EDITORIAL

# Advancing Multiscale and Multifunctional Materials for a Sustainable Future

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## Abstract

***ICCK Transactions on Advanced Functional Materials and Processing* (*TAFMP*) offers the industry and academia breakthrough research information in the materials science and engineering field. Being a global, peer-reviewed journal, *TAFMP* is responsive to the increasing need for multifunctional materials and serves biomedical, aerospace, electronics, energy, sustainability and more agglomerative industries. This issue focuses on smart biomaterials, nanotechnology, additive manufacturing, and sustainable materials development. Topics cover bulk metallic glasses (BMGs), bio-nanocomposites, 3D printed AI materials, and novel fabrication and processing technologies. Moreover, the journal covers organic materials development, functional coatings, and surface engineering for greater performance and longevity of the coatings and the materials. Furthermore, *TAFMP* is glad to welcome to its Editorial Board Top 2% Scientists from across the globe, which further enhances its journal quality. We invite you to join researchers in tackling an emerging field, easing the development of advanced materials and novel sustainable solutions.**

**Keywords**: functional materials, biomaterials, nanotechnology, additive manufacturing, sustainable materials.

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## 1 Introduction

The *ICCK Transactions on Advanced Functional Materials and Processing* (*TAFMP*) have been started with mission to spread ground-breaking research in the fast growing area of material science and engineering. As a global, vetted, open-access quarterly journal, *TAFMP* acts as an essential channel of communication for academic and industry professionals interested in the research and development of multiscale and multifunctional materials. There is a growing need for advanced materials in the biomedical, aerospace, electronics, energy, and sustainability sectors, which underscores the importance of pioneering research in material synthesis, processing, and application. This issue brings together this variety of efforts spearhead to improve the material properties and functional efficiency. The *TAFMP* is focused on following research

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areas.

## 2 Evolution of Advanced Materials

In recent years, the field of materials science has had a drastic shift from traditional materials to multiscale and multifunctional smart materials, which is a response to transforming industrial needs. The growing requirements of high-performance materials for aerospace, automotive, biomedical, and energy industries are driving researchers towards new novel synthesis methods and more advanced processing techniques. The extensive use of solid and functional parts stems from multifunctional metals, ceramics, and composites that exhibit significant mechanical strength, corrosion resistance, and thermal stability. Bulk metallic glasses (BMGs) are unique materials that contain an outstanding amorphous structure that gives the BMG enhanced mechanical strength and excellent wear resistance. Furthermore, polymers designed with particular features are quickly building a reputation for their ability to easily adapt to lightweight structures, superb electrical insulation, and resistance to extreme heat making them perfect for aerospace and medical engineering.

### 2.1 Advanced Functional Materials

The rise of smart biomaterials has changed the face of healthcare and biomedicine. These biomaterials demonstrate a responsive behaviour towards external stimuli that includes pH, temperature, and even mechanical force. As a result, more sophisticated systems for drug delivery, tissue engineering, and regenerative medicine are possible. Also, bio-inspired materials that replicate natural biological structures have shown great promise when used in medical implants and scaffolds because of the greater biocompatibility and superior mechanical strength. Surface area and catalytic activity of these materials can be controlled with the usage of nanotechnology in engineering functional materials such as nanoparticles, nanowires, etc. So, this opens doors for their application in multiple advanced engineering fields such as sensors, semiconductors and energy storage devices. These techniques transform the traditional engineering techniques which relied on more dense structures. The use of 3D printing has also taken off due to its ability to process materials with complex shapes and high functional strength. The use of nanocomposites also enables the creation of highly specific biomedical implants, aggressive materials for the aerospace industry, and even robust structural materials. Their recent work in 3D printing provides unprecedented room for creativity as they developed ways to print materials with pre-defined locations for varying properties.

### 2.2 Improvements in Additive Manufacturing Techniques

The forma fabrication of intricately contoured shapes that is required in materials processing is now achievable through the disruptive techniques of additive manufacturing and 3D printing. These techniques enhance functional properties' mechanical performance. The combination of nanocomposites with 3D printing technology has paved the way for significant developments in tailored biomedical implants, lightweight aerospace parts, and advanced structural nanocomposites. Multi-material 3D printing developed more recently enables the production of components with spatially varying properties further increasing structure's functionality and providing greater design freedom.

### 2.3 Sustainable Materials and Approaches to Green Manufacturing

The shift towards eco-friendly and sustainable processing methods has resulted in novel materials and bio-based, environmentally-friendly polymers becoming parts of extreme focus in academic research. Environment coordination materials containing bio-based and biodegradable components are emerging as a viable alternative to traditional petroleum-based polymers. Industrial waste recycling methodology and the creative so-termed upcycling of by-products material made to develop high-value materials is one way to limit the environmental footprint of manufacturing activities.

The use of sustainable engineering practices is increasing. The use of low-energy-consumption and low-emission materials is being advanced in the construction of hydrogen fuel cells, photovoltaic materials, and energy-efficient building components. Moreover, living materials that incorporate algae and bacteria are being developed for bio-remediation, bio-sensing, and self-sustaining systems applications.

### 2.4 Innovations in Surface Engineering and Functional Coatings

Surface engineering is critical in the development of materials that withstand harsh conditions, regarding their performance and durability. Coatings and surface modifications augment the wear, corrosion, optical properties, and even the biocompatibility of engineering materials. Current studies are directed towards the fabrication of surface nanocomposites that possess self-healing and anti-fouling properties which significantly increase the operational lifespan of strategically important components in aerospace, biomedical, and industrial engineering.

## 3 Editorial Board

The *TAFMP* aims to focus on these innovations and publish research that would help decipher claims made regarding enhanced understanding of advanced functional materials and their applications in the real world. We welcome scholars, researchers and professionals in the field to engage with this volume's pioneering contributions and to foster an active dialogue in material science and engineering.

The following editors have joined the *TAFMP*'s editorial board:



**Top 2% Scientists Join *TAFMP*'s Editorial Board** We are delighted to announce that several distinguished researchers, recognized among the Top 2% Scientists globally, have joined the *TAFMP* as esteemed members of the Editorial Board. Their inclusion enhances the journal's commitment to advancing cutting-edge research and fostering academic excellence.

**New Editorial Board Members (Top 2% Scientists):**



## 4 Emerging Frontiers and Future Directions

The advancement of science and technology in materials science is creating novel innovation gaps that make it possible to rethink and reconstruct advanced functional materials. Smart materials like shape-memory composites, self-healing materials and responsive polymers are redefining the field of materials thanks to their capacity to assimilate to environmental changes as well as self-repair. The incorporation of carbon-based catalysts within energy storage and conversion systems is creating new prospects with regards to green chemistry and renewable energy.

Moreover, the combination of applied materials science, biotechnology and artificial intelligence is facilitating the creation of next generation materials with amazing new properties. The application of machine learning brings forth an entirely novel paradigm in the way materials with specific properties are synthesized by applying predictive analytics on data obtained from existing materials.

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Not applicable.


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## Conflicts of Interest

The authors declare no conflicts of interest.

## Ethical Approval and Consent to Participate

Not applicable.

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