethyl alcohol fluids at flow rates of 50-100 and 150 l/h, with a spiral having 11-55-99 turbulators and with classic, Black 2.0 and Black 3.0 coatings. The results emphasize the significance of optimizing absorber plate configurations, enhancing heat transfer processes, and utilizing advanced materials to improve FPSWH performance. According to the study results; It was determined that the coating applied to the surface of the plane surface solar collector increased the heat transfer efficiency very little, increasing the number of turbulators per spiral tube increased the heat transfer considerably, and the use of different fluids at different flow rates increased the heat transfer efficiency considerably.

Keywords:

Turbulators, Thermal Performance, Solar Water Heating Systems (FPSWH)

Utilization of Geothermal Water Source Heat Pump in Space Heating in Cold Climate Regions

Sedat AKMEŞE[1]

[1] Erzurum Technical University

Corresponding *sedat.akmese@erzurum.edu.tr*

Energy is the most important fundamental factor in the development and prosperity of societies. Today, approximately 80% of global energy consumption comes from fossil fuels. Renewable energy sources have significant effectiveness in reducing dependence on fossil fuels such as natural gas, oil and coal. Heat pumps have enabled low-grade energy sources such as geothermal, soil, sun, and air to be used effectively with heat pumps. Heat pumps enable the effective and efficient use of energy thanks to their ability to transfer heat from a low-temperature heat source to a higher-temperature region, contrary to the normal heat transfer direction. Geothermal spring waters offer significant advantages in use in heat pumps due to their constant water temperature feature. In this study, the use of geothermal water source heat pumps for space heating in cold climate regions was investigated. It is aimed to use the geothermal water source at approximately 37 - 40C temperature effectively and efficiently in space heating by means of a heat pump. Additional precautions to be taken against possible adverse situations that may arise in this system used in cold climate regions have been set forth.

Keywords:

heat pump, renewable energy, geothermal, coefficient of performance, efficiency

Investigation of Heat Transfer and Dynamic Instabilities in an Empty Tube with Boiling Two-Phase Flow

Hasan GÜVEN[1], Orhan YILDIRIM[1], Ömer ÇOMAKLI[1], Şendoğan KARAGÖZ[1]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *hasanguven.92@hotmail.com*

Two-phase flow with boiling and the heat transfer associated with these flows are gaining increasing importance in industrial applications due to the fact that they provide higher heat transfer coefficients compared to single-phase flows. In this study, the dynamic instabilities of two-phase flow in a horizontal empty pipe with a diameter of 13.7 mm were investigated using a forced convection boiling experimental setup. No heat transfer enhancement elements were used in the experiments, only the flow conditions in the empty pipe were analyzed. As a result of the experimental studies, it was observed that the period and amplitude of the density change type oscillations were lower than the pressure drop type oscillations. With the increase in the thermal power given to the system, the pressure drop in the two-phase region increased and it was determined that the minimum point on the characteristic curve shifted to the right. However, it was determined that the boiling point shifted to lower mass flow rates in case of a decrease in the fluid inlet temperature, i.e. an increase in the subcooling level. This study has shown that the effects on heat transfer in two-phase flow with boiling in an empty tube can be analyzed without using more complex geometries (internal spring, turbulence, etc.) and has revealed that the relationship between pressure drop and heat transfer performance is important in such systems. In general, the findings of the study have provided an important basis for the effective design of two-phase flow systems, especially in industrial applications.

Keywords:

Two-phase flow, oscilations, thermal performance

Evaluation of the Effects of Geometric Parameters on Thermal Performance in an Air Duct with an S-shaped Turbulator Using Numerical Methods

Orhan YILDIRIM[1]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *orhan.yildirim@atauni.edu.tr*

Temperature control in electronic systems is of critical importance to ensure reliable and efficient operation of equipment. Heat sinks are widely used in these systems to improve heat transfer. Thermal performance of heat sinks is evaluated based on the principle of maximizing heat transfer rate with minimum pressure drop. In this study, in order to determine the effects of geometric properties, the thermal performances of "S-shaped" turbulators with different geometric properties were numerically investigated by analyzing the changes in Nusselt number and friction factor. The numerical analysis results showed that the "S-shaped" turbulator significantly increased heat transfer, but this increase caused a certain increase in friction factor. In particular, with the change of element height, step value and radius, Nusselt number increased significantly, and partial increases were observed in pressure drops at different values. However, when the thermal performance factor was taken into account, it was understood that the heat transfer gains obtained compensated for the increase in friction factor. In the evaluation, it was observed that the highest improvement coefficient was obtained in the model with element height of 30 mm, transverse pitch of 18 mm and element radius of 50 mm. The results obtained in this study reveal that S-shaped turbulators, when designed with optimum geometric parameters, can provide significant improvement in space-constrained applications such as compact heat sinks.

Keywords:

Turbulators, Thermal Performance, Geometric Parameters

Development of Nano-Sensors for Detecting Carcinogenic Food Color Additives

Sümeyra OKCİ[1], Azize ALAYLI[2], Hayrunnisa NADAROĞLU[1]

1 Ataturk University
2 Sakarya University of Applied Sciences

Corresponding *sumeyra_gunduz@outlook.com*

In recent years, synthetic colorants have been used more widely in the food industry instead of natural colorants. Synthetic colorants offer many advantages over natural dyes, such as high stability to light, oxygen and pH fluctuations, uniformity in color, high brightness, minimum sensitivity to microbiological contamination, a wide range of shades and relatively low production costs. However, since synthetic dyes generally have aromatic ring structures and azo (N N) functional groups, they have many harmful effects on human health, such as allergic reactions, neurocognitive effects, behavioral disorders and toxicity. Therefore, alternative detection methods are required for the detection of toxic dyes in foodstuffs and real samples. For all these reasons, special attention is paid to nanosensors, one of the electroanalytical approaches, for the detection of food dyes due to reasons such as sensitivity, excellent selectivity, reproducibility, low cost, easy sample preparation and less time. In sensor applications, the use of electrochemical sensors based on nanostructured metal oxides (NMOs) offers many potential benefits and significantly increases the sensitivity of the system. In this study, undoped and K-doped nanostructured metal oxide thin films produced by USP (Ultrasonic Spray Pyrolysis) technique were successfully grown on glass substrates. Then, X-ray diffraction (XRD), scanning electron microscopy (SEM, EDX) and current-time (I–T) measurements were performed. As a result of this study, it was concluded that metal oxide nanocomposite thin film supported techniques can be successfully used in electrochemical sensing systems for the detection of azo dyes in food samples and for food safety.

Keywords:

Nanosensors, Electrochemical, Amperometric, Ultrasonic spray pyrolysis (USP)

Experimental and Numerical Investigation of the Effect of Open Cell Aluminum Foams in Air Channel on Heat Transfer

Beytullah İsmet TOPRAK[1], Muhammet Taha TOPÇU[1]

1 Faculty of Engineering, Department of Mechanical Engineering, Ataturk University, Erzurum, Türkiye

Corresponding *bismet.toprak@atauni.edu.tr*

In this study, the system created by integrating aluminum foam fins of a certain thickness with pore densities of 20 PPI in a horizontal channel in a inline arrangement was experimentally investigated. Afterwards, aluminum foam fins with different thicknesses and different pore densities were integrated into the channel and numerical analyses were performed. The heat transfer and pressure drop characteristics of AFFHC (Aluminum foam filled horizontal channel) were investigated. The numerical analyses carried out throughout the study were modeled by means of COMSOL Multiphysics program and this model was verified with the experimental study data carried out in the experimental system established in the laboratory environment. As a result of the investigations, it was observed that placing aluminum foam inside the channel increases the thermal performance value (η) of the system up to 3.44 times. For fin profiles with the same volume, as the thickness increases, the pressure drop increases and the Nu value also increases. However, since the increase in ΔP with increasing thickness is larger than the increase in Nu, the lowest η value is obtained for the case using the fin with the highest thickness. It is seen that the increase in the PPI ratio of the aluminum foam fins with the increase in Re in the studied range has a directly proportional effect on Nu and ΔP.

Keywords:

Heat transfer, Pressure drop, Porous media, Aluminum foam, Thermal and flow performance

Design of a Decision Support System for Evaluating Students' Learning Outcomes and Program Outcomes Acquisition Levels in the Education and Training Process

Mahmut YEŞİLYURT[1]

1 Department of Computer Technologies, İzmir Kavram Vocatiomal School, İzmir, Türkiye

Corresponding *mahmut.yesilyurt@kavram.edu.tr*

The success of education systems is directly related to the extent to which students successfully achieve the determined learning and program outcomes. This study addresses the design of a decision support system (DSS) for evaluating students' learning and program outcomes. The designed system enables students' success levels to be measured more precisely and curricula to be effectively optimized. This paper presents the design process, data collection methods, algorithms and implementation details of the system. The education and training process aims to ensure that students gain academic, social and professional competencies. However, measuring the level of achievement of these goals and implementing output-based feedback mechanisms is a complex problem. At this point, it is important to process education data effectively and provide solutions that will guide decision makers. The project aims to evaluate students based on both course learning outcomes and program outcomes based on the scores they receive from measurement and evaluation tools using Multi-Criteria Decision Making (MCDM) as a method and artificial intelligence-based approaches in the future. The following steps were followed in the system design: Data Collection: Data obtained from various dimensions such as students' academic achievement, attendance status, project and laboratory studies were analyzed. Output Analysis: Criteria were defined and prioritized to relate the determined program outcomes to each student's performance. Modeling and Algorithm Development: A multi-criteria decision-making system algorithm is being designed and optimized for the decision support system. In addition, fuzzy logic, decision trees and machine learning algorithms will be included in the system with artificial intelligence support in the future. User Interface Design: The system is equipped with an interface that faculty members and administrators can easily use and continues to be developed. The prototype system was tested with pilot applications and provided faculty members with the opportunity to analyze student performance in detail. The system has presented an approach to measuring the achievement levels of program outcomes according to learning outcomes and the impact rates of these outcomes, and it is thought that it has the potential for wider applicability in the future, will contribute positively to education quality assurance processes and can be adapted to different education levels.

Keywords:

Software, Decision Support Systems, Program Outcomes

Comparison of Power Consumption in Data Transmission at Different Distances in Edge Computing Systems of Wireless IoT Technology

Ahmet Ekmel KURT[1]; Bilal USANMAZ[1]; Zülküf GÜMAN[1]

1 Ataturk University, Faculty of Engineering

Corresponding kurtahmetekmel@gmail.com

LoRa (Long Range) technology, which enables low-power and long-distance communication in edge computing systems, is an ideal solution for Internet of Things (IoT) applications. These systems consist of local nodes that perform data processing near the device instead of in the cloud. Low power consumption is especially important for energy-constrained portable devices and remote sensor networks. In this study, the power consumption of the circuit is analyzed during data transmission and reception over different distances using the SX1268 433 MHz LoRa HAT module integrated on the embedded circuit. The aim of the study is to determine the distance dependent power consumption of the SX1268 LoRa module and to evaluate the energy efficiency by comparing these consumptions. In the experimental setup, the power consumption of the circuit during data transmission and reception was measured at 0.1 second intervals using a current sensor and recorded in real time. The experiments were conducted at varying distances of 100 meters, 1 kilometer and 2 kilometers. At each distance, 10 transmissions were made at 1-second intervals after a 20-second waiting period, with each message being 200 bytes in size. The obtained data shows that the change in transmission power consumption with increasing distance reveals that the power consumption of the circuit increases as the distance increases. In particular, while the power consumption is low at short distances, it is observed that the power consumption increases significantly at distances of 1 kilometer and above. During reception, the power consumption was found to remain relatively constant regardless of the distance. In conclusion, the power consumption analysis of the SX1268 LoRa module in the embedded circuit at different distances in this study provides usable data for energy saving in IoT applications. These findings can play a role in system selection, especially for battery-based systems that require long-term operation.

