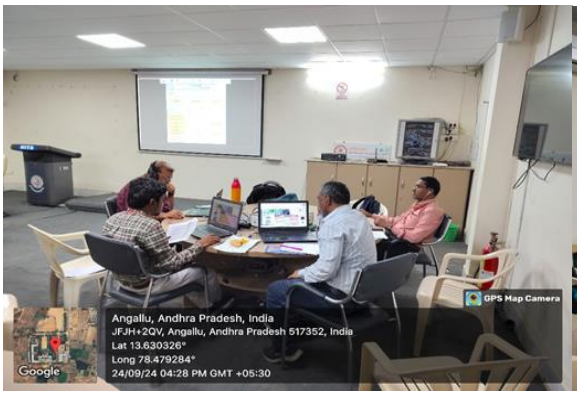
A Report on
3-Days Virtual International Conference on
"Recent Trends in Energy Harvesting 2024 (ICRTEH-2024)"
Organized by Department of Physics
From 23.09.2024 to 25.09.2024



Report Submitted by: Dr. K Chandrakanta, Assistant Professor, Department of Physics.

Resource Person Details:

The International Conference on Recent Trends in Energy Harvesting-2024 featured an esteemed lineup of resource persons, including **Prof. Simanchalo Panigrahi**, Professor at NIST, Berhampur, and **Dr. Pratap Kollu**, Associate Professor at the University of Hyderabad. **Dr. Surya Prakash Ghosh**, Assistant Professor at CV Raman Global University, Bhubaneswar, and **Dr. Surjyakanta Rana** from Alexander Dubček University of Trenčín, Slovakia, also contributed their expertise. The conference welcomed **Dr. Manas Ranjan Sahoo**, Assistant Professor at GITAM University, Bangalore, and **Dr. Anirban Datta**, Assistant Professor at MNIT Jaipur. **Dr. Apurba Mohapatra** from the Institute of Physical Chemistry, Polish Academy of Science, Poland, and **Dr. Sahil Dani**, Assistant Professor at Chitkara University, Chandigarh, presented their research as well. Further, **Dr. Mohamad Ahamad Mohiddon**, Assistant Professor at SRM University, NCR, and **Dr. A. Samudrala**, Assistant Professor at Pondicherry University, contributed valuable insights. The list also included **Dr. Hari Sankar Mohanty**, Assistant Professor at GIET University, Gunupur, **Dr. P. G. Krishna** from GITAM University, Vishakhapatnam, and **Dr. Chinmayee Dash** from CSIR-IMMT, Bhubaneswar. Rounding out the group were **Dr. Yugandhar Bitla** from Central University Rajasthan and **Dr. B. V. R. S. Subramanyam** from the University of Hyderabad, all of whom provided a significant contribution to the discussions on cutting-edge research in energy harvesting.

Mode of Conduct: Online

Report Received on 05.10.2024

Day-1 (23/08/2024)

The Department of Physics at Madanapalle Institute of Technology & Science, Madanapalle organized a Three Day Virtual International Conference on Recent Trends in Energy Harvesting, 2024" during 23rd-25th September 2024. The inaugural session began at 9:30 AM on September 23, 2024, and set the tone for the conference. **Dr. Rajesh D**, Assistant Professor, Department of Physics, MITS, played a crucial role in moderating the opening session. His opening remarks welcomed all participants and provided a brief overview of the conference's objectives, emphasizing its significance in the ever-growing domain of energy harvesting technologies. Then Dr. Rajesh D, invited the **Convener Dr. Rasmita Jena** to give welcome address (9:32 AM to 9:38 AM) to the respected dignitaries, distinguished delegates and all the participants. The convener, responsible for overseeing the smooth organization and execution of the event, highlighted the collaborative effort put into curating a conference of this scale. The convener's speech acknowledged the support of the Department of Physics at MITS and thanked all stakeholders, including participants and speakers, for their contributions.

