

INTERNATIONAL ANALYTICAL SCIENCE CONGRESS 2024



Focal Theme : Analytical Sciences and Technologies: Futuristic Trends - for Energy,
Environment and Sustainable Development (AST: FT-EESD)



VNIT, Nagpur
Maharashtra

SOUVENIR & BOOK OF ABSTRACTS



IASC 2024



22nd to 24th
February 2024

Jointly Organised by



Indian Society of Analytical Scientists &
Jawaharlal Nehru Aluminium Research Development and Design Centre

Co-organised by

Sponsored by





RARE EARTH ELEMENTS

CATALYSING ENERGY TRANSITION



IREL (India) Limited
(Formerly Indian Rare Earths Ltd)
A Govt. of India Undertaking
A Miniratna-I Company

200K+
Employment generation

10K+
CSR beneficiaries

1.5K+
Industries supported
in the value chain

1K+
Families rehabilitated

1.5K+
Acres of Green belt
developed

INDUSTRIES CATERED

AEROSPACE | CONSTRUCTION | COSMETICS & SKIN-CARE | CHEMICALS | DEFENCE | ELECTRIC VEHICLES | ELECTRONICS
GLASS & CERAMICS | GREEN ENERGY | GUIDANCE & CONTROL SYSTEM | HEALTH CARE | LASER | METAL & ALLOYS | NUCLEAR POWER
PAINTS & COATING | PETRO CHEMICALS | PRECISION CASTING | PROSTHETICS | REFRACTORIES & FOUNDRIES | TELECOMMUNICATION



CORPORATE OFFICE:

PLOT NO. 1207, ECIL BLDG., VEER SAVARKAR MARG, OPP. SIDDHIVINAYAK TEMPLE, PRABHADEVI, MUMBAI-400 028
PHONE: 022-24211630, 24382042, 24220230 | FAX: 022-24220236 | EMAIL: CONTACTUS@IREL.CO.IN



2024

INTERNATIONAL ANALYTICAL SCIENCE CONGRESS 2024

SOUVENIR & BOOK OF ABSTRACTS

IASC 2024

Jointly Organised by



Indian Society of Analytical Scientists &
Jawaharlal Nehru Aluminium Research Development and Design Centre

Co-organised by

Sponsored by



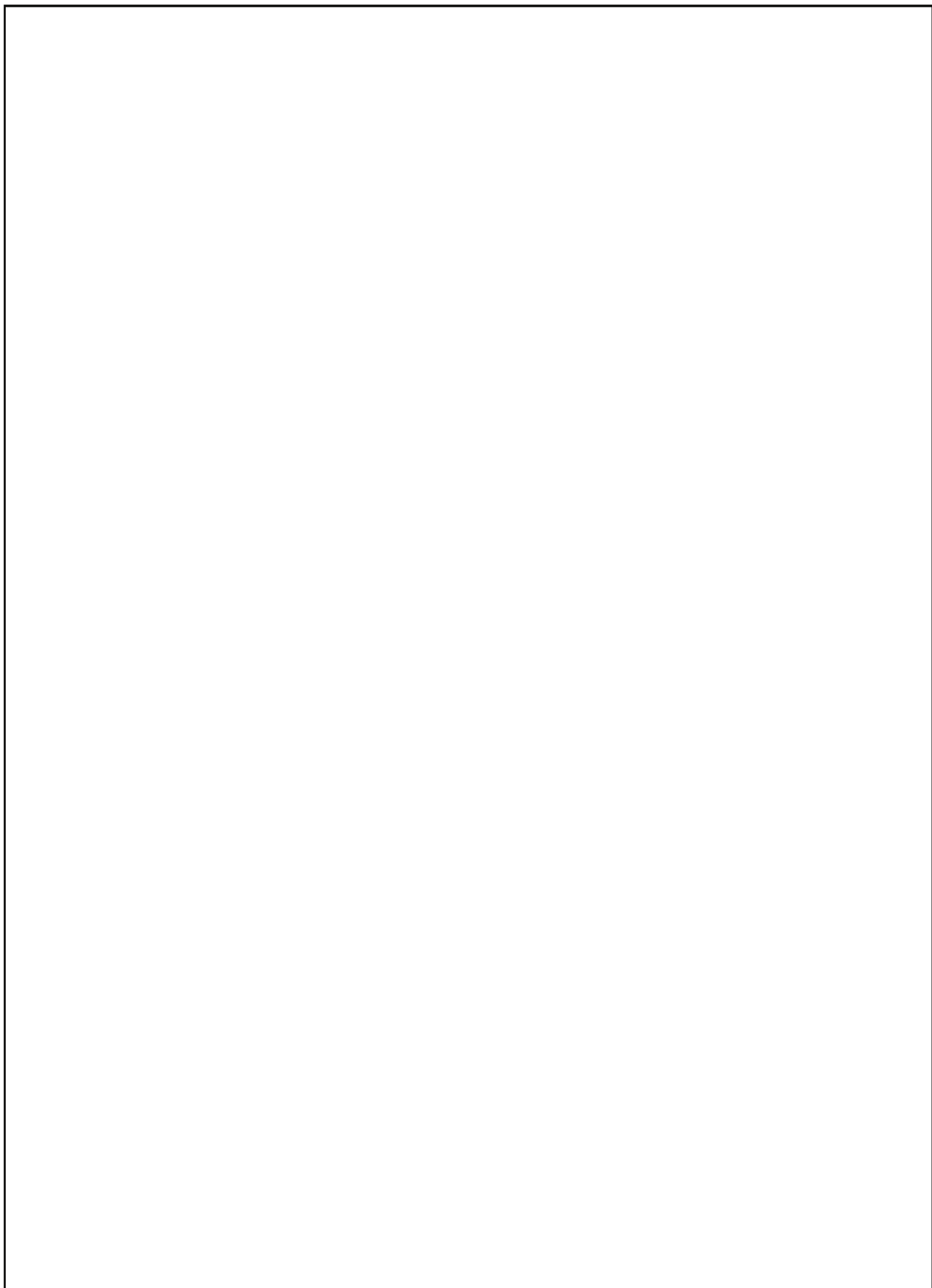
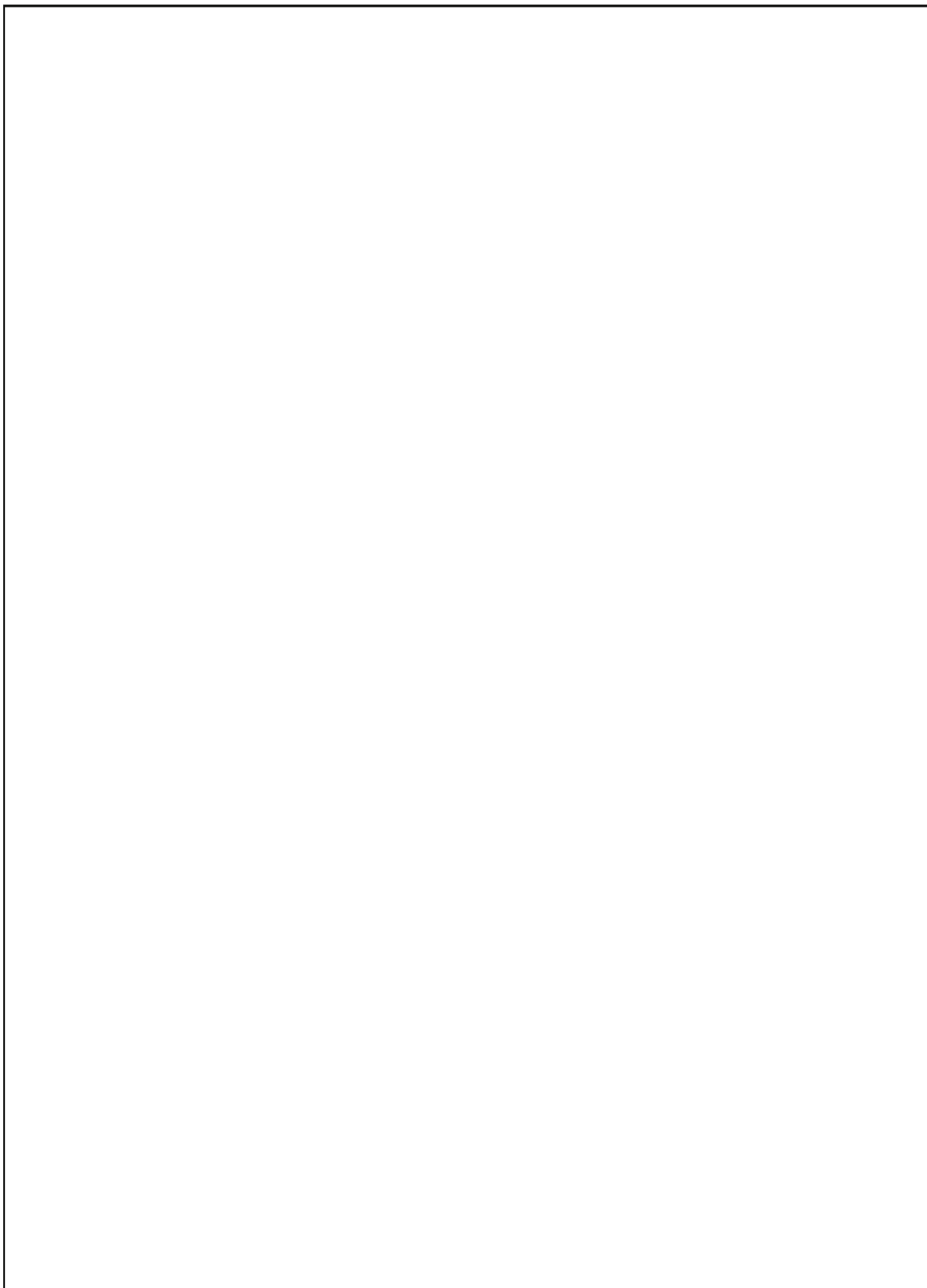


TABLE OF CONTENTS

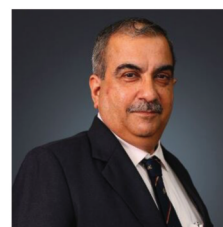
1	Messages
2	Preface
3	Sponsors
4	About Us
5	About Nagpur
6	Committees
7	Content
8	Keynote lectures
9	Invited lectures
10	Abstracts
11	Exhibitors
12	Advertisements



विवेक भसीन
Vivek Bhasin



निदेशक, भामा परमाणु अनुसंधान केंद्र
Director, Bhabha Atomic Research Centre
सदस्य, परमाणु ऊर्जा आयोग
Member, Atomic Energy Commission



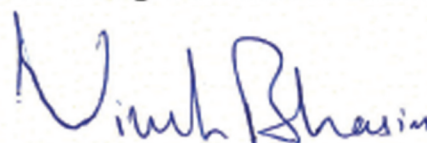
MESSAGE

I am delighted to know that Indian Society of Analytical Scientists (ISAS) is organizing an International conference, "International Analytical Science of Congress 2024, IASC 2024" from February 22-24, 2024 at Nagpur. The theme of the conference "Analytical Sciences and Technology: Futuristic Trends- for Energy, Environment and Sustainable Development" is a noble endeavour to streamline and enrich the thought process in the field of Analytical Sciences. The platform helps to create and refurbish the collaboration of analytical scientists, researchers, and educators Internationally.

Analytical science plays a pivotal role in developing and applying materials and is an integral part of various national development activities.

I am sure, the conference can bring innovation and collaboration among researchers, academics and industries and help self-sustainability in the field. I also hope the exhibitors will provide great opportunities for entrepreneurs.

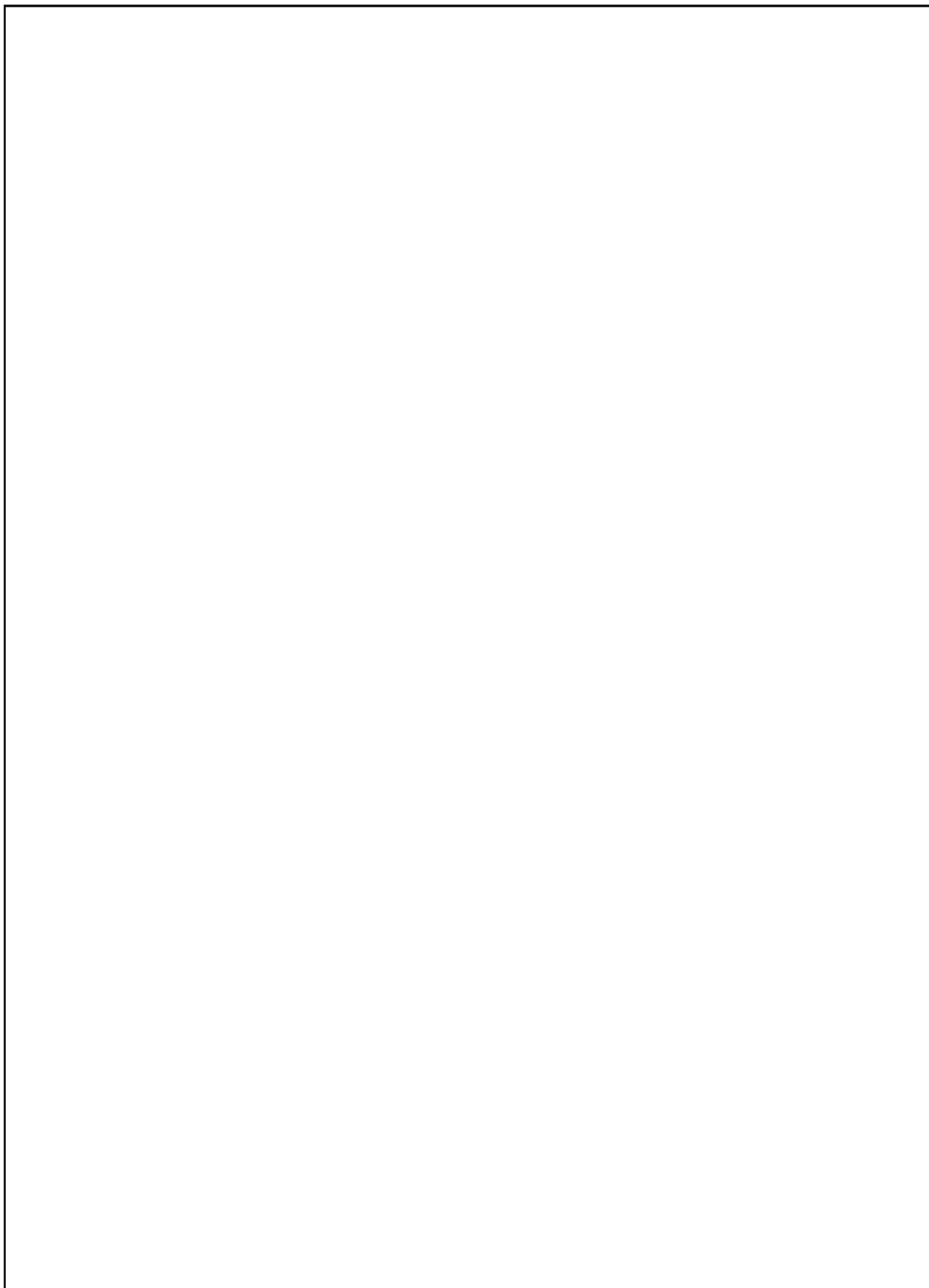
I appreciate the efforts made by ISAS towards contributing the national cause and wish ISAC 2024 a grand success.


(Vivek Bhasin)

29.01.2024



Bhabha Atomic Research Centre, Trombay, Mumbai - 400 085 India
Phone : +(+91)(22) 2550 5300, 2551 1910, Fax: +(+91)(22) 2559 2107, 2550 5151
E-mail: director@barc.gov.in



ಪ್ರೊ. ಕೆ. ಬಿ. ಗುಡಸಿ

ಎಂ.ಎಸ್.ಸಿ., ಪಿ.ಎಚ್.ಡಿ.

ಕುಲಪತಿಗಳು

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ
ಪಾವಟೆನಗರ, ಧಾರವಾಡ-೫೮೦ ೦೦೩

☎ 0836-2215355 / 2448600
ಫ್ಯಾಕ್ಸ್ : 0836-2747884
ಇ-ಮೇಲ್ : vc@kud.ac.in



NAAC Accredited with "A" Grade
University with "Potential for Excellence"

Prof. K. B. Gudasi

M.Sc., Ph.D.

Vice-Chancellor

Karnatak University
Pavate Nagar, Dharwad-580 003

☎ 0836-2215355 / 2448600
Fax : 0836-2747884
E-mail : vc@kud.ac.in

MESSAGE

MESSAGE



I am pleased to know that the Indian Society of Analytical Scientists (ISAS) is organizing the International Analytical Science Congress (IASC-2024) from February 22-24, at VNIT, Nagpur, India.

The theme of the congress "Analytical Sciences and Technology: Futuristic Trends for Energy, Environment and Sustainable Development" can provide innovative collaborations among researchers, academicians and industries along with scientists and constitute an integral part of national development activities. Analytical Science is a highly dynamic field already grown to be borderless. Hyphenated techniques have unfolded new perspectives and challenges in chemical analysis, dealing with complex problems related to recent materials applied in all walks of life. It is a good strategy to organize an International congress like this to take stock of current activities and identify further developments needed in this important field in the march of zero carbon sustainable development of the country.

I extend my best wishes to the organisers and participants for a successful and fruitful endeavour and wish IASC 2024, a grand success.

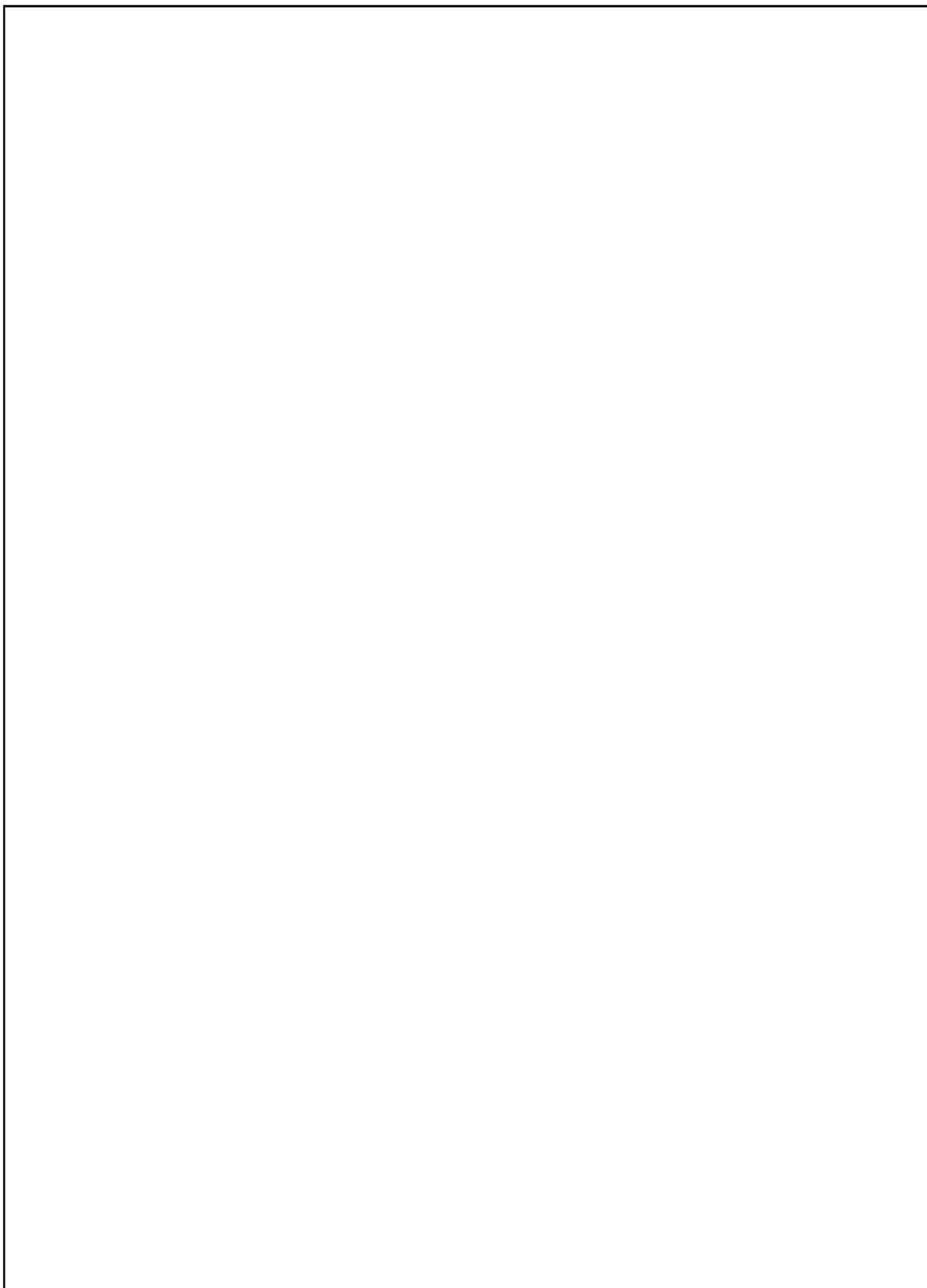
01-02-2024



(Prof. K.B. Gudasi)

Vice-Chancellor
Karnatak University
Dharwad

ಪ್ರಸ್ತುತ ಮನೆ : ಕುಲಪತಿಗಳ ವಸತಿಗೃಹ, ಕೆ.ಬಿ.ವಿ. ಆವರಣ, ಪಾವಟೆನಗರ, ಧಾರವಾಡ
Present Address : Vice-Chancellor's Bungalow, Pavate Nagar, Dharwad-580 003





भा. सरवणन
उत्कृष्ट वैज्ञानिक एवं निदेशक
B. Saravanan
Outstanding Scientist & Director



भारत सरकार
परमाणु ऊर्जा विभाग
परमाणु खनिज अन्वेषण एवं अनुसंधान निदेशालय
Government of India
Department of Atomic Energy
Atomic Minerals Directorate for
Exploration and Research

February, 2024

MESSAGE

It gives me great pleasure to learn that Indian Society of Analytical Scientists (ISAS) is organizing International Analytical Science Congress during 22-24 February, 2024 at Nagpur, Maharashtra. The focal theme of the technical event is pertinent to create a vision for sustainable development by discussions among such diverse and knowledgeable group of experts.

The aim of International Congress is to bring together a diverse domain of experts, academicians, researchers and professionals working in multidisciplinary fields to explore the innovative developments in analytical methodologies, challenges and expansion of knowledge in analytical sciences.

Analytical science plays a critical role in setting the futuristic trends for energy environment and sustainable development by providing essential data, insights and tools for decision-making, performance monitoring, technology assessment, environmental compliance, resource management, risk assessment and policy development. By leveraging analytical approaches and methodologies, society can drive innovation, enhance sustainability and create a more resilient energy future.

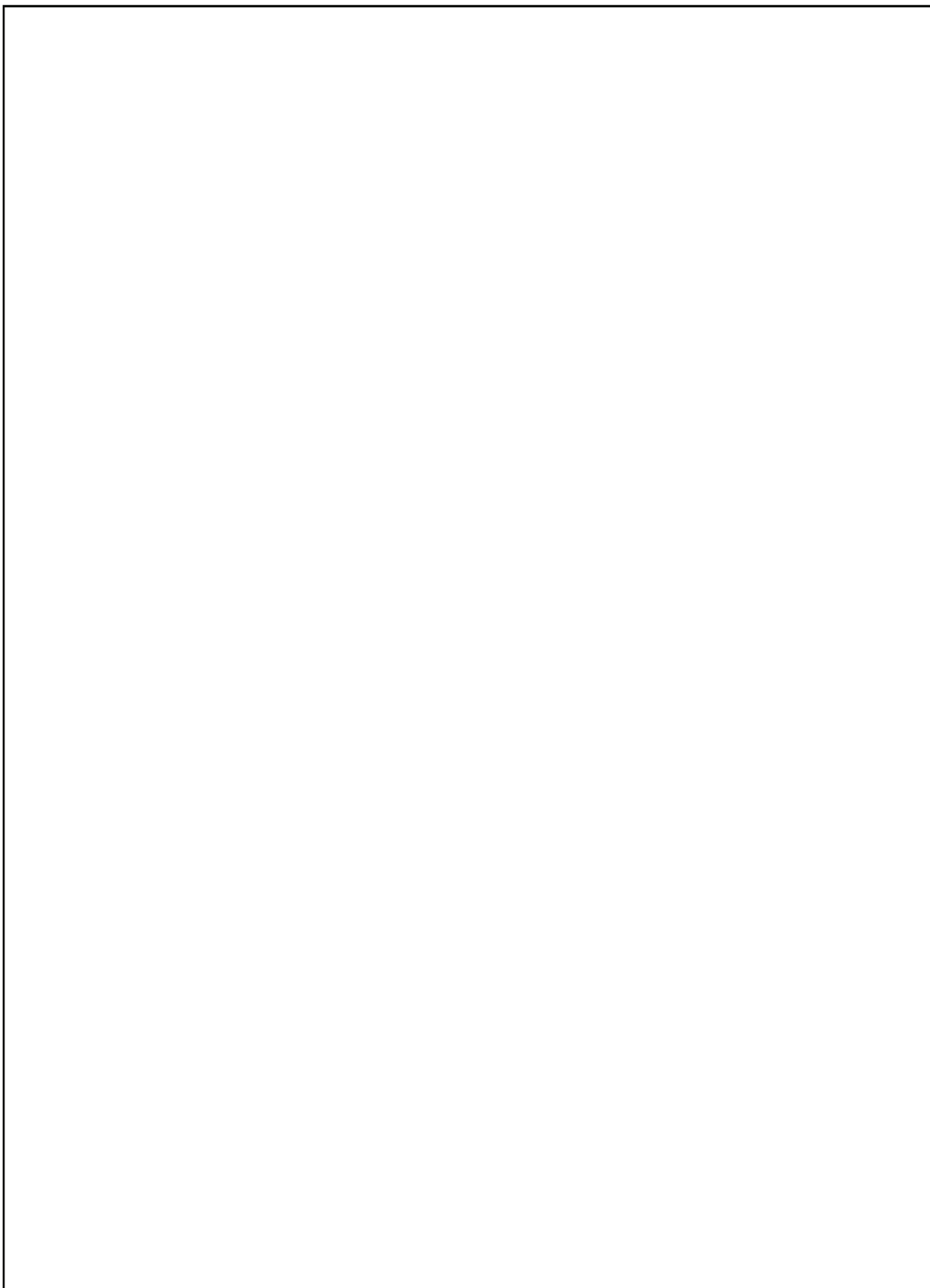
I am hopeful that this International conference will serve as the ideal platform for focused technical deliberations, sharing expertise, churning of novel ideas, interdisciplinary collaborations and dissemination of knowledge on the vital issues related to analytical sciences.

I extend my greetings to all learned academicians, scientists, researchers and students and congratulate the organizers for hosting such eloquent event and express my best wishes for the success of the Conference.



(भास्करन सरवणन B. Saravanan)







सेन्टर फॉर मैटेरियल्स फॉर इलेक्ट्रॉनिक्स टेक्नोलॉजी
(वैज्ञानिक संस्था इलेक्ट्रॉनिक्स और सूचना प्रौद्योगिकी मंत्रालय, भारत सरकार,
आई.डी.ए. फेज-III, चेरलापल्ली, हेच.सी.एल.डब्ल्यू.अर,
हैदराबाद-५०००५९, भारत)

CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY
(Scientific Society, Ministry of Electronics and Information Technology (MeitY), Govt. of India :
IDA Phase-III, Cherlapally, HCL (PO), Hyderabad-500 051, Telangana State, INDIA
Phone : +91-40-2726 5673 EPABX : +90-40-2726 7006, 2726 5587
FAX : +91-40-2726 1658 E-mail : ratheesh@cmet.gov.in
Website : www.cmet.gov.in

Dr. R. Ratheesh
Director



MESSAGE

It gives me immense pleasure to know that Indian Society of Analytical Scientists (ISAS) is organizing an International Analytical Science Congress 2024 with the theme "Analytical Sciences and Technologies: Futuristic Trends for Energy, Environment and Sustainable Development (AST:FT-EESD)" during February 22-24, 2024. Analytical science has a pivotal role to play in some of the most critical areas viz. health, environment and climate change.