Keywords:

Edge Computing, Internet of Things (IoT), Power Consumption Analysis, LoRa (Long-Range), Low-Power Wide-Area Network (LPWAN)

RConvLSTM4AD: Residual Convolutional LSTM Model for Anomaly Detection on 3D Printer

Fadime KARADAŞ[1], Bilal USANMAZ[1]

1 Ataturk University, Faculty of Engineering

fadimekaradas@atauni.edu.tr

The Detecting vibration anomalies in 3D printers is critical for maintaining print quality and increasing efficiency in production processes. Early awareness reduces costs by preventing faulty production and contributes to longer device life. Artificial intelligence applications using classification and anomaly detection models can detect these errors at an early stage by analyzing the data obtained with signal processing techniques. In this study, data collected from a 3D printer using vibration sensors were used to evaluate the performance of machine learning and deep learning algorithms in anomaly detection. The analyzed dataset consists of 7,967 vibration data (405 anomalies and 7562 normal data). In this analysis, eight machine learning algorithms such as Isolation Forest, K-Means, Single Class SVM and Spectral Clustering, among others, and two deep learning models, namely Autoencoder and the proposed Residual Convolutional LSTM model. In the data preprocessing process, dimensionality reduction and normalization were performed using PCA (Principal Component Analysis). The study also presents a new model (RConvLSTM4AD) that can detect anomalies by hybridizing Residual Techniques and Convolutional Long-Short Term Memory method. The hybrid model performed the best with 98.77% accuracy compared to the others. This was closely followed by Spectral Clustering with 94.95% accuracy and Agglomerative clustering with 94.82% accuracy. These findings emphasize the effectiveness of the proposed hybrid approach for vibration anomaly detection in 3D printers.

Keywords:

Anomaly Detection, 3D printer, Vibration Data, Machine Learning, Deep Learning

Powder Characteristics and Mechanical Properties of AlCrCo Middle Entropy Alloy Synthesized via Mechanical Alloying

Serdar ÖZKAYA[1]

1 Karadeniz Technical University, Metallurgy and Materials Science Engineering

Corresponding *sozkaya@ktu.edu.tr*

This study explores the synthesis, powder characteristics, and mechanical properties of an AlCrCo medium entropy alloy (MEA) fabricated via mechanical alloying (MA). Elemental powders of Al, Cr, and Co in equiatomic proportions were subjected to high-energy ball milling to achieve a homogeneous alloy. The evolution of phase formation, crystallite size, and particle morphology during milling was analyzed using X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS). Differential scanning calorimetry (DSC) was employed to investigate the thermal stability and phase transformation behavior of the alloy. The milled powders were consolidated through hot pressing to produce dense bulk samples, which were subsequently characterized for microstructural homogeneity, hardness, and compressive strength. The results demonstrated the formation of a single-phase BCC structure with fine grains and excellent mechanical properties, including high hardness and strength, primarily due to grain refinement and solid solution strengthening. This study underscores the potential of AlCrCo MEAs for lightweight structural applications, offering a balance between strength and thermal stability.

Keywords:

Low entropy alloy, powder metallurgy, mechanical alloying

Synthesis of Carbon Dots from Plants for Biosensor Applications

Hatice YÜNCÜ[1], Ebru BOZKURT[1], Hayrunnisa NADAROĞLU[1]

1 Ataturk University

Corresponding *dincarslanhatice@gmail.com*

Mold contamination of agricultural products poses a significant health threat to consumers. One of the most widespread and persistent toxins is mycotoxins, which are classified as class 1 carcinogens by the International Agency for Research on Cancer. Agricultural products such as peanuts and hazelnuts are the most susceptible to mycotoxin contamination and are of economic importance due to their threat to human and animal health. In the field of biosensors and environmental monitoring, the synthesis and use of carbon-based nanomaterials in particular has increased the interest in nanotechnology. Carbon quantum dots (CQDs), which are generally smaller than 10 nanometers in size, exhibit exceptional fluorescence, high stability, and low toxicity, making them suitable for various applications such as biological imaging, drug delivery, and contaminant detection. In this study, green fluorescent CQDs were synthesized from plant wastes using a new approach by pyrolysis, exhibiting remarkable stability, water solubility, and good biocompatibility. The fluorescence quantum yield of CQDs was measured as 0.04. Furthermore, CDs are very effective in detecting aflatoxin B1 (AFB1) using a fluorescence resonance energy transfer (FRET) mechanism, with a clear fluorescence emission peak seen at 451 nm. The photoluminescence properties of CDs were evaluated under various pH conditions and showed a blue shift and increased fluorescence intensity at pH 9–10, suggesting their potential use in pH-sensitive sensor applications. This eco-friendly and cost-effective synthesis method offers a promising alternative for AFB1 detection in food samples by using waste material to create valuable analytical tools. Conclusions Using the unique properties of CQDs, a rapid, sensitive, and cost-effective detection platform that can be integrated into food safety monitoring systems was developed. This work not only contributes to the advancement of CQD synthesis from sustainable sources, but also addresses a critical need in food safety and environmental monitoring.

Keywords:

Plant waste, Carbon Quantum Dots (QCDs), Mycotoxin, Fluorescent probe

FULL-TEXT PAPERS (ORAL PRESENTATIONS)

Assessment of Plant Development of Bean (*Phaseolus vulgaris* L.) Under Deficit Irrigation Conditions

Muhammet Gökhan GÜRBULAK[1], Özlem KORKUT[1], Yasemin KUŞLU[2], Hasan ER[3]

[1] *Faculty of Engineering, Department of Chemical Engineering, Ataturk University, Erzurum, Turkiye*
[2] *Department of Agricultural Structures and Irrigation, Faculty of Agriculture, Ataturk University, Erzurum, Turkiye*
[3] *Joint Application and Research Center for Beekeeping and Bee Products, Bingol University, Bingöl, Turkiye*

** Corresponding author E-mail: m.g.gurbulak@gmail.com*

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Plant development

ABSTRACT

Water scarcity is one of the main negative impacts of global climate change. Water scarcity is a growing problem in many countries around the world, particularly in arid and semi-arid regions. Accordingly, rationalization of irrigation water has become a necessity for these countries to achieve their sustainable development goals. Constrained irrigation practices in agricultural production are critical strategies for water resource conservation and sustainable irrigation management, especially in arid and semi-arid areas. In this direction, the study investigating the effects of different irrigation water applications on plant growth parameters of bean (Phaseolus Vulgaris L.) plant was carried out in Erzurum conditions in 2024. In the study, 25% (I25), 50% (I50), 75% (I75) and 100% (I100) of the evaporation values read from the Class A pan were applied as irrigation levels. Plant height, stem diameter, number of leaves, root length, root weight, pod length and number of grains per pod were determined. The values for plant height, stem diameter, number of leaves, root length, root weight, pod length and number of grains in the pods varied between 20.10-25.41 cm, 9.87-9.99 mm, 13.5-25 pieces, 15.23-18.65cm, 22.05-28.41g, 14.10-14.55cm, 5-5.37 pieces. The study found that plant height, number of leaves, root length and root weight increased with increasing amount of irrigation water. Considering the results of the study, it was found that stem diameter, pod length and number of grains in pods had no significant influence by irrigation level treatments.

Contents

1. Introduction

Common bean (Phaseolus vulgaris L.) is a legume consumed by millions of people in many countries around the world as a source of protein, vitamins and fiber (Padilla-Chacón et al., 2017). However, drought stress causes significant seed yield declines in global bean production areas (Herrera et al., 2021).

Drought is a major environmental constraint that negatively affects plant productivity (Tura and Tolossa, 2020). Bean production under rain-fed agricultural conditions, especially in semi-arid regions, is subject to widespread abiotic limitations resulting from drought periods (Soureshjani et al., 2019). Therefore, it is necessary to cultivate crops with greater tolerance to such

stresses and develop new strategies to maintain yields in regions where dry seasons are common.

Constrained irrigation is an important approach to ensure efficient use of water resources in agriculture and to achieve sustainable production goals. This method minimizes water loss and saves water by providing the minimum amount of water necessary to meet the water needs of plants (Chai et al., 2016). Constrained irrigation has a critical role in both improving water use efficiency and maintaining the quality and yield of agricultural crops, especially in semi-arid and arid regions where water resources are limited (Fereres and Soriano, 2007). It is also an effective way to mitigate the impacts of climate change by supporting the adaptation of agricultural crops to drought and water stress (Li et al., 2022).

In this study, it was aimed to determine the effects of limited irrigation on plant growth of bean.

2. Materials and Methods

2.1. Site and Experiment Description

The research was carried out in 2024 at Atatürk University Crop Production Application and Research Center in Erzurum province (39° 55´ N and 41° 16´ E) at an altitude of approximately 1830 m above sea level.

Erzurum province has mostly dry and cool summers and generally cold and snowy winters. It is a semi-arid region with an average air temperature of 5.8 °C, a maximum temperature of 36.5 °C, a minimum temperature of -37.2 °C and an annual precipitation of 431.5 mm in the past years (1929-2023) (Anonymous, 2024). Evaporation and precipitation data were measured directly from a Class A pan and a pluviometer located in the experimental area.

Before the study, soil samples were taken to determine various physical and chemical properties of the experimental area. The samples were then analyzed according to the methods given by Klute (1986) and Page et al. (1982). The results of the analysis showed that electrical conductivity, organic matter, $CaCO_3$, field capacity and wilting point values were 1.25 dS m^{-1}, 1.58%, 1.54%, 28.50% and 15.74%, respectively, and the soil texture was determined as clay loam.

Bean seeds were first sown in seedling vials. After the seedlings formed four true leaves, they were removed from the vials and planted in the field in the second week of May. All plots were treated with 70 kg N ha^{-1} and 50 kg P_2O_5 ha^{-1}, respectively, and weed control was done by hand hoeing during the growth period.

