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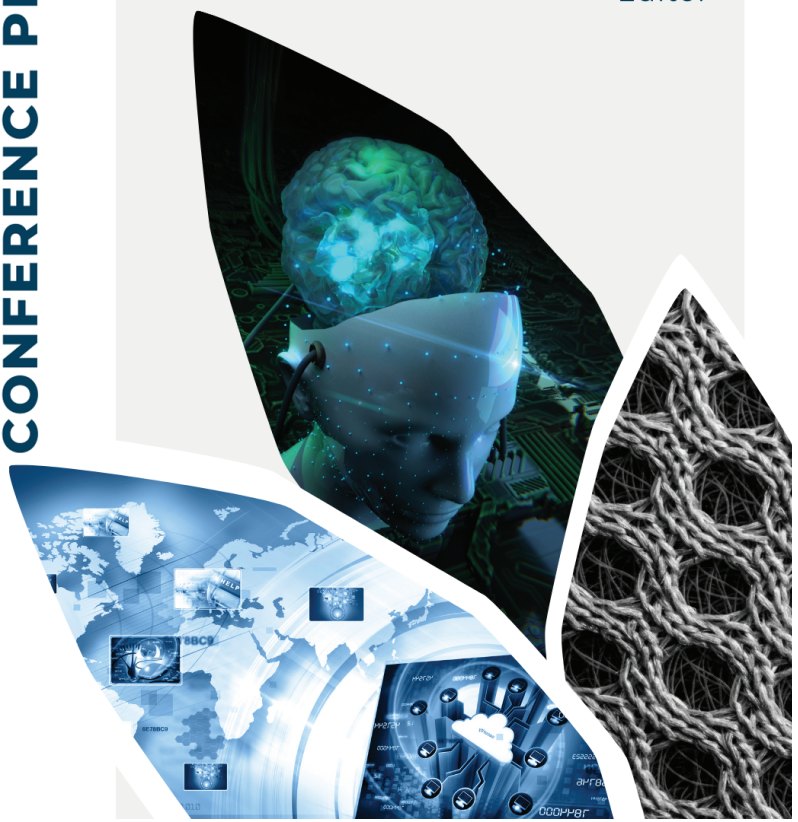
Virtual International Conference

Sustainable Frontiers in
Advanced Materials Science

Dr. Udyama J
Editor



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2	Dr. Sajan D. George	Manipal Academy of Higher Education (MAHE), Karnataka.
3	Dr. Honey John	Cochin University of Science and Technology, Kerala.
4	Dr. P. Narayanasamy	Kamaraj Collage of Enginerring and Technology, India.
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6	Dr. T. Prakash	National Center for Nanoscience and Nanotechnology (NCNSNT), University of Madras, Chennai.
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8	Dr. Pandiyarasan Veluswamy	Indian Institute of Information Technology Design and Manufacturing (IIITDM), Kancheepuram.
9	Dr. Velu, P	School of Mechanical Engineering,Vellore Institute of Technology (VIT), Chennai.
10	Dr. Sabarinathan Palaniyappan	King Fahd University of Petroleum and Minerals, Saudi Arabia.
11	Dr. Jesse Dondapati	Columbia University,USA.

Foreword

On behalf of the organizing committee, we are pleased to present the Arashi Global Annual Summit on Advanced Materials (AGASAM 2025), a distinguished gathering of minds dedicated to advancing sustainable innovation. Reflecting the urgent need for science and technology to address global challenges while building a greener and more sustainable future.

Materials science stands at the crossroads of discovery and application, shaping industries from energy and healthcare to electronics and environmental solutions. The emergence of nanomaterials has opened unprecedented opportunities, enabling breakthroughs that can transform the way we live and interact with our environment. Yet, the true strength of science lies not only in innovation but in collaboration—in the sharing of knowledge across borders, disciplines, and generations.

AGASAM 2025 embodies this spirit of cooperation. By convening virtually, we ensure inclusivity and accessibility, allowing participants from diverse regions to contribute their expertise and perspectives. This booklet serves as a guide to the conference proceedings, a record of the ideas exchanged, and a testament to the collective commitment of our community.

We extend our deepest gratitude to the researchers, speakers, reviewers, and participants whose dedication makes this conference possible. May AGASAM 2025 inspire new partnerships, spark innovative solutions, and strengthen our shared mission to advance sustainable and ecofriendly materials science for the benefit of humanity.

