**INTERNATIONAL CONFERENCE ON**

**CURRENT TRENDS IN FUNCTIONAL MATERIALS AND APPLICATIONS ​(CTFMA-2024)**

**April 25-27, 2024 | Akal University Talwandi Sabo | Bathinda | Punjab**

**About the Conference**

The proposed international conference shall provide a platform for scientists, young researchers, academicians, and industrial R&D personals worldwide to share current scientific developments. The present conference has been proposed to discuss and resolve the real-time challenges in the designing and application of functional materials. The conference will revolve around the experimental and theoretical aspects of functional materials. The broad areas to be covered in the conference will be:

* Hydrogen generation and Storage
* Renewable Energy
* Photovoltaic and Thermovoltaic Materials
* Sensors and Actuators
* Superconductivity and spintronics
* Functional 2D materials and applications
* Sensing devices
* Polymers and composites
* Magnetic Materials and Phenomenon
* Battery Materials
* Supercapacitors
* Hydrogen Storage Materials
* Advanced Electrode Materials
* Optoelectronic Materials
* Glasses, Ceramics, Polymers and Composites
* Biophysics and Biomaterials
* Computational Physics and Modelling
* Advanced Nanomaterials
* Electronic and photonic materials
* Sensing devices

The conference will be organized during March 25-27, 2024 in hybrid mode (online as well as offline) at Akal University, Talwandi Sabo, Punjab, India.

**FUNCTIONAL MATERIALS AND THEIR POTENTIAL IMPACT**

Functional materials, smart materials, intelligent materials are the synonyms of the materials of the twenty-first century. Functional materials are essential components of various industries because of their unique properties and functionalities which make them appropriate for real time applications. These materials play a pivotal role in enhancing the performance, efficiency, and safety of the underlaying devices. They are engineered to perform specific roles in diverse applications across various sectors. The functional materials which have been utilized includes a broad range of materials such as ceramics, chalcogenides, perovskite, and polymers etc. In recent years, the development of sustainable materials with tailored properties evolves as the major thrust area of research with particular applications in energy storage and conversion, future electronics, molecular imaging and sensing, informatics, environmental remediation, and smart materials capable of perceiving and reacting to their surroundings. Although, the functional materials provide a necessary and firm base for the development of advanced technologies across various industries but the present conference will mainly focus on some important industry-specific applications:

1. **Energy Industry:**

For decades, several human activities (industrial emissions, transportation, fossil fuel combustion, etc.) have been responsible for air pollution due to the emission of greenhouse gasses like CH4, N2O, NH3, CO, NO, etc. These gasses are hazardous for human beings as well as to the environment. The issue of the global warming and the climate change has prompted researchers to find methods for clean energy production with the development of cost-effective and efficient renewable energy resources. The shift from large-scale centralized power generation to smaller-scale distributed energy resources can increase access to clean and affordable energy, such as solar panels, batteries, and microgrids. A desire to address these issues has popularized solar or photovoltaic technology. Whereas piezoelectric technology is being developed to power handheld devices without batteries, and thermoelectric technology is being explored to convert waste heat (for instance automobile engine combustion) into electricity. In recent years, perovskites, chalcogenides, and many 2D materials have emerged as potential clean energy materials.

1. **Electronics and Semiconductor Industry:**

The demand for semiconductors has surged due to the growth of artificial intelligence (AI), the Internet of Things (IoT), smartphones, and other high-tech devices. The semiconductor industry is constantly striving to innovate and improve its products to meet the continuously changing market demands. However, the industry is also facing some innovation challenges, such as the physical limits of Moore’s law, the increasing complexity and cost of design and fabrication. The semiconductor industry needs to overcome these challenges by exploring new materials, architectures, and domains of semiconductor technology. Perovskites evolved as promising materials for various semiconductor applications, such as light-emitting diodes (LEDs), lasers, photodetectors, transistors, and memory devices. Perovskites have many advantages over conventional semiconductors, such as high absorption coefficient, tunable band gap, long charge carrier diffusion length, low-cost fabrication methods, and compatibility with flexible substrates. Perovskites can also be combined with other materials to form hybrid structures that enhance their performance. Another contemporary functional material CNTs possess remarkable electrical, thermal, mechanical, and optical properties that make them suitable for various semiconductor applications, such as, sensors, and transistors.