2.2. Irrigation Applications

Irrigation water was filtered with a disk filter at the system inlet. The plots were 800 x 150 cm in size with a spacing of 100 cm in length and 50 cm in width between the plots. Laterals were planted 70 cm apart, 33 cm above the row and 40 cm between the rows. Polyethylene drip pipes (Ø 16 mm) have in-line type drippers spaced 0.33 m apart. The average flow rate of the drippers was 4 L h^{-1} at an operating pressure of 0.1 MPa with a pump. The drip pipes in each plot were connected to individual manifold pipelines in each plot and were manually controlled using a valve on the manifold to control irrigation applications. Irrigations were applied when total evaporation from the Class A pan reached 50 ± 5 mm. The amount of irrigation required for each irrigation was calculated by the following equation (Ertek, 2011).

$$I = Epan \times K \times P$$

where I is the irrigation quantity (mm), Epan is the cumulative evaporation amount between two irrigation dates (mm), K is the irrigation level, P is the plant cover ratio. K values for different irrigation levels were selected as 1, 0.75, 0.50 and 0.25; herefore, plants in I100, I75, I50, and I25 treatments were irrigated with water amounts equal to 100, 75, 50 and 25 % of cumulative evaporation measured from the Class A pan, respectively.

2.3. Plant sampling and harvest

Harvesting was done manually by pulling the dry plant out of the soil and removing the roots. Fifteen plants were randomly sampled from the middle two rows for each plot and then plant height, stem diameter, number of leaves, root length, root weight, pod length and number of grains per pod were determined.

3. Results and Discussion

The mean values of plant height, stem diameter, number of leaves, root length, root weight, pod length, seed number per pod, pod length, number of leaves, root length, root weight, pod length and seed number per pod of bean plants in terms of the average values of 2024 are given in Figure 1. Figure 1 shows that the effect of different irrigation treatments on plant height, number of leaves, root length and root weight was statistically significant at $p<0.05$ level, while the effect on stem diameter, pod length and seed number per pod was found insignificant.

According to the results of the research, plant height, stem diameter, number of leaves, root length, root weight, pod length and seed number per pod varied between 20.10-25.41 cm, 9.87-9.99 mm, 13.5-25 pieces, 15.23-18.65 cm, 22.05-28.41 g, 14.10-14.55 cm and 5-5.37 pieces, respectively. It was observed that plant height, number of leaves and root weight decreased as water stress increased, while stem diameter, pod length and seed number per pod did not change under drought stress.

Caliskan et al. (2017) reported that seedling and root development of seeds obtained from different bean varieties grown under limited irrigation conditions were lower. It was reported that severe water stress in beans will significantly reduce vegetative development and seed yield (Rai et al., 2020). Chattha et al. (2021) cultivated under full and limited irrigation conditions for

two seasons to investigate water limitation tolerance. As a result of the research, it was observed that all parameters reacted negatively to water stress.

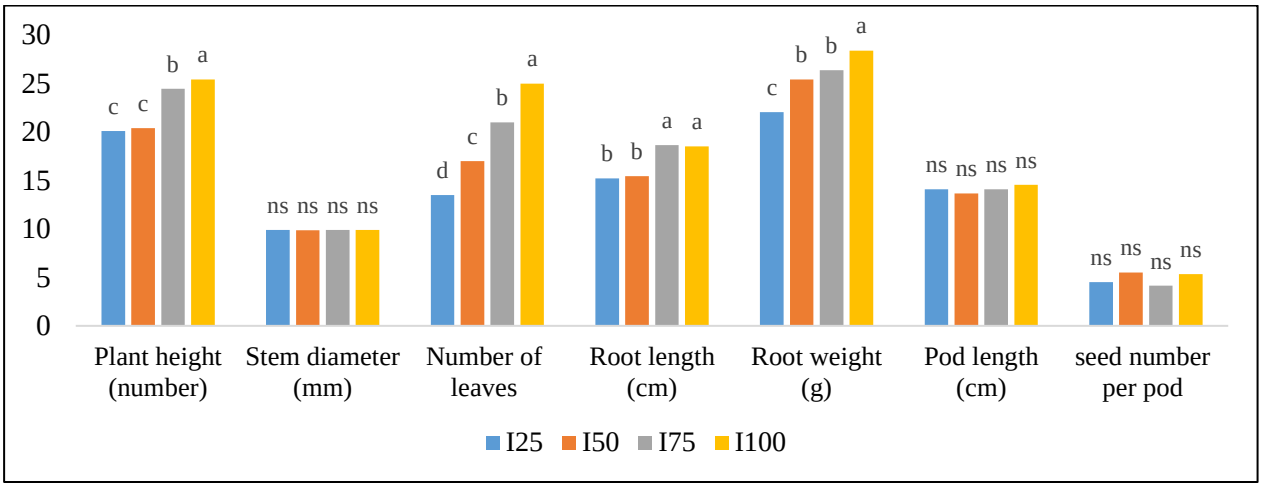

Figure 1. Plant growth parameter values of bean plants treated with different irrigation levels in 2024

ns: not statistically significant; *: statistically significant at $p<0.05$ level.

4. Conclusion

Our results showed that there was no statistically significant effect on stem diameter, pod length and seed number per pod under drought stress, but there was a significant effect on plant height, number of leaves, root length and root weight of bean plants. As drought stress increased, plant height, number of leaves and root weight values decreased. On the other hand, stem diameter, pod length and seed number per pod were not affected under drought stress, which may be advantageous for agricultural production in arid and semi-arid regions where water resources are limited. These findings are of great importance for the conservation of water resources and sustainable water management. Our study reveals that the application of restricted irrigation strategies in regions with insufficient water resources may be a useful approach to increase water productivity and ensure the continuity of agricultural production.

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Effect of Temperature and Agitation Speed on Adsorption Activity of TiO_2/PLDOPA/Fe_3O_4 Nanocomposite for Lead Removal

Hayrunnisa MAZLUMOĞLU[1,2*] Şule BİNİCİ[2]

[1] *Department of Chemical Engineering, Ataturk University, 25240 Erzurum, Türkiye*
[2] *Department of Nanoscience and Nanoengineering, Ataturk University, 25240 Erzurum, Türkiye*

** Corresponding author E-mail: h.mazlumoglu@atauni.edu.tr*

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ABSTRACT

The presence of lead in the environment poses a serious threat to ecosystems. This heavy metal is an inorganic pollutant that is non-biodegradable and toxic. The health issues associated with lead poisoning are numerous such as kidney damage, nerve damage, liver damage, infertility, miscarriages, and neonatal deaths. Due to their large specific surface area, high reactivity, and ability to remove a wide range of pollutants (1–1000 ppm) in a shorter time, nanosized adsorbents are advantageous for removing heavy metal ions. Titanium dioxide (TiO_2) is one of the popular nano-metal oxide adsorbents that is employed in the remediation of organic and inorganic pollutants in wastewater due to its distinctive properties, including low toxicity, low-cost, hydrophilicity, a large surface area, and photocatalysis. Furthermore, nanosized magnetite (Fe_3O_4) particles are an effective means of removing heavy metals, due to their magnetic properties, large surface area, chemical stability, facile synthesis, and low toxicity. The separation of magnetic adsorbents from the aqueous medium is an easy process that can be achieved through an external magnetic field, thereby reducing secondary waste. Support materials are used to enhance the surface area of the magnetic adsorbent and prevent aggregation. As a support material, TiO_2 nanowires with a large surface area were synthesized and coated with PLDOPA film, in this study. The film facilitated the deposition of Fe_3O_4 nanoparticles on a nanowire in a controlled manner, thereby preventing aggregation. TiO_2/PLDOPA/Fe_3O_4 nanocomposite was employed in adsorption experiments to remove Pb^{+2} from aqueous medium. We investigated the effect of temperature and agitation speed on Pb^{+2} removal. The nanocomposite was characterized by X-ray diffraction (XRD) and transmission electron microscopy (TEM), and its adsorption activity was determined by inductively coupled plasma mass spectrometry (ICP-MS). Consequently, it was observed that the adsorption first increased and then decreased with temperature and agitation speed.

Contents

1. Introduction

The rapid development of urbanization, industrialization, and agricultural practices have raised many risks in recent years. They have significant harmful effects on the environment. Among the risks is that industrial wastewater is released into the environment without being removed to meet the specified standards. Besides being highly toxic and carcinogenic, heavy metals in wastewater are also extremely stable, non-biodegradable, highly soluble, and easily transportable in aqueous medium. Due to these factors, various diseases and disorders are caused by heavy metals accumulating in living organisms. Therefore, removing heavy metals from wastewater is crucial to protecting the environment and human health (Cai et al. 2019; Al osman, Yang, and Massey 2019; Sankhla 2019).

Lead (Pb) is a heavy metal harmful even in trace amounts in wastewater. Pb is not an element the human body needs. As a result of long-term exposure to lead, many health issues can be caused, including memory loss, kidney damage, digestive problems, reproductive problems, sensory organ disabilities, irritability, dizziness, headaches, and a variety of joint and muscle problems. The United States Environmental Protection Agency (EPA) and the World Health Organization (WHO) have identified the maximum permissible limits for Pb^{+2} in drinking water as 0.015 ppm and 0.01 ppm, respectively (Abarikwu 2013; Rehman et al. 2019; Xu and Yoo 2020).

Heavy metal ions can be controlled by removing them from wastewater, as well as protecting the environment. Efficient, convenient, and low-cost technologies have become extremely important to remove heavy metals. The adsorption method is widely used to remove heavy metals since it offers several advantages, including easy and rapid removal, low-cost, selectivity, high activity, wide applicability, and minimal secondary pollution. In the adsorption process, it is crucial to select an appropriate adsorbent. An effective adsorbent should generally have high adsorption activity, large surface area, fast adsorption rate, and high selectivity so that it can be used to remove a large amount of pollutants rapidly (Ahmad and Azam 2019; Bashir et al. 2019).

Nanosized metal oxides as adsorbents have attracted attention in recent years. The properties of TiO_2 make it an effective nanoadsorbent, including its chemical stability, large surface area, low toxicity, easy manufacture, and abundant supply. On the other hand, it has disadvantages such as aggregation and recovery issues. As a result of its magnetic properties, magnetite (Fe_3O_4) nanoadsorbents are capable of manipulating and controlling nanosized materials. In this regard, they are frequently preferred in separation processes (Ahrouch et al. 2019; Bi et al. 2019; Lei et al. 2024; Tao et al. 2020).

This study investigated the effect of temperature and agitation speed on the removal of Pb^{+2} through TiO_2/PLDOPA/Fe_3O_4 nanocomposite. The production of TiO_2 nanowires was carried out by the hydrothermal method, and the production of Fe_3O_4 nanoparticles was carried out by the solvothermal method. The TiO_2 nanowires were coated with PLDOPA film and deposited with Fe_3O_4 nanoparticles. Nanoadsorbents exhibited large surface areas and magnetic properties allowed for easy and effective separation. As temperature and agitation speed increased, the adsorption rate increased and then decreased. A major reason is due to the contact between the adsorbent and adsorbate. The future of this study will focus on addressing other conditions that affect the adsorption of Pb^{+2}.