At 9:38 AM, the **Head of the Department (HOD) of Physics, Dr. M. Chandrasekhar**, Co-ordinator of ICRTEH-2024, who had been instrumental in guiding the team, took the virtual podium to address the audience. The HOD's speech emphasized the importance of interdisciplinary collaboration in energy harvesting research and how such conferences provide a crucial platform for facilitating knowledge exchange across borders.

From 9:43 AM to 9:48 AM, **Dr. P. Sivaiah, the Associate Dean of Research and Development (R&D),** delivered an insightful address. He highlighted the importance of conferences like ICRTEH-2024 in fostering an environment of research and development and encouraged participants to take advantage of the knowledge-sharing opportunities provided by the event.

The next segment of the inauguration featured the **Vice-Principal Academics of MITS**, **Dr. P. Ramanathan**, who spoke from 9:48 AM to 9:52 AM. The Vice-Principal extended a warm welcome to the speakers and participants, acknowledging the hard work of the organizing team. He underlined the importance of staying abreast of technological advancements in energy harvesting; a domain that has become increasingly crucial for addressing global energy needs sustainably. The Vice-Principal also expressed appreciation for the international collaboration and knowledge exchange fostered by the conference.

Following this, at 9:52 AM, **Dr. S. Sreedhar**, the Co-convener of the event, took the stage to provide further insights into the organization of ICRTEH-2024. As Co-convener, Dr. Sreedhar played a key role in managing the logistics and ensuring that the event ran smoothly. Dr. Sreedhar's acknowledgment of the teamwork involved set a positive tone for the rest of the conference.

The inaugural session concluded with a **Vote of Thanks** delivered by **Convener Dr. K. Chandrakanta**, from 9:56 AM to 10:00 AM. Dr. K Chandrakanta expressed sincere gratitude to the organizing committee, faculty members, sponsors, and participants for making the event a success.

Conference Sessions:

First session of Day-1 talk was started at 10:00 AM chaired by Convener Dr. Rasmita Jena, who introduced the resource person of plenary lecture-1 **Prof. Simanchalo Panigrahi, Professor, Department of Physics at the National Institute of Science and Technology, Berhampur,** to the participants and thanked him for accepting the invitation.

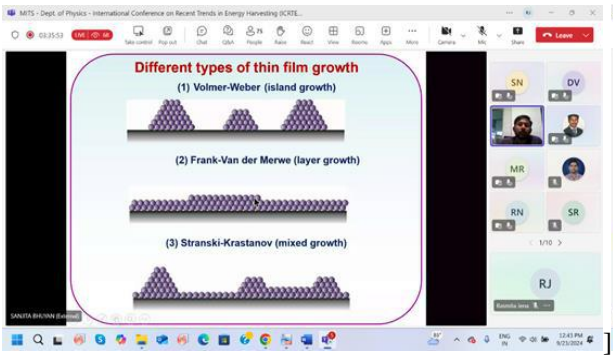
Prof. Simanchalo Panigrahi began the lecture by sincerely thanking the audience, the organizers, the HOD Physics, the Principal, the Vice Principal, and the Management of MITS Madanapalle for providing him with the chance to share his expertise in condensed matter research and related fields. His title of the talk was **"Pedagogical Focus on Energy Harvesting and its Storage".** He discussed the basic focus on dielectric materials and their utilization in day-to-day life. He also covered cutting-edge research on this material and its various applications. Finally, he answered all the questions raised by the audience side.

The second talk of the session-1began at 11.10 AM, and the resource person was introduced by **Dr. Rasmita Jena**, who gave a brief introduction about the resource person, **Dr. Pratap Kollu, Assistant Professor at the CASEST School of Physics, University of Hyderabad.**

In his opening remarks, Prof. expressed his gratitude to the audience, the lecture's organizers, the HOD Physics, the Principal, the Vice Principal, and the Management of MITS Madanapalle for giving him the opportunity to share his knowledge of Material science and associated subjects. His title of the talk was **"Economical and Efficient Sodium ion Batteries-an Alternative to Li Ion Batteries".** In the course of his talk, he spoke about the current study being done by his research team. This talk focuses on the importance of batteries in daily life. He first focused on the heterostructure preparation and its various designs, the heterojunctions and their characterization using various techniques to understand the behavior of charge transfer. characterizations like I-V characteristics, reproducibility, capacity, etc.