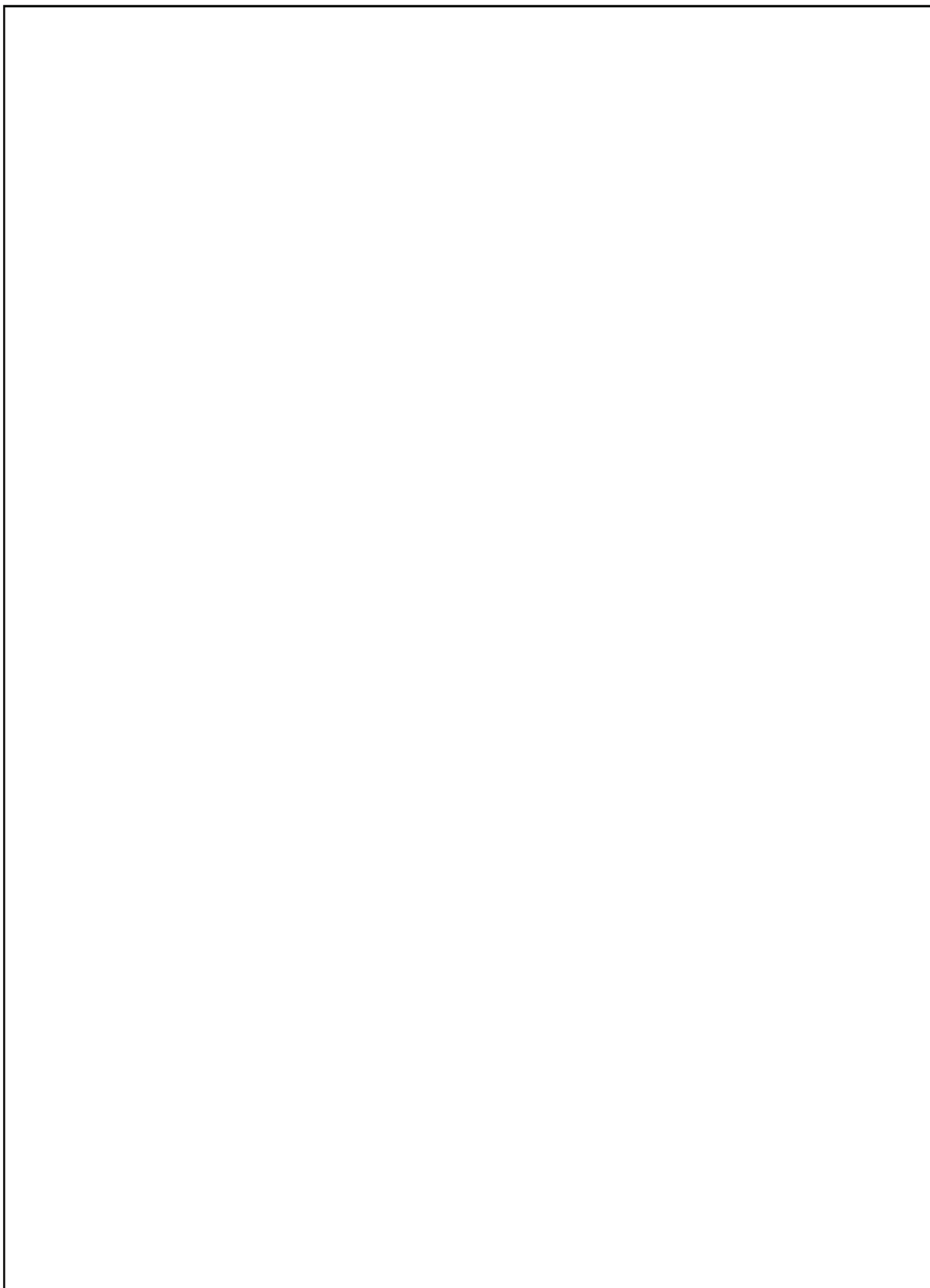
I am sure that the conference will provide an ideal platform for national and international researchers, academicians, students and industrialists to interact together and get involved in cutting-edge research and innovation. The deliberations in the conference are expected to spur novel ideas and nucleate collaborative projects between researchers from multidisciplinary areas.

I congratulate the Organizing Committee of AST:FT-EESD for selecting the right theme for the conference and wish them all success.

02-02-2024



Dr. R. Ratheesh
Director





डॉ. अनुपम अग्निहोत्री
निदेशक

Dr. Anupam Agnihotri
Director

जवाहरलाल नेहरु एल्युमीनियम अनुसंधान विकास एवं अभिकल्प केंद्र
(स्वायत्त संस्थान, खान मंत्रालय, भारत सरकार के अधीन)
Jawaharlal Nehru Aluminium Research Development & Design Centre
(Autonomous Body under Ministry of Mines, Government of India)

Amravati Road, Wadi, Nagpur - 440023 (India)

Phone : 91-7104-220763 (D), EPABX : 220017, 220476

Email : director@jnarddc.gov.in Website:www.jnarddc.gov.in



भारत 2023 INDIA
वक्षुण्डे वृद्धयन्
ONE EARTH - ONE FAMILY - ONE FUTURE

MESSAGE

MESSAGE



As we gather for the International Analytical Science Congress 2024 (ISAC-2024), it is an honor to reflect on the remarkable journey of analytical science and its pivotal role in shaping our world. With the theme "Analytical Science and Technology: Futuristic Trends for Energy, Environment, and Sustainable Development (AST: FT-EESD)", this conference serves as a beacon of innovation and collaboration.

Analytical science transcends boundaries, permeating diverse sectors such as industrial research, healthcare, environmental protection, and beyond. At ISAC-2024, we celebrate the transformative power of analytical expertise in driving progress and fostering sustainable development.

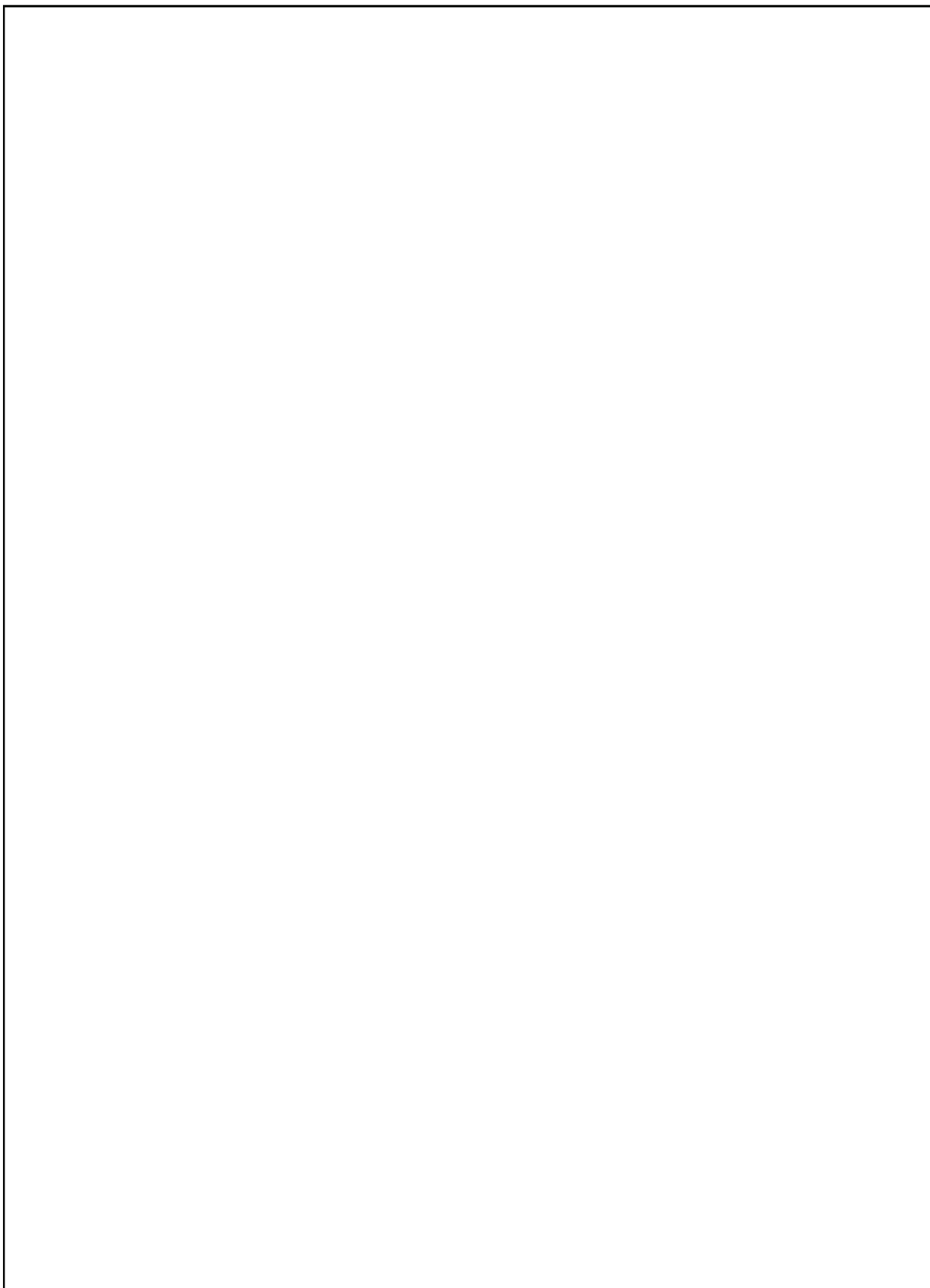
ISAC-2024 is a testament to our collective commitment to excellence and progress. Through interdisciplinary collaboration and the exchange of cutting-edge ideas, we aim to address the pressing challenges facing our world today. From exploring innovative solutions in green chemistry to charting a course for sustainable energy, this conference provides a platform for scholars, researchers, industry professionals, and policymakers to converge and inspire change.

As we embark on this journey together, let us seize the opportunity to shape the future of analytical science. Our contributions, insights, and collaborations are the building blocks of a brighter, more sustainable tomorrow.

To all participants of ISAC-2024, I extend my heartfelt gratitude for your dedication and passion. Your presence enriches this conference and reaffirms our shared commitment to advancing analytical science for the betterment of society.



(Dr Anupam Agnihotri)
Director



MESSAGE



Dear Members and Participants,

I am delighted to extend a warm welcome to all of you for the upcoming International Conference - Analytical Science Congress 2024, themed "Analytical Science and Technology: is going to be held in the Department of Chemistry VNIT Nagpur. Futuristic Trends for Energy, Environment, and Sustainable Development (AST: FT-EESD)," organized by the Indian Society of Analytical Scientists (ISAS).

Set against the vibrant backdrop of Nagpur, Maharashtra, this conference promises to be a convergence of minds, ideas, and innovations that will shape the future of analytical sciences and allied fields. This event, scheduled to take place from February 22nd to 24th 2024, is a pivotal moment for our society and the larger scientific community.

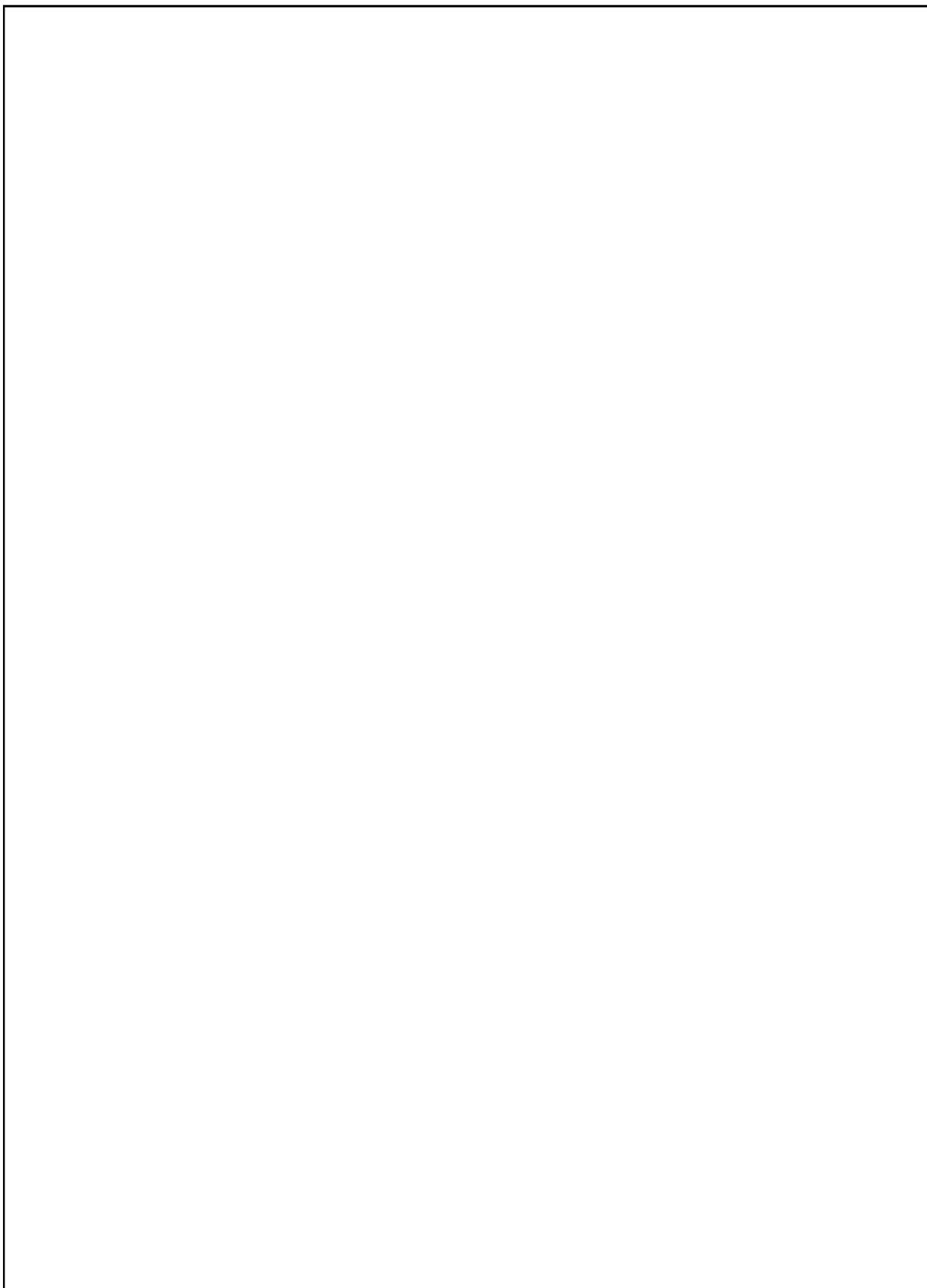
As we navigate through the challenges and opportunities presented by the rapidly evolving landscape of analytical science, it becomes increasingly imperative for us to come together and exchange novel ideas, cutting-edge research, and innovative solutions. The AST: FT-EESD conference acts as a beacon of cooperation, bringing together professionals from academia, industry, and government to participate in meaningful talks and build fresh collaborations. In the spirit of innovation and interdisciplinary cooperation, this conference will highlight future trends, cutting-edge technology, and creative solutions from a variety of industries. The program includes presentations, conversations, and one-on-one interactions with industry, government, and research professionals. This exchange of ideas and information will help us all work toward a more sustainable and prosperous future for our country.

I encourage each participant to actively engage in the conference, share their research findings, and contribute to the success of this grand event. Your presence and participation will enhance the collaborative spirit of this gathering and contribute to the broader goal of advancing analytical science for the benefit of society.

I look forward to welcoming you all to Nagpur and witnessing the vibrant exchange of ideas that will undoubtedly make the Analytical Science Congress 2024 a resounding success.

Prof. P. M. Padole

Director, Visvesvaraya National Institute of Technology, Nagpur





॥ श्री रामदेवायनमः ॥
**Shri Ramdeobaba College
of Engineering and Management**

Autonomous College Permanently Affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University

Ramdeo Tekdi, Katol Road, Nagpur - 440 013.
Phone : +91-712-2580011, Fax : +91-712-2583237
Web Site : www.rk nec.edu Email : principal@rk nec.edu
'A+' Grade Accredited by NAAC

RCOEM
Shri Ramdeobaba College of
Engineering and Management, Nagpur

An ISO 9001 : 2015
Certified Institution

MESSAGE

MESSAGE



It is my honour and privilege to be a part of this conference titled "International Analytical Science Congress 2024: Futuristic Trends - for Energy, Environment and Sustainable Development"

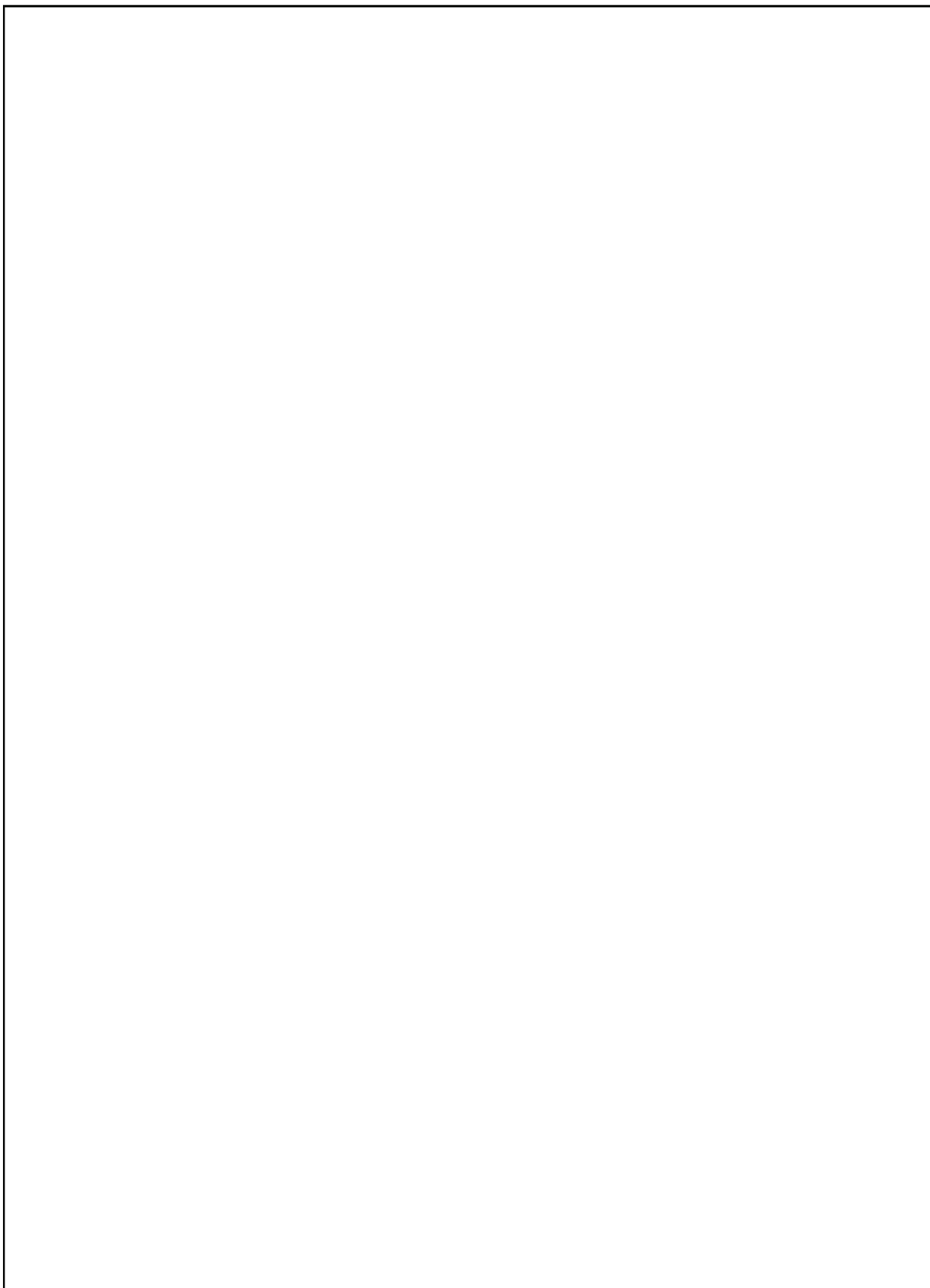
The theme of the conference highlights the importance of Analytical Science which plays a pivotal role in unravelling the mysteries and providing answers to our scientific curiosities. Be it the microscopic world of atoms and molecules or even the vast expanse of outer world, Analytical Science has always been dynamic in providing us with tools and methodologies to measure, interpret and analyse our data.

Over the next few days, as we share our varied backgrounds, expertise and experience, we are marching towards the common goal- the pursuit of knowledge and advancement of science. I wish all of you a productive and enriching experience and I wish that this conference leaves you new insights, newer collaborations and a renewed purpose. It is imperative that we continue to invest in these fields, nurturing talent, fostering collaboration, and embracing new methodologies and technologies. By doing so, we can harness the power of analytical sciences to address the challenges of today and unlock the possibilities of tomorrow.

I would like to express my heartfelt gratitude to the organizers, sponsors, and coordinators who have worked tirelessly to make this conference a reality. Their dedication and hard work are truly commendable, and without their efforts, this event would not have been possible.



Dr. Rajesh Pande
Principal





INDIAN SOCIETY OF ANALYTICAL SCIENTISTS

Dr. Raghaw Saran
National President, ISAS



MESSAGE

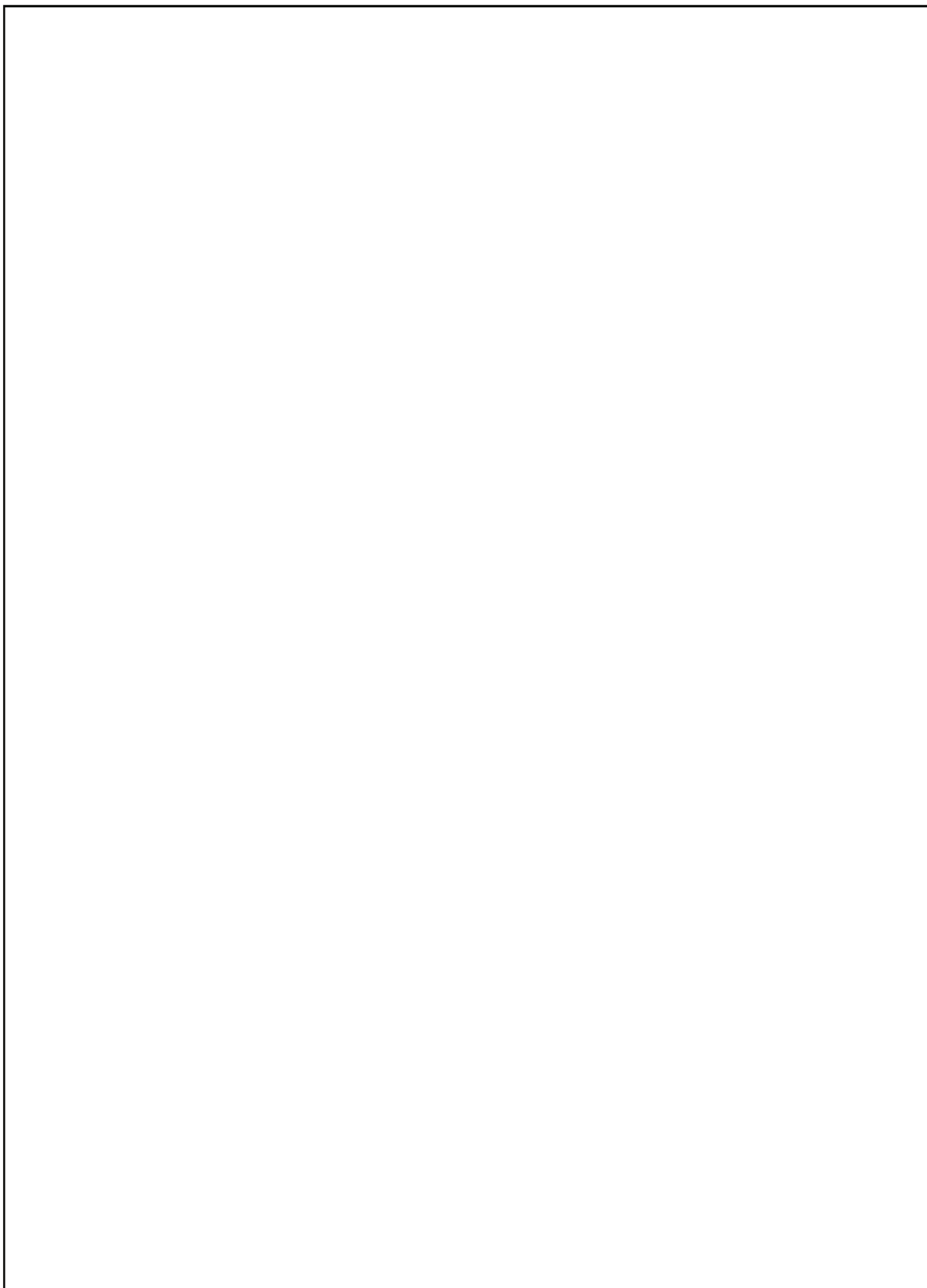
Hearty greetings to the distinguished scientific luminaries and delegates of international analytical science congress 2024 (IASC 2024). A very special gratitude to the Chief Guest and Guest of Honour for their graceful presence and put the congress in higher orbit and add a distinguished aura to IASC 2024.

Analytical Sciences entwined with analytical technology leads to all-inclusive growth. The unstinted dynamism of analytical sciences needs exploration of their futuristic trend. Their wise, constructive ecofriendly application for energy with growing need of unconventional energy including nuclear energy assures an inclusive sustainable development with a safe environment - the requisite need of the present era. This formed the objective of IASC 2024. Nagpur was selected as venue being central place, education hub and several other features providing an extra dimension to the congress. The aim of the congress is to support the scientific research in analytical sciences in the Indian sub-continent involving participation of leading analytical scientists from different parts of the world. The Indian subcontinent has significantly increased its profile in analytical sciences over the last several years.

Evolution in analytical sciences have supplemented the classical empiricism of earlier era into a new chemistry of nuclear analytical techniques (NAT), laser ablation plasma based mass spectrometry -laser micro mass analyser (LA MMA), gas chromatography mass spectrometry (GC MS), resonance ionization mass spectrometry (RI MS), X-ray and synchrotron devices and other non- destructive, structural, kinetic and inductively coupled plasma based destructive techniques (inductively coupled plasma - optical emission spectroscopy [ICP-OES], mass spectroscopy [ICP MS] with different improved versions like ICP-TOF-MS, HR-ICP-MS, ICP- QQQ-MS alone or coupled with vapor generation or electrothermal atomization, high resolution continuum atomic absorption spectrometry [HR-CS-AAS] and suitable hyphenation technique besides the portable p-XRF, LIBS with suitable care of sampling and statistical treatments of data with proper analytical quality assurance and (AQA) and analytical quality control (AQC) measures; leaving behind several destructive techniques such as molecular-spectrometry (UV-Vis-spectrophotometry), fluorometry, etc.

The advances have brought down the earlier concept of determination limits of trace elements to ppm to ppb and sub-ppt level in several cases. The sample size continues to

-PTO-





INDIAN SOCIETY OF ANALYTICAL SCIENTISTS

shrink, instruments get miniaturized, sample preparation devices and micro- fluidity improves eventually culminating a lab on chip (LOC) technology. The Growing role of analytical sciences and its prominent role in multifaceted fields such as geochemical exploration, environment, agriculture, medical to biological sciences, living organisms, various materials of commerce from semiconductors to food, forensic science, petrochemicals, weaponry, consumer products, process management and automation, particle sizing, beverages, glass and ceramics, water and effluent analysis is highly significant. In brief, analytical sciences are very inextricably interwoven part of the entire gamut of Science & Technology (S & T) activities encompassing all sectors of development of the Nation.

It is heartening to see the huge response, presence of august gathering adding value to the congress- 250 participants from countries, more than 100 high quality R & D papers by researchers, 2 Keynote Lectures and 35 excellent Invited Talks by leading subject experts with par excellence expertise in respective fields being interacted in the international analytical science congress IASC 2024.

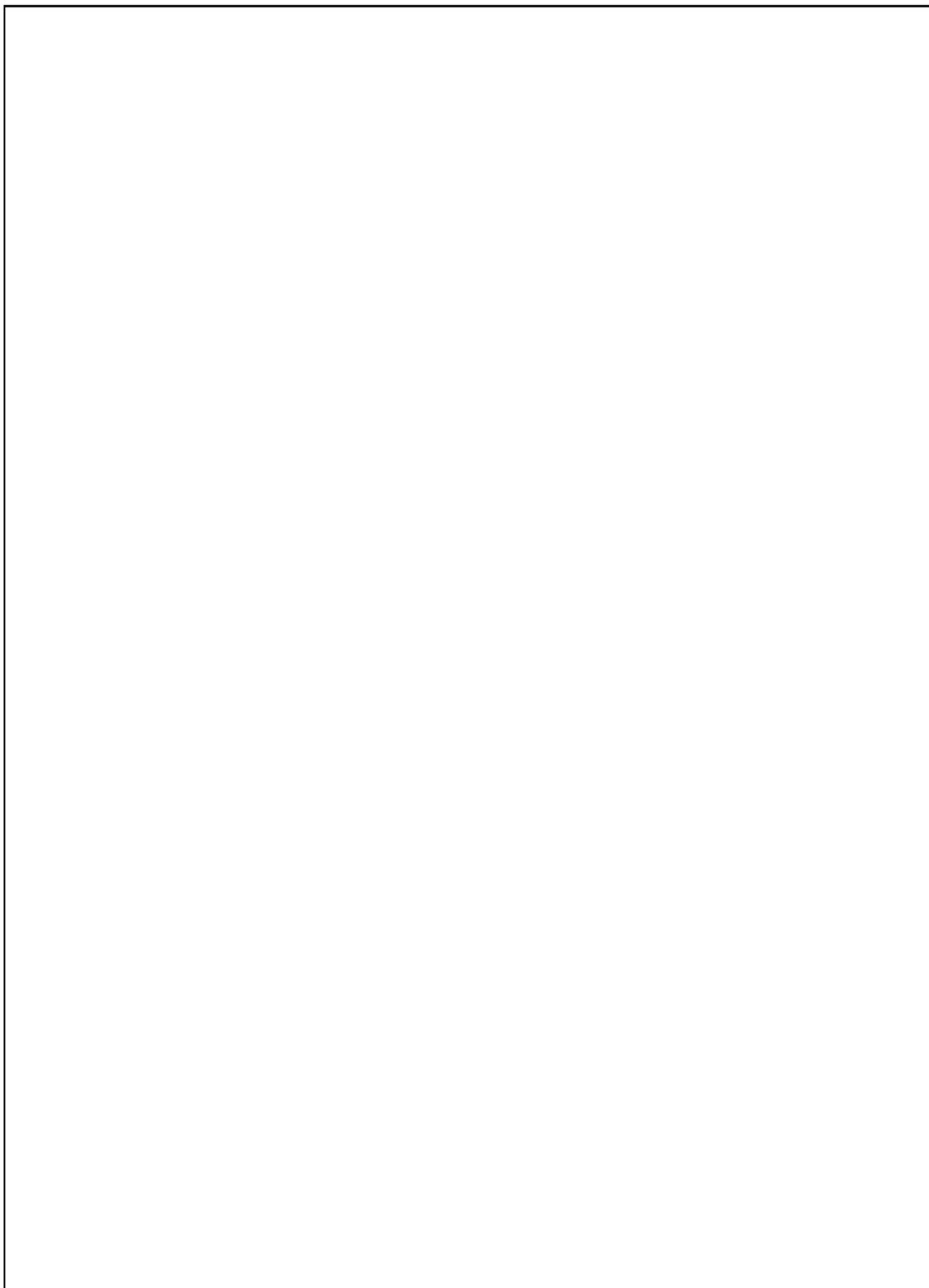
Peer reviewed selected papers presented in IASC 2024 will also be considered for publication in referred journal J. ISAS and Scopus indexed journals. Thus, the souvenir of IASC 2024 will be highly valuable technical document for all the ISAS and allied S & T Communities in India and abroad. The congress is enriched by participation from senior scientists and technologists from DAE, BARC, BRIT, IREL, AMD, NFC, VSSC, various universities, National Labs, and Industries. The update, exchange, and dissemination of futuristic trends in analytical sciences and technology for energy, environment and sustainable development will be a motivating milestone for the participants and its proceedings a valuable document for upcoming researchers. Valuable contributions of several leading Indian Scientists and Technologists will be duly recognized by conferring ISAS awards on them.