Preface

It is with great pleasure that we welcome you to **AGASAM 2025 – The International Virtual Conference on Materials Science**, a global platform dedicated to advancing knowledge, fostering collaboration, and inspiring innovation. This conference booklet enlightened us on various topics of materials science, shaping industries, improving lives, and opening new frontiers of discovery. In today's world, the urgency of sustainability and ecofriendly solutions through nanomaterials and smart and functional biomaterials had calls for deeper collaboration across disciplines and borders.

This conference bought together researchers, academicians, industry professionals, and students from around the world to exchange ideas, present cutting-edge research, and build networks that transcend geographical boundaries. By convening virtually, we embrace inclusivity and accessibility, ensuring that knowledge flows freely and widely.

We extend our heartfelt gratitude to all contributors—Abstract authors, speakers, and participants—whose dedication and insights make AGASAM 2025 a vibrant forum of learning and collaboration. May this booklet serve not only as a record of the conference but also as a source of inspiration for future endeavours in sustainable materials science.

Together, let us continue to innovate responsibly, collaborate meaningfully, and shape a world where science drives sustainability.

Conference Details

Theme: Advancement in material sciences with smart and sustainable materials

Welcome to the Arashi Global Annual Summit on Advanced Materials (AGASAM 2025), organized by Arashi Scientific Publishers Pvt. Ltd., India, a premier virtual gathering of researchers, industry leaders, and professionals on Advanced Materials.

The aim of this meeting is to provide a forum for scientists and researchers working in the field of material science to share their findings, insights, and advancements with the global scientific community. Join us on 13–15 November 2025 from anywhere in the world to explore cutting-edge research on material science, nanotechnology, composites, smart materials, biomaterials, and sustainable innovations that are shaping the future.

Website: https://agasam.com/

Table of Contents

1

Clinical and Microbiological Profile of Neonatal Sepsis– An Overview

Vidhya Ravi, Antinate Shilpa, D. Caroline, Vignesh Narasimman, Ramadevi Santhanakumar

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Department of Biotechnology, Karpaga Vinayaga College of Engineering and Technology, Tamil Nadu, India

Abstract

Neonatal sepsis (NS) is a severe systemic infection occurring within the first 28 days of life and continues to be a leading cause of neonatal morbidity and mortality, especially in developing countries. It is broadly classified into early-onset sepsis (EOS), resulting primarily from vertical maternal transmission, and late-onset sepsis (LOS), which is often acquired from hospital or community sources. The predominant causative pathogens include Group B Streptococcus, Staphylococcus aureus, coagulase-negative Staphylococci, Escherichia coli, Klebsiella pneumoniae, and Acinetobacter species. Risk factors such as prematurity, low birth weight, prolonged rupture of membranes, and invasive medical interventions significantly contribute to infection susceptibility. The clinical presentation is frequently nonspecific, encompassing respiratory distress, temperature instability, lethargy, and feeding difficulties. Blood culture remains the diagnostic gold standard, though biomarkers

such as C-reactive protein, procalcitonin, and interleukins (IL-6, IL-8), alongside molecular assays like polymerase chain reaction (PCR), have enhanced early and precise detection. Recent evidence also highlights the influence of gut microbiota dysbiosis in the pathogenesis of LOS, with probiotics showing promising preventive potential. Effective management includes timely empirical antibiotic therapy, supportive care, and implementation of infection control measures. Preventive strategies such as maternal screening, aseptic delivery practices, and antibiotic stewardship programs are vital to reduce disease burden and antimicrobial resistance. Strengthening diagnostic precision and promoting rational antibiotic use remain essential for improving neonatal outcomes globally.

Keywords: Neonatal sepsis, Microbes, Biomarkers, gut Microbiota dysbiosis

2

Nanomaterials in Gut Microbiome Modulation–Mechanistic Insights and Therapeutic Perspectives

Ramadevi Santhanakumar

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Abstract

The human gastrointestinal (GI) tract harbors a dynamic and metabolically diverse microbial ecosystem essential for nutrient metabolism, immune regulation, epithelial barrier integrity, and colonization resistance. Disruptions in this microbial equilibrium contribute to a wide range of gastrointestinal and systemic disorders, highlighting the need to understand factors that influence gut microbial stability. As nanotechnology rapidly advances, engineered nanomaterials (ENMs) are increasingly incorporated into food systems, consumer products, and biomedical formulations, raising the likelihood of their entry into the GI tract through ingestion or oral therapeutics. Owing to their unique physicochemical features, nanomaterials interact closely with gut microorganisms, mucosal barriers, and host tissues, creating complete bidirectional relationships. Gut-derived enzymes and metabolites can modify the structure, stability, and bioactivity of nanomaterials, while ENM exposure may alter microbial composition, metabolic output, and immune pathways. Although certain metAL-based and polymeric nanoparticles exhibit antimicrobial or microbiome modulating