The third talk of the session-1 began at 12.00 PM, and the resource person was introduced by Dr. Rasmita Jena, who gave a brief introduction about the resource person, **Dr. Surya Prakash Ghosh, Assistant Professor Physics, CV Raman Global University, Bhubaneswar.** His title of the talk was **"Perspectives of Semiconducting Thin Films and Nanomaterials on Silicon Substrates for the Development of Chemical/Gas Sensor".** He discussed the thin films and nanofabrication of the various materials using the sputtering method and its experimentations. He fabricated a gas sensor device that can detect various gases like ammonia, hydrogen, etc. Finally, he addressed the participant's queries.

The first talk of the session-2 began at 2.00 PM, and the resource person was introduced by **Dr. B. Jagadeesh Babu**, who gave a brief introduction about the resource person, **Dr. Surjyakanta Rana, senior researcher at FunGlass, Alexander Dubcek University in Trenčín, Slovakia.** His title of the talk was **"Constructing Z-scheme-based Photocatalysts with H2 Generation Performance & Separation"**. He basically discussed Z-scheme-based photocatalysts are inspired by natural photosynthesis and are used for efficient hydrogen (H_2) generation through water splitting. These systems combine two different semiconductors with complementary energy levels, forming a Z-shape in terms of energy bands. This configuration enhances charge separation, reduces recombination of electrons and holes, and provides higher redox potential, which is crucial for efficient H_2 production. Common materials like TiO_2 and g-C_3N_4 are used, and recent research explores advanced materials like metal-organic frameworks and 2D materials. Key challenges include optimizing interfaces for better electron transfer, ensuring material stability, and improving performance. Despite these challenges, Z-scheme photocatalysts have shown high efficiency in solar-driven hydrogen production and hold promise for future renewable energy applications



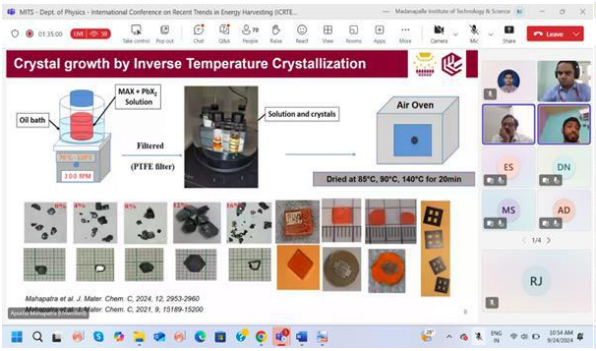
The second talk of session-2 began at 2.40 PM, and the resource person was introduced by Dr. B. Jagadeesh Babu, who gave a brief introduction about the resource person, **Dr. Manas Ranjan Sahoo, Assistant Professor at GITAM (Deemed to be University), Bengaluru Campus.** His title of the talk was **"Magnetoelectric Coupling and Their Impact on Energy-Harvesting Area".** Dr. Manas Ranjan Sahoo thanked the audience, the organizers of the lecture, the head of the department of Physics, the principal, the vice principal, and the administration of MITS Madanapalle for allowing him the chance to share his expertise in material science and related fields. He emphasizing on the magnetic and magnetoelectric materials and its application towards the energy storage. His group has been synthesized the Hexafeerite materials using the conventional solid- sate method. Structural distortion was verified from XRD and neutron diffraction analysis. Followed by the morphological study, resistivity, conductivity, magnetic, and magnetoelectric characteristics. Based on the magnetoelectric coupling value at room temperature, above material can be useful foe the storage devices. Apart from that, he focused on utilization of the waste energy i.e., heat in terms of the storage also.