My congratulations are due to the untiring efforts of organizing committee and vibrant subcommittees, the real pillars of success behind IASC-2024.

Wish you all a fruitful exchange of your researches during IASC- 2024



Dr. Raghaw Saran
National President, ISAS





INDIAN SOCIETY OF ANALYTICAL SCIENTISTS

Dr. Avinash V. Bharati

Convener
Organizing Committee, ISAS



PREFACE

Dear Participants,

It is my pleasure and privilege to welcome you to the INTERNATIONAL ANALYTICAL SCIENCE CONGRESS 2024 at Visvesvaraya National Institute of Technology (VNIT), Nagpur.

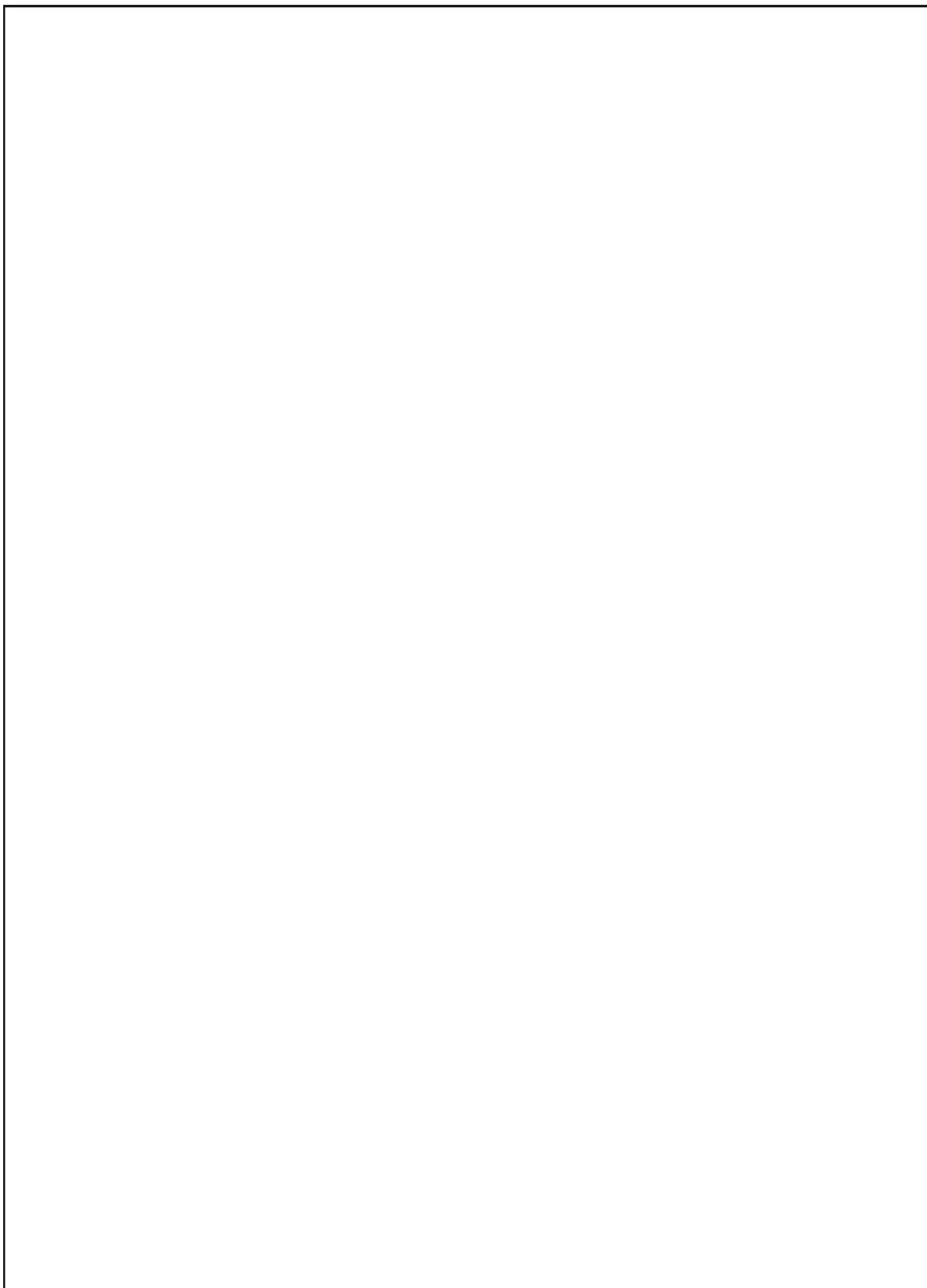
This conference is a culmination of our collective efforts and aspirations to advance the field of analytical science, material science, environmental science, organic chemistry, spectroscopy and allied areas of science and technology.

The theme for this year's conference is: Analytical Sciences and Technologies: Futuristic Trends - for Energy, Environment and Sustainable Development (AST: FT-EESD).

We have invited distinguished speakers, experts, and leaders from academia, industry, government, and society to share their knowledge, perspectives, and solutions on how analytical science can contribute to the global challenges of environmental protection, health care, food safety, energy security, and more. We have also received an impressive number of abstracts from researchers and students who have demonstrated their creativity, originality, and rigor in various domains of analytical science and spectroscopy. These abstracts have been peer-reviewed and selected for oral or poster presentations at the conference. I congratulate all the authors for their excellent work and thank them for enriching the scientific program of the conference.

I hope that this conference will provide you with a stimulating and rewarding experience. I encourage you to take advantage of the opportunities to learn from the speakers, interact with your peers, network with potential collaborators, and explore new ideas and possibilities.

-PTO-





INDIAN SOCIETY OF ANALYTICAL SCIENTISTS

I also invite you to enjoy the souvenir or abstract book that we have prepared for you. This book contains the abstracts of all the presentations, as well as some useful information about the conference venue, sponsors, organizers, and committees. I hope that this book will serve as a souvenir of your participation in this conference and as a reference for your future research and practice.

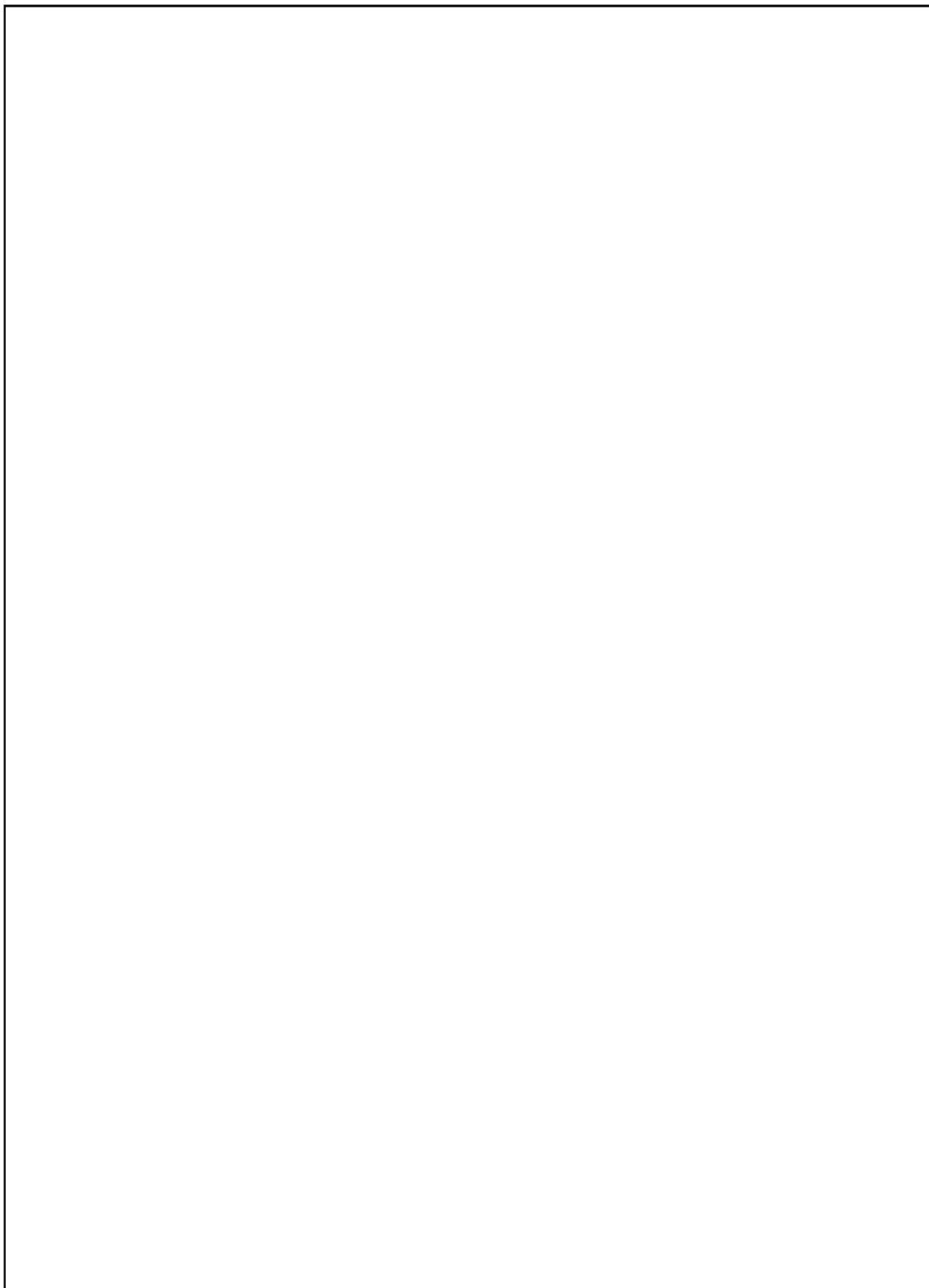
I would like to express my sincere gratitude to all the sponsors, partners, organizers, committees, volunteers, and staff who have supported this conference in various ways. Without their generous contributions and cooperation, this conference would not have been possible.

Finally, I would like to thank you for your interest and enthusiasm in attending this conference. You are the most important part of this event and the reason why we organize it. I wish you a fruitful and enjoyable time at the International Analytical Science Congress 2024.

Sincerely,



Dr. Avinash V. Bharati
Convener
Organizing Committee, ISAS



GOVT. SPONSORS

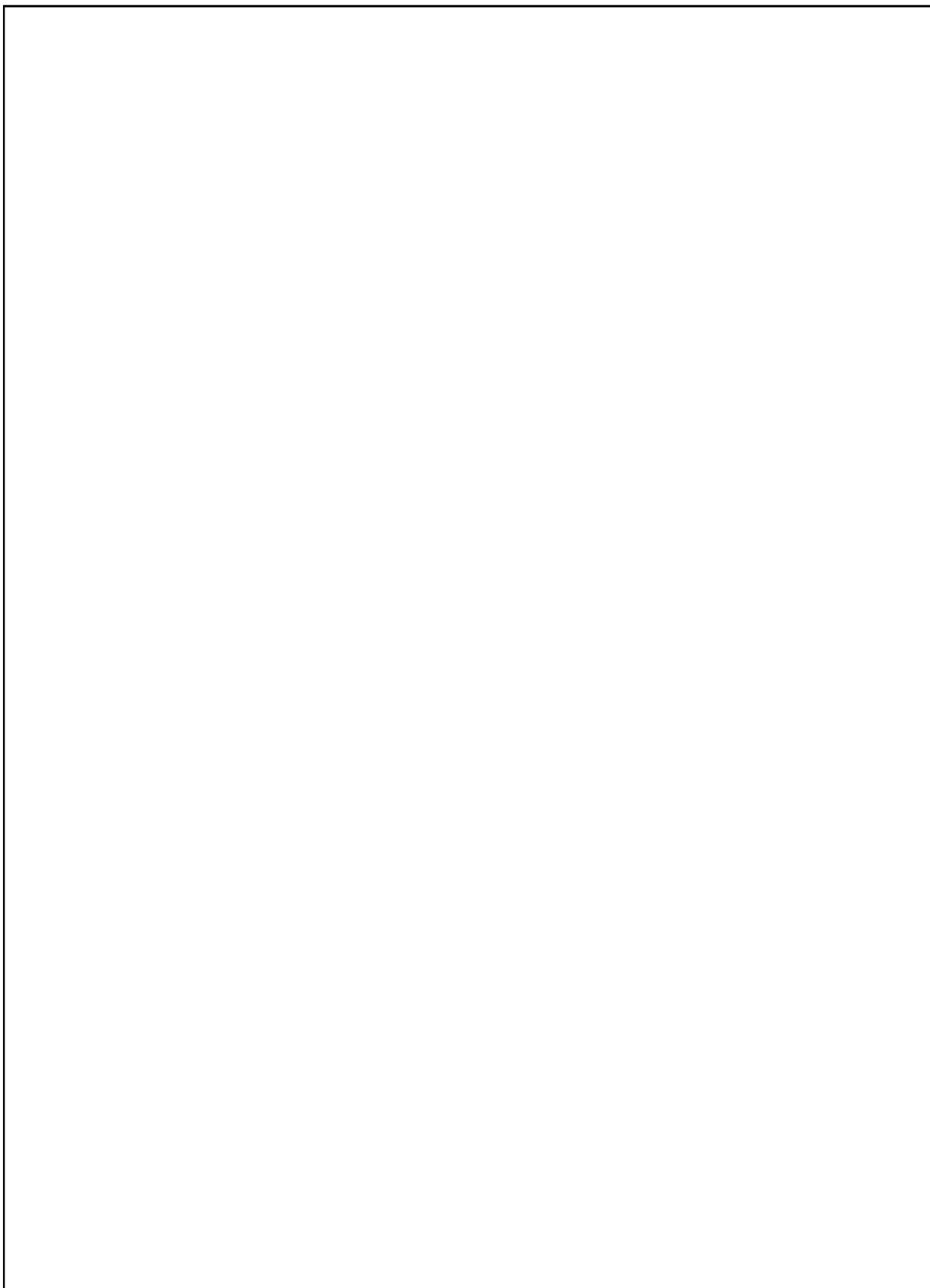


सीएसआईआर
CSIR
भारत का नयाचार इंजन
The Innovation Engine of India



NEERI

SPONSORS

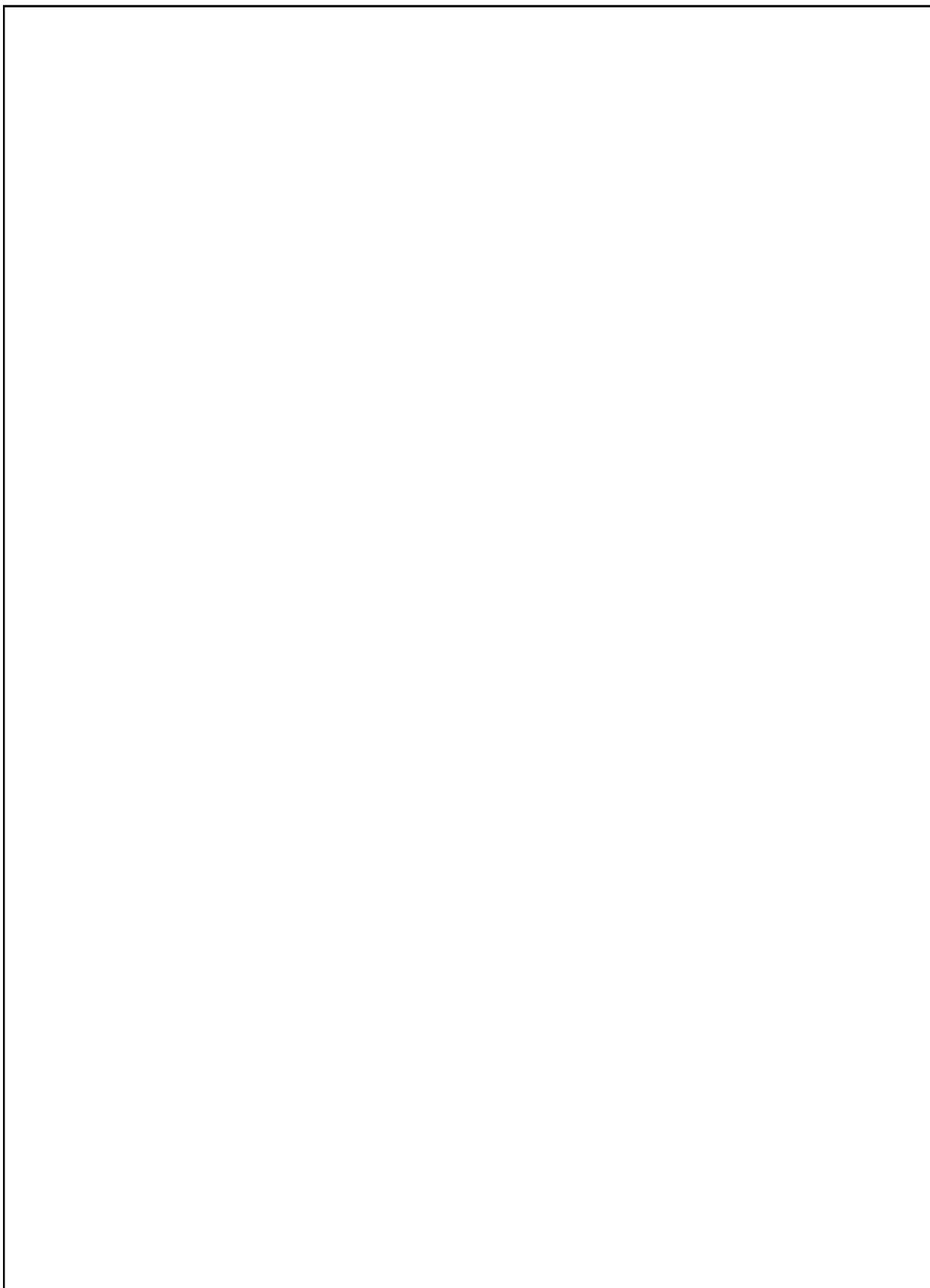


SILVER SPONSORS



SÜD-CHEMIE
Creating Performance Technology



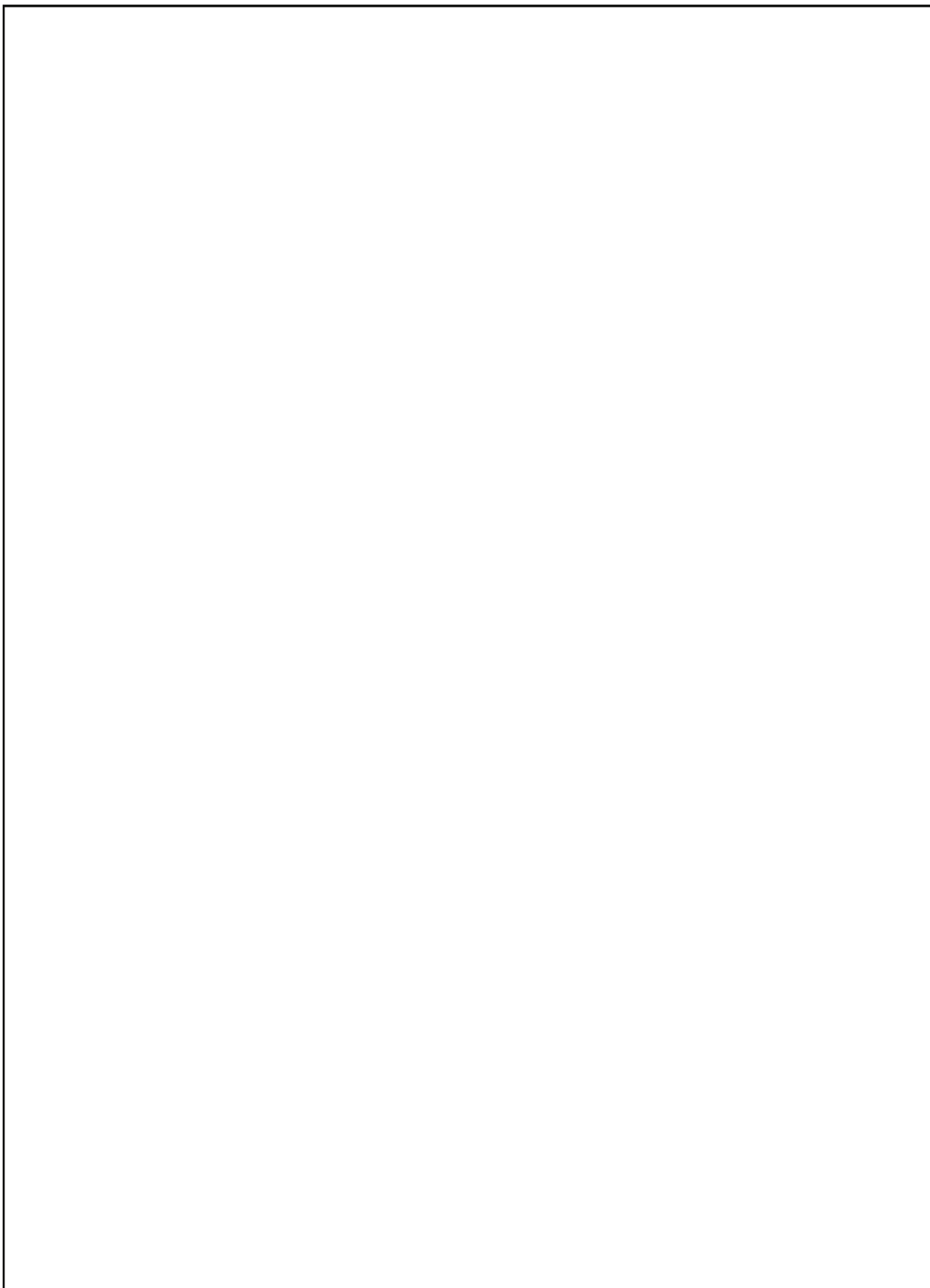


THE CONFERENCE

Analytical Science is essential for rational research and action in all areas of science and technology whether industrial research and development, in production and quality assurance, geosciences, metallurgical, pharmaceuticals, household goods, food, health care, forensics, environment protection etc. High quality analytical expertise leads to safe, eco-friendly sustainable development. The present century, is all set to witness smart information through intelligent instrumentation system utilizing AI. It would not be far to realize the vision of LOC (Laboratory on Chip) with the advent of miniaturization with great benefits of space economy, far reduced consumption of chemicals and environmental pollution leading to green chemistry.

ISAS being one of the largest vibrant societies of the country is in unique position to assess the fast-growing Research and Development in the analytical and allied fields. The programs organized by ISAS, its members could be instrumental in solving the product and service-oriented challenges through a common forum of broad spectrum of analytical and allied sciences and technology. The forum would provide opportunities for newer chemical and analytical researches employing ecofriendly green chemistry for sustainable development to realize centenary goals of the independence of the country. As we are at a juncture where innovation and interdisciplinary research are crucial to achieve and boost the goals set for the growing nation like ours, it becomes a moral imperative to exchange novel ideas using available advanced technologies. With this in view, ISAS has decided to organize an International Conference - Analytical Science Congress 2024 (IASC 2024) with the theme, "Analytical Science and Technology: Futuristic Trends for Energy, Environment and Sustainable Development (AST: FT-EESD)".

The conference is organized at Nagpur, Maharashtra during February 22-24, 2024. The conference will provide an interface for innovation and research highlighting futuristic trends in multidisciplinary sciences and technologies, analytical and allied science, paradigms of conventional and non-conventional energy with an aim to create a vision for future supporting sustainable development. Exploration of advances in diversified and strategic sector of analytical science and technology will be prioritized and the conference would provide a platform to all stakeholders to share their research work and new research areas, cutting edge technologies, innovative solutions etc., which may cause furtherance to their work. Participants would get an opportunity to have one to one interaction with experts from industry, government bodies and research institutes to enrich their knowledge and future collaborations. The conference would provide a national platform to the participants to evaluate the status of the development made and to be made to achieve sustainable centenary targets of the country. The august presence of all the participants to derive utmost benefit of the conference and make it a grand success by sharing your research data is earnestly solicited.



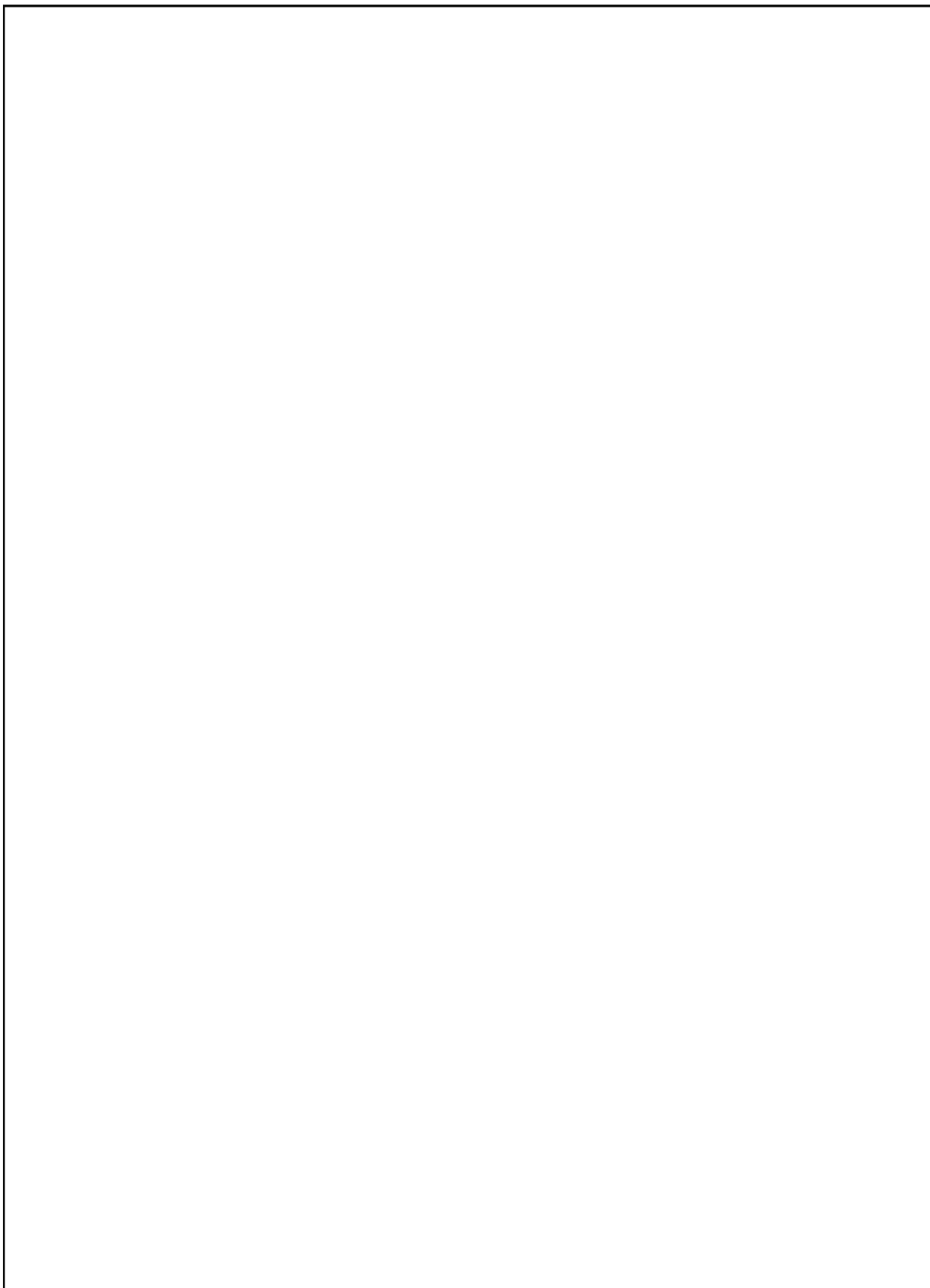
THE SOCIETY

ISAS, Indian Society of Analytical Scientists, is a premiere Scientific body of the country with the sole objective to provide nodal forum for multidisciplinary Sciences, Technology, R&D, Academia, and Industry to reap the benefit of new Research and Developments for common populace.

The Society was established in the year 1983 at Bhabha Atomic Research Centre as headquarters, almost four decades back and is 3000+ members strong with 10 chapters spread in wide part of the country. Since inception, the Society is involved in realising the pivotal objective of disseminating science from the grassroots. During the past 40 years, the Society a professional body of the analytical scientists has been engaged in assessing and analysing the impact of analytical sciences in almost every walk of life employing the latest state of art analytical techniques including on site analytical techniques LIBS etc. With the objective in view, Society has organized seventeen analytical science congress (annually one), over forty -five national and international conferences on various relevant topics of interest to the scientific community keeping the metamorphism of analysis in sight. The conferences were very well attended by leading professionals from India and abroad. Besides, large number of workshops, seminars, invited talks and several student-based activities such as quiz, essay writing, debate competitions, etc. were also organized by the Society.

Though the long pandemic, Covid-19, reduced normal activities due to mandatory isolations/quarantines, the society organized 78 webinars during 2020 and 2021 to commemorate Azadi ka Amrit Mahotsav and launched an e-version of selected talks with the title "Azadi ka Amrit Mahotsav- a few excerpts". The Society publishes Journal of ISAS, an open access, peer reviewed, quarterly e-Journal, free of any charge (both sides, author as well as reader) with DOI to bring research articles related to analytical and allied fields such as process development, instrumentation, statistical analysis, environmental analysis, and management to light. The Society publishes its e- newsletter too. The Society has instituted various awards such as Life time achievement awards, Awards of Excellence, Aatmanirbharta awards etc. to outstanding Scientists besides Fellowship of ISAS.