1. **Environment and Water Treatment:**

Functional materials can help to address the environmental challenges like waste management and environmental remediation, and sustainable development. Functional materials can play a vital role in water treatment to improve the quality of water for different purposes, such as drinking, irrigation and industrial use. For example, zero-valent metal nanoparticles, such as iron and silver, can be used for the removal of contaminants by redox reactions or antibacterial effects. Metal oxide nanoparticles, such as titanium dioxide and zinc oxide, can be used for the photocatalytic degradation of organic pollutants or the inactivation of microorganisms. Carbon nanotubes (CNTs) can be used for the adsorption of various contaminants or the enhancement of membrane performance. Polymer composites can be used for water treatment by modifying their surface with functional groups or active agents that can interact with contaminants or microorganisms. For example, graphene-based composites, carbon-based composites, and clay-based composites can be used for the adsorption, removal, or degradation of pollutants from water.

1. **Medical Industry:**

Functional materials are the also the potential candidates for medical applications. These materials are meticulously designed to possess specific properties and functionalities that improve their efficacy in medical devices, diagnostics, and treatments. The medical industry has benefited greatly from the development of a wide variety of advanced functional materials, such as shape memory alloys, which make it possible to perform less-invasive operations, and smart polymers, which respond to environmental factors to ensure accurate drug delivery. Nanomaterials, such as nanoparticles and nanocomposites, are redefining targeted drug therapies and diagnostic imaging, whereas biodegradable polymers and bioactive materials foster tissue engineering and regenerative medicine. The incorporation of these materials into medical devices, implants, diagnostics, and therapies highlights their critical role in improving healthcare, expanding medical technology, and, ultimately, increasing the quality of life for people around the world. Thus, in order to create safer, more effective, and patient-centered solutions in the healthcare industry, future developments in materials science are crucial.

Modern scientific and technological advancements in various fields (some are listed above) are the result of collaborative efforts founded on numerous scientific and engineering disciplines. The development of new functional materials to address future issues such as energy, water, and health is one of the current focal points of research. For the sake of economic and social prosperity, scientists are continuously researching for alternative solutions. This requires the exchange of ideas between scientists and researchers from various fields of science, technology, and industry.

In the view of a common interest in Functional Materials, the Department of Physics at Akal University, Talwandi Sabo, is bringing a special opportunity and providing an appropriate platform in form of International Conference on “Current Trends in Functional Materials and Applications (CTFMA-2023)”. This conference will provide a multidisciplinary forum that will exceed the departmental, institutional, industrial and global barriers, in turn, promote the integration of research and education in the diverse field of Functional Materials. This conference aims to bring together experts from academic institutions, industries, and research organizations, as well as professional engineers, in order to facilitate the exchange of knowledge, expertise, and experience regarding emerging trends in functional materials, characterization, modeling and simulation, properties, performance, and device fabrication industries.

**Main Objectives of the Conference**

* The primary purpose of the conference is to provide a unique forum for scientists, researchers, academics, industrialists, and students to discuss the most recent developments and challenges in all facets of Functional Materials, Manufacturing, and Performances.
* To discuss the status of knowledge, present the results of scientific work, implementations, and innovations, as well as to discuss and share experience in the field of Materials Science, Processing, and Manufacturing for a variety of industrial applications.
* To facilitate the exchange of innovative ideas between researchers in the fields of materials science and advanced manufacturing for diverse industrial applications.
* To provide a forum for national and international experts and industry leaders to contribute their knowledge and insights.

The conference is structured as follows: keynote lectures, invited lectures followed by parallel sessions with oral and poster presentation by participants. The keynote lectures will be delivered by eminent personalities of international repute to introduce the theme of the conference. We are expected to have 30 invited lectures by experts in the field of quantum materials, nanotechnology, functional materials and devices, magnetic materials etc. The conference will be interdisciplinary in nature and will have intensive technical sessions throughout.

Our primary goal in hosting this conference is to provide a platform for the young and budding scientists to make their mark on the country's scientific and technological landscape. Students will participate via oral and poster presentations showcasing their work to the scientific community. Papers are invited from the prospective authors from industries, academic institutions and R&D organizations and from professional engineers.

We firmly believe that interaction with experts one-on-one will improve students' ability to think critically and pursue their ideas. This conference is an excellent opportunity for postgraduate and graduate students to expand their scientific and technical knowledge, which will be beneficial to their studies.

Again, we would be delighted to have you all attend, make this conference your own, and gain scientifically from it. Attending the conference will provide you with access to innovative concepts and future collaborations. Let us all collaborate to create a better society tomorrow.

We look forward to your participation and contribution to the success of the conference.