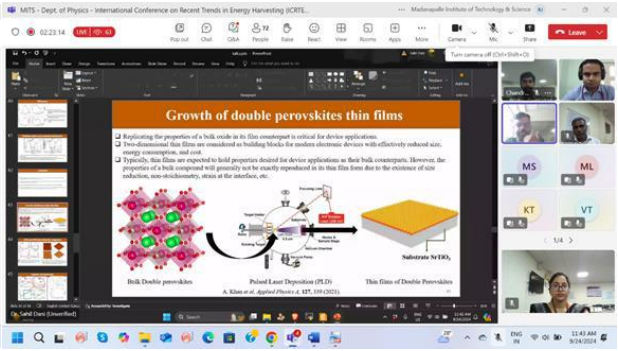
The resource person of the third talk of Session 2 (Day-I) was introduced by **Dr. Ashis Kumar Manna** who gave brief introduction about the resource person **Dr. Anirban Datta, Assistant Professor in the Department of Physics at Malaviya National Institute of Technology Jaipur.** The session was begun at 3.35 PM. His title of the talk was **"Electrocatalytic Activity of 2D Janus Monolayers with Chalcogen Vacancy for Hydrogen Evolution".** The electrocatalytic activity of 2D Janus monolayers with chalcogen vacancies is a promising area for advancing hydrogen evolution reactions (HER). Janus monolayers, asymmetric in structure with different atoms on each side, provide unique properties such as intrinsic dipole moments and tunable electronic structures. Introducing chalcogen vacancies (missing sulfur, selenium, or tellurium atoms) further enhances their catalytic performance by creating active sites that facilitate hydrogen adsorption. These vacancies improve electron transfer and lower the overpotential required for HER, making the process more efficient. By optimizing vacancy concentration and tailoring the monolayer composition, researchers aim to achieve higher hydrogen generation rates, positioning 2D Janus materials as potential candidates for clean energy technologies With the 6 talks, first day of the conference concluded at 5:00 PM

Day-2 (24/09/2024)

Convener **Dr. Rasmita Jena** began the program on Day 2 at 10.00 AM by welcoming the participants with a few announcements about the ICRTEH-2024 conference.

On Day 2 (September 24, 2024) of ICRTEH-2024, the first session began at 10:00 AM**,** chaired by **Dr. Shreyansh Shankar Dave**, Assistant Professor at MITS Madanapalle. The session opened with an invited talk by **Dr. Apurba Mohapatra from the Institute of Physical Physics, Polish Academy of Science, Poland,** on the topic **"Role of Electrical and Optical Manipulations on the Performance and Ion Migration of Perovskite Single Crystal Based Photodetectors."** Dr. Mohapatra began the lecture by sincerely thanking the audience, the organizers, the HOD Physics, the Principal, the Vice Principal, and the Management of MITS Madanapalle for providing him with the chance to share his expertise in photodetectors. Presented a detailed analysis of how external electrical and optical manipulations could be used to enhance the performance of perovskite single crystal photodetectors.



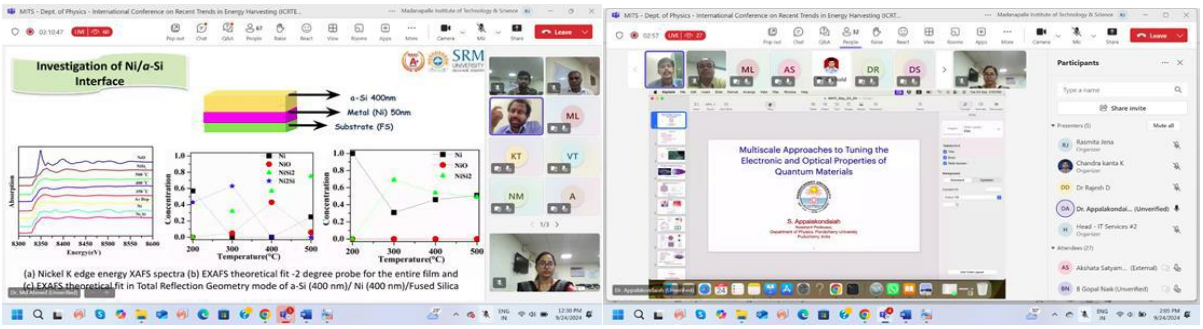


He discussed how controlling ion migration in perovskite materials can improve the stability and efficiency of these photodetectors, which have garnered interest due to their potential for next-generation optoelectronic devices. His presentation also covered recent advances in ion transport mechanisms within these materials and their impact on device longevity and response speed.