Nagpur Chapter of ISAS founded in the year 2000 with similar objective is equally active and was awarded as the most vibrant chapter of ISAS for the tenure 2019-2022 besides Performance Excellence Award - 2022 to the Chairman, Secretary, and office bearer of the chapter during Indian Analytical Science Congress 2022 at Munnar.



NAGPUR

Nagpur known as tiger capital of India is geographical center of country. It is also winter capital of state of Maharashtra, a sprawling metropolis, and the 13th largest city of the India.

Nagpur is also famous for orange production and known as "Orange city"

Few Visiting Places near by Nagpur:



Zero Mile (Geographic Center of India)



Tadoba Tiger Reserve (Chandrapur)



Ramtek Fort Temple



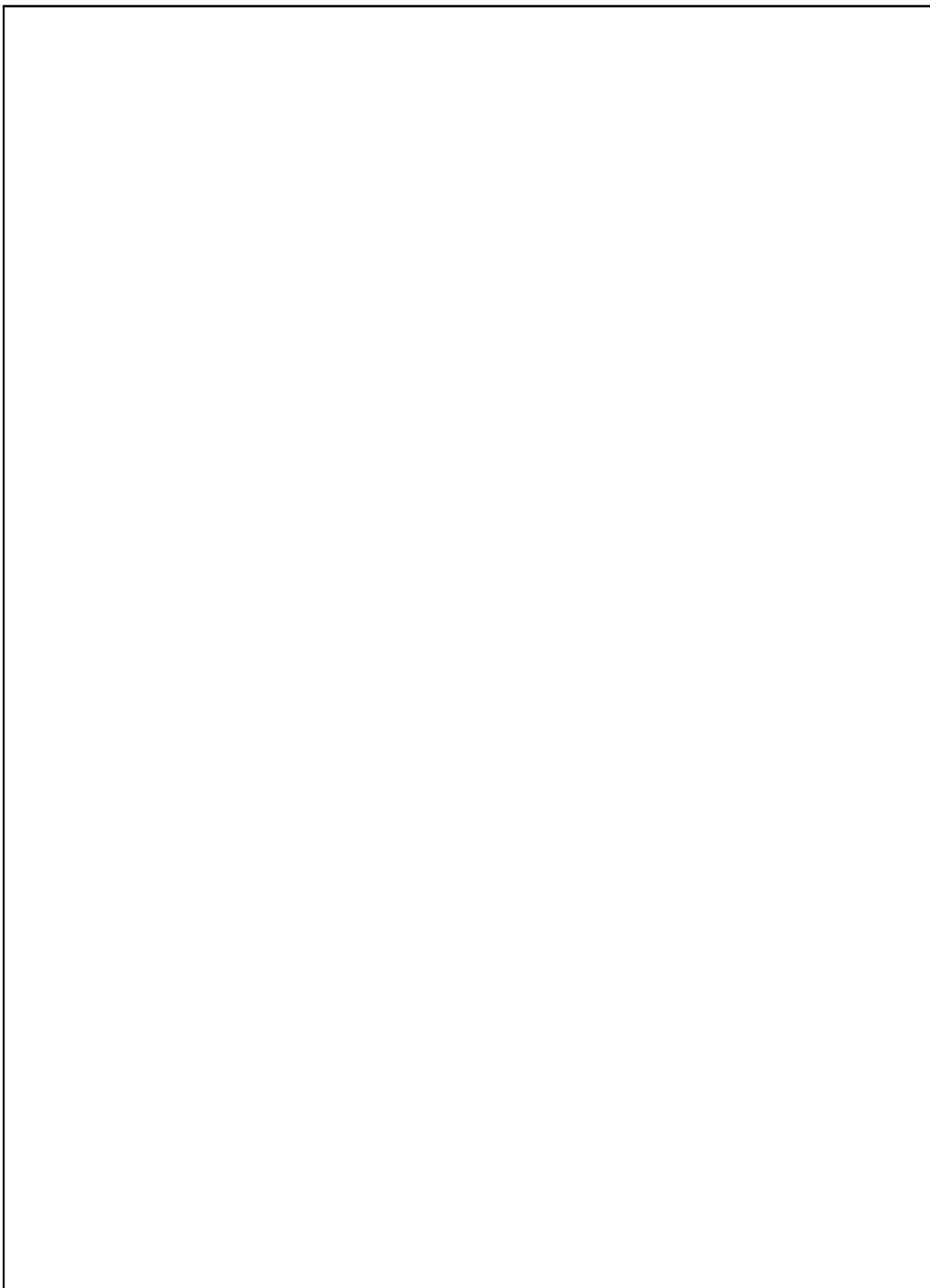
Dikshabhoomi Nagpur



Boar Tiger Reserve



Pench Tiger Reserve



COMMITTEE

PATRON

Dr. S. Unnikrishanan Nair, Director, VSSC, ISRO, Trivandrum
 Dr. Pramod M. Padole, Director, VNIT, Nagpur
 Shri. Satyanarayanji Nuwal, Chairman, RCOEM Nagpur and Chairman Solar industries India

NATIONAL ADVISORY COMMITTEE

Dr. Anupam Agnihotri, Director, JNARDDC, Nagpur
 Prof. T. N. Singh, Director, IIT Patna
 Dr. B. Venkatraman, Director, IGCAR, Kalpakkam
 Shri. B. Sarvanan, Director, AMD, Hyderabad
 Dr. C. K. Asnani, CMD, Uranium Corporation of India Limited, Jaduguda
 Shri. D. Singh, CMD, Indian Rare Earths Ltd. Mumbai
 Shri Komal Kapoor, CEO, NFC, Hyderabad
 Dr. A. K. Tyagi, Director, Chemistry Group, BARC, Mumbai
 Dr. P. K. Mohapatra, Associate Director, Radiochemistry & Isotope Group & Head, Radiochemistry Division, BARC, Mumbai
 Dr. R. Ratheesh, Director, C- Met, Hyderabad
 Shri. Pradeep Mukherji CEO, BRIT, BARC, Mumbai
 Shri. Amrit Prakash, Head, RMD, BARC, Mumbai
 Dr. R. N. Singh, Former Director, NEERI, Visiting Professor, IIT Gandhinagar, Gujarat
 Dr. Rajesh S. Pande, Principal, RCOEM, Nagpur
 Shri. S. K. Malhotra, Former Outstanding Scientist & Former RRF, DAE
 Prof. S. C. Sharma, Director NAAC, Bangalore
 Prof. N. C. Shivaprakash, Department of Instrumentation IISC, Bangalore
 Dr. D. K. Sinha, Former Director, AMD, Hyderabad
 Dr. P. K. Jaiswal, Former President, ISAS, and Former Director of Laboratories, Central Agmark, Delhi
 Dr. A. Ajayghosh, Director, CSIR, NIIST (Rtd.), Thiruvananthapuram
 Dr. Govindan Rangarajan, Director, IISC, Bangalore
 Prof. Jayaram N. Chengalur, Director, TIFR, Mumbai
 Prof. Vivek Polshetiwar, TIFR, Mumbai
 Prof. Vinay A. Juvekar, IIT Bombay, Mumbai
 Prof. (Dr.) Atul Gonsai, Department of Computer Science, Saurashtra University, Rajkot
 Prof. Madhuri A. Chaudhari (Dean R&C), VNIT, Nagpur
 Prof. J. D. Ekhe, Dean (P&D), VNIT, Nagpur
 Prof. R. R. Yerpude, Dean (FW), VNIT, Nagpur
 Prof. A. S. Gandhi, Dean (Acad.), VNIT, Nagpur
 Prof. D. H. Lataye, Dean (SW), VNIT, Nagpur
 Prof. Sanjay Giri, Padmashri Vikhe Patil College, Pravaranagar, Loni

NATIONAL ORGANISING COMMITTEE

Dr. V. R. Nair, Former GM, IREL, Kochi
 Dr. A. N. Garg, Former Professor, IIT Roorkee
 Dr. V. Balram, Former Emeritus Scientist and Chief Scientist & Head, Geochemistry Division NGRI, Hyderabad
 Dr. N. K. Pillai, Former President ISAS and CEO, KEIL, Kochi
 Dr. K. K. Mohammed Yusuff, Former Professor, CUSAT, Kochi
 Dr. S. Sriraman Narayanan, Vice President ISAS, Vice-Chancellor, Vels University, Chennai
 Dr. D. K. Singh, Former Secretary, ISAS and Head REDS, BARC, Mumbai
 Dr. Neeta Thacker, Former Chief Scientist & Head, Analytical Instruments Division, CSIR-NEERI, Nagpur
 Shri. S. B. Singh, Former Head, Chemistry Group, AMD, Delhi

COMMITTEE

NATIONAL ORGANISING COMMITTEE

Dr. K. P. Vijayalakshmi, Head TCAMS/ASD, VSSC, Thiruvananthapuram
 Dr. S. K. Yadav, Chairman ISAS Vadodara and Sudchemie, Vadodara
 Dr. J. Manjanna, Chairman ISAS Belgavi and RC University, Belgavi
 Dr. Rajeev Raghavan, Chairman ISAS Kerala and VSSC (Rtd.), Thiruvananthapuram
 Dr. Nilima Rajurkar, Chairperson, ISAS Pune Chapter & Former Head, Dept. of Chemistry, SPPU, Pune
 Dr. K. K. A. Rashid, Former Chairman, ISAS Kerala and Suracsh Filters, Kochi
 Dr. S. K. Satpati, Senior Scientist, UED, BARC, Mumbai
 Dr. Pradeep Kumar, Senior Scientist, BARC, Mumbai
 Dr. T. M. Sridhar, Madras University, Chennai
 Shri. P. Chakraborty, Senior Scientist, AMD, Nagpur
 Dr. P. V. Joseph, Former Professor, Maharaja's College, Ernakulam
 Dr. V. V. Hanuman, Senior Scientist, AMD, Shillong
 Shri. Arunkumar Sadanandan, IREL, Mumbai
 Dr. Vijayalaxmi C. Adya, Former Senior Scientist, RCD, BARC, Mumbai
 Prof. Suresh Umare, Professor, Dept of Chemistry, VNIT, Nagpur
 Dr. Daisy Joseph, Former Senior Scientist, BARC, Mumbai
 Prof. Anupama Kumar, HOD, Dept of Chemistry, VNIT, Nagpur
 Prof. H. D. Juneja, Former Professor, PGTD, Dept of Chemistry, RTMNU, Nagpur
 Prof. N. N. Karade, Professor, Dept of Chemistry, RTMNU, Nagpur
 Prof. N. Khati, Professor, Dept of Chemistry, LITU, Nagpur

LOCAL ORGANISING COMMITTEE

Dr. A. R. Choudhari	Dr. Seema Rawat	Dr. M. V. Borkar	Dr. G A Wankhade
Dr. Chayan Das	Dr. Ranjeet Ghumde	Dr. Manish Jachak	Dr. M. P. Joshi
Dr. Aruna Sudame	Dr. Pankaj Belsare	Dr. V. V. Hiwase	Dr. P. U. Waghe
Dr. Ramani V. Motghare	Dr. H. C. Pandhurnekar	Dr. M. Karmakar	Dr. R. R. Gupta
Dr. Sujit Ghosh	Dr. Balvinder Talwar	Dr. S. K. Patle	Dr. Ram Gupta
Dr. Susanta K Nayak	Dr. Ekta Meshram	Dr. Datta Bharti	Dr. M. Najar
Dr. S. Laxmi Gayatri	Dr. K. G. Rewatkar	Dr. Doyal Bhattacharya	Dr. Paparao Mondli
Dr. Abhishek Banerjee	Dr. M. G. Dhonde	Dr. K. L. Wasewar	Dr. Minal Joshi
Dr. Sandipan Halder	Dr. S. R. Thakare	Dr. R. R. Shrivastav	Ms. Babita Yadao
Dr. S. A. Mandavgane	Dr. C. S. Bhaskar	Dr. D. M. Chafle	Dr. R. Choudhary
Dr. D. B. Rana	Dr. P. V. Tekade	Dr. V. N. Bhusari	Dr. S. Mendal
Dr. Archana Kawde	Dr. C. B. Talwatkar	Dr. D. M. Borikar	Dr. S. Jengnate
Prof. P. S. Agrawal	Dr. S. K. Khakate	Dr. P. V. Meshram	Dr. P. Dhakite
Prof. M. R. Lanjewar	Dr. Animesh Halder	Dr. C S Burande	Dr. Berkar
Dr. Seema Shrivastava	Dr. S. S. Sonawane	Dr. C. B. Masram	
Dr. Kavita Gour	Dr. J. K. Gunjate	Dr. A. P. Fartode	

COMMITTEE**CHAIRMAN**

Dr. Raghaw Saran
National President, ISAS
e-mail : president@isasbharat.in, saranraghaw@gmail.com
Mob. : +91 9371136828

CO-CHAIRMAN

Dr. Upendra Singh
Senior Principal Scientist, JNARDDC
e-mail : upendra1970@gmail.com
Mob. : +91 9890191849

CONVENERS

Dr. Avinash V. Bharati
Secretary, ISAS & HOD
Dept. of Chemistry, RCOEM, Nagpur
e-mail : avbharati@gmail.com
Mob. : +91 9923255049



Dr. Atul V. Wankhade
Jt. Secretary ISAS & Associate Professor
Dept. of Chemistry, VNIT, Nagpur
e-mail : wankhade.wankhade@gmail.com
Mob. : +91 9423402441

CO-CONVENERS

Dr. Pranav Nagarnaik
President, ISAS Nagpur Chapter



Dr. Chandrashekhar P. Pandhurnekar
Treasurer, ISAS Nagpur Chapter

COMMITTEE

TREASURER



Dr. M. G. Shinde
Treasurer ISAS, AMD

JOINT TREASURERS



Dr. Suraj Butoliya
ISAS Nagpur Chapter



Dr. Indrani Das Sharma
Secretary, ISAS Nagpur Chapter

CO-ORDINATORS



Dr. Arunkumar Singh



Dr. Umesh Pratap



Dr. P. A. Mangrulkar



Dr. R. M. Jugade



Dr. S. Zodape



Dr. S. M. Meshram



Dr. V. M. Tangade



Dr. Atul Maldhure



Dr. S. R. Mudliar

CONFERENCE SECRETARIAT

INDIAN SOCIETY OF ANALYTICAL SCIENTISTS
82, Swamy Colony, Phase II
Kotal Road, Nagpur-13, 440 013
e-mail : iasc2024nagpur@gmail.com
<https://iasc-24.isasbharat.in>
Mob. : +91 9371136828

SUB-COMMITTEE

Team members for the Respective committees in IASC-2024 Scheduled from 22nd February to 24th February 2024.

Chairman	Dr. Raghaw Saran (9371136828)		
Co- Chairman	Dr. Upendra Singh (9890191849)		
Conveners	Dr. Avinash V. Bharati (9923255049) Dr. Atul Wankhade (9423402441)		
Co- convener	Dr. C. P. Pandhurnekar (9011449803)		
Coordinators	Dr. Singh, Dr. Ravindra Jugade, Dr. Vijay Tangde, Dr. Sanjogta Meshram, Dr. Swarooplaxmi Mudliar, Dr. Priti Mangrulkar		
S No.	Event/ committee	Co-Ordinator/ Student Volunteers	Mob. number
1	Reception and Registration	Dr. Suraj Butoliya Dr. Sangesh Zodape Dr. Minal Joshi Student Volunteers Awanti Talmale Anuja Jain Shivani Bhagat	9822286321 9730108481 9096730640
2	Transportation Photography	Dr. Upendra Singh Dr. Mohammad Nazar Dr. Papa Rao Mr. Mayur Tirpude	9890191849 9890826441 9164898889 9595459542
3	Comparing/Technical	Dr. Vijay Tangde Dr. Priti Mangrulkar Dr. Swarooplaxmi Mudliar Ms. Sakshi Barad	9545112555 9823740794 9850081443 8237841311
4	Souvenir and Certificates (DTP, Printing, etc.)	Dr. Raghaw Saran Dr. Avinash Bharati Dr. Atul Wankhade Dr. C. P. Pandhurnekar Dr. Suraj Butoliya	9371136828 9923255049 9423402441 9011449803 9822286321
5	Food	Dr. Raghaw Saran Co-in charges- Dr. M. G. Shinde, Dr. Ranjeet Ghumde Student Volenteers- Vandan Patel Sneha Wahurwagh	9371136828 9422505334 9850945355 9451982762 9145686567
6	Accommodation	Dr. Avinash Bharati (Solitaire) Dr. Dr. C. P. Pandhurnekar Dr. Atul Wankhade(VNIT) Dr. Neeta Thacher (NEERI) Dr. Atul Maldhure (NEERI) Student in charges - Rudra P. Singh Student Accommodations at MLA Hostel Student Volenteers - Vandan Patel Adarsh Kumar Mourya (Guest House VNIT) Mohmmad Amin (Hostel VNIT)	9923255049 9011449803 9423402441 9850302887 9883043031 9451982762

SUB-COMMITTEE

S No.	Event/ committee	Co-Ordinator/ Student Volunteers	Mob. number
7	Cultural	Dr. Raghaw Saran Dr. Avinash V. Bharati Dr. Upendra Singh	9371136828 9890191849 9011449803
8	Stage Management	Dr. Sangogta Meshram Dr. C. P. Pandhurnekar Dr. Dr. Swarooplaxmi Mudliar Dr. Priti Mangrulkar	9890761019 9011449803 9850081443 9823740794
9	Infrastructure (Pandal, Seating arrangement etc), Backdrop, Banners floor Management at VNIT	Dr. Atul Wankhade Dr. Umesh R. Pratap Student Volunteers - Shivani Bhagat Ankita Chandak	9423402441 9730160868,
10	Infrastructure (Pandal, Seating arrangement etc), Backdrop, floor Management at JNARDDC	Dr. Upendra Singh Dr. Papa Rao R. Shrinivasan	9890191849 9164898889 9823842455
11	Memento and Valedictory	Dr. Mohammad Najjar Dr. Papa Rao Dr. Sanjogta Meshram Dr. Priti Mangrulkar	9890826441 9890761019 9890761019 9823740794
12	Finance	Dr. M. G. Shinde Dr. Suraj Butoliya Dr. Indrani Das Sarma R. Srinivasan, ICWAI	9422505334 9822286321 9675991974



INDIAN SOCIETY OF ANALYTICAL SCIENTISTS

Dr. Avinash V. Bharati
Editor

EDITOR



We are delighted to introduce the proceedings of the **International Analytical Science Congress 2024 (IASC 2024)** with the theme 'Analytical Sciences and Technologies: Futuristic trends - for Energy, Environment and Sustainable Development'. This conference is organized by Indian Society of Analytical Scientists (ISAS), Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur with Visvesvaraya National Institute of Technology, Nagpur. (VNIT) Ramdeobaba College of Engineering and Management, Nagpur and ISAS, Nagpur Chapter as co-organisers.

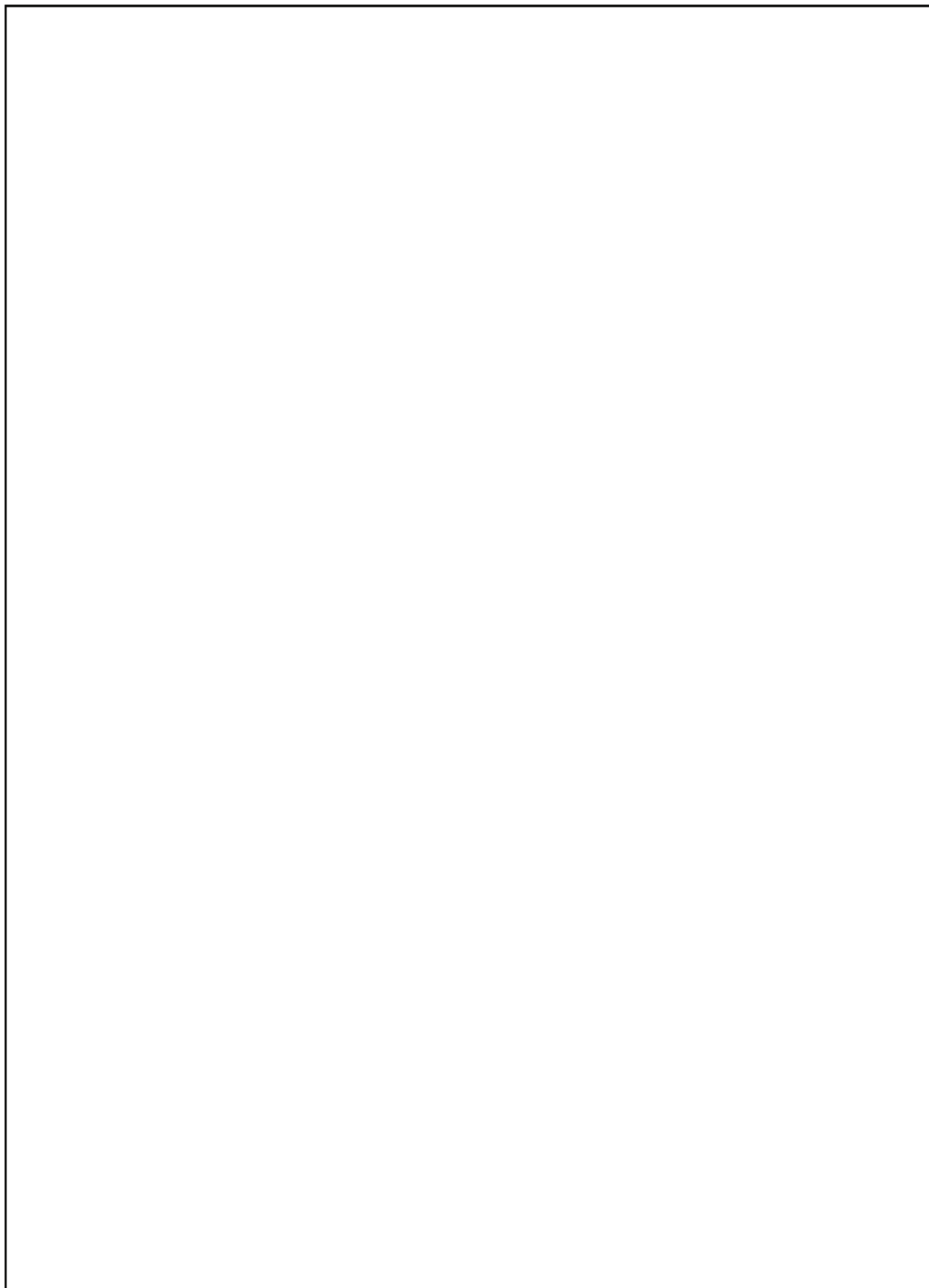
This conference brings together researchers, technocrats and educators working on the design, development, use, and evaluation of different analytical techniques in the diverse fields of science and technology. This conference also aims to provide the platform to all academicians and researchers to explore the recent development in the field of Analytical sciences and allied fields.

The conference received large response from all the corners of country. More than 110 oral and posters were presented by the researchers. They provide insights into the latest research trends, connect researchers' and offer glimpses into the work done by various institutions and organisations. This proceeding covers the conference program, invited talks, oral and poster presentations.

On behalf of organising committee, we extend warm welcome to all delegates and invited speakers, chairpersons involved in this conference and wish for the grand success of the conference.



Dr. Avinash V. Bharati
Convener, ISAS



CONTENT

S. No.	Title of the talk	Name of Speaker
KEYNOTE LECTURES		
1	AN OVERVIEW OF ANALYTICAL TECHNIQUES IN THE EXTRACTION, PROCESSING AND PURIFICATION OF RARE EARTHS	Deependra Singh
2	PROGRESSIVE DEVELOPMENTS IN EXPLORATION FOR ATOMIC MINERALS IN INDIA AND WAY FORWARD	B. Saravanan
INVITED LECTURES		
1	DESIGN AND FABRICATION OF 2D G-C ₃ N ₄ BASED NANOSTRUCTURED MATERIALS FOR RAPID DEGRADATION OF ENVIRONMENTAL POLLUTANTS	Rengaraj Selvaraj
2	DESIGNING AND RATIONALIZATION THROUGH COMPUTATIONAL MATERIALS CHEMISTRY	Sandeep Nigam
3	DESIGN OF MOBILE FOOD IRRADIATOR WITH INTEGRATED CHILLER SYSTEM	Pradip Mukherjee
4	SIMPLE AND RELIABLE ANALYSIS OF URANIUM RAW MATERIALS IN NUCLEAR FUEL CYCLE	D. P. S. Rathore
5	SOLAR-TO-X TECHNOLOGIES FOR WATER-ENERGY NEXUS	Sai Kishore Ravi
6	WASTE TO WEALTH: SUSTAINABLE RECOVERY OF RARE EARTH ELEMENTS BY RECYCLING OF E-WASTE FOR A CIRCULAR ECONOMY	V. Balaram
7	ROLE OF NUCLEAR POWER IN ACHIEVING NET ZERO EMISSION TARGET OF INDIA	Swapnesh Kumar Malhotra
8	ELECTROCHEMICAL SYNTHESIS OF NEW ISOXAZOLES AND TRIAZOLES TETHERED WITH THIOURACIL BASE AS INHIBITORS OF HISTONE DEACETYLASES IN HUMAN BREAST CANCER CELLS	Basappa Basappa
9	BIOCHAR: A PROMISING SOIL AMENDMENT FOR ENHANCING SOIL QUALITY AND INCREASING CROP YIELD	S. S. Shetye
10	A SELF RELIANCE APPROACH TOWARDS CHEMICAL CHARACTERIZATION OF NUCLEAR MATERIALS AT NFC - A 50 YEARS OF SUCCESSFUL JOURNEY FROM PAST TO PRESENT	Y. Balaji Rao
11	AN OVERVIEW OF CONSUMER AWARENESS AND RIGHT IN CONTEXT OF PRESENT FOOD SAFETY ACT, RULES AND REGULATIONS	Dr. Prem Kumar Jaiswal
12	NET ZERO GOAL-TECHNOLOGICAL OPTIONS FOR INDIA	Dr. G. S. Kapur
13	IONIC LIQUIDS AS BENIGN SOLVENTS FOR THE SUSTAINABLE DEVELOPMENT	Ramesh L. Gardas
14	DEVELOPING SODIUM-ION BATTERY TO ADDRESS INTERMITTENCY OF RENEWABLE ENERGY	Palani Balaya
15	ENVIRONMENTALLY BENIGN LI-ION BATTERY RECYCLING TOWARDS RESOURCE EFFICIENCY AND CIRCULAR ECONOMY	Ajay Kaushal
16	CHARACTERISATION OF NUCLEAR FUELS: AN UPDATE	Amrit Prakash
17	ANALYTICAL SCIENCE IN SPECIAL MATERIAL DEVELOPMENT	Dr. S. K. Satpati
18	INTEGRATING SCIENCE AND ENGINEERING FOR SUSTAINABLE DEVELOPMENTS IN WATER AND WASTEWATER TREATMENT	Dr. Vinay M. Bhandari
19	REVOLUTIONARY BENCHTOP NMR TECHNIQUE OF FLOW CHEMISTRY – CHALLENGES AND SOLUTIONS	Sandip S. Jagtap
20	RECENT INNOVATIONS IN PLASMA SOURCE MASS SPECTROMETRY AND HOW THESE CAN BE USED TO SOLVE DEMANDING REAL-WORLD PROBLEMS IN ANALYTICAL SCIENCE.	Dr. John Cantle

S. No.	Title of the talk	Name of Speaker
INVITED LECTURES		
21	VISIBLE LIGHT ASSISTED BIODIESEL PRODUCTION FROM WASTE COOKING OIL BY PORPHYRIN PHOTOCATALYST	Pundlik Rambhau Bhagat
22	NUCLEAR MEDICINE TECHNIQUES FOR MONITORING IODINE LEVELS IN PREGNANT WOMEN AND CHILDREN: A FOCUS ON RADIOPHARMACEUTICALS	Nilima Rajurkar
23	TECHNOLOGY DEVELOPMENT OF RE VALUE CHAIN	Dhruva Kumar Singh
24	CO ₂ SEQUESTRATION IN DEEP SALINE AQUIFERS	Pradeep Kumar
25	SMECTITE CLAY MINERALS IN THE GEOLOGICAL DISPOSAL OF HIGH-LEVEL WASTE, AND CONVENTIONAL APPLICATIONS AS SOLID ACID CATALYSTS/ ADSORBENTS	Prof. J. Manjanna
26	ROLE OF ANALYTICAL SCIENCES IN CATALYSING VARIOUS APPLICATIONS FOR ENVIRONMENTAL SUSTAINABILITY	Dr. Suneet Kumar Yadav
27	CARRYING CAPACITY BASED DEVELOPMENTAL PLANNING FOR SUSTAINABLE DEVELOPMENT	Dr. C. V. Chalapati Rao
28	CHEMICAL CONVENTIONS TO PROTECT HUMAN HEALTH AND ENVIRONMENT FROM TOXIC CHEMICAL	Neeta Thacker
29	ROLE OF RAMAN SPECTROSCOPY IN SUSTAINABLE NANOTECHNOLOGY AND BIOTECHNOLOGY	Kinshuk Dasgupta
30	ROLE OF GEOCHEMICAL ANALYTICAL TOOLS IN MINERAL EXPLORATION AND CRUSTAL EVOLUTION STUDIES	D. Srinivasa Sarma
31	TRACE ELEMENTS IN THE ENVIRONMENT –XRF ANALYSIS USING PROBES SUCH AS PHOTONS, PROTONS AND SYNCHROTRONS	Daisy Joseph
32	HETEROGENEOUS CATALYSTS IN THE BIOMASS VALORIZATION: THEIR UNDERSTANDING AND DESIGNING	P. L. Dhepe
33	POLY-METALLIC SULPHIDE EXPLORATION IN DEEP OCEAN: INDIAN INITIATIVE	Dr. Parijat Roy
34	MACHINE LEARNING ASSISTED SENSOR ARRAY FOR DISCRIMINATIVE ANALYSIS OF DIFFERENT GASES AND THEIR MIXTURES	Somalapura Prakasha Bharath
ORAL PRESENTATION		
1	OPTIMIZATION OF ANALYTICAL PARAMETERS TO ENHANCE THE EFFICIENCY OF NITRATE REDUCTION FROM GROUNDWATER USING CARBOXYMETHYL CELLULOSE-STABILIZED ZERO-VALENT IRON (CMC-ZVFe ⁰) NANOPARTICLES	Devsharan Verma
2	A SIMPLE AND EFFICIENT ELECTROCHEMICAL SENSOR FOR FOLIC ACID DETERMINATION BY USING TiO ₂ NANOPARTICLES MODIFIED CARBON PASTE ELECTRODE	Shaila G. Sanjeevagol
3	PLANT-MEDIATED SYNTHESIS OF n-ZnO@Cs FOR ENHANCED REMOVAL OF REMAZOL BRILLIANT BLUE R DYE	P. J. Doondani
4	COMPARATIVE STUDY OF IRON AND COPPER METAL OXIDE NANOPARTICLES FOR THE REMOVAL OF HEXAVALENT CHROMIUM FROM WATER	Dr. Vivek Bhusari
5	UV-VISIBL SPECTROMETRIC TECHNIQUE FOR QUANTIFICATION OF URANIUM AND SUBSEQUENT DEDUCTION OF NITRATE CONTENT IN AMMONIUM DIURANATE SAMPLES	Y. Balaji Rao
6	PHOSPHORYLATED ZIRCONIUM CROSS LINKED BIOPOLYMER FOR EFFICIENT SEQUESTRATION OF URANIUM FROM WATER	Dhanya V
7	SENSING POTENTIAL OF HYDROTHERMALLY SYNTHESIZED NiO DOPED YSZ	R. R. Purandare
8	KERATIN: A VERSATILE BIOPOLYMER FOR BIOTECHNOLOGICAL AND INDUSTRIAL ADVANCEMENTS – INSIGHTS INTO STRUCTURE, EXTRACTION METHODS, AND DIVERSE APPLICATIONS	Mohd Amin S. K. Husain