2. Materials and Methods

2.1. Materials

TiO_2 nanowires were produced with titanium dioxide (TiO_2), sodium hydroxide (NaOH), Fe_3O_4 nanoparticles were produced with iron (III) chloride hexahydrate ($FeCl_3.6(H_2O)$), urea (CH_4N_2O), propylene glycol ($C_3H_8O_2$), succinic acid ($C_4H_6O_4$) and PLDOPA coatings were made with 3,4-dihydroxyphenyl-L-alanine (LDOPA), tris (hydroxymethyl) aminomethane $C_4H_{11}NO_3$. Washing was accomplished with (HCl) and ethanol (C_2H_6O). All chemicals were purchased from Sigma-Aldric.

2.2. Synthesis of Nanocomposite

TiO_2/PLDOPA/Fe_3O_4 nanocomposite was used as an adsorbent for Pb^{+2} removal.

TiO_2 nanowires were produced by the hydrothermal method. 1 g TiO_2 was added to 40 mL, 10 M NaOH solution. It was transferred to a stainless steel reactor with a teflon chamber after stirring for 10 minutes on a magnetic stirrer. It was kept at 200 ° C for 20 hours. The reactor was cooled to room temperature and the product was washed with dilute HCl acid, deionized water, and ethanol, respectively. TiO_2 nanowires were dried at 60 °C for 12 hours and stored for nanocomposite production (Mazlumoglu and Yilmaz 2021; Zhang et al. 2002).

Fe_3O_4 nanoparticles were produced by the solvothermal method. 3 mmol $FeCl_3.6(H_2O)$, 1 mmol succinic acid, and 30 mmol urea were added to 30 mL propylene glycol. The mixture was kept in a stainless steel reactor with a teflon chamber at 200 ° C for 12 hours. A magnet was used to separate Fe_3O_4 nanoparticles from the product after cooling down to room temperature. The washing process was done with ethanol and deionized water, respectively. Fe_3O_4 nanoparticles were dried at 45 °C for 5 hours and stored for nanocomposite production (Cheng, Xu, and Gu 2011; Hou, Yu, and Gao 2003).

TiO_2/PLDOPA/Fe_3O_4 nanocomposite was prepared as follows; 12 mg TiO_2 nanowires and 4 mg Fe_3O_4 nanoparticles were dispersed in 60 mL tris buffer solution (10 mM, pH 8.5) and 12 mg LDOPA was added. After agitating in a shaker for 3 hours, a magnet separated the

nanocomposite. After drying, the TiO_2/PLDOPA/Fe_3O_4 nanocomposite was stored for adsorption experiments.

2.3. Characterization Studies

Transmission electron microscope (TEM, Hitachi HighTech HT7700) and X-ray diffraction device cihazı (XRD, PANalytical Empyrean) were used for characterization studies of nanomaterials. Inductively coupled plasma-mass spectrometry (ICP-MS, Agilent 7800) determined the heavy metal removal rate. Size analysis was performed via the free software ImageJ.

2.4. Adsorption Studies

Batch adsorption method was used to determine the effect of temperature and agitation speed on Pb^{2+} adsorption of TiO_2/PLDOPA/Fe_3O_4 nanocomposite. 50 mg nanocomposite was added into 100 mL, 50 ppm Pb^{2+} solution. Experiments were carried out separately for 3 hours in a shaker in a dark environment at certain temperatures (298, 308, and 318 K) and agitation speeds (50, 100, and 150 rpm). The adsorbent was separated with a magnet and the amount of Pb^{+2} remaining in the solution was determined by ICP-MS device. To calculate the adsorption efficiency of nanocomposites, the percentage removal rate (R(%)) and the amount of adsorbed Pb^{+2} (q_t) after 3 hours were calculated using Equation 1 and 2, respectively;

$$R\ (\%) = \frac{(C_0 - C_t)x100}{C_0} \quad (1)$$

$$q_t = \frac{(C_0 - C_t)xV}{m} \quad (2)$$

where, R (%); is the percentage removal rate of Pb^{+2}, C_0 ve C_t (ppm); is the concentration of Pb^{+2} in the solution at the beginning and after t time, q_t (mg/g); is the amount of adsorbed Pb^{+2} at t time, V (L); is the volume of Pb^{+2} solution and m (g); is the amount of adsorbent.

3. Results and Discussion

3.1. Characterization studies

Characterization studies were carried out to determine the morphology, size, elemental distribution, and crystal structure of the nanomaterials.

Figure 1 presents TEM images at different magnifications and XRD pattern of TiO_2 nanowires. TEM images in Figures 1a-b demonstrate that TiO_2 nanowires were successfully synthesized. It was determined that the nanowire diameters ranged from 23 to 63 nm. In the XRD pattern in Figure 1c, diffraction peaks corresponding to the angle values of 2θ = 10.6°, 25.1°, 29.8°, 31.9°, 34.7°, 35.9°, 39°, 45.6°, 48.7°, 52.9° and 60.1° are observed. They correspond to the planes (200), (110), (003), (112), (312), (113), (004), (204), (200), (105) and (204), respectively. Furthermore, the peaks are sodium titanate ($Na_2Ti_3O_7$) structures that are formed by introducing sodium ions between TiO_2 nanowires and the layered titanate layers (JCPDS kart no 01-071-1169 ve 01-72–0148). This is consistent with the EDX data in Figure 1c (Ameur and Bachir 2020; Chen and Mao 2007; Yin et al. 2017).

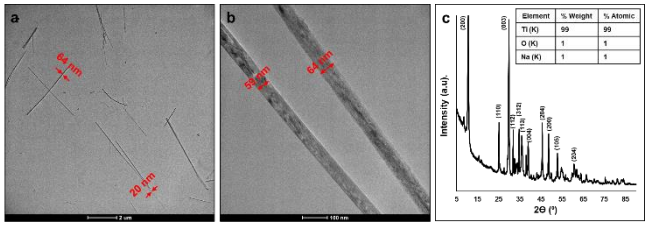

Figure1. a-b) TEM images at different magnifications, **c)** XRD pattern of TiO_2 nanowires

Figure 2 presents TEM images at different magnifications, XRD pattern, and size distributions of Fe_3O_4 nanoparticles. Figure 2a and b TEM images demonstrate that Fe_3O_4 nanoparticles are semi-spherical in shape. A partial aggregation due to magnetic properties is also observed. Figure 2b illustrates the magnet effect on Fe_3O_4 nanoparticles collecting on the bottle edge. The synthesis of magnetite was successful, as demonstrated by this result. The XRD pattern is presented in Figure 2c. 2θ = 24.8°, 30.2°, 35.4°, 43°, 53.4°, 57.1°, 62.9°, 71.3° and 74.3° angles correspond to the planes (111), (220), (311), (400), (422), (511), (440), (553) and (533). These peaks are related to the specific peaks of Fe_3O_4 nanoparticles (JCPDS kart No 79–0418). Fe and O atoms in the table inside Figure 2c confirm the TEM images, magnetism test, and XRD pattern, which indicate magnetite formation. The graph in Figure 2d shows that nanoparticle diameters range from 3-12 nm and are more dense between 9-12 nm (El Ghandoor et al. 2012; Kharisov et al. 2012).

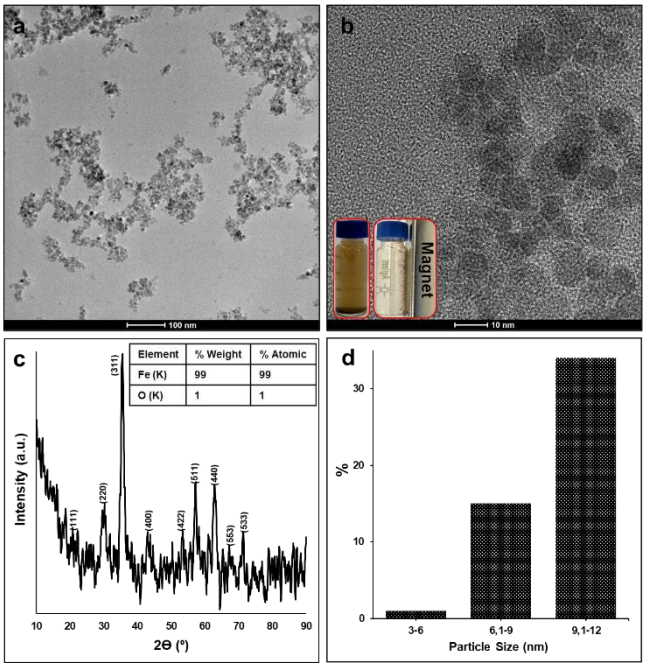

Figure 2. a-b) TEM images at different magnifications, **c)** XRD pattern, **d)** size distribution of Fe_3O_4 nanoparticles.

Figure 3 presents TEM images at different magnifications and XRD pattern of the nanocomposite. Magnetite nanoparticles have been successfully deposited on the wire as shown in Figures 3a-b. From TEM images, PLDOPA film is obvious and measured to be approximately 5 to 9 nm thick. XRD pattern in Figure 3c demonstrates that the intensity of TiO_2 peaks decreases and new peaks are formed due to Fe_3O_4 nanoparticles. As verified by TEM and XRD results, EDX data inside Figure 3c confirm the successful deposition of Fe_3O_4 nanoparticles into the nanocomposite.

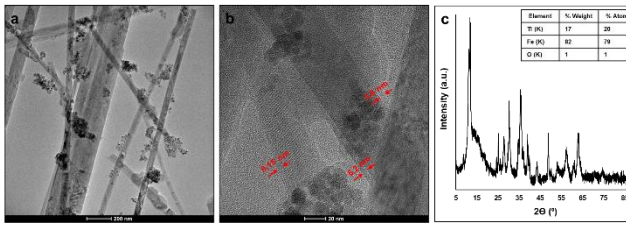

Figure 3. a-b) TEM images at different magnifications, **c)** XRD pattern of TiO_2/PLDOPA/Fe_3O_4 nanocomposite

Figure 4 presents TEM images at different magnifications and XRD pattern of the nanocomposite after adsorption. Comparing Figures 3a-b and Figures 4a-b, it is observed that the dark areas of the Fe_3O_4 nanoparticles increase after adsorption. It can be interpreted that the dark areas are the sites of Pb^{+2} adsorption. XRD pattern of the nanocomposite in Figure 4c has not changed significantly after adsorption. EDX data inside Figure 4c shows a high value for Pb^{+2}. The results confirm the adsorption of Pb^{+2}.

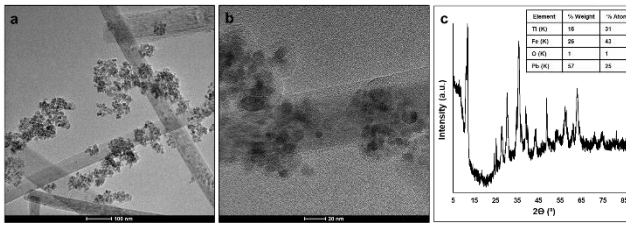

Figure 4. a-b) TEM images at different magnifications, **c)** XRD pattern of TiO_2/PLDOPA/Fe_3O_4/Pb nanocomposite

3.2. Adsorption Studies

3.2.1. Effect of Temperature on Adsorption

We conducted adsorption experiments at 298, 308, and 318 K to investigate the effect of temperature on lead adsorption. The other parameters were kept constant (agitation speed; 150 rpm, adsorbent amount; 50 mg, initial lead concentration; 50 ppm and volume; 100 mL). The amount of Pb^{+2} remaining in solution after 3 hours was determined. Figures 5a and b show the percentage removal rate and adsorption amount of Pb^{+2} versus temperature, respectively. Based on Figure 5, the adsorption rate initially increases with temperature and then decreases.