At 10:50 AM**,** **Dr. Sahil Dani from Chitkara University, Chandigarh,** delivered a lecture titled **"Mott Insulating Behaviour in Double Perovskite Ruthenates A2BRuO6 (A= Ba, Sr and B= Gd, Sm, Dy)."** Dr. Dani delved into the complex interplay between crystal structure, electronic configuration, and magnetic properties in double perovskite ruthenates. These materials exhibit Mott insulating behaviour, where electron interactions cause the material to act as an

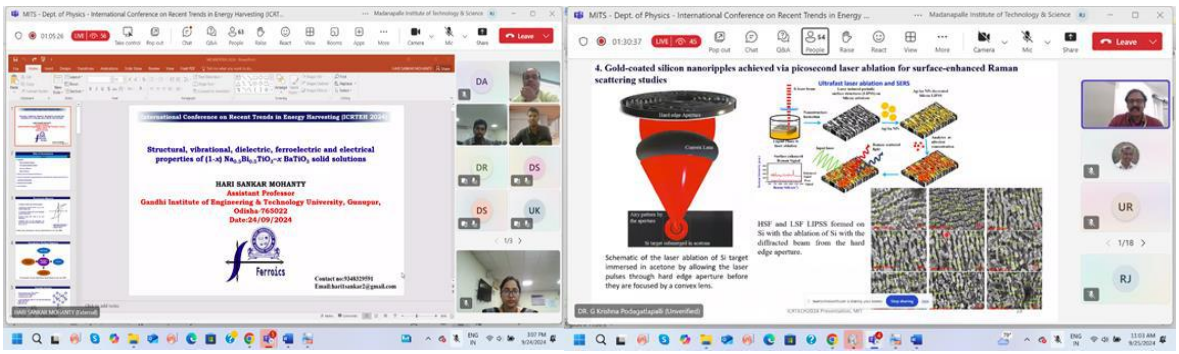
insulator despite theoretical predictions suggesting it should conduct electricity. He also explored how doping these materials with different elements (Gd, Sm, Dy) can lead to dramatic changes in their electronic properties, which are of particular interest for applications in spintronics and high-temperature superconductors.

At 11:45 AM, **Dr. Mohamad Ahamad Mohiddon from SRM University, NCR**, presented a session on **"XAFS: A Tool to Investigate Metal-Semiconductor Interface."** Dr. Mohiddon discussed the application of X-ray Absorption Fine Structure (XAFS) spectroscopy in studying the intricate details of metal-semiconductor interfaces, which are crucial for the development of advanced semiconductor devices such as transistors, sensors, and photovoltaic cells. He highlighted how XAFS could provide information about the local atomic structure and electronic states of materials, offering insights into how metal-semiconductor contacts can be engineered to optimize device performance, stability, and efficiency.



After a short break, the second session of Day 2 resumed, chaired by **Dr. Rajesh Dagupati**, Assistant Professor at MITS Madanapalle. The first speaker of the session was **Dr. A. Samudrala**, who presented on the topic **"Multiscale Approaches to Tuning the Electronic and Optical Properties of Quantum Materials."** Dr. Samudrala discussed cutting-edge methods for modulating the electronic and optical properties of quantum materials across different scales, from atomic to macroscopic levels. These quantum materials, which include superconductors, topological insulators, and quantum dots, hold promise for various technological applications. He explained how integrating computational modeling with experimental techniques allows for precise tuning of material properties, enabling the development of more efficient optoelectronic devices, sensors, and quantum computers.