properties, others may suppress beneficial taxa, disrupt shortchain fatty acid production, or compromise mucosal integrity. Conversely, nanomaterials also offer significant opportunitiesfor advancing GItargeted therapeutics. Their capacity to protect labile compounds from gastric degradation, enhance mucosal penetration, prolong intestinal retention, and enable sitespecific delivery positions them as promising tools for oral vaccines, microbiome modulation, bioactive metabolite transport, and restoration of eubiosis in dysbiosisassociated conditions. Natural polymerbased nanocarriers and biocompatible platforms such as graphene derivatives further expand avenues for safe therapeutic design. This review synthesizes current knowledge on nanomicrobiome interactions, integrating mechanistic insights, therapeutic applications, and potential risks. Understanding this crosstalk is essential for optimizing nanomedicine approaches while minimizing unintended consequences. The convergence of nanotechnology and microbiome science represents a transformative frontier for nextgeneration interventions aimed at enhancing GI health, precision drug delivery, and microbiome-centred therapy.

Keywords: Microbiota, GI health, gut health, nanomaterial and microbiome cross-talk

3

Assessment of Cerium Oxide-Based Curcumin–Loaded Polymeric Film for Anti-Bacterial Activity: Formulation, Characterization and Biological Assessmen

Satheesh Selvaraj, Ankush Chauhan

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Abstract

The present study examines the process of synthesizing cerium oxide-based curcumin-loaded polymeric film using Juglans regia leaf extract as a reducing agent. This approach provides an ecologically conscious and sustainable alternative to traditional approaches. A comprehensive characterization protocol, involving UV-Vis spectroscopy, FTIR, DLS, Zeta potential, XRD, SEM, TEM and SAED was used to verify the fabrication of cerium oxide-based curcumin-loaded polymeric film. The average hydrodynamic diameter of is 532.7 nm. The drug release profile of HPC-PVP-Cur-CeO_2 film is significantly high while comparing to the Cur-CeO_2 NPs. The antibacterial efficacy of the nanoparticles produced through green synthesis was evaluated using the agar well diffusion assay, demonstrating significant suppression against a range of

gram-positive and gram-negative microbial species. Furthermore, the efficacy of inflammation reduction was evaluated by quantifying the degree to which egg albumin denaturation, a crucial marker of the inflammatory reaction, was suppressed. The results showed that the decrease in egg albumin denaturation depends on the concentration, indicating a substantial anti-inflammatory effect. Furthermore, HPC-PVP-Cur-CeO_2 film possess a notable ability to scavenge ascorbic acid due to their antioxidant properties. The HPC-PVP-Cur-CeO_2 film synthesized by biosynthesis exhibited significant antioxidant capabilities, which varied in intensity based on the dosage. Based on our research, HPC-PVP-Cur-CeO_2 film have shown great potential for use in biological and therapeutic applications, particularly in the treatment of bacterial infections.

Keywords: cerium oxide, anti-bacterial activity, UV-Vis spectroscopy, HPC-PVP-Cur-CeO_2

4

FSM–Based Colour Detection System Using Verilog

Harish Raj, Maclin Toni, Jasim Anwar J S

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Abstract

Color is an essential factor in robotics, automation, and smart vision systems. Conventional color sensors like the TCS3200 depend on photodiode arrays and optical filters, which can suffer from environmental variations and calibration overhead. This paper presents a purely digital Finite State Machine (FSM)-based color detection system designed using Verilog HDL. The model reproduces the operational logic of a physical color sensor by simulating RGB detection through Frequency Scaling (FS) and Pulse Width Modulation (PWM). The FSM orchestrates color sampling, frequency measurement, and state transitions, identifying the dominant color with high reliability. Functional simulation using ModelSim and synthesis in Xilinx Vivado demonstrate accurate color detection with low hardware utilization, making the design suitable for embedded FPGA applications and educational use.

Keywords: Verilog, Finite state Machine (FSM), Frequency scaling (FS)

5

Emergency Alert System for Heavy Vehicles Using RF and V2V

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Abstract

The proposed accident detection system is an advanced and integrated solution that intends to improve road safety through real-time monitoring and rapid emergency response. An accelerometer is used to detect sudden changes in the acceleration pattern of a vehicle, which indicate a possible collision. In addition, a GPS module captures and records the exact location of the incident. When an accident is detected, the Arduino controller will process and format the location data for transmission. The information is then transmitted wirelessly via an RF transmitter to police patrols or nearby monitoring stations equipped with RF receivers for immediate alert and timely dispatch of emergency services.