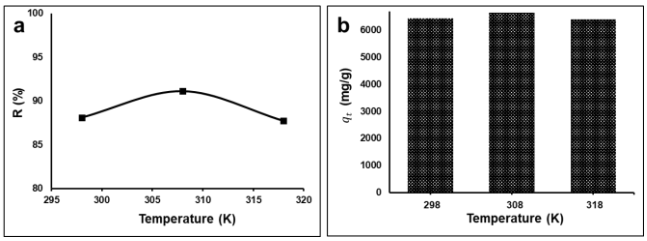

Figure 5. a) Percentage removal rate and **b)** amount of adsorbed Pb^{+2} at t time versus temperature.

During adsorption, temperature plays a significant role in thermodynamics and adsorption balance. As temperature increases, adsorption activity increases for the following reasons; i) adsorbate solubility increases, ii) liquid viscosity decreases, iii) adsorbent-adsorbate contact increases as the particle mobility increases, iv) transfer rate to the adsorbent surface increases, v) a break in internal bonds near the particle edge, and vi) the number of adsorption sites increases. The reaction rate generally increases at high temperatures, but the adsorption activity may not always increase. The adsorption activity is affected by temperature change depending on whether an exothermic or endothermic reaction occurs. Adsorption activity increases with increasing temperature when an endothermic reaction occurs, but decreases when an exothermic reaction occurs. Furthermore, increasing temperature decreases adsorption activity for the following reasons; i) adsorbate-adsorbent binding force decreases, ii) active sites number and activity decreases, and iii) adsorbate kinetic energy increases (Abdel Maksoud et al. 2020; Karapinar et al. 2023; Nassar 2010; Sobhanardakani and Zandipak 2017).

The effects of temperature in our study agree with the explanations provided above. It can be assumed that Pb^{+2} is adsorption onto the TiO_2/PLDOPA/Fe_3O_4 nanocomposite in an exothermic manner.

3.2.2. Effect of Agitation Speed on Adsorption

Adsorption experiments at 50, 100, and 150 rpm were conducted to study the effects of agitation speeds on lead adsorption. The other conditions were kept constant (temperature 298 K; adsorbent amount; 50 mg, initial lead concentration; 50 ppm and volume; 100 mL). A period of 3 hours was required for the experiment to reach equilibrium. The effect of agitation speed on adsorption is presented in Figure 6. The figure shows that the adsorption activity initially increased and decreased with agitation speed.

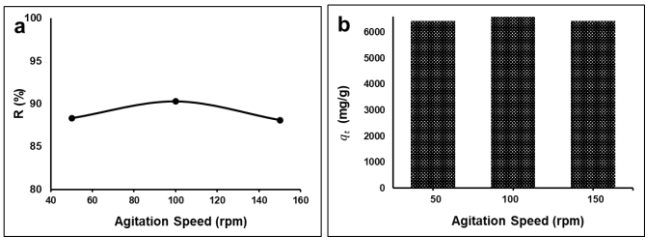

Figure 6. a) Percentage removal rate and **b)** amount of adsorbed Pb^{+2} at t time versus agitation speed.

The agitation speed plays a significant role in the adsorption process and affects the distribution of solutes. As the agitation speed increases, the adsorbate is distributed more uniformly. Also, diffusion increases with turbulence caused by agitation and a decrease in the thickness of the adsorbent boundary layer. This increases the contact between the adsorbent and the adsorbate, thereby increasing adsorption. Agitation speeds above a certain value, however, may cause vortex formation. In this manner, the contact time between the adsorbate and adsorbent decreases, and the adsorption activity decreases (Chong, Chia, and Ahmad 2013; Liang et al. 2019; Moradi et al. 2017). The results of the study can be based on these facts.

4. Conclusion

In this study, TiO_2@PLDOPA@Fe_3O_4 nanocomposite was used as an adsorbent and the effects of temperature and agitation speed on Pb^{+2} adsorption were investigated. Magnetic TiO_2@PLDOPA@Fe_3O_4 nanocomposite was synthesized by depositing Fe_3O_4 nanoparticles on TiO_2 nanowires via PLDOPA film. The nanocomposites were characterized by XRD, and TEM analysis methods before and after adsorption. The characterization results are consistent with each other. The percentage removal rate and amount of adsorbed Pb^{+2} were calculated based on the ICP-MS data collected before and after the adsorption experiments.

Based on the results, adsorption activity increased with temperature increase and then decreased. A rise in adsorption with temperature can be attributed to a change in the parameters that increase contact between adsorbate and adsorbent. At higher temperatures, Pb^{+2} adsorption can decrease due to the weakening of bonds, and an exothermic manner.

According to the results, the adsorption activity increased and then decreased with agitation speed. The rise in adsorption can be attributed to the contact between the adsorbent and the adsorbate due to an increase in turbulence and a decrease in the thickness of the adsorbent boundary layer with the agitation speed. It can be said that a vortex forms, shortening the contact time and decreasing adsorption by exceeding a certain value.

The future of this study will focus on addressing other conditions that affect the adsorption of Pb^{+2}.

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Numerical Evaluation of Aerosol Deposition in the Respiratory Tract Based on Chemical Properties and Size

Hacer ÜÇÜNCÜ[1,3*] Doğan ÇİLOĞLU[2,3]

[1]*Department of Electrical and Electronics Engineering, Faculty of Engineering, Atatürk University, Erzurum, Turkey*

** Corresponding author E-mail: ucuncuhalise49@gmail.com*

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ABSTRACT

The accurate evaluation of aerosol dynamics and particle deposition in the respiratory tract is critical for studying inhalation drug delivery and the effects of toxic particles. This process involves complex, multiphase flows with diverse respiratory characteristics, playing a significant role in human health. Computational Fluid Dynamics (CFD) offers a powerful tool to overcome the limitations of in vivo and in vitro experiments, enabling a microscopic understanding of the fundamental mechanisms of respiratory flow and particle behavior. Understanding the behavior of aerosol particles and airflow dynamics within the respiratory system is essential for achieving desired therapeutic outcomes and reducing disease risks. Technological advancements have facilitated the development of image-based models that enhance the efficiency of numerical and experimental research. CFD plays a vital role by enabling the simulation and evaluation of key parameters affecting aerosol deposition. This study provides a comprehensive literature review of various methods and solutions developed for aerosol dynamics in the human respiratory system. Existing studies in the academic literature are critically analyzed, focusing on airflow and particle deposition in different respiratory regions. The findings reveal that aerosol dynamics vary based on particle size, charge, and hygroscopicity. These analyses form the foundation for developing aerosol-based therapeutic strategies and mitigating the impact of toxic particles on human health. Moreover, they guide future research by promoting more effective simulation approaches.

Contents

1. Introduction

The lungs, as the only internal organ in constant contact with the external environment, play a critical role in the human body. Individuals inhale significant amounts of air daily, exposing them to potentially harmful pollutants present in the air. These pollutants may include vehicle emissions, occupational substances, and microbial contaminants. With the increase in these pollutants, a significant rise in respiratory diseases has been observed. This increase indicates a growth not only in the number of affected individuals but also in disease prevalence rates.

Inhalation therapy emerges as an effective method for treating respiratory diseases due to its ability to rapidly target the affected region and minimize systemic side effects. Additionally, inhalation therapy bypasses first-pass metabolism in the liver by directly connecting the alveolar region to the bloodstream, thereby enhancing treatment efficacy. This therapy method also offers

advantages due to its non-invasive nature, making it a viable option for systemic treatments.

2. Materials and Methods

Accurately predicting aerosol deposition in the respiratory tract is crucial for both inhalation drug therapy and preventive protection against air pollution. Methods used to predict aerosol deposition include semi-empirical models, experimental approaches, and CFD simulation models.

Semi-Empirical Models: Dosimetry models such as the ICRP model and ExDoM are typically suitable for regional deposition predictions. However, these models have limitations in providing accurate individual-specific predictions.

Experimental Methods: Experimental methods, despite being limited by high costs and ethical concerns, can provide real-world data. These methods aim to directly observe particle deposition but may face challenges in large-scale applications.

CFD Simulation Models: CFD simulations offer a more detailed approach for examining airflow and particle transport in the respiratory tract. These models can reveal finer details of the airflow field within the respiratory tract, enabling more accurate predictions of particle movement and deposition. With appropriate boundary conditions, CFD simulations can provide highly accurate regional predictions of particle behavior.

The air flow field is developed in CFD with the ANSYS Workbench finite element algorithm. The model obtained from CT scans (Fig. 1) creates a numerical simulation and includes basic parameters such as flow characteristics, pressure drop, turbulence intensity, velocity profile for particle accumulation. With advancements in computational power, the use of CFD for studying aerosol transport in the respiratory tract has become increasingly popular. However, these simulations still face challenges. Simulating the respiratory tract requires significant computational power because the respiratory system encompasses a wide range of size variations, from the upper respiratory tract to the bronchial tree and thousands of bronchioles within it. Consequently, the computational cost for simulating the entire respiratory tract remains high, necessitating technological advancements to make such models more efficient.

Despite these challenges, CFD and other simulation techniques offer substantial potential for understanding aerosol transport in the respiratory tract and enhancing the effectiveness of treatment methods.

In general, CFD results show good agreement with data obtained from in vivo tests and in vitro experiments. In Figure 2, in silico results obtained by Huang et al. (2018) using the USP throat, an IMT model, and an RMT model are compared with in vivo and in vitro data from Cheng et al. (1999). The deposition efficiency of the IMT and RMT models shows quantitative agreement with the in vivo data, while deposition in the USP model differs significantly from the other models. This indicates that the IMT and RMT models are closer to anatomical structures.