The final talk of the session was delivered by **Dr. Hari Sankar Mohanty**, who spoke on **"Structural Transformations and Physical Properties of (1−x) Na0.5Bi0.5TiO3−xBaTiO3 Solid Solutions Near a Morphotropic Phase Boundary."** Dr. Mohanty explored the fascinating structural phase transitions and related physical properties of these solid solutions, which are of great interest for their piezoelectric and ferroelectric applications. His presentation focused on the behavior of these materials near the morphotropic phase boundary (MPB), a region where two phases coexist, allowing for the optimization of material properties such as dielectric constant, electromechanical coupling, and polarization. He discussed the implications of these findings for the design of high-performance materials for use in actuators, sensors, and energy harvesting devices.



The day 2's activities concluded with a Virtual Poster Session from 3.50-5.30 PM, held in two parallel sessions (A and B), bringing an end to another insightful day at ICRTEH-2024. With the 5 talks, second day of the conference concluded at 5.00 PM.

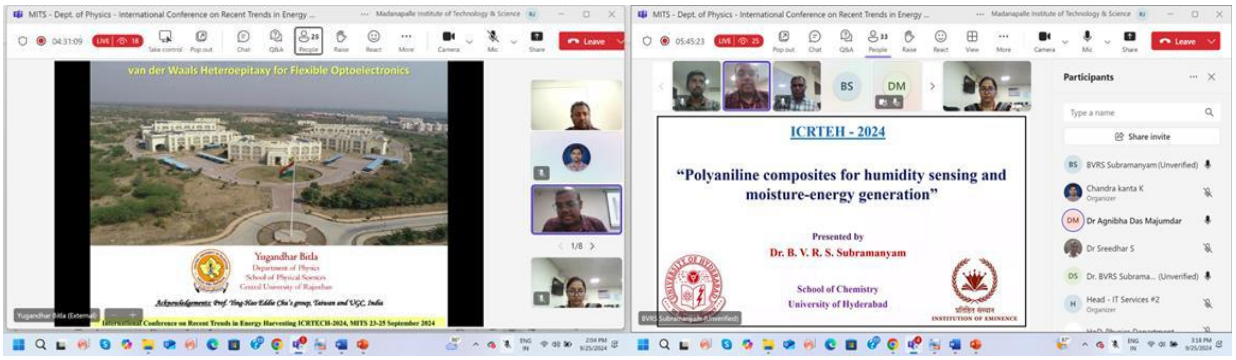
Day-3 (25/09/2024)

On Day 3 (25-09-2024) of the ICRTEH-2024 conference, the first session (Session 5) was chaired by **Dr. Yusuf Rahaman**, Assistant Professor at MITS Madanapalle. The session commenced with the introduction of the first invited speaker, **Dr. P. G. Krishna from GITAM University, Vishakhapatnam.** Dr. Krishna began his lecture by sincerely thanking the audience, the organizers, the HOD Physics, the Principal, the Vice Principal, and the Management of MITS Madanapalle for providing him with the opportunity to share his expertise in nanomaterials research.

His talk, titled **"Nanomaterials via Ultrafast Laser Ablation in Liquids and Their Applications in SERS,"** delved into the cutting-edge technique of ultrafast laser ablation to synthesize nanomaterials in liquids. Dr. Krishna highlighted the unique properties of nanomaterials generated through this method, such as controlled size, morphology, and surface Physics, which make them highly suitable for Surface Enhanced Raman Scattering (SERS) applications. He discussed how SERS can be employed for ultra-sensitive molecular detection, with potential applications in medical diagnostics, environmental monitoring, and material science. The talk provided insights into the recent advancements and challenges in the field, captivating the audience with practical examples of SERS applications.

Following this, at 11:10 AM**, Dr. Chinmayee Dash from CSIR-IMMT, Bhubaneswar,** took the stage for her talk titled **"Natural Fibers for Sustainable Energy Harvesting: An Approach towards Waste to Health."** She began her presentation by expressing her gratitude to the attendees and the organizing team, praising the platform provided by MITS Madanapalle for interdisciplinary collaboration. Dr. Dash's lecture focused on the innovative use of natural fibers—biodegradable and abundant materials—for energy harvesting. She explained how these fibers, derived from agricultural and industrial waste, could be transformed into sustainable energy-harvesting materials, promoting a circular economy. Her approach of converting waste into health-promoting materials and devices aimed to address environmental concerns while providing energy solutions for low-power devices such as wearable electronics. The audience appreciated her vision for integrating sustainability into energy technology.