One of the unique features of the system is the module that includes the Emergency Alert System (EAS), which informs surrounding drivers about the accident to ensure cautious driving and minimal secondary accidents. The system places much emphasis on reliability and real-world performance through comprehensive tests to optimize the model for accuracy and responsiveness in various conditions. It provides an approach to managing accidents

in a cost-effective, efficient, and scalable way by combining sensors, communication modules, and automation. The design bridges the gap between accident occurrence and emergency response by reducing reaction time and potentially saving lives. This will enhance road safety, strengthen the coordination of emergency units, and contribute towards safer traffic environments through proactive information sharing and intelligent technology integration.

Keywords: RF meters, accelerometer, Emergency Alert System (EAS), real-time monitoring

6

Combination of Zinc Oxide Nanoparticles with Syzygium Aromaticum and Acacia Nilotica Extracts as Effective Agents Against Common Pathogens in Dental Applications

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Abstract

The present study investigates the antibacterial efficacy of zinc oxide nanoparticles (ZnO NPs) in combination with medicinal plant extracts against common oral pathogens, *Escherichia coli* and *Staphylococcus aureus*. ZnO NPs were synthesized via a precipitation method and characterized using UVVis spectroscopy, FTIR, and dynamic light scattering (DLS) to confirm particle formation, size, and zeta potential. Antibacterial assays were conducted to evaluate the effects of ZnO NPs, *Syzygium aromaticum* and *Acacia nilotica* extracts and their combinations. The combination of ZnO NPs with

Syzygium aromaticum and *Acacia nilotica* extracts demonstrated significantly enhanced antibacterial activity, with complete inhibition of *E. coli* and *Staphylococcus aureus* growth observed up to 1 mg/ml. The study has demonstrated the significance of plant extracts in relation to ZnO NPs. Results revealed that the combination of ZnO NPs with plant extracts exhibited significantly enhanced antibacterial activity compared to individual treatments. This suggests a combination of ZnO NPs and plant bioactives, highlighting their potential as effective agents for combating oral bacterial infections.

Keywords: Zinc oxide nanoparticles, *Syzygium aromaticum*, Acacia nilotica, Characterization, Antibacterial activity

7

Bridging Scale-Up to Market: The Strategic Importance of Post–Approval Regulatory Adaptations in Drug Commercialization

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Abstract

The transition from laboratory-scale production to commercial manufacturing represents a pivotal phase in a drug's lifecycle, where scale-up ensures feasibility, efficiency, and quality consistency. However, successful commercialization extends beyond scale-up, requiring continuous regulatory oversight through post-approval adaptations (PAAs) to maintain product integrity throughout its market life. This study examines the U.S. Food and Drug Administration's

(USFDA) evolving regulatory framework governing post-approval changes, emphasizing its risk-based and science-driven approach. Under 21 CFR 314.70, post-approval modifications are categorized as major, moderate, or minor, necessitating submission through Prior Approval Supplements (PAS), Changes Being Effected (CBE), or Annual Reports, respectively. Furthermore, the Priority Review framework (MAPP 5240.3 Rev.5) **and** Pre-Submission Facility Correspondence (PFC) mechanism have streamlined assessment timelines, ensuring faster access to quality medicines in critical scenarios such as drug shortages or public health emergencies. The incorporation of Real-World Evidence (RWE) into post-marketing surveillance represents a transformative advancement, enabling more informed regulatory decisions. Collectively, these strategies reflect the USFDA's commitment to balancing regulatory flexibility, innovation, and patient safety, ensuring that post-approval changes remain integral to the long-term success of drug commercialization.

Keywords: Scale-up, Post-approval adaptations, USFDA, Priority review, PFC, Real-world evidence, Drug commercialization

8

Enhancing Structural Performance and Adaptive Capabilities Using Smart and Functional Materials

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Abstract

Smart and functional materials are a new class of engineered materials capable of sensing, actuating, and responding intelligently to external stimuli such as temperature, stress, electric/magnetic fields, vibration, and chemical environments. This study focuses on the design, behaviour, and application potential of key smart materials such as Shape Memory Alloys (SMA), Piezoelectric Materials, Magneto-Rheological (MR) Fluids, Electroactive Polymers (EAP), and Self-Healing Polymers. The objective of the work is to evaluate how these materials enhance structural performance, enable adaptive functionality, and provide built-in sensing or actuation capabilities. Experimental studies were performed on SMA wire actuators and piezoelectric composite patches to analyse their strain recovery, actuation force, and voltage generation under mechanical loading. SMA samples demonstrated up to 6–8% recoverable strain during thermal activation, while piezoelectric samples

produced measurable voltage output suitable for structural health monitoring. These results confirm that integrating smart materials into mechanical systems significantly improves performance, responsiveness, and reliability. The study concludes that smart materials can revolutionize modern engineering applications, particularly in robotics, aerospace, biomedical devices, automotive systems, and intelligent manufacturing.