S. No.	Title of the talk	Name of Speaker
ORAL PRESENTATION		
9	ENVIRONMENTAL FRIENDLY APPROACH FOR CHEMICAL CHARACTERIZATION OF MAGNESIUM METAL BY GD-OES	Y Balaji Rao
10	ETHYLENE SCAVENGING PROPERTIES FROM HALLOYSITE NANOTUBES LOADED NATURAL RUBBER LATEX/BUTYL STEARATE COATING ON PAPER FOR FOOD PACKAGING APPLICATION	Armaan jot Singh
11	FERROUS OXIDE NANOPARTICLE FOR ENHANCED CO ₂ CAPTURE IN MONOETHANOLAMINE SOLUTION	Snehal Deshmukh
12	ANALYSIS OF SEASONAL FLUCTUATION OF FLUORIDE CONCENTRATION IN GROUNDWATER IN KORPANA TEHSIL, CHANDRAPUR DISTRICT, INDIA AND SUGGESTED PRECAUTIONARY MEASURES	Mrs. Dipti. G. Iyer
13	CARBONIZATION OF CASIA FISTULA SEEDS: AN EXPERIMENTAL APPROACH FOR THE REMOVAL OF CRYSTAL VIOLET DYE AND REGENERATION STUDY BY GAMMA IRRADIATION	A. S. Bambal
14	NOVEL CHITOSAN-GLUTAMIC ACID MEMBRANE FOR EFFICIENT REMOVAL OF Cr (VI) AND DICLOFENAC: INVESTIGATIONAL AND STATISTICAL APPROACH	Tejaswini. A. Rathi
15	LYOPHILIZED CHITOSAN-BARBITURIC ACID HYDROGEL FOR REMAZOL BRILLIANT BLUE R-19 DYE ADSORPTION: A THERMODYNAMIC STUDY	Vaishnavi Gomase
16	ASSESSMENT OF PESTICIDE RESIDUE LEVELS IN THE EXPOSED DERMAL REGIONS OF FARM WORKERS: IMPACT OF USE OF PERSONAL PROTECTIVE EQUIPMENT	Summaiya Lari
17	PREPARATION AND ASSESSMENT OF POLYHERBAL FORMULATION FOR SYNERGISTIC ANTIOXIDANT ACTIVITY	Sheba Raju
18	VISIBLE LIGHT ASSISTED BIODIESEL PRODUCTION FROM WASTE COOKING OIL BY PORPHYRIN PHOTOCATALYST	Bhairav Chandroday Mataghare
19	A METHOD FOR ESTIMATION OF THORIUM IN THORIUM BEARING EFFLUENTS BY ICP-AES	Y. Balaji Rao
20	COMPARATIVE ANALYSIS OF SOLAR ENERGY OVER CONVENTIONAL POWER SUPPLY	P. G. Lokhandea
21	ASSESSMENT OF WATER QUALITY IN AMGAON'S LAKES: IMPLICATIONS FOR BEAUTIFICATION AND RECREATION	Dipali Garghate
22	OPTIMIZATION OF USED COOKING OIL BIODIESEL PRODUCED IN NOVEL REACTOR: A FUTURE RENEWABLE ENERGY	A. V. Kurve
23	INCLUSION COMPLEX OF VORICONAZOLE WITH HYDROXY PROPYL BETA CYCLODEXTRIN: PREPARATION, CHARACTERIZATION, AND A STRUCTURAL INSIGHT	P.S. Kanojiya
24	REMOVAL OF CRYSTAL VIOLET, AN EMERGING POLLUTANT FROM ITS AQUEOUS SOLUTION USING BIOCHAR PREPARED FROM COCONUT SHELL	Jonty Rodriguesa
25	A SIMPLE METHOD FOR DETERMINATION OF NON-METALLIC ELEMENTS IN URANIUM BASED SAMPLES USING ICP-AES	Y BalajiRao
26	EXPLORATION OF MOLECULAR PROPERTIES AND BIOLOGICAL ASSESSMENT OF NEWLY SYNTHESIZED N-(1H-BENZO[D]IMIDAZOL-2-YLCARBAMOTHIOYL)-2/4-SUBSTITUTED BENZAMIDES	P. M. Wanjari
27	REVOLUTIONIZING PROTEOMIC VALIDATION: THE ROLE OF N-TERMINAL ACETYLTATION IN ENHANCING PROTEIN IDENTIFICATION AND CHARACTERIZATION	M. V. Jagannadham
28	SPECTROPHOTOMETRIC ANALYSIS TO IDENTIFY POTENTIAL CONTAMINATION USING IMAGE PROCESSING ALGORITHM ON LEAFY VEGETABLES	V. S. Lande

S. No.	Title of the talk	Name of Speaker
ORAL PRESENTATION		
29	LIQUID CHROMATOGRAPHIC APPROACH IN QUANTIFYING PHENYL PORPHYRIN, SUBSTITUTED PHENYL PORPHYRINS AND THEIR METAL COMPLEXES: NOVEL METHOD DEVELOPMENT AND VALIDATION	Ashish M. Ujagarea
30	XENOTIME : A SUITABLE PHASE FOR IMMOBILIZATION OF NUCLEAR WASTE, A CASE STUDY BASED ON PETROGRAPHIC OBSERVATION OF RADIOACTIVE LEUCOSOMES OF NANIYAGARH AREA, SINGRAULI DISTRICT, MADHYA PRADESH, CENTRAL INDIA	Pritam Karmakar
31	EFFECT OF ELECTROLYTE CONCENTRATION ON DIFFUSION OF Fe ³⁺ IONS IN AGAR GEL MEDIUM CONTAINING COPPER SULFATE	M. S. Gupte
32	NATURAL INDIAN INDICATORS: AN ALTERNATIVE TO THE FOREIGN INDICATORS	M. S. Joshi
33	COMPARATIVE STUDY OF UV SPECTROSCOPY, RP-HPLC AND HPTLC METHODS FOR QUANTIFICATION OF ANTIVIRAL DRUG LAMIVUDINE IN TABLET FORMULATION	Komal Somkuwar
34	DEVELOPMENT AND VALIDATION OF RP-HPLC METHOD FOR QUANTITATIVE ESTIMATION OF RITONAVIR IN BULK AND PHARMACEUTICAL FORMULATION	Vaibhav Sawale
35	GREEN ROUTE SYNTHESIS OF PMMA AND MgO COMPOSITE MATERIALS FOR INDUSTRIAL APPLICATIONS	Pranali P. Kharwade
36	ESTIMATION OF MOX FUEL HOMOGENEITY BY RADIATION IMAGE ANALYSIS	Rajashree Dixit
37	MONTE CARLO SIMULATION OF GAMMA IMAGES OF MOX FUEL PELLETS AND THE MINIMUM DETECTION LEVEL OF Pu AGGLOMERATES	Biju Keshavkumar
38	DEMONSTRATION OF GLOVE BOX INTEGRATION OF CARBON & SULPHUR DETERMINATOR (C&S) AT FUEL FABRICATION PLANT/FRFCF	B Siva Kumar
39	LED FLUOROMETRIC TECHNIQUE FOR ANALYSIS OF URANIUM AT PPB LEVEL IN AQUEOUS SAMPLES	Supriya Singh
40	MICROWAVE-ASSISTED ACID DIGESTION OF METAL FLUORIDE FOR SAMPLE PREPARATION FOR TRACE ELEMENT ANALYSIS	R. Valsha
41	EFFECT OF COMPLEXING AGENT ON UPTAKE BEHAVIOR OF NAFION MEMBRANE	Jayshree Ramkumar
42	AATMANIRBHARATA IN FABRICATION OF CRITICAL SPARES AND CONSUMABLES AS IMPORT SUBSTITUTES	S. N. V. M. S. Gupta
43	DEVELOPMENT OF HYDROGEN CHARGING INSTRUMENT FOR REACTOR CORE STRUCTURAL COMPONENTS	Prasun Ghosh
44	DETERMINATION OF BORON AND CADMIUM IN ZIRCONIUM BASED ALLOYS BY FLAME-AAS USING ATOM TRAP CELL	Y. BalajiRao
45	DEVELOPMENT OF INERT GAS FUSION TECHNIQUE FOR QUANTIFICATION OF HYDROGEN IN ZIRCONIUM BASED ALLOY USING DIFFERENT FLUX MATERIAL WITH TCD AND NDIR DETECTION	Y. BalajiRao
46	APPLICATION OF THERMAL ANALYSIS TECHNIQUES IN ALUMINIUM RESEARCH/INDUSTRIES	S. U. Bagde
47	CHEMICAL AND MINERALOGICAL ASSESSMENT OF CERAMIC MATERIAL DEVELOPED FROM UNUSED INDUSTRY REJECT: CASE STUDY OF MANGANESE MINE OVERBURDEN DUMP OF DONGRI, BUZURG, MAHARASHTRA, INDIA	Paparao Mondli

S. No.	Title of the talk	Name of Speaker
ORAL PRESENTATION		
48	EXTRUDABILITY OF AA3103 IN COMPARISON WITH AA6063 ALLOYS BY NUMERICAL SIMULATIONS AND PRESS TRIALS	V. N. S. U. Viswanath Ammu
49	UTILIZING XRF FOR CHEMICAL ANALYSIS OF MINERALS AND ORES	Priyanka Nayar
50	PROSPECTIVE OF "SUSTAINABLE PROCESS DEVELOPMENT FOR THE RECOVERY OF RARE EARTH ELEMENTS FROM ALUMINIUM DROSS"	Shweta Dhamande
51	LITHIUM DETERMINATION IN INDIAN BRINES BY HIGH RESOLUTION-CONTINUUM SOURCE (FLAME) ATOMIC ABSORPTION SPECTROMETER (HR-CS-(F)AAS)	M. Krishnakumar
52	NEW METHODS OF ANALYSING AUTORADIOGRAPHS FOR MIXED NUCLEAR FUEL CHARACTERISATION	Vrinda Devi K. V.
POSTER PRESENTATION		
1	NANOCATALYSIS: UNLOCKING THE POTENTIAL OF NANO-SIZED CATALYSTS FOR A SUSTAINABLE FUTURE	Falguni Dhabal
2	MICROWAVE-ASSISTED GREEN SYNTHESIS OF CuO NANOPARTICLES AND THEIR APPLICATION IN PHOTOCATALYTIC H ₂ EVOLUTION	Raju S. Kangutkar
3	BIOGENIC SYNTHESIS OF Fe ₃ O ₄ AND ITS FUNCTIONALIZATION TO Fe ₃ O ₄ @C-SO ₃ H: COMPARATIVE PHOTOCATALYTIC DYE DEGRADATION STUDIES	Raju Shekhanavar
4	METAL-ORGANIC FRAMEWORK (MOF) BASED LUMINESCENCE SENSORS OUTLINE: A FACILE PLATFORM FOR RAPID SENSING OF PESTICIDES FROM EFFLUENT	Samiksha Borghare
5	ZnO-BIOPOLYMER NANOBIOCOMPOSITES: CHARACTERIZATION AND APPLICATION IN DEGRADATION OF DYES	H. Dave
6	FACILE SYNTHESIS OF BENZOTHAZOLE BASED AIE FLUORESCENT PROBE FOR VISCOSITY SENSING	P. Somkuwar
7	NOVEL BIOINSPIRED PORPHYRIN PHOTOSENSITIZER FOR TRANSESTERIFICATION OF SESAME OIL UNDER VISIBLE LIGHT AT AMBIENT CONDITIONS	Vijay Shivaji Patil
8	RIETVELD REFINEMENT ANALYSIS OF HD PROCESSED EOL Nd ₂ Fe ₁₄ B MAGNETS	Rohit Vinod K
9	BRONSTED ACID FUNCTIONALIZED PORPHYRIN FOR METAL-FREE BUCHWALD-HARTWIG TYPE COUPLING IN A HOME-MADE PHOTOREACTOR	Piyush R. Yadav
10	A FORCED DRAFT RETROFIT TO IMPROVE COOKSTOVE PERFORMANCE: LABORATORY BASEDEVIDENCE	Anas Ahmad
11	SEPARATION AND PRE-CONCENTRATION OF RARE EARTH ELEMENTS FROM GEOLOGICAL SAMPLES USING Fe ₃ O ₄ @ APTES NANOPARTICLES	Neelam
12	THERMOGRAVIMETRIC ANALYSIS DOPED POLYMERS SYNTHESIZED BY HYDROTHERMAL METHOD FOR ENVIRONMENTAL APPLICATIONS	J. N. Thakre
13	THERMOGRAVIMETRIC STUDY OF GOPANI POLYMER COMPOSITES SYNTHESIZED BY HYDROTHERMAL METHOD FOR POTENTIAL APPLICATIONS	N. C. Kongre
14	TUNING THE MORPHOLOGIES OF ZnO FOR ENHANCED PHOTOCATALYTIC ACTIVITY	Adarsh Kumar Mourya
15	Ag ₂ V ₄ O ₁₁ NANOFILAKES MEDIATED PHOTOACTIVATION OF PEROXYMONOSULFATE ION FOR ENHANCED DYE DEGRADATION AND INTRINSIC BACTERICIDAL ACTIVITY	Awanti S. Talmale

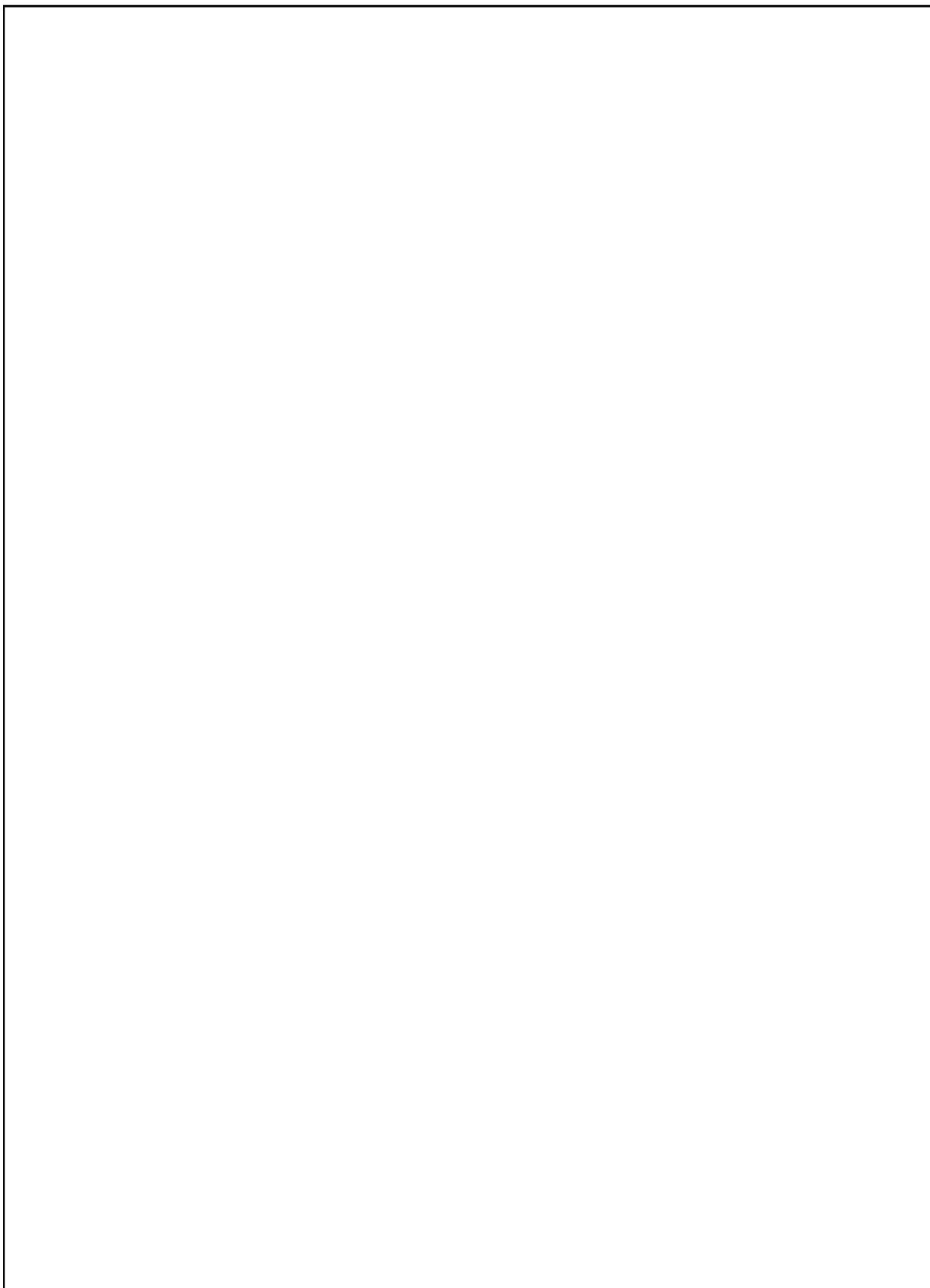
S. No.	Title of the talk	Name of Speaker
POSTER PRESENTATION		
16	MODIFIED SYNTHESIS OF SILVER ZIRCONATE AS AN EXCELLENT VISIBLE LIGHT ACTIVE PHOTOCATALYST FOR ENERGY AND ENVIRONMENTAL APPLICATIONS	Rudra P. Singh
17	GREEN SYNTHESIS OF COPPER OXIDE NANOPARTICLE USING LEAF EXTRACT OF CASSIA TORA AND ITS ANTIOXIDANT/ANTIBACTERIAL ASSAYS	Shivani R. Sharma
18	SYNTHESIS OF NANOPARTICLES USING ANNONA SQUAMOSA LEAVES AND ASSESSMENT OF ITS ANTIOXIDANT ACTIVITY	Ms. Nilima M Dhote
19	Cu/Ni-BDC@MWCNT: A SYNERGISTIC APPROACH TOWARDS SUPERIOR ELECTROCHEMICAL PERFORMANCE	Prashu Jain
20	RECENT ADVANCES IN NANOMATERIAL SYNTHESIS AND SURFACE PLASMON RESONANCE OPTIMIZATION FOR PHOTOCATALYTIC DEGRADATION OF ORGANIC DYES IN WASTE WATER	Babita G. Yadao
21	IONIC CONDUCTIVITY OF NANOCRYSTALLINE $Ce_{1-x-y}La_xCa_yO_{2-\delta}$ AS AN ELECTROLYTE FOR SOLID OXIDE FUEL CELLS	Mubeen H Jakati
22	RECOVERY OF Pt, Pd AND CeO_2 FROM SPENT AUTO CATALYTIC CONVERTER THROUGH ECO-FRIENDLY HYDROMETALLURGICAL APPROACH	Bhagyashree Uppin
23	TRACING THE ORIGIN OF DISSOLVED ORGANIC MATTER IN THE NATURAL WATERS USING ^{13}C ENVIRONMENTAL ISOTOPE	Bhumika Kumari
24	AN APPROACH TO REMOVE THE RHODAMINE-B FROM AQUEOUS MEDIA USING COST EFFECTIVE NATURAL SORBENT	Bhumika Kumari
25	BAMBOO WASTE PYROLYSIS FOR SUSTAINABLE GREEN CHEMISTRY: A NOVEL APPROACH TOWARDS ECO-FRIENDLY PRODUCT DEVELOPMENT	Dayaram T. Sarve
26	SYNTHESIS, CHARACTERIZATION AND APPLICATION OF SILVER LOADED BIOCHAR IN CATALYTIC REDUCTION OF PARA-NITROPHENOL	R. Rao
27	BIOCHAR FOR HEAVY METAL DECONTAMINATION: A SUSTAINABLE SOLUTION FOR POLLUTED WATER	Vaishali Meshram
28	IONIC LIQUID ENTANGLED SULFONIC ACID FUNCTIONALISED PORPHYRIN PHOTOCATALYST FOR CONTROLLING WATER POLLUTION BY DEGRADATION OF METHYL ORANGE DYE	Vaibhav Devidas Channe
29	EFFECT OF BIOCHAR AND GREEN MANURE ON SOIL FERTILITY	S. S. Ansari
30	APPLICATION OF ACTIVATED BIOCHAR FOR PESTICIDE ADSORPTION	Kavita Gandhi
31	TOWARDS SUSTAINABLE COOKING: ANALYSING TRADITIONAL VS LOW COST IMPROVED COOKSTOVES PERFORMANCE USING ISO 19869:2019 GUIDELINES	Ateeb Hamdan
32	PAHs CONCENTRATION IN THE GROUND WATER AQUIFER OF VILLAGES IN VICINITY OF MSW LANDFILL SITE	Sarvesh Dixit
33	CITRUS WASTE VALORIZATION TO DESIGN NUTRACEUTICAL RESOURCE BY MOLECULAR IMPRINTING	Shailesh Kumar
34	PYROLYSIS OF INDUSTRIAL WASTE LIGNIN INTO VALUE-ADDED FUEL PRODUCTS	Swagat R. Pantawane
35	TRACING THE ORIGIN OF DISSOLVED ORGANIC MATTER IN THE NATURAL WATERS USING ^{13}C ENVIRONMENTAL ISOTOPE	Bhumika Kumari
36	MACHINE LEARNING CALIBRATION OF LOW-COST AIR QUALITY SENSORS FOR ENHANCED PRECISION	A. S. Mishra
37	UV SPECTROPHOTOMETRIC METHOD FOR QUANTITATIVE DETERMINATION OF DORAVIRINE IN BULK AND TABLET FORMULATION	Rina Ikhar

S. No.	Title of the talk	Name of Speaker
POSTER PRESENTATION		
38	DETERMINATION OF PLANT PIGMENTS (ASTAXANTHIN, RETINOL & B-CAROTENE) IN BIO-SAMPLES BY HPLC-UV TECHNIQUE	Ravindra Singh
39	EXPLORING THE THERMOACOUSTIC AND VOLUMETRIC BEHAVIOUR OF BIOGENIC POLYAMINES: IMPLICATIONS FOR DRUG DELIVERY AND BEYOND	Pranali Y. Umredkar
40	THERMOPHYSICAL PROPERTIES OF PYRIDINIUM-BASED IONIC LIQUID IN AQUEOUS AND IN AQUEOUS AMINO ACIDS SOLUTIONS AT VARIOUS TEMPERATURES	Ankita S. Chandak
41	THERMOPHYSICAL STUDIES OF SOME DRUGS IN AQUEOUS DEXTROSE AND UREA SOLUTIONS AT T = (288.15-318.15) K	V. M. Tangde
42	INTERACTION STUDIES OF CHLORPHENIRAMINE MALEATE IN GLYCINE: A COMPREHENSIVE ANALYSIS USING DENSITY AND SOUND VELOCITY MEASUREMENTS	Vandana Patel
43	ELUCIDATING MOLECULAR INTERACTIONS: THERMODYNAMIC AND COMPRESSIBILITY PARAMETERS OF METHYL NICOTINATE IN WATER AND AQUEOUS L-ALANINE SOLUTIONS	Anuja Jain
44	SYNTHESIS, ELECTROCHEMICAL AND BIOLOGICAL ACTIVITY EVALUATION OF NOVEL CURCUMIN DERIVATIVES	Kantharaju Kamanna
45	SYNTHESIS, MOLECULAR DOCKING, DRUG LIKELINESS, ELECTROCHEMICAL AND BIOLOGICAL STUDIES OF DIHYDROQUINAZOLINONE DERIVATIVES	Radhika Mane
46	DESIGN OF PORPHYRIN COMPRISING IONIC LIQUID AND SULFONIC ACID MOIETIES FOR THE GREEN SYNTHESIS N-SUBSTITUTED BENZIMIDAZOLE	Rutuja Ganesh Maske
47	DESIGN AND SYNTHESIS OF NOVEL DIHYDROPYRIMIDINE DERIVATIVES: A APPROACH TOWARDS POTENT ANTI-BACTERIAL AGENTS	Priya H. Rahangdale
48	ZINC-EMBEDDED POROUS ORGANIC FRAMEWORK CATALYZED SYNTHESIS OF 2-PHENYL BENZIMIDAZOLES	Sneha Wahurwagh
49	SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL ACTIVITIES OF 3-(3-(4-(4-HYDROXYPHENYL)-3,5-DIMETHYL-1,7-DIPHENYL-2,3,6,7-TETRA-HYDRODIPYRAZOLO[3,4-B:4',3'-E]PYRIDIN-8(1H,4H,5H)-YL)PHENYL)-2-(ARYL)THIAZOLIDIN-4-ONE	Himani C. Pandhurnekar
50	FUROIC FRONTIERS: UNLEASHING THE POWER OF Ru CATALYSTS IN AQUEOUS AEROBIC OXIDATION FOR THE SYNTHESIS OF 2-FUROIC ACID FROM FURFURAL	Priya. L. Lokhande
51	SYNTHESIS AND CHARACTERIZATION OF 1-(2,4-DIHYDROXY-5-NITROPHENYL)-3-P-TOLYLPROPANE-1,3-DIONE AND ITS METAL COMPLEXES	Pooja R. Mohobe
52	SYNTHESIS OF 4H-BENZO[b] PYRAN SCAFFOLDS USING FUNCTIONALISED MONTMORILLONITE CLAY AS AN EFFICIENT SOLID ACID CATALYST	Priya Nikkam
53	A DEEP COMPREHENSIVE THERMODYNAMIC APPROACH TO THE VOLUMETRIC AND ACOUSTIC PROPERTIES OF AMINO ACID BASED DEEP EUTECTIC SOLVENTS	Shweta Bawne
54	ROLE OF LINEAR ALIPHATIC BIOPOLYESTERS IN SCAFFOLD: A REVIEW	S. M. Meshram
55	GENETICALLY MODIFIED MOSQUITOES: A REVIEW OF ADVANCEMENT AND IMPLICATIONS	Manashwi Patle
56	ASSOCIATION OF OCCUPATIONAL HAZARDS WITH SKIN CANCER: A REVIEW	Mayuri Dhande

S. No.	Title of the talk	Name of Speaker
POSTER PRESENTATION		
57	UTILITY OF RARE EARTH METAL ION INCORPORATED NANOFERRITES IN REMOVAL OF DYE FROM WATER	Ashvini V Meshram
58	SYNTHESIS AND CHARACTERIZATION OF AMINE FUNCTIONALIZED GRAPHENE OXIDE	P. P. Kalbende
59	PYROLYSIS OF INDUSTRIAL WASTE LIGNIN INTO VALUE-ADDED FUEL PRODUCTS	Swagat R. Pantawane
60	SYNTHESIS AND APPLICATIONS OF GREEN SYNTHESIZED NANOPARTICLES FOR PHOTOCATALYTIC DYE DEGRADATION AND ANTIBACTERIAL ACTIVITY	Sakshi Barad
61	REMOVAL OF BRILLIANT GREEN DYE USING BIO-CHAR OF BAHAWA SEEDS AND ITS REGENERATION STUDIES	M. A. Khapre

A decorative horizontal band with a dark blue background. The top and bottom edges of the band are decorated with a pattern of overlapping triangles in shades of red, light blue, and dark blue. The text 'KEYNOTE LECTURE' is centered within this band in white, bold, uppercase letters.

KEYNOTE LECTURE



Keynote Lecture-01

AN OVERVIEW OF ANALYTICAL TECHNIQUES IN THE EXTRACTION, PROCESSING AND PURIFICATION OF RARE EARTHS



Deependra Singh

Centre for Management Development – IREL, Email: cmd@irel.co.in

ABSTRACT

Rare earth materials are utilised in a wide range of critical products enabling many emerging green energy technologies, high-tech applications and defence systems, such as, hybrid cars, plug-in hybrid electric-vehicles (PHEVs), the latest generation of efficient windpower turbines, computer disc drives, missile guidance systems, etc. The lanthanide elements as a group have magnetic, chemical and spectroscopic properties that have led to their application in a wide range of end-uses.

IREL being the only organization in India specialized for extraction of Rare earths from mining to concentration of 99.99 % individual REO, has been resourced with a well equipped analytical wing for characterization of its products with respect to its chemical composition as well as with respect to the morphology ,texture, Size, phase etc to sustain its business when comes to international credibility.