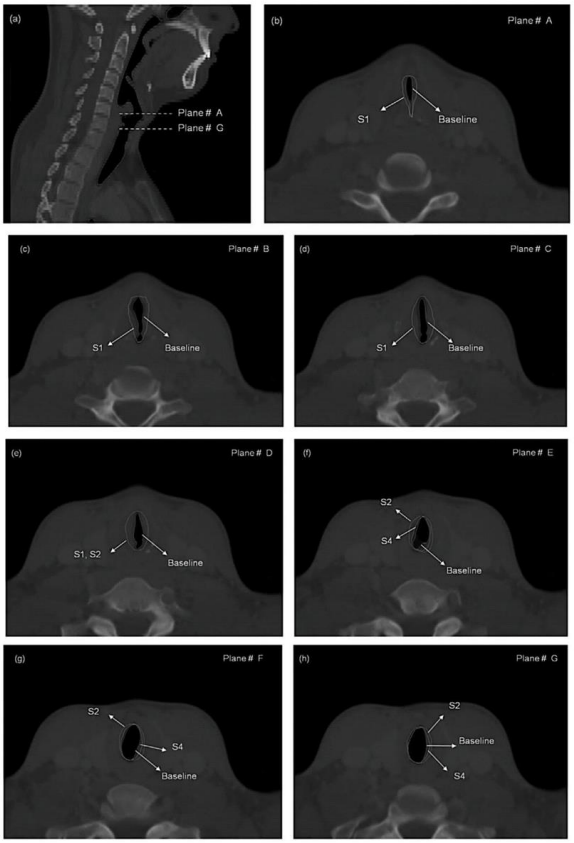

Figure 1 Images obtained from CT scans of the lungs

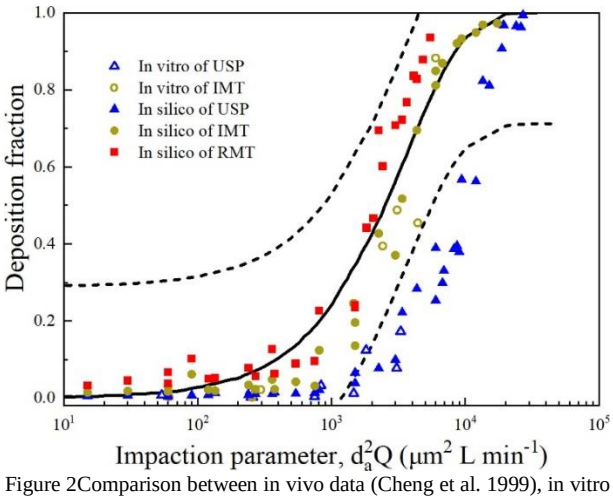

Figure 2Comparison between in vivo data (Cheng et al. 1999), in vitro data obtained by IMT and USP, and simulation data produced by USP, IMT, and RMT (Huang et al. 2018). (In this comparison, solid lines represent the mean curve of in vivo data, and dashed lines represent the standard deviation of in vivo data.)

3. Results and Discussion

3.1. The Effect of Particle Charge

Respirable particles are classified into three main categories based on their impact on human health: pollutants, viruses, and drugs. While these categories encompass a diversity of particles in the atmosphere, they exhibit significant differences in transport and deposition mechanisms in the respiratory tract due to variations in their sources and internal compositions. For instance, pollutant particles are of environmental origin, viral particles possess infectious properties, and drug aerosols are designed for therapeutic purposes.

Rahman et al. (2022) conducted a comprehensive study investigating the transport and deposition processes of particles such as traffic emissions, cigarette smoke, and dust within the respiratory tract. Complex particles like cigarette smoke exhibit intricate behavior in the respiratory tract, driven by various physical and chemical processes. Key mechanisms include inertial impaction, gravitational settling, diffusion, hygroscopic growth, coagulation, and agglomeration.

Longest and Xi (2008) emphasized that water vapor condensation is a critical factor that could lead to high deposition of cigarette smoke in the lungs. Feng et al. (2015) simulated the deposition characteristics of e-cigarette aerosols and traditional cigarette smoke in G3-G6 airway regions, finding significant differences between the two aerosol types. Inhalable drug aerosols (Ciloglu, 2020) and viral aerosols (Shim et al., 2023) are often modeled as droplets containing NaCl or multicomponent droplets. While viral particles are characterized by aerosol behaviors that heighten infection risks, drug aerosols are optimized for targeted transport and deposition mechanisms for therapeutic purposes.

3.2. The Effect of Hygroscopic Growth

Hygroscopic particles tend to grow due to atmospheric water vapor or relative humidity (RH), enhancing their inertial effects and leading to higher deposition rates in the respiratory tract. Longest and Xi (2008) demonstrated that relative humidity in thermally saturated airflow within the upper respiratory tract could exceed 100%, causing a marked increase in particle size. Their research revealed that while particle size increased by less than 50% in unsaturated airflow, it could grow more than twofold in saturated airflow.

Chen and Kleinstreur (2018) investigated particle trajectories and local accumulation in the respiratory tract, emphasizing the impact of hygroscopic growth influenced by temperature and humidity. Their study analyzed the accumulation efficiency of hygroscopic particles in the (MT region) under different thermal airway wall conditions at a flow rate of 15 L/min. Results showed that evaporation in the mucus layer and heat transfer reduced hygroscopic growth, leading to a 10% decrease in accumulation efficiency under specific thermal conditions.

Chen et al. (2019) comprehensively examined the transport and deposition processes of hygroscopic aerosols using idealized mouth-throat models. They showed that the relative humidity level at the inlet significantly influenced particle growth rates. Under humid boundary conditions, particle deposition efficiency was found to be 5% higher compared to dry conditions, highlighting the critical impact of relative humidity on particle transport dynamics and deposition in the respiratory tract.

Hindel et al. (2010) developed the Enhanced Condensation Growth (ECG) method for targeted drug delivery, finding that deposition rates in G0-G2 and G3-G5 airway regions increased significantly under ECG conditions compared to control scenarios. This innovative approach demonstrates the potential of controlling hygroscopic growth dynamics to improve drug transport and deposition.

Narayanan et al. (2022) investigated the effect of inlet temperature on the flow field and particle deposition in an idealized mouth-throat model, demonstrating the accuracy of these effects. The study examined how different temperature conditions influence flow dynamics and particle deposition rates, confirming that inlet temperature plays a significant role in the movement and deposition of particles in the respiratory tract.

Sajadi et al. (2023) studied the behavior of water droplets of varying sizes in the nasal airways of a healthy male under cyclic inspiration conditions with a flow rate of 15 L/min. Using a convection-diffusion model, they evaluated interactions between droplets and the mucus layer. Their findings revealed that the mucus layer reduced droplet evaporation by 90%, although its impact on droplet deposition remained limited.

3.3. The Effect of Particle Size

Particle size is a critical parameter determining airflow and deposition dynamics in the respiratory tract. Larger particles typically deposit in the extrathoracic (ET) region, while smaller particles are transported by airflow to the tracheobronchial (TB) region (Kleinstreuer et al., 2008b; Balashazy et al., 2003; Zhang et al., 2005). Deposition in the ET region is primarily associated with inertial impaction. Simulations using realistic mouth-throat models have shown that deposition in the ET region increases proportionally with particle size (Gemci & Shortall, 2003; Rahimi-Gorji et al., 2016; Takano et al., 2006), highlighting the filtering function of this region.

Particles not deposited in the oral region often travel to the end of the trachea, bypassing the pharynx (Figure 3).

Particle deposition in the alveolar region occurs through a combination of mechanisms: impaction, sedimentation, diffusion, and convection (Longest et al., 2012; Dailey & Ghadiali, 2007; Lee et al., 2003; Haber et al., 2003). Using a single alveolus model, Haber et al. (2003) demonstrated the complexity of particle deposition, particularly for particles smaller than 0.5 μm. Their studies revealed that deposition of 0.5 μm particles in the

alveolar region balances between diffusion and transitional mechanisms.

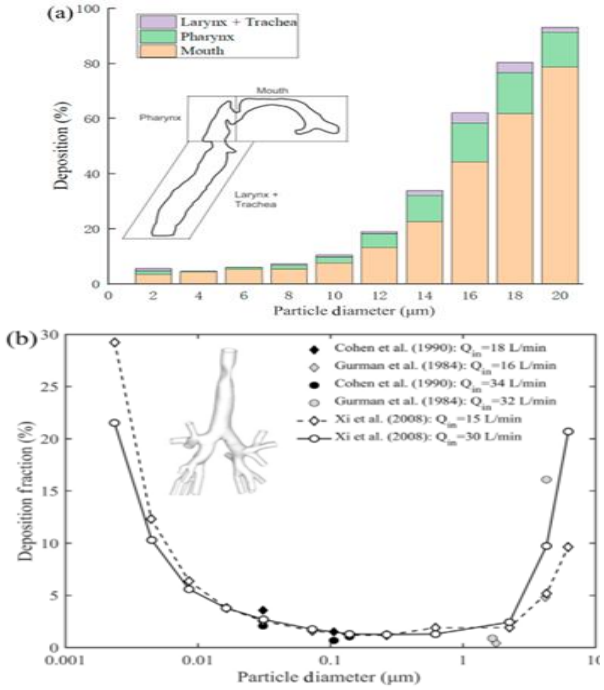

Figure 3 (a) The three subregions of the extrathoracic (ET) region. (b) Deposition rates corresponding to each subregion (Jayaraju et al., 2007).

Balashazy et al. (2008) investigated deposition mechanisms for particles sized 0.1 μm and 1 μm in alveolar regions, noting that the dominant deposition mechanism changes depending on particle size. A model developed by Çiloğlu et al. (2015) focused on alveolar fluid-structure interaction to study the respiratory mechanics of alveoli and particle deposition within alveolar sacs. The model analyzed the effects of particle diameter, tidal breathing time, flow streamlines, particle-fluid interaction, and gravitational orientation. The findings indicated that particles with diameters between 1 and 5 μm exhibited directional movement influenced by gravitational forces throughout the G18-22 generations of the respiratory tract.

Kadota et al. (2022) aimed to investigate the transport and deposition behavior of inhaled particles of various sizes (1.0, 2.5, 5.5, 8.5, and 10.0 μm) in the pulmonary airways of three COPD patients with varying disease severities by combining CFD and the Lagrangian multiphase model. The deposition levels of inhaled particles in the airways differed among patients, highlighting the influence of individual airway geometry and the degree of obstruction on the deposition process. Regardless of the model, small particles (1.0–2.5 μm) generally exhibited low deposition efficiency in generations G0–G10 of the bronchial tree due to the low effects of gravitational settling and Brownian diffusion. In contrast, larger particles (5.0–10.0 μm) tended to deposit in the narrowed bronchi of generations G2–G6 in severe COPD cases. The deposition of particles in this size range was attributed to inertial effects, which reduced their penetration into the peripheral regions of the lungs

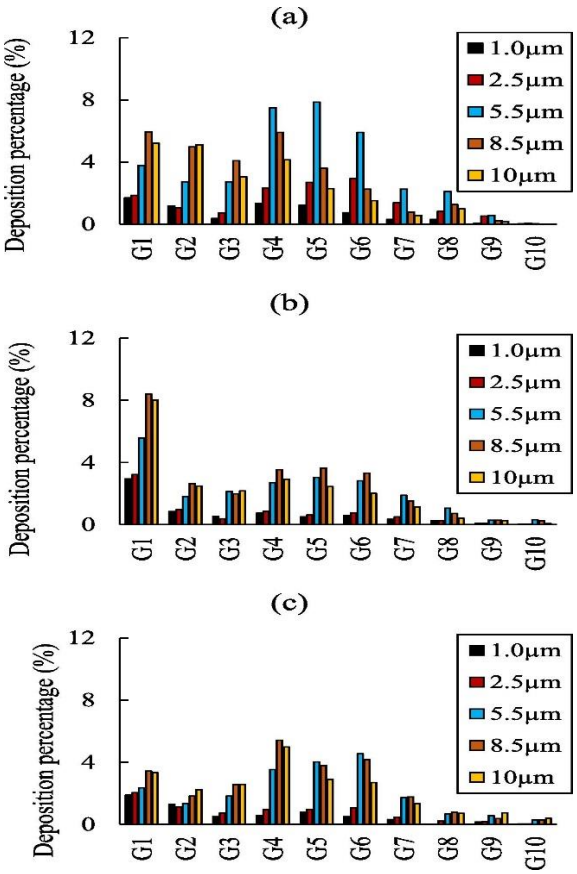

Figure 4 Deposition rates of particles of different sizes in each region of three distinct airway models: (a) Airway 1, (b) Airway 2, (c) Airway 3 (Kadota et al., 2022)

Extensive research has been conducted to predict aerosol transport and deposition in the human respiratory tract. Due to the complexity of lung structure and interindividual differences in powder formulation and inhaler performance, as well as the difficulty in measuring local deposition in the lung, in vivo-in vitro correlations for inhaled aerosols are still lacking.