After a break, Session 6 resumed in the afternoon, chaired by **Dr. Agnibha Das Majumdar,** Assistant Professor at MITS Madanapalle. The session began at 2.00 PM with **Dr. Yugandhar Bitla from the Central University Rajasthan,** who presented on the topic **"Van der Waals Heteroepitaxy for Flexible Optoelectronics."** Dr. Bitla expressed his gratitude to the audience and organizers and proceeded to discuss the "potential of Van der Waals heteroepitaxy for the development of flexible optoelectronic devices"**.** He explored how the integration of two-dimensional (2D) materials into optoelectronic platforms could lead to more efficient and flexible devices, such as solar cells, LEDs, and sensors. He also elaborated on the advantages of this approach for scalability and industrial applications, particularly in the context of flexible and wearable technologies.



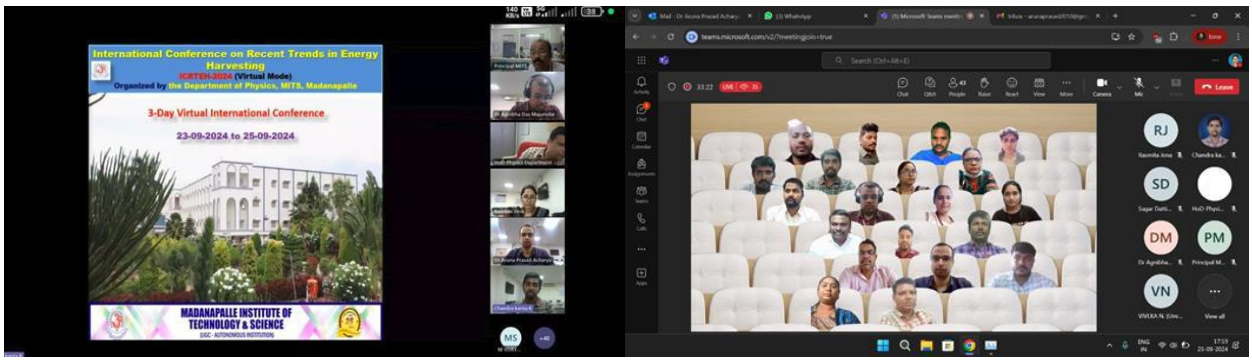
The final talk of the day was delivered by **Dr. B. V. R. S. Subramanyam** from the University of Hyderabad at 3:00 PM. His talk, titled "Polyaniline Composites for Humidity Sensing and Moisture-Energy Generation," addressed the role of conducting polymers, particularly polyaniline, in environmental sensing and energy harvesting applications. He outlined how humidity-sensitive polyaniline composites could be used for real-time environmental monitoring and discussed their potential for moisture-energy generation—a novel concept that could contribute to low-power, self-sustaining sensors. Dr. Subramanyam also touched upon the technical challenges in fabricating these composites and how their scalability could be optimized for industrial purposes. His presentation concluded with an engaging Q&A session, where participants discussed the future of moisture-energy generation

The virtual poster session on Day 3 began at 3:30 PM. 15 contestants in all displayed their posters. Each competitor gave a presentation of their poster for around 10 minutes, and then the judges took questions for 3 mins to determine which posters were the best. Around 4:30 PM, the poster presentation was finished. At end of the session, Judges finalized the 5 best posters.