IREL has enhances its capability to determine the concentration of heavy rare earths as well as the impurities in RE metals in ppm to ppb range by ICP-MS.

The estimation of concentrations of rare earths elements (REEs) continues to be important today in metallurgical, biological, medical, electronics and environmental fields specially when the application of rare earths find its use in the green energy mission of our country. At a time when the greatest advances in analytical equipments are available, IREL has utilized those for estimation of REEs using different techniques of classical quantitative methods includes gravimetric, complexometry, to instrumental methods like UV-Vis spectrophotometers ,AAS, ICP , X-ray analysis methods etc.

When the processing of rare earths from Mining at concentration of 0.06 % REE to a concentration of 99.99 % of individual rare earths which involves a complexity of process of mineral separation and chemicals processing , process control activities demands a accurate , fast & reliable method of estimation at every step along with the final product quality determination. IREL has developed non destructive methods for various process control activities.

Because of similar properties REEs and the association of other impurities during its processing , the elimination of chemical interference & spectral interference while estimation of rare earths in different matrixes and establishing a validated procedure is a challenge to satisfy customers with diversified application as a end use product.

Every analytical method ,specifically when we talk of instrumental methods has its own limitations with respect to sensitivity, selectivity & detection level, The aim of the determination of REEs by spectrophotometer is to develop a method that is highly selective, sensitive, fast, and easily reproducible without excessive control of experimental conditions.

IREL has been able to standardize the quantitative estimation methods to a great extent by employing a blend of classical methods to instrumental methods and including in the scope of NABL to achieve a higher level of customer satisfaction for its diversified products.



Keynote Lecture-02

PROGRESSIVE DEVELOPMENTS IN EXPLORATION FOR ATOMIC MINERALS IN INDIA AND WAY FORWARD

B. Saravanan

Director, Atomic Minerals Directorate for Exploration and Research, Hyderabad-500 016
Email: director.amd@gov.in



ABSTRACT

Atomic Minerals Directorate for Exploration and Research (AMD), the oldest unit under the Department of Atomic Energy (DAE) is mandated with exploration and augmentation of resources of Uranium (U), Thorium (Th), Niobium (Nb), Tantalum (Ta), Zirconium (Zr), Beryllium (Be), Lithium (Li) and Rare Earth Elements (REE) required to support the Nuclear Power Programme (NPP) of India.

Multidisciplinary mineral exploration techniques adopted by AMD is primarily aimed at establishing economically viable deposits and concomitant R&D activities in understanding the genetic processes of mineralisation. Last seven decades have witnessed a remarkable evolution in the exploration strategies and technologies followed by AMD. Initially, exploration activities for uranium were confined mostly in delineating surface manifestation of hydrothermal vein type mineralisation in Singhbhum geological domain and in granites/pegmatites in parts of Rajasthan and subsequent follow up by drilling. Augmentation of Rare Metals (Nb, Ta, Li and Be) were confined to the pegmatite belts of Bihar, Andhra Pradesh and Rajasthan. The surficial concentrations of Rare Metal (RM) minerals viz. columbite-tantalite (Nb-Ta), beryl (Be), spodumene (Li) and lepidolite (Li) are generally contained in in-situ and eluvial soils, which are derived from the weathering of pegmatites. The handpicking of the coarser, discrete minerals from these eluvial soils and panning of the stream sediment/residual soil samples were carried out for segregation of RM minerals. The heavy mineral (HM) assemblage in the Beach Sand Minerals (BSM) are being explored by AMD since 1950s for thorium resources, the envisaged fuel for 3rd stage nuclear power programme of India. The HM concentrations along the coastal tracts are assessed by drilling short boreholes down to the water table by hand-augers and depth-wise sampling is carried out up to the bedrock for resource estimation.

The exploration strategy world over has witnessed a paradigm shift since 1970s and the Proterozoic/Phanerozoic sedimentary basins developed over fertile granitoids became potential targets for uranium exploration. Subsequently, exploration efforts put forward by AMD in diverse geological domains of the country have resulted in several new discoveries related to paleo-placer Quartz Pebble Conglomerate (QPC) type, sandstone type, stratabound dolostone hosted, metasomatite type, migmatite related and unconformity related uranium mineralisations. Besides, carbonatite as well as peralkaline granite/tuff hosted REE mineralisation and HM resources established in inland placers are testimonials of diversification of AMD's exploration strategies since its inception.

Presently, remote sensing and high-resolution satellite data processing technique is adopted to narrow down the target areas. Geophysical investigations conducted through airborne/heliborne methods is validated by ground surveys and subsurface exploration. The heliborne geophysical surveys usually employ gamma ray spectrometry, magnetic and time domain electromagnetic (TDEM) methods besides the state-of-the-art Audio Frequency Magneto Telluric (AFMAG)/Z-TEM and gravity methods. During ground surveys, presence of naturally occurring radioactive elements such as uranium, thorium and potassium is detected and assessed by the application of robust radiometric detectors. For identification of deep-seated deposits, indirect methods such as geochemical and ground geophysical surveys such as

electrical, magnetic, gravity and electromagnetic are employed to pin-point the target areas. Systematic sampling by means of pitting/trenching and drilling is carried out to evaluate potential of these anomalies to assess the subsurface continuity and configuration of the mineralisation in three dimensions and to assess its commercial viability. AMD now deploys modern hydrostatic rigs for achieving greater drilling output and quick assessment of the area by sub-surface exploration. AMD's drilling productivity has increased manifold during the recent years and has also become a bench mark for other exploration agencies in the country. The multidisciplinary exploration programme of AMD is ably supported by the state-of-the-art analytical facilities and expertise in mineral deposit modelling, resource estimation and ore body simulation utilising the sub-surface exploration data.

Sustained efforts by AMD over last seven decades have identified several potential geological domains for uranium investigations viz. southern and northern parts of Cuddapah Basin in parts of Andhra Pradesh and Telangana; Singhbhum Shear Zone, Jharkhand; North Delhi Fold Belt, Rajasthan and Haryana; Bhima basin, Karnataka, Mahadek basin, Meghalaya. The pegmatites, granites, peralkaline and peraluminous volcanics and alkaline-ultramafic and carbonatite complexes are most explored for RM and REE resources. Recent exploration inputs have established immense potential for REE and RM mineralisation in carbonatite complexes of Ambadungar (LREE rich) in Gujarat and per-alkaline granite-rhyolite of Siwana Ring Complex (HREE rich), Barmer district, Rajasthan. 'Sonic drilling' has been initiated for expanding the scope of BSM resource augmentation in the coastal placer sand deposits wherein the beach sand heavy mineral concentration up to a depth of 50m is being probed to substantially augment the heavy mineral resources of the country. New exploration conceptual models and analytical techniques are being developed for augmentation of atomic mineral resources from concealed deeper level sources.

Endowed with favourable geological domains which can host potential uranium, RM and REE deposits in India and by adapting to the advancements in global practices in mineral exploration, India is on its way to self-sufficiency in atomic mineral resources to fulfil our sustainable clean energy needs.

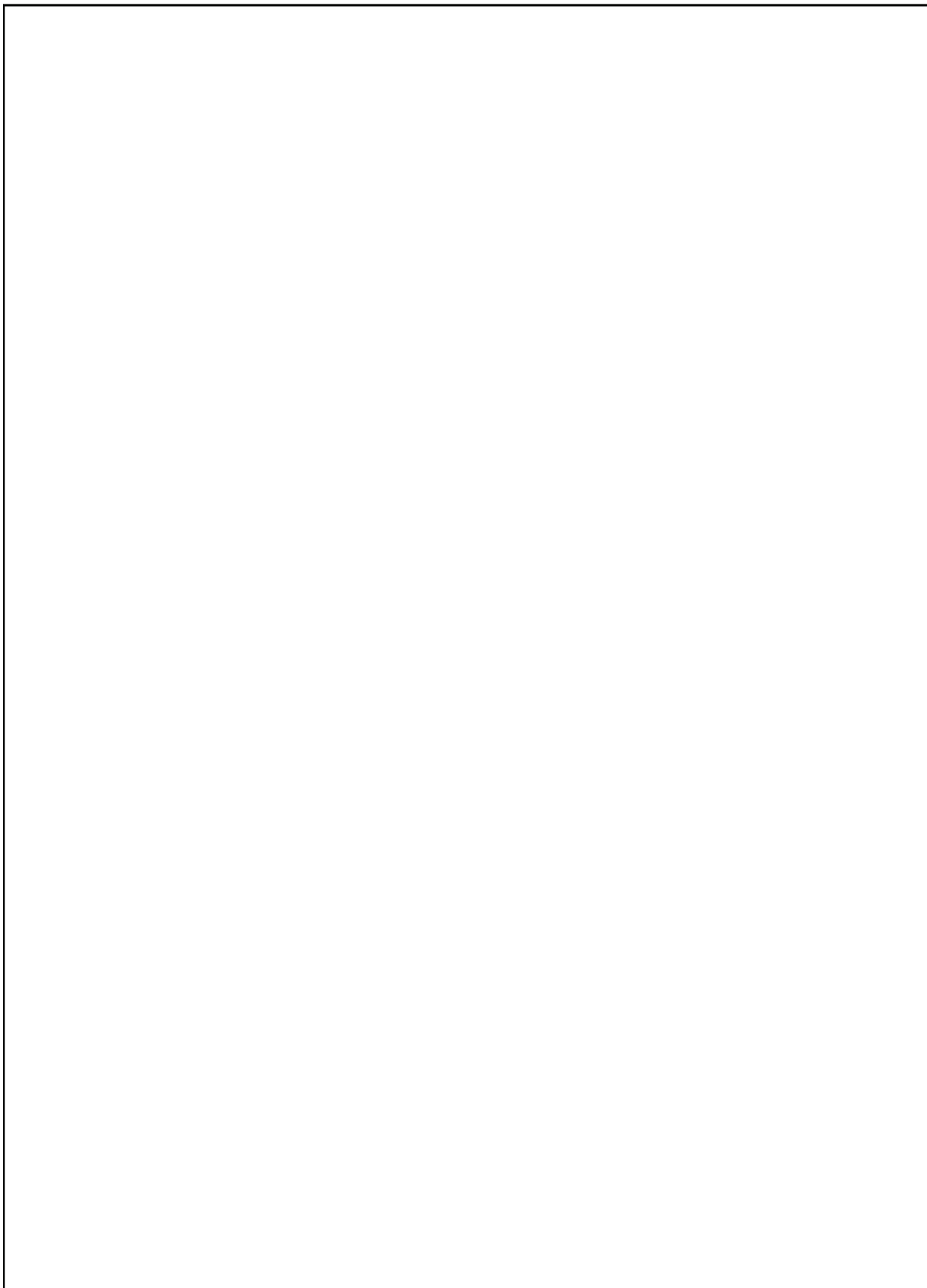


ABSTRACTS

A large empty rectangular box with a black border, intended for abstract content.

A decorative horizontal band with a dark blue background. The top and bottom edges of the band are decorated with a pattern of overlapping triangles in shades of red, light blue, and dark blue. The text "INVITED LECTURES" is centered in white, bold, uppercase letters within this band.

INVITED LECTURES



Invited Lecture-01

DESIGN AND FABRICATION OF 2D g-C₃N₄ BASED NANOSTRUCTURED MATERIALS FOR RAPID DEGRADATION OF ENVIRONMENTAL POLLUTANTS



Rengaraj Selvaraj

Department of Chemistry, College of Science, Sultan Qaboos University, P.O. Box 36., P. C. 123., Al Khoudh, Muscat, Sultanate of Oman

E-mail: rengaraj@squ.edu.om; srengaraj1971@yahoo.com

ABSTRACT

Nowadays 2D nano structure are gradually attracting significant interest from researchers because of their excellent physicochemical and optoelectronic properties. However, the efficient fabrication of 2D nanosheets with high crystallinity and ultrathin thickness still faces huge challenges. Recently a substantial progress has been made in the development of highly active photocatalytic 2D nanomaterials for environmental applications. Especially metal free photocatalysts such as modified and unmodified graphitic like carbon nitride (g-C₃N₄) materials. Metal free semiconductor has attracted a lot of attention due to its exceptional electron mobility properties. These semiconductors exhibit a 2D nanostructure with high surface area and often combined with other nanomaterials to enhance their photocatalytic performance. Recently, these photocatalytic materials are used in various applications. Providing clean and affordable water to meet human needs is a big challenge nowadays. The presence of volatile organic compounds (VOCs) in aquatic and atmospheric environments is an emerging environmental issue that has been receiving increasing attention in recent years. Environmental pollution particularly by VOCs is a major concern in many developing countries. Large volumes of VOCs present in aquatic and atmospheric environment are emitted from household activities, industrial process and petrochemical industries. Moreover, VOCs emissions can contribute the formation of urban smog and ozone, stratospheric ozone depletion and the greenhouse effect. Therefore, it is necessary to find safe and sustainable methods for the removal and degradation of VOCs present in water and wastewater. Recently, our research group designed and fabricated modified and unmodified photocatalytic 2D graphitic like carbon nitride for the degradation of organics present in aqueous solution under visible and solar energy. The prepared and modified g-C₃N₄ materials have been characterized by a various advanced analytical method such as XRD, XPS, SEM, EDX, TEM, UV-DRS and PL emission. Furthermore, the photocatalytic activity studies revealed that the modified g-C₃N₄ exhibit an excellent photocatalytic performance in rapidly degrading VOCs under visible-light irradiation. These results suggest that modified g-C₃N₄ will be an interesting candidate for photocatalytic detoxification studies under visible light irradiation. [1-5]. In our laboratory we have applied this modified 2D material for the rapid degradation of pharmaceuticals, EDCs, phenolics, separation of oil and water and toxic organic pollutants present in water under visible and solar energy.

References

- 1 Said Al Mamari, Fakhri Suliman, Younghun Kim, Rengaraj Selvaraj, *Advanced Powder Technology*, 2023, 34, 104026.
- 2 Said Al Mamari, Emad Khudaish, Younghun Kim, Majeda Khraisheh, Rengaraj Selvaraj, *Inorganic Chemistry Communications*, 2023, 150, 110539.
- 3 Said Al Mamari, Faisal Al Marzouqi, Abdulrahman Al Nabhani, Younghun Kim, Rengaraj Selvaraj, *Toxicological and Environmental Chemistry*, 2022, 104 (2), 211 – 231.



- 4 Said Al Mamari, Singaravadivel Thangavel, Younghun Kim, Rengaraj Selvaraj, Desalination and Water Treatment, 2022, 254, 94 - 103.
- 5 Said Al Mamari, Alex T Kuvarega, Rengaraj Selvaraj, Desalination and Water Treatment., 2021, 235, 141-176.

Invited Lecture-02

DESIGNING AND RATIONALIZATION THROUGH COMPUTATIONAL MATERIALS CHEMISTRY

Sandeep Nigam

Chemistry Division, Bhabha Atomic Research Centre, Mumbai-400 085
Homi Bhabha National Institute, Anushakti Nagar, Mumbai-400 094
E-mail: snigam@barc.gov.in, snigam.jpr@gmail.com



ABSTRACT

Computational materials chemistry fortifies a broad spectrum of science disciplines, including basic chemistry and biochemistry, catalysis, nanoscience, materials science, environmental science, geosciences and renewable energy. Computational studies have been indispensable tool to get insight regarding origins of chemical phenomena and examination of physicochemical properties. Sometimes experiments are expensive and time-consuming, materials scientists have been relying on computational methods for computation of materials properties and processes at the atomic level to guide/support experiments. The present talk will be providing summary of recent computational efforts for designing the materials for energy application. The talk will be also providing glimpses our computational investigations for rationalization of peculiar experimental observations.

Invited Lecture-03

DESIGN OF MOBILE FOOD IRRADIATOR WITH INTEGRATED CHILLER SYSTEM

Pradip Mukherjee, Dhiren Sahoo, Mukhar Sharma

Board of Radiation & Isotope Technology
Department of Atomic Energy



ABSTRACT

Food spoilage due to microbial load, pathogens and infestation is a major problem that threatens food security of a nation. Irradiation using gamma radiation is one of the technologies that can maintain food quality and address food safety and security problems without significantly affecting food's sensory or nutritional attributes. Irradiation can delay ripening, inhibit sprouting, improve rehydration, and control spoilage due to food borne pathogenic microorganisms. It is a cold process, leaves no harmful residues and can be applied to packaged food, thus limiting the chances of re-infestation or re-contamination. Currently, more than 30 land based gamma irradiation plants are running in India which are used for irradiation of spice, onions and potato and sterilization of medical products etc. When it comes to seasonal products like fruits, vegetables, cereals etc., large land based irradiators are not convenient and it is

difficult to control the temperature in large irradiators. In addition, transportation will be a major issue for seasonal produce which grow in different seasons and in different parts of the states/ country.

BRIT has conceptualized and designed a "Mobile Food Irradiator" which is a Category-II batch type irradiator to irradiate food grains such as fruits, vegetables, rice, wheat, rawa or sooji, pulses and other cereals, raisins, figs and dried dates etc. These products required a dose of 0.25-1 kGy for reduction of microbial load and insect disinfestation. The irradiator will be mounted on a 40 feet trailer bed and can move from one place to the other. A suitable chiller system is designed which can be placed in another truck and can be integrated with the mobile irradiator so that the cold chain can be maintained during irradiation. The irradiator is designed for 100 kCi of Co-60 radioactive source which is expected to give a throughput of 5-50 tonnes/ day depending on the product. The paper brings out the main design features & its working principle.

Keywords

Irradiation, Chiller, Irradiator

Invited Lecture-04

SIMPLE AND RELIABLE ANALYSIS OF URANIUM RAW MATERIALS IN NUCLEAR FUEL CYCLE

D. P. S. Rathore

Atomic Minerals Directorate for Exploration and Research
Department of Atomic Energy, Jaipur-302033, Rajasthan, India
Email: dpsr2002@yahoo.com



ABSTRACT

Application of differential technique in laser-induced fluorimetry/ pulsed LED- fluorimetry is recommended for simple and reliable determination of uranium over a wide range of concentrations, which is based on the comparison of the response of the standard with a sample of similar but unknown concentration on the same sample weight basis. In this approach, the procedure of elimination of interference by simple dilution of the sample has the distinct advantage of being quick and very simple to perform because it does not require any chemical preparation or solvent extraction. By taking advantage of high sensitivity of laser fluorimetry/LED fluorimetry, the interferences from the associated and accompanying elements are eliminated by simple one-step dilution of the sample aliquots using push-button microlitre pipettes, thereby to bring the concentration of uranium within the operational range of the instrument, followed by measurement with differential technique in laser-induced /Pulsed LED fluorimetry using more suitable acidic buffer mixture of H_3PO_4 - $\text{NH}_4\text{H}_2\text{PO}_4$ (pH~2.5, H_3PO_4 , 1 M and $\text{NH}_4\text{H}_2\text{PO}_4$, 2.17 M) as fluorescence-enhancing reagent. The experiments are designed in such a way that for very diluted sample solutions, prefilter (species absorbing at the laser wavelength, 337 nm, LED wavelength of excitation at 400 nm) and postfilter (species absorbing at the maximum fluorescence wavelengths, 480-560 nm) effects are negligible(verified by spectrophotometry). Differential laser-induced/LED fluorimetry method has been evaluated using standards, SY-2, SY-3, reference uranium ore, BL-2a, low-grade uranium ore-IAEA reference samples, and core samples of diverse matrices. The use of at least three independent standards of accurately known concentration in differential technique further minimizes the total errors associated with dilution steps, measurement of signal, overall errors associated

with the method of measurement. Differential technique is like applying indirectly the 'method of least squares' while obtaining the more reliable common factor of slope. In this way, differential technique using reference standards guarantees the quality of an analytical result (accuracy, high precision, reliability, comparability & traceability). It is a self standardized and an absolute methodology of measurement. Application of differential technique in laser/LED fluorimetry fulfills the basic essential requirements of RAPs: Reliability: accuracy and high precision; Applicability: applicable to diverse sample matrices for wide applications in entire nuclear fuel cycle; Practicability: simple, rapid and direct, easy equipments calibration, method standardization and operation, eco-friendly, cost-effective, high sample throughput, comparability, and traceability. Application of differential technique in Laser-induced fluorimetry/pulsed LED-fluorimetry will be useful for the analysis of uranium in ores, certification of reference materials, borehole core assay, beneficiation product, and other diverse applications in the entire nuclear fuel cycle worldwide.

References

D. P. S. Rathore, P. K. Tarafder, V. Balaram, M. Mishra, J.Pari, A.G. Bhujle and D.D. Bhawalkar, Environ. Sci. : Adv., 2023, 2, 1340–1350, and references cited therein.

DOI : <https://doi.org/10.1039/D3VA00134B>.

Invited Lecture-05

SOLAR-TO-X TECHNOLOGIES FOR WATER-ENERGY NEXUS

Sai Kishore Ravi

Asst. Prof., School of Energy and Environment
City University of Hong Kong



ABSTRACT

Can the abundantly available solar energy be tapped sustainably to meet our clean energy and clean water demands with no burden on the environment? Exploring bioinspired artificial and semi-artificial materials could hold the key. Our energy use and water use are intricately intertwined and we must of cognizant of the water footprint of energy technologies as well as the energy requirement of water technologies. Developing materials technologies for achieving sustainability in Water-Energy Nexus is therefore a important area of research. One emerging broad concept toward this goal is the idea of "Solar-to-X". While Power-to-X is already a popular term referring to use of electric power (ideally renewable power) for a wide range of applications like Power-to-Hydrogen, Power-to-Ammonia, Power-to-Gas, Power-to-Heat, etc. "Solar-to-X" is an emerging term that refer to a broad umbrella of technologies that capture solar energy for wide range of applications besides electricity generation. While Solar-to-X includes both mature and niche concepts, in my talk I will touch on some of the emerging technologies/concepts like Solar-to-Bioelectricity, Solar Biocapacitors, Solar Fuels, Solar Desalination, Solar Atmospheric Water Harvesting, particularly from an applied materials science perspective while also highlighting my past and ongoing works in these areas.

Invited Lecture-06

WASTE TO WEALTH: SUSTAINABLE RECOVERY OF RARE EARTH ELEMENTS BY RECYCLING OF E-WASTE FOR A CIRCULAR ECONOMY



V. Balam

CSIR-National Geophysical Research Institute (NGRI), Hyderabad -500 007, India
E-mail: balaram1951@yahoo.com

ABSTRACT

Crucial and innovative technologies are being developed and effectively applied to mitigate carbon emissions by replacing non-renewable energy resources with renewable energy technologies. Huge quantities of rare earth elements (REE) and a few other critical metals such as Co, Ni, Li, graphite, Ge, Te, Pt, and Pd, are required for tackling the current climate crisis and achieving the necessary transition to carbon-neutral technologies to run the whole world in the coming 30 years. Mining of REE elements is heavily concentrated only in a few countries with potential restriction of exports making the primary supplies of these industrially important elements vulnerable to short and long-term disruptions. Our oceans have huge deposits of REE and several other critical metals. Though several mining companies are ready to mine deep-sea sediments for these valuable metals, the International Seabed Authority (ISA) is not granting permissions for mining because of environmental concerns as deep-sea mining activity can severely harm ocean ecosystems. Hence, alternative approaches such as recycling e-waste for an uninterrupted supply of these critical metals are assuming importance. Recycling of REE and a few other elements such as Li and Co, is a rapidly growing industry that can partly meet the growing demand for these metals and achieve a sustainable circular economy. This presentation aims at an in-depth understanding of different e-waste recycling and recovery methods and processes adopted for the extraction of REE from e-waste materials with examples of REE recoveries of some e-waste items like NdFeB magnets. Some of the critical issues such as the related progress in multinational companies, environmental issues, and the importance of effective governmental regulations are also highlighted. The recycling activity can supplement the supply chain and also contribute to reducing the environmental stress due to the opening of new REE mines. Controlled recycling of e-waste materials and the use of artificial intelligence (AI) for the extraction of REE using eco-friendly methods for the recovery of REE in achieving a circular economy will provide significant benefits.

References

- 1 V. Balam, *Journal of Geographical Research*, 2023, 6(3): 1-17. doi: <https://doi.org/10.30564/jgr.v6i3.5706>.
- 2 V. Balam, J. S Armstrong-Altrin, R.M.K. Khan, B. S. Rao, Potential Lithium Sedimentary Deposits of the Land and Deep Oceans. *Minerals*, 2024 13, x. <https://doi.org/10.3390/xxxxx> (in press).
- 3 V. Balam, *Geoscience Frontiers*, 2019, 10, 4, 1285-1303. <https://doi.org/10.1016/j.gsf.2018.12.005>
- 4 V. Balam, *Minerals*, 2023, 13, 425; <https://doi.org/10.3390/min13030425>
- 5 V. Balam, *Minerals and Mineral Materials*, 2023, 2. 5. 1-17. doi: 10.20517/mmm.2022.12
- 6 V. Balam, *Criticality of the Rare Earth Elements: Current and Future Sources and Recycling*. P.N.V. Prasad (Ed) Elsevier, 2024 (in press).



Invited Lecture-07

ROLE OF NUCLEAR POWER IN ACHIEVING NET ZERO EMISSION TARGET OF INDIA

Swapnesh Kumar Malhotra

Former Outstanding Scientist & Raja Ramanna Fellow
Department of Atomic Energy, Mumbai, India
swapneshmalhotra@gmail.com



ABSTRACT

It is now well accepted that the Climate Change and global warming are a reality. The devastating forest fires and rampant floods in different parts of the globe bear testimony to the damages due to global warming. To mitigate this, we need to bring down green house gas emissions to 'Net Zero' much faster than done so far. Otherwise we will have to face the increasingly catastrophic consequences. Over 100 countries have set or are considering net-zero emission targets to be achieved in next 3 to 5 decades with an objective of restricting the global temperature rise to 1.5°C. It is worth mentioning here that eight countries viz. Bhutan (Asia), Camaros, Gabon, Madagascar (Africa), Guyana, Suriname (South America), Panama (Central America) and Niue (Oceania) have already reached net zero emissions. Most of them are small countries with limited industrial sectors. The strategy for achieving net zero emission consists of two key elements – first, extensive electrification of the economy with low carbon electricity (renewables and nuclear) and second, employing other low carbon energy carriers (hydrogen, synthetic fuels, heat etc,) for applications that are not suitable to electrification.

In the recently held COP28 meeting at Dubai during November – December, 2023), for the first time, the crucial role of nuclear energy in achieving the net zero targets hand in hand with the renewable technologies was acknowledged. 22 countries pledged to triple nuclear generation capacity by 2050 as compared to the global nuclear capacity of 375 GW in 2020.

India has pledged to cut its emissions to net zero by 2070 at COP26 held at Glasgow, United Kingdom in November 2021. India's energy-mix strategies include a larger shift toward clean energy alternatives, increased manufacturing capacities, energy use efficiency and a policy push for Hydrogen. India is set to achieve its short term and long term targets under the Panchamrit action plan - reaching a non-fossil fuel energy capacity of 500 GW by 2030; fulfilling at least half of its energy requirements via renewable energy by 2030; reducing CO₂ emissions by 1 billion tons by 2030; reducing carbon intensity below 45 percent by 2030; and finally achieving a Net-Zero emission target by 2070. As per a report by Vivekananda International Foundation (2022), a minimum of 24,000 - 30,000 TWhr of electricity will be required to reach NZE by 2070. The report also found that renewable high scenario (95% renewable, 5% nuclear) at \$ 15.5 trillion (about 1286 Lakh crore INR) was the most expensive while the nuclear high scenario (5% renewable, 95% nuclear) at \$ 11.2 trillion (about 930 lakh crore INR) would be the cheapest. Further, it may be noted that renewables also entail a much larger land footprint.

The role of different reactor types viz. 700 MW PHWRs, Large PWRs to be put up under foreign collaboration and SMRs primarily to be put up at brown sites and for production of hydrogen for sectors where emissions are hard to abate, will be discussed during the talk.

Invited Lecture-08
ELECTROCHEMICAL SYNTHESIS OF NEW ISOXAZOLES AND TRIAZOLES TETHERED WITH THIOURACIL BASE AS INHIBITORS OF HISTONE DEACETYLASES IN HUMAN BREAST CANCER CELLS


Divakar Vishwanath, Zhang Xi, Shreeja Basappa, Vijay Pandey, Peter E Lobie, Basappa Basappa*
Laboratory of Chemical Biology, Department of Studies in Organic Chemistry, University of Mysore, Mysore 570006, Karnataka, India, Email: salundibasappa@gmail.com

ABSTRACT

Histone deacetylases (HDACs) are an attractive drug target for the treatment of human breast cancer (BC), and therefore, HDAC inhibitors (HDACis) are being used in preclinical and clinical studies. The need to understand the scope of the mode of action of HDACis, as well as the report of the co-crystal structure of HDAC6/SS-208 at the catalytic site, provoked us to develop an isoxazole-based lead structure called 4-(2-(((1-(3,4-dichlorophenyl)-1H-1,2,3-triazol-4-yl)methyl)thio) pyrimidin-4-yl) morpholine (5h) and 1-(2-(((3-(p-tolyl) isoxazol-5-yl)methyl)thio) pyrimidin-4-yl) piperidin-4-one (6l) that targets HDACs in human BC cells. We found that the compound 5h or 6l could inhibit the proliferation of BC cells with an IC50 value of 8.754 and 11.71 μ M, respectively. Our detailed in silico analysis showed that 5h or 6l compounds could target HDAC in MCF-7 cells. In conclusion, we identified a new structure bearing triazole, isoxazole, and thiouracil moiety, which could target HDAC in MCF-7 cells and serve as a base to make new drugs against cancer.