In silico modeling can play an important role in this regard. Aerosol transport and deposition is essentially a multiphase flow, and its macroscopic properties are determined by the behavior of the gas flow and gas-aerosol interactions.

In silico modeling and analysis based on Computational Fluid Dynamics (CFD) can help elucidate the underlying mechanisms and connect fundamental knowledge to applications.

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Structural, Optical and Morphological Properties of α-Fe_2O_3: Ag Thin Films Grown On Different Substrates

Hilal Kübra SAĞLAM[1,3*] Sevda SARITAŞ[2,3]

[1] *Department of Electrical and Electronics Engineering, Faculty of Engineering, Atatürk University, Erzurum, Turkey*
[2] *Department of Electrical and Energy, İspir Hamza Polat Vocational School, Atatürk University, Erzurum, Turkey*
[3] *Department of Nano-Science and Nano-Engineering, Institute of Science and Technology, Ataturk University, Erzurum, Turkey*

** Corresponding author E-mail: hilalk.saglam@atauni.edu.tr*

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ABSTRACT

Metal oxides such as hematite, a type of iron oxide, are cheap and have practical applications. For this reason, they are often preferred in electronic technology. Characterization analyses show that homogeneous polycrystalline films with similar structures are formed in different substrate selections. However, when glass is preferred as the substrate while growing Ag doped α-Fe_2O_3 films, the measured band gap value decreased when ITO substrate was selected.

Contents

1. Introduction

Hematite (α-Fe_2O_3) is an interesting metal oxide due to its physical and chemical properties. It is preferred because it is compatible with environmental conditions, stable and non-toxic. The reason why it is the center of attention among various metal oxide materials is that it offers a suitable platform for many applications. It is promising for sensors, solar cells, photocatalysts, lithium-ion batteries, sustainable energy storage devices and various industrial purposes.

Recently, monitoring hazardous gases has become important for environmental protection and health applications. Therefore, there is intense interest in developing gas sensors. In addition to being compact and cheap, semiconductor sensors are promising due to their simple operating principles. Therefore, metal oxide gas sensing materials are widely investigated. Semiconductor oxides such as Fe_2O_3, ZnO, SnO_2 and In_2O_3 have been investigated to detect toxic, polluting and flammable gases such as H_2, H_2S, CO and CO_2.

In previous studies, α-Fe_2O_3 sensors have been significantly supported by doping with sil metals such as Au, Pd and Pt.

However, due to high costs, investigating an alternative component such as silver will contribute to the literature.

In another study, it was observed that the surface area of Ag/Fe_2O_3 nanoparticles was several times larger than the surface area of pure α-Fe_2O_3. Compared to pure α-Fe_2O_3, all Ag-doped sensors showed better sensing performance in terms of response, selectivity and optimum operating temperature. In Ag-doped samples produced by hydrothermal method, the inclusion of silver increased both the electrical performance and improved the charge transport mechanisms for nano-electronic applications. The features are important for applications where fast charge transport is important such as sensors and energy storage devices [1,2].It was found that Ag-doped α-Fe_2O_3 based sensors showed good gas sensing performance for H_2S with high response, fast response time, ultra-low detection limit and good selectivity. This is thought to be due to the formation of ohmic contact between noble metal Ag and α-Fe_2O_3 and the unique catalytic behavior

of silver nanoparticles in the decomposition of H_2S molecules. These effects increase the number of adsorption/reaction sites for oxygen and target gas. Thus, there is improved charge transfer and improved reaction kinetics [3]. Ag doped Fe_2O_3 NPs show better photodegradation efficiency than pure α-Fe_2O_3 and have improved performance due to reduced band gap and inhibition of electron-hole pair recombination [4].

Large-scale synthesis of nanowires is possible with simple surface texturing techniques. Substrate texture is a very effective tool to control the growth of nanowires [5]. When composites of hematite (α-Fe_2O_3) nanoparticles with different materials (NiO, TiO_2, MnO_2 and Bi_2O_3) were synthesized, it was observed that pure α-Fe_2O_3 nanoparticles were affected by the presence of different materials in the composite sample. Crystallite size and strain analysis also confirmed this situation. However, the value of indirect band gap was found to increase for all composite samples except α-Fe_2O_3/Bi_2O_3 [6]. In addition, many researchers are focusing on nanoparticles synthesized by green methods to investigate various biological effects such as antimicrobial, anticancer, analgesic and antibacterial. Silver and cerium additives increase the therapeutic efficacy of iron oxide nanoparticles and are known for their strong antioxidant properties [7].

2. Materials and Methods

The study consists of magnetron sputtering processes. The films that were grown with glass substrate were named "F1". The films that were gron with ITO substrate were named "F2". It was aimed to grow Ag doped Fe_2O_3 films on both substrates via magnetron sputtering technique.

2.1. Magnetron Sputtering

α-Fe_2O_3 thin films were deposited on glass substrates at 320°C substrate temperature using the RF - DC magnetron co-sputtering technique Two gun were equipped with 2-inch Fe (99.99 % purity) - 2-inch Ag (99.99 % purity) sputtering targets. DC sputtering voltage applied to the Fe target was varied as 120 W. RF sputtering voltage applied to the Ag target was varied as 20 W The distance between the target and substrate was 57 mm from both targets in all cases. The substrate plate was located at the top of the sputtering chamber. Substrate rotation was applied during depositions. The substrate rotation speed was 3 rpm. For all depositions, the sputtering chamber was evacuated to 1×10^{-6} Torr by a mechanical pump and turbo molecular pump and then filled with high purity (99.99 %) Ar gas. Ar and O2 flows were maintained inside the chamber during depositions with a flow rate of 44 sccm and 3 sccm, respectively. Chamber pressure was sustained to be 7.8×10^{-3} Torr. 40 min were spent on for deposition procedure.

3. Results and Discussion

XRD results show that F1 and F2 thin films are formed in polycrystalite. The diffraction main peak of F1 is shifted and points to the (113) plane. The diffraction main peak of F2 points to the (113) plane with a similar shift, while the other peaks point to the (222), (104) and (110) planes. Therefore, it is expected that the angle of the main diffraction peak changes. In addition, it is seen that the intensity is different for different substrate films.

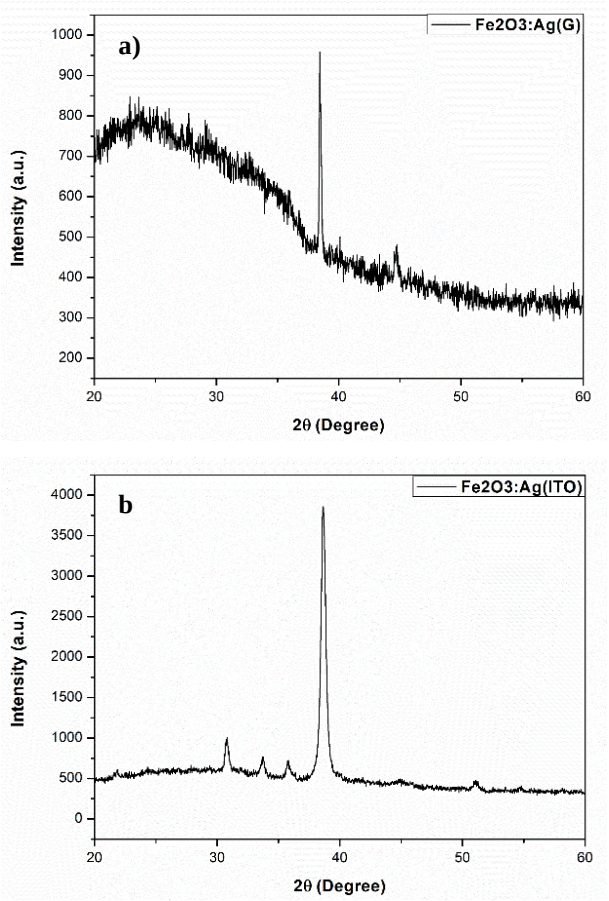
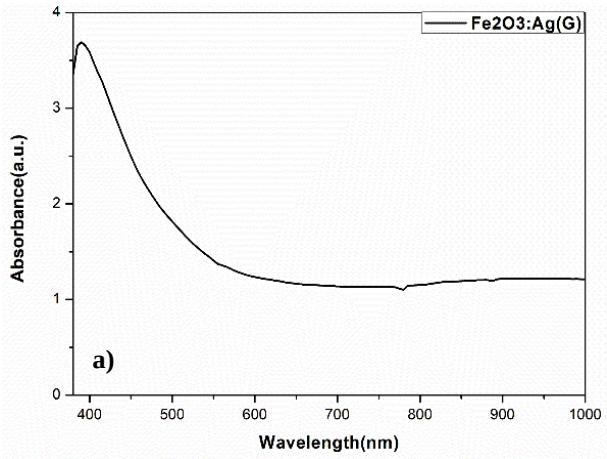


Figure 1. XRD graphs of films a) F1 and b) F2

The figures show the absorption spectra of glass and ITO substrate thin films grown by magnetron sputtering. It is seen that the absorbance value of F1 film on glass substrate is approximately the same as that of F2 film on ITO substrate. It is also observed that the grown thin films exhibit strong absorbance at around 400 nm wavelength for different substrate growths.

Optical band gap (Eg) values were calculated from the widely known Tauc equation. The band gap of the glass substrate thin film (F1) is approximately 2,6 eV as seen in the figure above. The band gap of the ITO substrate thin film (F2) is significantly reduced to approximately 2,1 eV.