Closing Ceremony:

The Closing Ceremony of ICRTEH-2024 took place on the final day of the conference and served as an opportunity to reflect on the success of the event. **Dr. K. Chandrakanta**, the convener initiated the ceremony with a brief summary of the three days, highlighting key sessions and memorable moments. Our beloved principal **Dr. C. Yuvaraj**, was invited by Dr. K. Chandrakanta to say a few words and declare the best poster winners of the virtual poster presentation sessions. He reiterated his appreciation for the Department of Physics for organizing such a well-executed conference. In his brief remarks, the principal expressed his gratitude to all the faculty members, participants, and invited speakers. Among the 50 posters displayed in the poster section throughout India and internationally, he declared the best 5 poster winners.

Following this, **Dr. Rasmita Jena**, the convener, delivered a heartfelt speech, commending the dedication and teamwork that went into organizing the event. Her words encapsulated the spirit of collaboration that defined ICRTEH-2024.



The **Coordinator and HOD**, **Dr. M.Chandrasekhar**, also addressed the participants, stressing the importance of continued research and collaboration in the field of energy harvesting.

Finally, **Dr. Sreedhar**, the Co-convener, delivered a brief speech to express his gratitude to the organizing team, technical support staff, and participants. The event concluded with a **Vote of Thanks** from Dr. Agnibha Das Majumdar, acknowledging everyone who played a role in making the event a success.

Finally, Convener Dr. Rasmita Jena formally declared the conference closed at 5:30 PM.

Outcomes of ICRTEH-2024:

- **Global Participation**: The conference attracted international participants from multiple countries including India, Poland, and the Germany.
- **Broad Academic Engagement**: Involvement of researchers, professors, and industry experts from leading institutions such as IIT, NIT, State University, Central University and the Foreign Academies of Science.
- **Interdisciplinary Collaboration**: Topics covered ranged across nanomaterials, optoelectronics, sustainable energy harvesting, and materials science, encouraging cross-disciplinary dialogues.
- **Showcase of Cutting-Edge Research**: High-level presentations on topics such as perovskite photodetectors, sustainable energy materials, and advanced optoelectronics.
- **Technological Innovation**: Featured talks on new technologies like ultrafast laser ablation for nanomaterial creation and the development of flexible electronics.
- **Sustainability Focus**: Emphasis on green and sustainable technologies, particularly in energy harvesting and the use of natural fibers for eco-friendly applications.
- **Platform for Emerging Researchers**: The virtual poster sessions provided early-career researchers a platform to showcase their findings and interact with senior scientists.
- **International Networking Opportunities**: Attendees were able to network with peers and experts globally, despite the virtual nature of the event.
- **Enhanced Visibility for MITS Madanapalle**: The host institution, MITS, was highlighted as a center for scientific research and international academic exchange.
- **Collaborative Research Discussions**: Several talks prompted discussions about potential research collaborations between institutes and industry partners.
- **Exploration of New Materials**: Presentations focused on the latest developments in materials such as polyaniline composites and Van der Waals heteroepitaxy.
- **Development of Future Technologies**: Discussions on the future of energy storage, optoelectronics, and photodetectors sparked interest in technology development for practical applications.
- **Increased Research Opportunities**: The conference opened opportunities for collaborative projects and grants, particularly in energy harvesting technologies.
- **Promotion of Energy Harvesting Innovations**: Significant attention was drawn to novel methods of energy generation, such as moisture-energy and photocatalytic hydrogen production.
- **Skill Development for Participants**: Attendees were exposed to advanced scientific techniques such as SERS (Surface Enhanced Raman Scattering) and quantum material engineering.
- **Recognition of Young Researchers**: The virtual poster sessions recognized innovative work from emerging scientists, motivating further research and publication.
- **Emphasis on Applied Research**: Talks focused on real-world applications of theoretical research, particularly in fields like humidity sensing and micro-supercapacitors.
- **Successful Virtual Format**: The conference effectively utilized a virtual format, ensuring smooth participation from international speakers and attendees.
- **Expansion of Research Horizons**: The exchange of ideas broadened research perspectives, leading to discussions about future trends in energy harvesting and material science.
- **Valedictory Function Recognition**: The closing ceremony provided recognition for outstanding contributions, fostering a sense of accomplishment and academic engagement among participants.