Invited Lecture-09
BIOCHAR: A PROMISING SOIL AMENDMENT FOR ENHANCING SOIL QUALITY AND INCREASING CROP YIELD
**S. S. Shetye**

Professor, Department of Chemistry
K. J. Somaiya College of Science & Commerce, Vidyavihar, Mumbai 400077
Email: sugandha@somaiya.edu Contact No.: +91 9819500324

ABSTRACT

According to the Indian Ministry of New and Renewable Energy (MNRE), India generates on an average 500 Mt of crop residue per year. Generation of crop residues is highest in Uttar Pradesh (60 Mt) followed by Punjab (51 Mt), and Maharashtra (46 Mt). Traditionally, crop residues have numerous competing uses such as animal feed, fodder, fuel, roof thatching, packaging and composting. The residues of cereal crops are used as cattle feed. Rice straw and husk are used as domestic fuel or in boilers for parboiling rice. Surplus residues i.e., total residues generated minus residues used for various purposes, are typically burnt on the farm. Total amount of crop residues surplus in India is estimated to be 91-141 Mt. Instead of burning, local farmers may adopt sustainable management practices like composting and biochar production. Biochar is found to be a potent material to amend problem soil as well as improve fertility of soil to enhance crop productivity due to its high porosity, water retention capacity and liming effect.

When added to soil, it is known to stabilize the Soil Organic Carbon (SOC) content. These techniques are viewed as a viable option to mitigate greenhouse gas (GHG) emissions while considerably reducing the volume of agricultural waste.

A systematic meta-analysis was conducted to validate the relationship between biochar and crop productivity considering 193 independent experiments from 46 published articles in context of the Indian sub-continent. The results from the meta-analysis showed that the addition of biochar to the soil increased the yield of crops by (24 %).

However, there are some challenges and knowledge gaps in biochar application such as the variability of biochar quality and quantity, the long-term effects of biochar on soil and plant health, the interaction of biochar with other amendments and management practices, the economic feasibility and social acceptability of biochar production and use, and the environmental impacts of biochar transportation and distribution.

Keywords

Biochar, Crop yield, Greenhouse Gas mitigation, agricultural waste, Soil Quality

References

- 1 Meena HN, Jat SL Meena, MS and Singh SK. 2020. Crop Residue Generation, Recycling and its Management for Agricultural Sustainability, Indian Journal of Fertilisers. 16(11):1152–1161.
- 2 Meena Hari Mohan and Prakasha H. C. 2020. Effect of biochar, lime and soil test value based fertilizer application on soil fertility, nutrient uptake and yield of rice-cowpea cropping system in an acid soil of Karnataka, Journal of Plant Nutrition. 43(17):2664–2679.

Invited Lecture-10

A SELF RELIANCE APPROACH TOWARDS CHEMICAL CHARACTERIZATION OF NUCLEAR MATERIALS AT NFC - A 50 YEARS OF SUCCESSFUL JOURNEY FROM PAST TO PRESENT



Y. Balaji Rao and Komal Kapoor

Nuclear Fuel Complex, Hyderabad-500062, India
ybrclabnfc@gmail.com / ybr@nfc.gov.in

ABSTRACT

Department of Atomic Energy (DAE) has established Nuclear Fuel Complex (NFC) with a clear cut mandate of manufacturing and supply of Fuel sub-assemblies on industrial scale to both PHWRs & BWRs with very stringent specifications for achieving the optimum performance of the fuel under reactor operating conditions. Natural UO₂ and enriched UO₂ in the form of pellets are being used as fuel in PHWR and BWR respectively. The desired specifications are achieved by having a strict control on material manufacturing process and can be achieved through monitoring the quality of materials taking part in the process and also with a strict vigil on process conditions. Chemical Quality Control (CQC) of raw materials, process intermediates and final products will ensure the desired quality of final products and thus, it becomes integral part of QA/QC program.

Control Laboratory (C.Lab) was established as a centralized analytical facility at NFC for qualifying raw materials, process intermediates and final products by employing state-of-the art analytical techniques for carrying-out estimations ranging from sub-ppm to percentage levels. It is to be noted that the chemical composition of nuclear materials like fuel and other reactor core components form a unique class and is distinct from other materials. Therefore choice of selecting a method depends on many factors like nature of sample, type of matrix, elements to be analyzed & their concentration levels and requirement to give quick analytical feedback etc. Different sampling procedures and sample preparation steps are adopted depending on nature of the sample. In some cases sample pre-concentration steps are also incorporated in sample preparation step to increase the analytical signal of analyte.

With ever growing demanding situation for supply of nuclear fuel, C.Lab is geared up to meet challenging analytical requirements of all production plants at NFC and average annual analytical load comes anywhere between 1 million of estimations. In order to manage such a massive analytical load a proper synergy between good chemistry, process conditions and analytical methods becomes a necessity and laboratory is able to meet this important requirement consistently.

The present paper discusses the application different analytical techniques that are being followed for chemical characterization of different nuclear materials used in nuclear fuel fabrication process at NFC. Further to this, some important developmental works carried-out in our lab towards attaining self reliance (Atma Nirbharata) also presented in the paper. As maintenance of health of all facilities is essential to provide un-interrupted analytical services, some significant maintenance works that are carried-out in lab are also given in the presentation. Besides this, communication of analytical results to different plants is a time bound activity and forms a very important step in realizing the goal of any testing lab, especially where analytical load is huge as seen in our laboratory. The presentation gives glimpses of type communication adopted in our lab to communicate the analytical results. Timely analysis and timely communication of analytical results are like two eyes of any testing laboratory's face. Even the slightest malfunctioning of one eye can eventually lead to defeat of organizational goal.

Invited Lecture-11

AN OVERVIEW OF CONSUMER AWARENESS AND RIGHT IN CONTEXT OF PRESENT FOOD SAFETY ACT, RULES AND REGULATIONS

Dr. Prem Kumar Jaiswal, D. Phil. D. Sc.

Former Director of Laboratories, Central Agmark Laboratory, Govt. of India
Former chairman, Scientific Panel, Member Scientific Committee,
Lead Expert(FSSAI), Food Safety Adviser
E-mail: prem1948@yahoo.co.in



ABSTRACT

Food safety eco system in India ensures to provide safe, nutritious and wholesome food to a consumer in the entire food chain right from farmer, manufacturer, storage, transportation, whole seller, distributor, retailer, consumer and other stake holders. Besides maintaining quality of a food in accordance with the prescribed regulatory standards or in case of non-standardised food (proprietary food), food should be safe from physical, chemical and biological contaminants and should be within the regulatory permissible limit. Consumer have a right to know as to whether food, they consume, is safe and is of desired and required quality as per their choice.



Food Safety and Standards Authority of India (FSSAI), an autonomous body established under the Ministry of Health and Family Welfare, Government of India under the Food Safety and Standards Act, 2006 is the sole apex body for implementation of Food Safety Act, Rules and Regulations in India. FSSAI is responsible for protecting and promoting public health through the regulations and supervision of food safety aspects. The objectives of FSS Act is to introduce unified food law in the country, to simplify and facilitate the food Business Operators (FBO).

Prior to Food Safety and Standards Act, Prevention of Food Adulteration Act 1954 and its Rules 1955 were in existence. According to earlier Act and Rules, there were no clear cut demarcation between misbranded / adulteration / sub – standard / unsafe food. Any violation under these were subject to the criminal offense and the punishment prescribed under the then Act were different depending upon the nature of the offenses. Consumers were also given the rights, under the then Act, of a Food Inspector for the purpose of taking the sample of any food deemed to be adulterated by them and the procedures were laid down for prosecution. The enforcement of the Act and Rules were totally by respective State. Government /UT and Central Government was only involved as a policy maker. Licensing requirement were also very simple and lenient and several departments were involved depending upon the local Administration prevailing in that State/Union Territories. There were several other government departments like BIS, Agmark, FPO, MFPO etc. engaged in maintenance of food quality and safety in the country. However PFA Act superseded other Act/Rules prevailing in the country.

Upon enactment of FSS Act 2006 with Rules 2011, different Regulations on different subjects were notified in 2011 and in subsequent years. Food Safety and Standards Authority of India was established on 5th September, 2008.

The common adulteration in food is described in this communication. Simple methods for detection of adulteration are available. These are basically for the consumer's knowledge and the methods prescribed are not confirmatory tests, hence adulterations have to be confirmed in a laboratory only by official methods as prescribed in the approved manuals for tests by FSSAI.

International food business have opened a new challenge for providing safe food. Hence, FSS Rules and Regulations have become dynamic to achieve goal of providing safe and nutritious food to consumers. This has resulted that not only FBO has to update his knowledge for compliances, but consumers have to be very cautious while purchasing a food for his utility. Due to new products coming in to market especially with an exaggerated claim /misleading information, particularly fortified food, nutraceuticals/health claim /Ayurveda food/weight reducing, with very high cost, consumer must take extra precautions while purchasing these foods. In the era of online procurements of food particularly prepared Food, Consumers should be careful to ensure freshness of the food, its food grade packing materials/boxes, before consumption. Sweet shop must display use by date for each item. Personnel and premises hygiene must be watched by the consumer at eating places as to whether the place is suitable for eating. Fresh cut fruits/ vegetables, chilled and frozen foods being sold in street food markets may be contaminated. Drinking water for washing food and drink is the biggest source of contamination. Proper storage temperatures are often not maintained. These cause food poisoning, stomach upset, dysentery etc.

Invited Lecture-12

NET ZERO GOAL-TECHNOLOGICAL OPTIONS FOR INDIA

Dr. G. S. Kapur

Advisor (R&D), GAIL India Limited

E-mail: gurpreetsinghkapur@gmail.com



ABSTRACT

India's announcement that it aims to reach net zero emissions by 2070 has set the agenda for the Indian Industry for next 5-decades. To meet fifty percent of its electricity requirements from renewable energy sources by 2030 is a hugely significant moment for the global fight against climate change. Coal and oil have so far served as bedrocks of India's industrial growth and modernisation, giving a rising number of Indian people access to modern energy services. The rapid growth in fossil energy consumption has also meant India's annual CO₂ emissions have risen to become the third highest in the world.

The present talk shall cover current primary energy basket of the world average and that of India in terms of share of Coal, Oil, Gas, Bioenergy, other Renewables, Nuclear energy, as well as associated global & India's GHG emissions trajectory over the years. Various drivers shaping the energy landscape of India shall be discussed along with Net Zero commitments, and various imperatives for India to achieve the ambitious goal by 2070. Role of different breakthrough technologies and pathways like; Renewable power, Sustainable Refineries including bio-refineries, accelerating efforts towards a Gas-based economy, Waste to Energy and Bioenergy technologies, Plastic circularity, Carbon Capture, Storage and Utilization (CCSU), Hydrogen and Fuel Cell, Electric Vehicles and Advanced Chemistry Cell (ACC) Batteries, Material & Energy Efficiency etc shall be discussed, along with the economic opportunity and the associated financial cost.

Invited Lecture-13

IONIC LIQUIDS AS BENIGN SOLVENTS FOR THE SUSTAINABLE DEVELOPMENT

Ramesh L. Gardas

Department of Chemistry, Indian Institute of Technology Madras, Chennai

Email: gardas@iitm.ac.in , Contact No.: +91 44 2257 4248



ABSTRACT

This invited talk delves into the transformative realm of ionic liquids, a distinctive class of molten salts, and explores their potential as benign solvents for fostering sustainable development. Ionic liquids exhibit extraordinary characteristics, including negligible vapor pressure, a broad thermal window, wide electrochemical tolerance, non-flammability, high ionic conductivity, and exceptional solvating capabilities across organic, inorganic, and organometallic compounds. Their role as compelling "alternatives to organic solvents" is gaining prominence in both academic and industrial spheres.

The discussion will provide a comprehensive overview of the rapidly expanding research landscape in ionic liquids, emphasizing their versatility stemming from the modifiability of cation-anion combinations and attached moieties. This adaptability allows for tailoring crucial physical properties such as hydrophobicity, viscosity, density, coordinating ability, ion selectivity, and chemical/electrochemical stability, rendering them highly suitable for diverse applications.



The talk will specifically address the unique thermophysical properties of novel ionic liquids and their applications in key areas, including metal ion extraction, CO₂ capture, desulphurization of fuels, and aqueous biphasic systems for the extraction of value-added products. Insights into how the thermophysical properties of ionic liquids influence these applications will be discussed, along with an exploration of current research trends positioning ionic liquids as pivotal solvents in the chemical industry. Join us for an enlightening journey into the world of ionic liquids and their potential to revolutionize analytical sciences for sustainable energy, environmental, and developmental outcomes.

Keywords

Ionic liquids; Sustainable development; Benign solvent; Analytical science; Thermophysical properties; Chemical industry.

Invited Lecture-14

DEVELOPING SODIUM-ION BATTERY TO ADDRESS INTERMITTENCY OF RENEWABLE ENERGY



Palani Balaya

Department of Mechanical Engineering, College of Design and Engineering, National University of Singapore, Singapore – 117575
E-mail: mpepb@nus.edu.sg

ABSTRACT

Although Li-ion battery technology is quite matured, present exponential increase in demand for electric vehicles cautions us serious supply chain related issues especially for its use in the large-scale stationary storage applications. Sodium, on the other hand, is the sixth most abundant element on the Earth's crust. Sodium-ion batteries (SIBs) operating at ambient temperature are expected to be durable, safe and inexpensive. Regardless of the relatively lower energy density of SIBs, they can be effectively employed in smart grid applications, where the weight and footprint requirement are not severe.

In this talk, I will present the progress made on developing sodium-ion battery technology at NUS. Author will present selected examples of sodium/sodium-ion batteries using Na₂MnSiO₄ and Na₃V₂(PO₄)₃ polyanions,^{1,4} conventional carbonate-based and non-flammable glyme-based electrolytes,^{2,3} O3-type⁵ and P3-type⁶ cathodes, and hard carbon anode.

Pros and cons of the developed sodium battery chemistries will be presented and discussed in terms of the heat generation and associated internal resistance of the commercial 18650 type Na-ion cells. The fundamental and translational battery research works presented in this talk is expected to bridge the gap between academic research and industry needs for specific market sectors.

References

- 1 M. Law, V. Ramar, P. Balaya, *Journal of Power Sources*, 359 (2017) 277.
- 2 A. Rudola, K. Du, P. Balaya, *J. Electrochemical Society*, 164 (2017) A1098.
- 3 K. Du, A. Rudola and P. Balaya, *ACS Applied Materials & Interfaces*, 13 (2021) 11732.
- 4 K. Du, C. Wang, L.U. Subasinghe, S.R. Gajjela, M. Law, A. Rudola, P. Balaya, *Energy Storage Materials*, 29 (2020) 287.
- 5 A. Tripathi, A. Rudola, S.R. Gajjela, S. Xi, P. Balaya, *Journal Materials Chemistry A*, 7 (2019) 25944.
- 6 A. Tripathi, S. Xi, S. R. Gajjela, P. Balaya, *Chemical Communications*, 56 (2020) 10686

Invited Lecture-15

ENVIRONMENTALLY BENIGN LI-ION BATTERY RECYCLING TOWARDS RESOURCE EFFICIENCY AND CIRCULAR ECONOMY



Ajay Kaushal*, M Balakrishna, K Ramaswamy, R Ratheesh**

Centre of Excellence in E-waste Management

Centre for Materials for Electronics Technology, Hyderabad-500051, India

*Corresponding Author's 1 Email: ajay.kaushal@cmet.gov.in Cont No. +91 8219251553

**Corresponding Author's 2 Email: ratheesh@cmet.gov.in

ABSTRACT

30 elements in the periodic table have been identified as critical minerals by Ministry of Mines, Government of India based on the economic importance and risk in supply chain. Among them lithium (Li), cobalt (Co) and nickel (Ni) are particularly important under clean energy initiative for electric vehicle batteries. About 70 % of the world's lithium comes from brine, and recovery of Li from it is water and energy intensive process. Lithium repositories are concentrated mostly in Bolivia, Argentina, Australia, USA, Chile and China. Recently, lithium reserves were also found in Salal-Haimana area of the Reasi district in Jammu and Kashmir (J&K). In case of cobalt, DR Congo houses ~47 % of cobalt reserves worldwide, ~23 % in Australia, ~10 % in Indonesia and ~20% in rest of the world. In recent years, changing the battery chemistry has been of preferences among the manufacturers to balance the cobalt supply with demand. According to the Trading Economics, cobalt prices have declined by over 31 per cent in recent year. Report says nickel-based lithium-ion batteries have begun to show a higher energy density than cobalt-based batteries. The total global nickel reserves amounted to approximately 100 million metric tons. Indonesia and Australia possess world's largest shares, at 21 million metric tons each. For each of the critical raw material required for battery manufacturing, India is heavily dependent on other countries for its supply. On the other hand, the Indian EV market is expected to grow from 0.38 billion USD in 2021 to 152 billion USD in 2030 at a CAGR of 94.4%. While India's EV battery market is estimated to expand by \$300 billion till 2030. Almost 30 percent of the Li-ion cell constitutes metals like cobalt, lithium, nickel, manganese, copper and others. While India has no reserves for cobalt, lithium and nickel, an efficient recycling seems to be the only solution to get these minerals. It is estimated that as much as 125,000 tonnes of lithium carbonate, 35,000 tonnes of cobalt and 86,000 tonnes of nickel could be recovered by 2027 from waste batteries. The recycling of Li-Ion batteries market is going to hit by \$6 billion by 2027. In India, Li-Ion battery recycling market will witness a significant exponential boost in the sector in the next financial year, complemented by an exponential growth in demand & supply side. In order to tap this opportunity, C-MET has developed patented process technology for the recovery of Li, Co and Ni from End of Life Li Ion batteries through hydrometallurgical route. The extraction efficiency and purity of the recovered materials are 95% and 99% respectively.

Keywords: Li-Ion battery; recycling, extraction; resource efficiency and circular economy

References

- 1 Critical Minerals for India, Report of the Committee on Identification of Critical Minerals, Ministry of Mines June 2023 (<https://mines.gov.in/admin/storage/app/uploads/649d4212cceb01688027666.pdf>)
- 2 Patricia, ALVES DIAS, et al. "Cobalt: demand-supply balances in the transition to electric mobility." (2018)
- 3 Nickel-demand-to-outstrip-supply-by-2024-causing-headaches-for-ev-manufacturers, RystadEnergy (<https://www.rystadenergy.com/newsevents/news/press-releases/nickel-demand-to-outstrip-supply-by-2024-causing-headaches-for-ev-manufacturers>)

Invited Lecture-16

CHARACTERISATION OF NUCLEAR FUELS: AN UPDATE

Amrit Prakash

Radiometallurgy Division, Bhabha Atomic Research Centre
Trombay, Mumbai-400094
Em-mail: amritp@barc.gov.in



ABSTRACT

Analytical chemistry plays a very important role for nuclear fuel activities be it fuel fabrication, waste management or reprocessing. Nuclear fuels are selected based on the type of reactor. The nuclear fuel has to conform to stringent chemical specifications like boron, cadmium, rare earths, hydrogen, oxygen to metal ratio, total gas, heavy metal content, chlorine and fluorine etc. Selection of technique is very important to evaluate the true specification. This is important particularly when the analyses have to perform inside leak tight enclosure. The present paper describes the details of advanced analytical techniques being developed and used in chemical characterization of nuclear fuels during their fabrication.

Nuclear fuels comprise of fuels based on UO_2 , PuO_2 , ThO_2 and combination of $(U+Pu)O_2$, $(Th+U)O_2$, $(Th+Pu)O_2$, $(U+Pu)C$, $(U+Pu)N$ etc depending on the type of reactors chosen viz. Thermal Reactors or Fast reactors. The production of these materials and their performance are underlying with the concept of composition and purity and to comprehend, the nuclear industry gives utmost importance for the characterization of the materials. It provides means to ascertain that the quality of the fabricated fuel conforms to the chemical specifications for the fuel laid down by the designer. The batch of sintered/de-gassed pellets are subjected to comprehensive chemical quality control for trace constituents, stoichiometry and isotopic composition.

However, analysis of nuclear materials poses challenges due to the complexity of the materials and the absence of relevant standards or reference materials. Advanced analytical technique based on titrimetry, spectroscopy, thermogravimetry, XRF and XRD have largely been used for this purpose. Since they have to be handled inside special enclosures, extreme care is being taken during handling. Instruments are being developed/modified for ease of handling and maintenance. The method should be fast to reduce the total analytical time. The instruments are chosen in such a way that a single instrument could do as many elements as possible. Inter laboratory comparison experiments are carried out to validate the method as well as to prepare certified reference materials. Regular analyses are carried out only after a satisfactory performance evaluation of the instruments.

Invited Lecture-17

ANALYTICAL SCIENCE IN SPECIAL MATERIAL DEVELOPMENT

Dr. S. K. Satpati

Uranium Extraction Division,
Materials Group, Bhabha Atomic Research Centre, Mumbai 400085
Email: sksatp@barc.gov.in / satpatisk@yahoo.co.in
Cont. No. 022-25594550 / 8779569909



ABSTRACT

Special material like uranium metal powder, thorium tetra-fluoride (ThF₄), thorium metal powder, uranium-thorium alloy are important nuclear materials for different specialised applications. State-of-art process technology is involved for preparation and development of those materials. Analytical science plays an important role in the developmental technique for every step of preparation. Quality assurance is an utmost requirement of nuclear material development. Quality control of desired product is ascertained in every process step applying analytical science. Preparation of uranium metal powder requires non-conventional technique and also needs intensive care in every step because of its pyrophoricity and hazardous nature. It has unique nature of non-alloying and non-isotropic stabilisation with temperature variation. Thorium in the form of fluoride and metal, has several special applications in nuclear technology. Process development with thorium material is very scanty in open and requires different innovative approach for its scaling up technology similar to rare earth materials.

The present talk will elaborate and put insight of operational steps for developed products having desired chemical, physical and metallurgical characteristics applying analytical sciences. Technological excellences will be highlighted during the deliberations covering the spectrum of quality assurance techniques for developing the finished products.

Invited Lecture-18

INTEGRATING SCIENCE AND ENGINEERING FOR SUSTAINABLE DEVELOPMENTS IN WATER AND WASTEWATER TREATMENT

Dr. Vinay M. Bhandari

Chief Scientist, Chemical Engineering and Process Development Division
CSIR- National Chemical Laboratory
Pune-411 008, India
E-mail: vm.bhandari@ncl.res.in



ABSTRACT

Water is an integral component of life and access to safe water and also cleaner environment is an important agenda for developing countries like India. In the present context, where emphasis on science is predominant, it is essential to integrate science and engineering for deriving sustainable solutions through innovations that are not just limited to laboratory developments but can be techno-economically exploited in real life applications and for societal benefits. Our research in this regard provides innovative indigenous technologies for water and wastewater treatment with "out of the box" thinking, newer



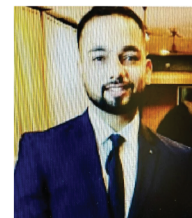
processes and for newer reactor developments apart from effective process intensifications. We, at CSIR-NCL, have developed a water disinfection technology- Safe Water and Sustainable Technology Initiative from Indian Knowledgebase (SWASTIIK), which combines the ancient knowledge of Ayurveda and modern hybrid hydrodynamic cavitation technology to provide alternative to existing disinfection processes, mainly chlorination. The technology is effective in eliminating practically all the harmful bacteria, including antimicrobial resistant (AMR) bacteria. Our inventions in vortex based hydrodynamic cavitation, intensified hydrodynamic cavitation processes and newer cavitation devices- vortex diode, dual activity reactors, surface coated cavitation reactors provide promising new alternatives in water and wastewater treatment for the removal of various contaminants/organic pollutants. The technology is successfully demonstrated for various industry sectors, specifically for the removal of API pollutants in pharmaceutical wastewater treatment, removal of COD and ammoniacal nitrogen for chemical/ dyes/textile/fertilizer industry wastewater treatment. In distillery wastewater treatment, it is highly useful mainly for increasing gas yield by converting part COD to BOD by integrating cavitation with biological treatment. The developed advanced oxidation technology mainly destroys organic pollutants via mineralization thereby generates no secondary waste. It also offers significant ease of operation and is believed to be cost effective compared to many other conventional processes. The scaled up was successfully demonstrated from lab/pilot plant scale of 500 LPH to an industrial scale up to 40 m³/h. The CSIR-NCL's technology- vortex diode for industrial wastewater treatment, is now commercialized and is being increasingly used in industries such as distilleries and different chemical industries for solving environmental pollution issues.

Invited Lecture-19

REVOLUTIONARY BENCHTOP NMR TECHNIQUE OF FLOW CHEMISTRY – CHALLENGES AND SOLUTIONS

Sandip S. Jagtap

Labindia Analytical Instruments Pvt. Limited



BUSINESS TALK

Invited Lecture-20

RECENT INNOVATIONS IN PLASMA SOURCE MASS SPECTROMETRY AND HOW THESE CAN BE USED TO SOLVE DEMANDING REAL-WORLD PROBLEMS IN ANALYTICAL SCIENCE



Dr. John Cantle

PhD Imperial College, London, Nu Instruments Ltd UK

ABSTRACT

In a world driven by constant innovation and evolving scientific frontiers, mass spectrometer manufacturers face a critical challenge: anticipating and addressing the analytical needs of tomorrow. At Nu Instruments, we embrace this challenge with a deep commitment to collaboration and a relentless pursuit of solutions. For nearly 30 years, we have partnered with researchers and industry leaders to push the boundaries of analytical capabilities, developing instruments that not only meet today's demands but pave the way for groundbreaking discoveries in the years to come.

This presentation will showcase a selection of our latest projects, highlighting how we are working to tackle some of the most pressing analytical challenges across diverse fields:

- The increasing demand for high-purity metals, particularly in the aircraft and semiconductor industry, necessitates highly sensitive analytical tools. We will demonstrate how Glow Discharge MS stands as an ideal solution, providing unparalleled precision and detection limits for trace element analysis in these critical materials.
- Laser ablation mapping and imaging has revolutionized the in-situ analysis of solid samples, offering invaluable insights into the distribution of elements within intricate structures. We will explore how Time of Flight MS techniques, excel in this domain, delivering high-resolution elemental maps with exceptional speed and sensitivity. This technique not only aids in diagnosis and disease research but also unlocks a deeper understanding of geological and biological processes at the microscale. We will touch upon its exciting potential for single-cell analysis, opening doors to groundbreaking discoveries in personalized medicine and beyond.
- We will discuss how the Dual Path Multicollector-ICP-MS is pushing the boundaries of the technique when applied to the study of high precision isotope ratio analysis. This technology is being applied in many of the top Geoscience laboratories in the world to solve the riddles of the early solar system and also more modern events associated with the world's oceans.



Invited Lecture-21

VISIBLE LIGHT ASSISTED BIODIESEL PRODUCTION FROM WASTE COOKING OIL BY PORPHYRIN PHOTOCATALYST

Bhairav Chandroday Mataghare and Pundlik Rambhau Bhagat*

Department of Chemistry, School of Advanced Sciences,
Vellore Institute of Technology, Vellore, TamilNadu, India-632014



ABSTRACT

The quantity of WCO generated from domestic waste can have severe environmental consequences. It has several disadvantages like, damage aquatic ecosystems, severely block pipes when drains in the sink, and may mix with other contaminants to form toxic substances which leads to water pollution. Some modification in the WCO has prodigious potential to yield green biofuel which can not only boost up production of biodiesel but also reduce the environmental snags. This study aims to convert the fatty acids (FA) in WCO to its corresponding ethyl esters (FAEE) by using the heterogeneous recyclable porphyrin-based photocatalyst. The porphyrin photocatalyst was synthesized and scrutinized by using FT-IR, NMR, and SEM/EDAX. The esterification process is optimized by using Response Surface Methodology (RSM) based on the Box Behnken Design (BBD) approach. The four independent variables photocatalyst (15-25 mg), time (10-20 h), molar ratio (05-15 mmol), and light intensity (3-7 W) were studied including their influence on the yield of biodiesel production. The highest yield achieved was 90.23% at room temperature, with 20 mg photocatalyst loading and ethanol to oil molar ratio (10: 01 mmol) in 15h, and by exposure of 5W LED light. The photocatalyst found very effective and was recycled six times in the process with a slight decrease in the esterified product yield. The composition of the oil was confirmed by GC-MS, ¹H NMR, ¹³C NMR, DEPT 135 analysis, and its physicochemical properties were scrutinized with the ASTM standard methods. The protocol was applicable for gram scale (200 g) reaction with the similar yield under optimized reaction conditions.

Keywords: Porphyrin, Photocatalysis, Waste Cooking Oil, Box Behnken Design.

Invited Lecture-22

NUCLEAR MEDICINE TECHNIQUES FOR MONITORING IODINE LEVELS IN PREGNANT WOMEN AND CHILDREN: A FOCUS ON RADIOPHARMACEUTICALS

Nilima Rajurkar

Former Professor and Head, Chemistry Department and
Former Head, Environmental Science Department
Savitribai Phule Pune University, Pune 411 007
Email: rnilima@rediffmail.com Contact No.: +91 9822599531



ABSTRACT

Iodine stands as a crucial micronutrient indispensable for the normal functioning of the thyroid, as well as for supporting growth and development. Inadequate intake of iodine results in insufficient production of thyroid hormones, giving rise to a range of unfavourable consequences collectively termed as iodine

deficiency disorders (IDD). These disorders pose a significant global health concern, impacting around 200 million individuals at risk and an additional 71 million afflicted with conditions such as goitre and other IDD. Affecting every stage of life, these disorders particularly jeopardize the well-being of children and pregnant women. The adverse outcomes associated with IDD are extensive and encompass various forms of disability and disease. These include goitre, cretinism, hypothyroidism, abortion, stillbirth, brain damage, learning disabilities, mental retardation, psychomotor defects, and impairments in hearing and speech. Consequently, regular assessment of iodine levels in the population is crucial, with a special focus on the most susceptible age groups. Nuclear medicines, specifically radiopharmaceuticals, play a pivotal role in detecting iodine levels, primarily in the form of thyroid hormones. The lecture commences by emphasizing the nutritional significance of iodine, delving into the spectrum of iodine deficiency disorders, and exploring diverse assay techniques for iodine estimation. Subsequently, the discussion shifts to the research conducted in our laboratory concerning the estimation of thyroid hormones in pregnant women and children from various geographical areas. Radiopharmaceuticals, specifically Radio Immuno Assay (RIA) kits labelled with I-125, were employed to estimate thyroid hormones, including triiodothyronine (T3), thyroxine (T4), and human thyroid-stimulating hormone (hTSH) using BRIA MAG 3, BRIA MAG 4, and IRMAK-9 RIA kits, respectively. Following the assay, I-125 activity was measured using a NaI(Tl) scintillation counter. The concentration of these hormones in serum samples allowed for the detection of thyroid status. Among the 243 pregnant women assessed, 128 were found to be susceptible to hypothyroidism. Similarly, out of 172 children examined, 65 were identified as being prone to hypothyroidism. In the concluding segment of the lecture, brief discussions will revolve around the measures to be taken to combat IDD effectively.