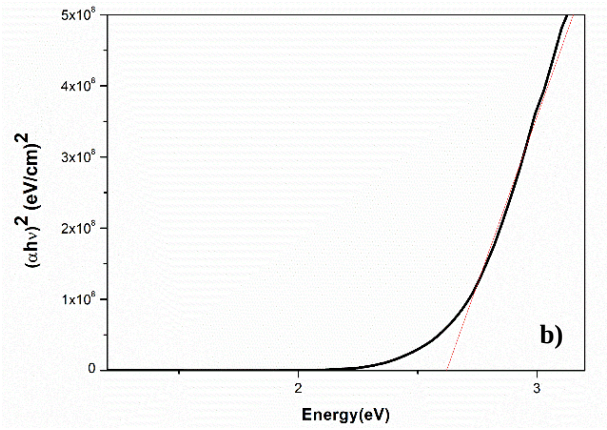
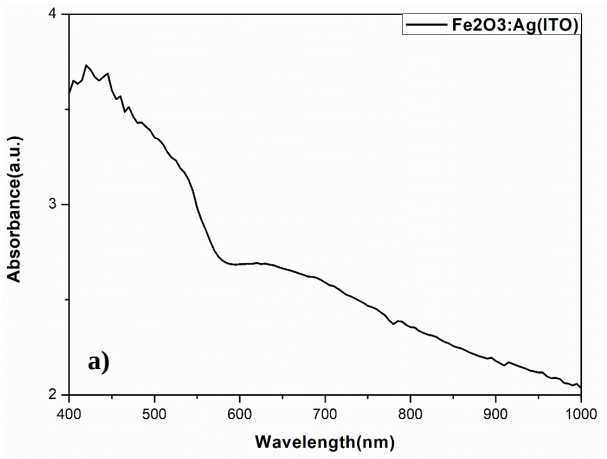


Figure 2. a) Absorbance graph of F1 and b) Bandgap graph of F1



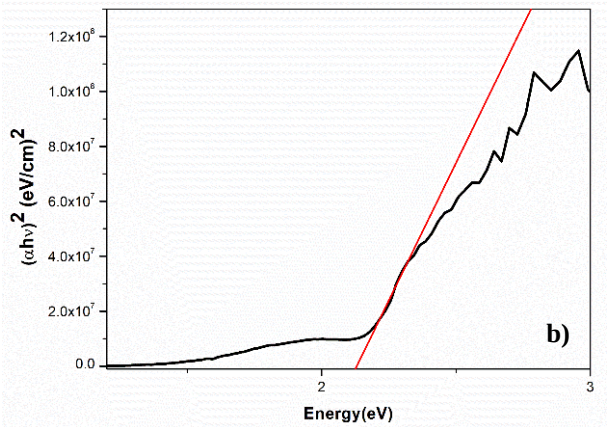
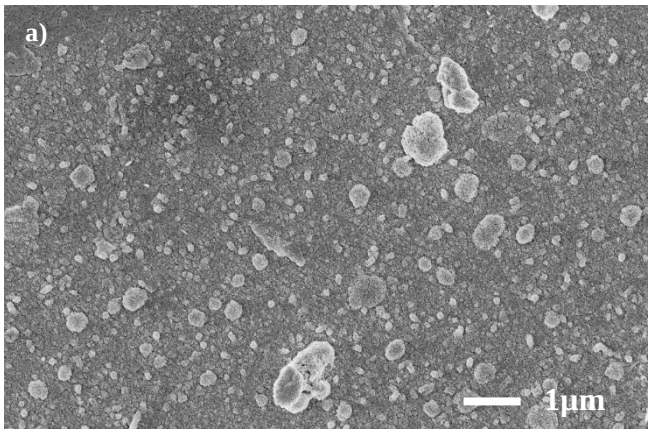
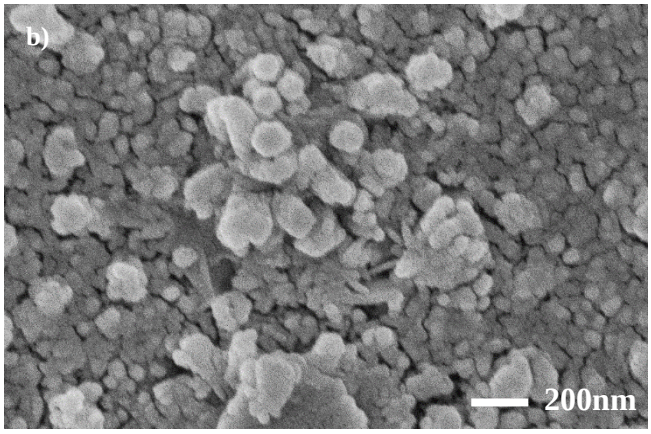
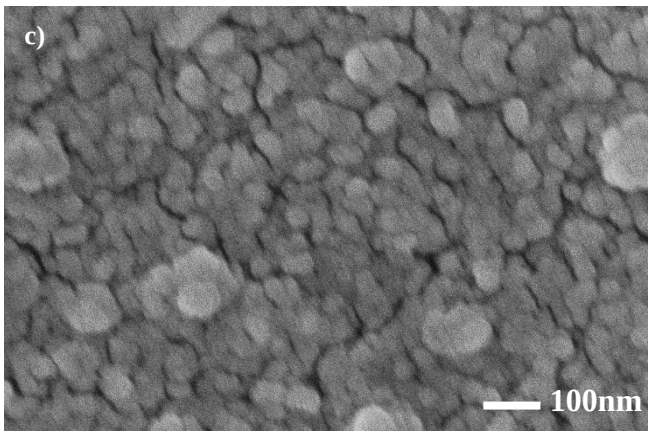


Figure 3. a) Absorbance graph of F2 and b) Bandgap graph of F2

SEM analysis shows that the surface morphology changes slightly after annealing. Both films (F1, F2) have a homogeneous structure. Similar nanostructures are observed on the film surfaces.







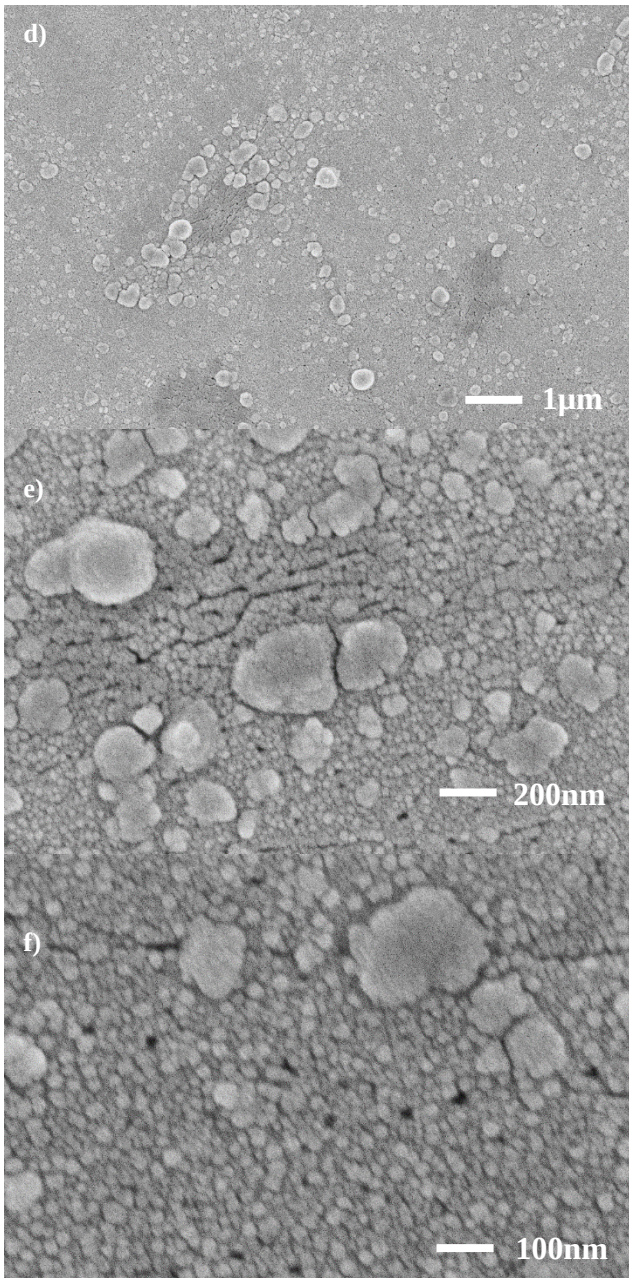


Figure 4. SEM graphs of films a-b-c) F1 and d-e-f) F2

4. Conclusion

The four semiconducter iron oxide species are: wustite (FeO), hematite (α-Fe2O3), maghemite (γ-Fe2O3), and magnetite (Fe3O4). The best known is hematite (α-Fe2O3), which is the mineral form of iron oxide (Fe2O3) and is the most stable iron oxide species in the ambient atmosphere. The reasons why hematite is preferred in popular electronic applications are its abundance in nature, low cost, practical applications and non-toxicity. The study includes the crystal structure, optical, electrical and surface morphology properties of Ag-doped α-Fe2O3 (hematite) thin films grown on different substrates such as glass and ITO. Both films were grown by magnetron sputtering technique. XRD results show that both films have a polycrystalline structure. When films grown on different substrates are compared, the absorbance values are approximately the same and have wavelengths of 400 nm. However, the bandgap value of the film grown on glass substrate is 2,6 eV, while the bandgap value of the film grown on ITO substrate decreased to 2,1 eV. SEM analysis shows that, although the surface morphology of the films changes slightly with different substrate selection, both films have a homogeneous structure and similar nanostructures are formed.

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Chair's Closing Speech

My dear professors, colleagues and dear students,

We have successfully completed the 2024 event of the International Congress on Trends and Developments in Global Research and Applications (TAGRA). It was a great honor and pleasure for me to be here with you and to be a part of this inspiring scientific journey.

Within the framework of the theme of our congress, "Discover the New Faces of Science", we discussed the latest developments in various fields of science and engineering for the last three days, exchanged ideas and prepared the ground for very valuable collaborations.

During this process, we listened to the visionary presentations of our 2 invited speakers, 9 main speeches, and 53 oral and poster presentations and understood once again how important interdisciplinary collaboration is. These presentations, which took place face-to-face and online, once again revealed that scientists work with a passion that knows no bounds and are open to innovations.

From energy systems to materials science, from artificial intelligence to environmental science, the topics covered not only meet today's needs but also offer a glimmer of hope for the future. In particular, I believe that the discussions held throughout our congress provided new perspectives and enabled concrete steps to be taken towards interdisciplinary collaboration.

I would like to once again express my deepest gratitude to everyone who made this event possible. First of all, I cannot help but appreciate the honorary chair of our congress, our university rector Prof. Ahmet Hacımüftüoğlu, and the devoted efforts of the entire organizing committee. Under the leadership of Dr. Lecturer Kaan YEŞİLYURT, thanks to the outstanding efforts of Dr. Lecturer Hilal Kübra SAĞLAM and Dr. Lecturer Aynur BABAGİL, TAGRA 2024 was a unique experience.

I would like to thank our valuable speakers for their presentations and sharings that provided us with new perspectives. And of course, I would like to express my gratitude to you, the participants, who made this congress meaningful. Every presentation you made here, every discussion you contributed to, and every idea you put forward was an important step towards the advancement of science.

The environment we created together has proven once again that science knows no boundaries and that interdisciplinary collaboration is powerful. I hope TAGRA 2024 brings new connections, collaborations, and inspiring ideas for you.

As I conclude my closing speech, I hope to meet again at the TAGRA Congress next year. I wish you all a healthy, happy, and productive year. Thank you.