Keywords: functional materials, Shape Memory Alloys (SMA), Piezoelectric Materials, Magneto-Rheological (MR) Fluids, Electroactive Polymers (EAP), Self-Healing Polymers

9

Enhancing Mechanical and Functional Properties of Structural Composites Using Carbon Nanotube Reinforcement

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Abstract

Carbon Nanotubes (CNTs) have emerged as one of the most promising nanomaterials for structural and functional reinforcement due to their extraordinary tensile strength, stiffness, and electrical conductivity. This study explores the synthesis, dispersion, and integration of multi-walled carbon nanotubes (MWCNTs) into epoxy resin to develop a high-performance nanocomposite. The objective was to enhance mechanical strength, wear resistance, and self-sensing capability. A series of epoxy–CNT composites with varying CNT weight fractions (0.1%, 0.5%, 1.0%, and 2.0%) were fabricated using ultrasonication-assisted dispersion and cast molding techniques. Mechanical tests, including tensile, hardness, and wear analyses, were conducted. The results revealed that the

1.0% CNT-reinforced composite achieved optimal performance with a 45% increase in tensile strength and a 60% reduction in wear rate compared to pure epoxy. Electrical resistance measurements under strain confirmed the material's potential for structural health monitoring. These findings demonstrate that CNT-based nanocomposites can revolutionize lightweight structural materials by combining strength and intelligence in a single design.

Keywords: Carbon Nanotubes(CNTs), Nanocomposites, Mechanical tests

10

Next-Generation SDN and Campus Network Solution for Intelligent DDoS Detection and Mitigation

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Abstract

GAMMA rays are high-frequency electromagnetic waves capable of penetrating dense materials. They are widely used in Non-Destructive Testing (NDT), medical imaging, and industrial inspection. However, exposure to gamma radiation poses severe biological risks such as tissue damage and increased cancer probability. Continuous radiation monitoring is essential in ensuring occupational safety in industries like aerospace, oil and gas, nuclear facilities, and healthcare. Traditional systems rely on manual readings or localized alarms, which are often inadequate during emergencies. The proposed IoT-based Gamma Rays Detection and Alert System integrates a Geiger–Müller (GM) tube with an ESP32 microcontroller and Firebase cloud services. This combination enables remote data access, real-time visualization,

and automated alert generation when unsafe radiation levels are detected. The project aims to create a cost-effective, accurate, and reliable monitoring platform that improves safety compliance and operational efficiency.

Keywords: Electromagnectic, Non-Destructive Testing (NDT), IoT-based Gamma rays

11

Enhanced Sustainability Through the Utilization of Eco-Friendly Engineering Materials

A Study on the Development and Application of Sustainable Materials for Mechanical Engineering

Praveen T

Department of Mechanical Engineering,
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Abstract

Sustainable and eco-friendly materials have gained significant attention as alternatives to conventional engineering materials due to their low environmental impact, renewability, and recyclability. This study investigates the selection, processing, and performance evaluation of natural and recycled materials, including bamboo Fiber composites, jute Fiber-reinforced polymers, and recycled Aluminum alloys, aimed at promoting sustainable engineering practices. The objective was to enhance material strength, durability,

and environmental compatibility while minimizing carbon footprint. Samples were fabricated through compression Molding and extrusion processes, followed by mechanical testing such as tensile, hardness, and impact analysis. The results indicated that bamboo and jute composites exhibited a 35–40% improvement in specific strength and up to 50% reduction in embodied energy compared to conventional synthetic composites. Life Cycle Assessment (LCA) confirmed significant environmental benefits in terms of recyclability and reduced greenhouse gas emissions. These findings demonstrate that eco-friendly materials can serve as efficient substitutes for traditional materials, achieving both mechanical reliability and environmental sustainability in engineering applications.

Keywords: sustainable materials, Recycled materials , Ecofriendly, lifecycle assessment (LCA)

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