Invited Lecture-23

TECHNOLOGY DEVELOPMENT OF RE VALUE CHAIN

Dhruva Kumar Singh

Hydrometallurgy & Rare Earths Development Section
Materials Processing & Corrosion Engineering Division
Materials Group, Bhabha Atomic Research Centre, Mumbai-400085
Email: dksingh@barc.gov.in



ABSTRACT

Rare earth elements (REEs), a group of 17 elements are vital to clean energy and modern technologies including cell phones, computers, electric vehicles, defense equipment, renewable energy systems, catalysts, polishing, glass, phosphors, pigments and many more. Rare earths have unique physical, chemical, catalytic, luminescent, magnetic, optical and structural properties which makes them special class of material due to their ability to provide critical functionality. However, it is their use in the magnets critical to defence, manufacturing, automotive and the transition to electric vehicles (EVs) is attracting attention of policy makers around the world. Deployment of energy technologies in particular wind turbines, EVs could lead to imbalance of supply & demand of these key materials leading to vulnerability in the RE value chain. Developing a roadmap by identifying the needed R&D coupled with better coordination with ongoing activities for easy integration in plants will establish the rare earth supply chain in the country.

BARC has been pioneer in doing excellent R & D on rare earths right from mineral beneficiation to separation of high purity individual rare earths to RE metal & alloys and supporting Indian Rare Earths Limited in implementation of technologies for commercial production. Upstream processing of rare earths is well established in the country, while down-stream process in terms of value addition such as metal making, alloying and manufacturing devices & components is still in nascent stage. The present talk will elaborate on the technological development in the area of hydrometallurgical and pyrometallurgical processing of rare earth resources essential for its value chain.

Invited Lecture-24

CO₂ SEQUESTRATION IN DEEP SALINE AQUIFERS

Pradeep Kumar

Integrated Fuel Fabrication Facility, Bhabha Atomic Research Centre, Mumbai

Email: pradeepk@barc.gov.in



ABSTRACT

Global energy demand is continuously increasing due to rapid industrialization coupled with population growth along with enhanced living standard. Energy demand has been supplemented mainly by fossil fuels: coal, oil, gas. The burning of fossil fuels releases CO₂ into the atmosphere leading to global warming, thus unbalancing Global Carbon Cycle. The fears associated with the global warming are enhanced polar ice melting, raising of sea level thereby drowning many coastal cities, adverse effects on marine life, disturbance of thermohaline circulation etc. Violent storms, droughts, floods, extreme cold or hot seasons are witnessed frequently now a days. CO₂ atmospheric concentration trend is ever increasing, current value is nearly 412 ppm which amounts to ~47 % rise since the beginning of the industrial age and ~11% rise since 2000. Already earth is at 1.2 °C above pre-industrial level. The alarming situation necessitates immediate action for mitigation of CO₂ concentration. The Paris Climate Agreement was adopted by 196 parties at the United Nation Climate Change Conference (COP21) held in Paris, in 2015. The Paris agreement persuades limiting the global temperature rise to 2°C above pre-industrial level and endeavoring to sustain below 1.5°C. In the COP28 Climate Summit held in Dubai, in 2023, most countries agreed for "Transition Away" from fossil fuel. Comprehending the severity of alarming situation, in 2014, NASA launched Orbiting Carbon Observatory-2 (OCO-2) satellite to globally monitor CO₂ concentration in the atmospheric air above from space.

One elegant way of mitigation of CO₂ concentration is CO₂ sequestration comprising of CO₂ Capture, Transport and Storage (CCS). A prominent CCS option is CO₂ sequestration in deep saline aquifers owing to available technology, applicability and huge storage capacity of aquifers. The supercritical CO₂ is injected into the brine formations in the sediments at depths deeper than ~800 m where CO₂ gets trapped in the porous structure by displacing saline. Efficient CO₂ storage capacity is combined effect of CO₂ properties along with reservoir characteristics. The composition of co-existing fluid phases at elevated pressure and temperature conditions could be obtained from Peng-Robinson equation of state by applying thermodynamics laws. Physical phenomenon such as surface tension, capillary action, viscosity and reservoir characteristics such as porosity, permeability govern the multi-phase, multi-component flow in the porous medium, described by Darcy's Law. CO₂ trapping occurs by various mechanisms such as structural, residual, solubility, mineral trapping. The structural trapping occurs during prograde regime, when immiscible non-wetting CO₂ plume migrates upward displacing saline from pores and gets confined in the region below the cap rock. The plume is cylindrical in shape consisting of three parts; plume cap, plume column, residual saturation region. During retrograde regime residual trapping occurs governed by capillary action. Solubility and mineral trapping provide storage security over time scale of the order of thousand years. Owing to heterogeneous nature of aquifers, capillary trapping causes instability in the flow leading to viscous fingering, thus effecting the buoyancy of CO₂ plume. The overall CO₂ trapping is the interplay of gravitational, capillary and viscous forces. Higher gravitational force leads to enhanced gravity segregation (more buoyant plume), whereas higher viscous force results in more cylindrical shape of the plume. Favorable condition for enhanced CO₂ trapping is capillary > viscous > gravitational force. Numerical simulation study provides very powerful tool for understanding and predicting the complex interplay of physical and chemical processes taking place in geological medium. The simulation study consists of model discretization, writing of balanced equations for system and solving by computer. Multi-phase, multi-component fluid flow is comprehensively described by reactive transport model. Some commonly employed computer softwares for this purpose are TOUGHREACT, SCALE2000, PHREEQC and SUPRCT92.

Invited Lecture-25

SMECTITE CLAY MINERALS IN THE GEOLOGICAL DISPOSAL OF HIGH-LEVEL WASTE, AND CONVENTIONAL APPLICATIONS AS SOLID ACID CATALYSTS/ ADSORBENTS

Prof. J. Manjanna

Dept. of Chemistry, Rani Channamma University, Belagavi 591156, India
Email: jmanjanna@gmail.com; Ph: 9916584954



ABSTRACT

Bentonite is the candidate buffer (backfill) material in the engineered barrier system for deep geological disposal of high-level waste (HLW). Montmorillonite (Mt, 2:1 smectite group clay) is the major clay mineral of bentonite with high capacity for swelling and adsorption, low hydraulic conductivity and self-healing properties. The interaction of Mt with the carbon steel (Fe), an overpack material of engineered barrier system, the corrosion products provide potential pathways for the alteration of Mt. Apart from small fraction of Fe-rich clay minerals, the conversion of Na-Mt to Fe(II)-Mt and Fe(III)-Mt.

The Fe(III)-Mt was prepared by conventional cation exchange of Na-Mt with FeCl₃. It was converted to Fe(II)-Mt through the reduction of interlayer and adsorbed Fe(III) ions with ascorbic acid. Also, pure Fe(II)-Mt was obtained by using weak Fe(II)-L complexes for cation exchange [1-3]. This new method enabled us to routinely prepare this redox sensitive Fe(II)-Mt under ambient conditions. The basic properties viz., sorption and diffusion characteristics of radionuclides relevant to geological disposal of HLW were studied using Fe(II)-Mt and Fe(III)-Mt [4]. The sorption behavior and apparent diffusion coefficients obtained for Fe-Mt are found to be marginally different from that of original clay mineral, Na-Mt. The effect of gamma irradiation and temperature on the redox behavior of interlayer iron was also studied [5].

Furthermore, organo-modified Fe-Mt was prepared through solid state reaction by in-situ complexation of interlayer Fe(II) ions with suitable chelating agent (1,10-phenanthroline). These intercalated compounds were converted to solid acid catalysts and used for the reduction of nitroarenes and Biginelli type of organic reactions [6]. Also, they are used for the adsorption of molybdenum from highly acidic solution towards HLLW [7].

References

- 1 J. Manjanna et al., J. Nucl. Sci. & Technol. 44 (2007) 929
- 2 J. Manjanna, Appl. Clay Sci. 42 (2008) 32
- 3 J. Manjanna et al., Appl. Clay Sci. 43 (2009) 208
- 4 Chikkamath et al., Radiochimica Acta 106 (2018) 971; Radiochimica Acta 107 (2019) 387; Aquatic Geochemistry 27 (2021) 31; Radiochimica Acta 109 (2021) 73
- 5 Chikkamath et al., Appl. Clay Sci. 200 (2021) 105893
- 6 Kabadagi et al., Appl. Clay Sci. 165 (2018) 148; Appl. Clay Sci. 189 (2020) 105518
- 7 Chikkamath et al., J. Radioanal Nucl. Chem. 321 (2019) 1027.



Invited Lecture-26

ROLE OF ANALYTICAL SCIENCES IN CATALYSING VARIOUS APPLICATIONS FOR ENVIRONMENTAL SUSTAINABILITY



Dr. Suneet Kumar Yadav

SUD-CHEMIE INDIA PVT LTD

A-1/2, Nandesari Industrial Area, Dist . VADODARA- 391 340, Gujarat, India

ABSTRACT

The consistent innovation and technology upgradation has opened a new arena in the field of catalysis which directly or indirectly supports in achieving environmental sustainability goals fixed by Indian government and globally during various conventions from time to time. Analytical Sciences plays an important role in catalysing the various applications for achieving sustainability goals and targets like green chemical processes, emission reductions, waste reductions, reduction in consumption of natural resources either by reuse or recycling, , regulatory requirements covering REACH, global compliances by avoiding, substituting or minimising use of various elements, substances or minerals of concern, thus complying with RoHS, EMRT, CMRT or CRT requirements. Use of catalyst is not only restricted to the conventional chemical processes or technologies but started entering the various chemical domains including protection of environment and for sustainability. The recent advances have brought the focus of analytical scientists into the characterization methods and elemental estimations for verification and validation of catalyst quality for meeting the desired performance targets. The mushrooming growth in instrumental techniques and availability of various instruments in the market has made the task of scientists easier but on another hand also brings in their mind the dilemma of using the right technique and method of analysis. The accuracy and precision required during Catalyst development, analytical estimations and characterization has created a challenging task for the analytical scientist. Getting the reference samples or methods from the market or from other relevant sources is a daunting task. These are not available in the open market but are required to be developed in-house and to be used as a "Working Standard". However, estimation by using ICP-OES and X-ray Fluorescence Spectrometers has simplified the estimation process with respect to conventional techniques but the challenge remains in the sample preparation techniques for getting right results. As Catalysts are generally patented products in the market, standard references are not available for verification, calibrations, and standardizations. Transition metals like Cobalt, Nickel and Molybdenum in heterogeneous catalysts is generally present in high percentages whereas precious metals like Silver, Platinum, Palladium and Rhodium are used in ppm levels. This creates a challenge for the analyst to work in a test sample from macro to microgram level of estimations. In Zeolites based products, the sample preparation throws a big challenge before the estimation work begins.

In this presentation, the focus is on the Catalysts used for environmental sustainability applications and extraction, separation, and recovery of these elements from spent or used Catalysts. The challenges faced by analytical scientists in developing such process flows and methods are also covered.

Invited Lecture-27

CARRYING CAPACITY BASED DEVELOPMENTAL PLANNING FOR SUSTAINABLE DEVELOPMENT

Dr. C. V. Chalapati Rao

Ex-Seniormost Chief Scientist ,NEERI , Nagpur &
Professor Emeritus, Andhra University ,Visakhapatnam



ABSTRACT

Carrying Capacity based developmental planning and Sustainable Developmental Planning are interlinked .Sustainable Development means having good quality of life having optimum society and economic capital available with optimum use which are the objective and subjective components responsible for quality of life .For sustainable development, along with society and economic capital, there are environmental resources linked to it which should have perfect balance with supportive capacity in order to have sustainable development .If the assimilative capacity do not meet the required demand for quality of life ,then we might have to import the environmental resources for having desired quality of life ,then we might have to import the environmental resources for having desired quality of life, only then sustainable development will follow.

The carrying capacity based planning process involves
Estimation of supportive capacity
Estimation of assimilative capacity
Estimation of parameters that define quality of life, and
Allocation of resources to various socio-economic activities through simulation and optimization of quality of life.

The Operational Framework for planning Sustainable Development includes allocation of resources among alternative uses in such a way that there is an efficient reduction of the waste, or residuals, discharged to the environment and in consequence, an increase in welfare. Major components of the proposed methodology include analysis of natural, transformational, distributive and socioeconomic resource base of the region making use of GIS/DIP tools, estimation of assimilative capacity of the environmental media through baseline data collection and modelling, evaluation of regional and sectoral plans, delineation of environmental and resource management plans (Short/Long Term) including cleaner technologies, projection of Business as Usual (BAU) scenario and vision/environmental policy issues and delineation of developmental alternatives/scenarios in terms of land-use, activity mix, industrial typology and zoning, Major outputs/outcomes/deliverables based on this study/approach which will be useful in Sustainable development include the following:

1. Preferred Landuse
2. Critical Environmental Areas/Hotspots
3. Environmental Status
4. Assimilative Capacity of Environmental Media
5. Designated Industrial Zones
6. Industrial Typology/Capacity
7. Alternative Sites/ Raw Materials /Process Technologies
8. Cleaner Technologies of Industrial Production
9. Associated Downstream Industries and Pollution Potential
10. Sensitive Receptors
11. Conservation Zones
12. Technological Interventions
13. Industry Specific Pollution Control Measures
14. Regional Environmental Management Plan
15. Environmentally Balanced Industrial Complexes
16. Resource base of the Region
17. Resource Supply and Demand Analysis (Present and Future)
18. Permissible Extraction Rate of Resources
19. Impact of Resource Extraction/Utilization Activities on Environmental Quality and Amenities
20. Critical Limiting Resources and Resource Availability Constraints
21. Resource Enhancement Strategies
22. Supply-side Management Options
23. Demand-side Management Options



24. Sustainability of the Resource Base 25. Alternative Resources for Development 26. Infrastructure Requirements 27. Activity and Employment Multipliers associated with Alternative Resource Exploitation Strategies 28. Renewable and Non-renewable Resources-Potential 29. Land use and Zoning Plans 30. Urban Area Development Plans 31. Ecofriendly Tourism Plans 32. Short and Long term Plans 33. Integrated Sectoral Development Plans 34. Strategic and regional environmental management plans and technological interventions

The above approach is illustrated with the help of a presentation of a case study

Invited Lecture-28

CHEMICAL CONVENTIONS TO PROTECT HUMAN HEALTH AND ENVIRONMENT FROM TOXIC CHEMICALS



Neeta Thacker

Former Chief Scientist and Head Analytical Instruments Division
National Environmental Engineering Research Institute, Nagpur
Email: neetathacker9@gmail.com
Phone: 9850302887

ABSTRACT

Basel, Rotterdam and Stockholm are three main chemical Conventions adopted in 1989, 1998 and 2001 respectively. The main objective of these conventions is to protect human health and environment from toxic chemicals. These Conventions were the outcome of first UN World Conference on human environment held on June 5-16, 1972 at Stockholm. Most of the persistent organic pollutants (POPs) are covered by these conventions. The advancement of industrialization have introduced large numbers of chemicals in man's daily life either through direct exposure and indirect due to their releases in environment. The modern sophisticated analytical instrumentation and development in analytical technology have made it possible to detect the pollutants at nanogram and femtogram levels in complex matrices.

POPs more specifically halogenated organics have become a major threat to the environment due to their transboundary movements, persistence, bioaccumulation in living organisms and high toxicity at very low levels. The conventions help to assess the chemistry, toxicology and transport of various identified POPs.

In 1996 the International Forum on Chemical Safety (IFCS) created and recommended the global binding to reduce and /or eliminate release of 12 POPs chemicals. India actively participated in Stockholm Convention since 1998. The Stockholm Convention on POPs was adopted in May 2001 by signing of treaties by 90 countries and came into force on May 17th by 2004. India became a party to the Convention since April 2006.

Parties to the Stockholm Convention required to develop a National Implementation Plan (NIP) to full fill its commitment to the Convention. The Ministry of Environment and Forest (MoEF). Government of India (GoI) identified various institutions in preparing the country's NIP on POPs. The brief outcome of the first NIP on POPs submitted by MoEF to UNEP in March 2011 and newly listed chemicals considered in the present development plan will be covered in the following lecture.

Invited Lecture-29

ROLE OF RAMAN SPECTROSCOPY IN SUSTAINABLE NANOTECHNOLOGY AND BIOTECHNOLOGY

Kinshuk Dasgupta

Materials Group, Bhabha Atomic Research Centre, Mumbai 400085, India



ABSTRACT

Raman spectroscopy is a non-destructive analytical technique that has gained immense popularity in the field of nanotechnology and biotechnology due to its ability to provide molecular-level information about a wide range of materials. In this talk, we will discuss the role of Raman spectroscopy in these sustainable fields, including the characterization of nanomaterials, monitoring of biological systems, and detection of diseases. We will also explore how Raman spectroscopy can be used to investigate the properties of materials and provide insights into their behavior and interactions with biological systems. Additionally, we will highlight the potential of Raman spectroscopy in developing sustainable solutions for various applications, including green nanotechnology and bioremediation. Overall, this talk aims to demonstrate the crucial role of Raman spectroscopy in driving sustainable advancements in nanotechnology and biotechnology, and its potential in contributing towards a better future.

Invited Lecture-30

ROLE OF GEOCHEMICAL ANALYTICAL TOOLS IN MINERAL EXPLORATION AND CRUSTAL EVOLUTION STUDIES

D. Srinivasa Sarma

CSIR-National Geophysical Research Institute, Uppal Road, Hyderabad-7

E-mail: dssarma@ngri.res.in

ABSTRACT

The development of the country's economy depends on mineral resources, particularly resources of critical minerals like rare earth elements (REE), Li, Co, and Ni. Our country has vast mineral resources, some in excess and some in insufficient quantities for our consumption and requirements. Mineral resource exploration is a continuous process carried out by different Government and Private Sector organisations. Exploration studies by geological, geophysical, mineralogical, geochemical, and remote sensing methods followed by drilling technology are very effective in finding new mineral deposits. In all these activities, different analytical techniques play crucial roles. Geochemical analytical tools such as X-ray fluorescence spectrometer (XRF) and inductively coupled plasma mass spectrometry (ICP-MS) help quantify elemental abundances to a great extent. Though the initial narrowing down of a specific area is done by more indirect geophysical methods, the actual quantification is carried out by measuring the elemental abundance in a particular sample using geochemical analytical tools. The geochemical instrumentation has seen rapid developments over the past few decades. Identifying a mineral resource involves many steps, from understanding the rock-forming minerals through petrography and initial screening based on elemental abundances. Scanning electron microscopy connected with the energy dispersive X-ray

spectroscopy (SEM-EDS) provides a qualitative chemical composition, thereby identifying minerals. The XRF analyses major oxides in rocks, and accurate data of ~25 elements in the rocks and soil samples can be obtained. These results constrain the rock types and are also useful in soil contaminant identification. The ICP-MS is a more versatile machine with the capability of analysing the materials up to the order of trace levels. Though this method involves wet-chemistry procedures to digest the sample to bring different elements into the solution, it is worthwhile to analyse most of the elements in the periodic table with better accuracy than several other methods. Modern ICP-MS instruments are coupled with laser ablation systems for the determination of both elemental and isotopic compositions directly on solid samples in different types of geological materials. Thermal ionisation mass spectrometry (TIMS) is used to obtain precise isotopic ratios of different elements to better understand the evolution of different crustal rocks. This isotopic information is also useful in mineral exploration and crustal evolution studies.

References

- 1 K. Rasheed, D. Srinivasa Sarma (2022) Occurrence of Gold in the Mesoarchean Mayurbhanj Gabbros of Singhbhum Craton, Eastern India. *Journal of the Geological Society of India*. <https://doi.org/10.1007/s12594-022-1927>.
- 2 A Panda, R Shankar, D Srinivasa Sarma, R Patel (2023) Precise Pb-Pb baddeleyite geochronology, geochemistry, and Sr-Nd isotopic constraints on the 2.36 & 1.88 Ga mafic dykes from the Bastar craton, India: Implications for their petrogenesis in conjunction with the Dharwar mafic dykes. *Precambrian Research*. <https://doi.org/10.1016/j.precamres.2023.107090>.
- 3 D. Srinivasa Sarma, Neal McNaughton, I.R. Fletcher, D.I. Groves, M. Ram Mohan and V. Balaram (2008) The Timing of gold mineralisation of Hutti gold deposit, Dharwar Craton, South India. *Economic Geology*, v.103-8, pp.1715-1727.

Invited Lecture-31

TRACE ELEMENTS IN THE ENVIRONMENT – XRF ANALYSIS USING PROBES SUCH AS PHOTONS, PROTONS AND SYNCHROTRONS



Daisy Joseph

Nuclear Physics Division, BARC, Trombay, Mumbai, India
E-mail: joseph@barc.gov.in

ABSTRACT

Trace metals in the environment, attributed to effluent effects in natural settings such as rainwater systems, mangroves, insects, marine fish, and water bodies, are a prevalent concern. Hence, investigations of the toxicity of these metals in the environment are very important. Moreover, the beneficial roles of trace elements found in naturally occurring plants, herbs, and spices, including medicinal extracts such as Ayurveda formulations and other alternative medicines, warrant exploration for bioremediation and phytoremediation purposes. The research focussed on these points will serve as a valuable resource for medical practitioners, environmentalists, bioscience researchers, pharmaceutical experts, and pharmacists. It will also provide insights into space travellers regarding atmospheric trace metal levels, particularly in light of ozone layer considerations.

Analysing trace metals in the environment can facilitate the mitigation of environmental toxicity through the introduction of eco-friendly waste disposal products. The "waste to wealth" approach can offer

comprehensive assessments of trace metal levels across all environment-related materials in the universe. Determining the elemental composition, especially in biological materials, presents a formidable experimental challenge, particularly due to the need to detect small concentrations of numerous elements amidst major concentrations of hydrogen, carbon, and oxygen. Biological samples are inherently heterogeneous on a minute scale and often pose compatibility issues with vacuum systems, necessitating extensive preparation for analysis. X-ray fluorescence (XRF) has been a longstanding method for measuring elemental concentrations in biological materials. XRF relies on high-energy X-rays to induce vacancies in the inner shells of material atoms, subsequently emitting characteristic X-rays for qualitative and quantitative analysis of elemental concentrations. The efficacy of XRF applications depends on the type of X-ray source employed. This presentation aims to elucidate the variations in XRF utilizing photons, protons, and synchrotrons as sources, along with their diverse applications pertaining to environmental studies.

Invited Lecture-32

HETEROGENEOUS CATALYSTS IN THE BIOMASS VALORIZATION: THEIR UNDERSTANDING AND DESIGNING



P. L. Dhepe^{1*}, T. Khan¹, P. Lokhande¹

¹CSIR-National Chemical Laboratory, Dr. Homi Bhabha Road, Pune 411008

*Email: pl.dhepe@ncl.res.in; Tel. +91-2025902024

ABSTRACT

It is imperative to develop catalytic systems for the synthesis of chemicals and fuels from renewable resource such as biomass. In the group, works on hemicellulose conversion into C5 sugars, furfural, furfuryl alcohol, cyclopentanone etc. were undertaken (1-5). Similarly, valorization of lignin into value added monomers and oligomers is undertaken (6-8). However, in doing so, it was important to develop new catalytic systems other than used in petrochemical industries. This is because of different catalytic and solvent systems used in both the chemistries. In the group for above mentioned works, synthesis and designing of various heterogeneous as well as homogeneous catalysts was undertaken after understanding the chemistry behind the reaction and also kinetics of the reactions. In the presentation, details on the journey to understand how catalyst development was evolved and what factors are important to develop industrially viable processes will be discussed.

Keywords

Bio-refinery; economic process; heterogeneous catalysis, designing of catalyst

References

- 1 P. L. Dhepe, R. Sahu, Green Chem. 12 (2010) 153.
- 2 R. Sahu, P. L. Dhepe, ChemSusChem 5 (2012) 751.
- 3 P. Bhaumik, P. L. Dhepe, ACS Catal. 3 (2013) 2399.
- 4 P. Bhaumik, P. L. Dhepe, RSC Adv. 3 (2013) 17156.
- 5 A. K. Deepa, P. L. Dhepe, ACS Catal. 5 (2015) 365.
- 6 S. K. Singh, P. L. Dhepe, Green Chem. 18 (2016) 4098.
- 7 R. Chaudhary, P. L. Dhepe, Green Chem. 19 (2017) 778.
- 8 Dheerendra Singh, Paresh L. Dhepe, Mol. Catal. 480 (2020) 110525.



Invited Lecture-33

POLY-METALLIC SULPHIDE EXPLORATION IN DEEP OCEAN: INDIAN INITIATIVE



Dr. Parijat Roy

Scientist E & Scientist In-charge Hydrothermal Exploration
National Centre for Polar and Ocean Research, Ministry of Earth Sciences, Goa
Email: parijatroy@ncpor.res.in

ABSTRACT

The fast depleting terrestrial mineral resources and the increasing demand for metals and strategic minerals forced the mankind to explore alternative resources in the oceanic domain. The successful recovery of potential seabed mineral resources in turn imparted great impetus on widespread search and greater interest for such resources in the deep-sea domains, which led to rapid development of our knowledge too. Deep Sea mineral resources such as polymetallic nodules (PMN), polymetallic hydrothermal sulfides (PMS), cobalt rich ferromanganese crusts (CC) have attained immense attraction as being considered as the future alternative of land resources and source for global metal supply.

Modern seafloor environments, characterized by a diversity of tectonic settings such as mid-oceanic ridges, arcs, and back-arcs, are significant hosts for polymetallic sulphide deposits rich in copper, zinc, lead, gold, silver, and other precious metals. Apart from their economic potential, active hydrothermal vent fields are also significant because of the presence of diverse types of living organisms around the vent sites and their biological evolution in sulfidic environment can be indicative of conditions during the evolution of early life on Earth. Formation of massive sulphides and hydrothermal chimneys or mounds in mid-oceanic ridge environments is the result of multiple episodes of fluid interactions and reactivation of older fluid pathways. The hydrothermal activity in ridges is a complex process that is primarily influenced by variable geological settings, resulting in the emergence of diverse genetic models.

Seafloor hydrothermal activity associated with concomitant sulfide minerals and biological resources is a major research topic with vital scientific significance and economic considerations. Although, exploration of all these deep sea minerals are considered to be challenging, searching for PMS deposits is a challenge, as they are confined to smaller areas and the exploration for active sites is by trailing the tracers in water column and the seafloor.

NCPOR under the aegis of Ministry of Earth Sciences has initiated a mission-mode multi-disciplinary program on hydrothermal sulphide mineralization studies at mid-ocean ridges, with emphasis on the South West and Central Indian Ridges. Ministry of Earth Sciences signed a 15 year contract with the ISA for undertaking exploration and other developmental activities related to Polymetallic Sulphides in the allotted area of 10,000 sq km. The approval has given India pre-emptive rights to start the exploration activities in the allocated area. Pursuant to the grant of exploration licence, NCPOR undertook an extensive exploration campaign in the region engaging latest techniques and technologies.

The integrated multidisciplinary studies carried out so far leads to the identification of few promising locations of hydrothermal activity and the recovery of sulphide samples from few distinct locations in the in the parts of CIR and SWIR.

Harnessing deep-sea minerals extends far beyond immediate economic gains. It has the potential to fundamentally reshape our understanding of mineral formation processes, pave the way for sustainable resource management practices, and establish the bedrock for a flourishing Blue Economy.

Invited Lecture-34

MACHINE LEARNING ASSISTED SENSOR ARRAY FOR DISCRIMINATIVE ANALYSIS OF DIFFERENT GASES AND THEIR MIXTURES

Somalapura Prakasha Bharath

Catalan Institute of Nanoscience and Nanotechnology
Barcelona, Spain

Email: pbharathbhat@gmail.com



ABSTRACT

Gas sensing and machine learning represent two powerful domains converging to revolutionize the field of chemical sensing. Gas sensors, ranging from metal oxide semiconductors to 2D material-based devices, offer a means to detect and quantify various hazardous gases and volatile organic compounds (VOCs) in diverse environments. These sensors operate based on principles such as changes in electrical conductivity induced by surface adsorption, subsequent reactions and desorption, enabling real-time monitoring of air quality, industrial processes, and safety applications. However, gas sensing faces challenges such as cross-sensitivity, drift, and interference from environmental conditions, which can affect the accuracy and reliability of measurements. To address these challenges, many sensors may be operated as arrays, and data can be collected and processed subsequently. Data from sensor arrays may be compared using machine learning methods such as classification, regression, clustering, and anomaly detection. Machine learning algorithms can examine vast datasets of sensor responses, detect trends, and understand complicated correlations between sensor signals and target gasses. By leveraging supervised and unsupervised learning approaches, machine learning algorithms can improve gas sensor selectivity, sensitivity, and robustness. They can also compensate for sensor drift, adapt to changing environmental conditions, and enable sensor fusion for enhanced performance.

In our work, sensors based on In_2O_3 , SnO_2 , TiO_2 , WO_3 and ZnO were fabricated, sensor selectivity was achieved through the integration of sensor array with machine learning based algorithms. An array of multiple sensors was deployed to detect many pollutant gases such as CO , NO_2 , NH_3 , VOCs and their mixtures across different concentrations and humid conditions. Principal component analysis was used as primary tool to assess the discriminative capability of the sensor array. Neural network -based models such as multilayer perceptron, convolutional neural networks was used to distinguish between distinct gases and their mixtures using response values, response and recovery phenomenon as inputs. Multivariate data, such as impedance spectra from sensor arrays, were also gathered and utilized to establish selectivity towards trace levels of volatile organic compounds. Cross-validated training and testing processes in test atmospheres resulted in a 100% discrimination efficiency.



ABSTRACTS

