

Research Scholars Meet on Materials Science and Engineering of Nuclear Materials



May 7-9, 2018



*Indira Gandhi Centre for Atomic Research
Kalpakkam, Tamil Nadu, India, 603 102*



Research Scholars Meet on Materials Science and Engineering of Nuclear Materials (RSM - MSENM)



May 7 - 9, 2018



Programme & Abstracts

Organized By

Indira Gandhi Centre for Atomic Research (IGCAR),
Kalpakkam, Tamil Nadu



Venue

Sarabhai Auditorium, Indira Gandhi Centre for Atomic Research,
Kalpakkam

Supported By

Board of Research in Nuclear Sciences







प्रो. पी.आर. वासुदेव राव

कुलपति

Prof. P.R. Vasudeva Rao

Vice-Chancellor

होमी भाभा राष्ट्रीय संस्थान

प्रशिक्षण विद्यालय परिसर, अणुशक्तिनगर, मुंबई-400 094, भारत

Homi Bhabha National Institute

Training School Complex, Anushaktinagar, Mumbai – 400 094, India

Tel. No. 91-22-25503385 ● Fax : 91-22-25503384

● Email : vasudeva@hbni.ac.in

Message

It gives me great pleasure that Homi Bhabha National Institute (HBNI) is organising the Research Scholars Meet (RSM-MSENM)-2018 during May, 7-9, 2018 at Indira Gandhi Centre for Atomic Research, Kalpakkam.

India's growth is related to our power generation program, and hence there is a concerted endeavour to harness various energy sources. As our nation is advancing towards harvesting the potential of nuclear energy for the country, the in-house knowledge base and the technology required to support the nuclear programme need to grow together. Materials are at the heart of the nuclear energy development, in various roles such as fuel, clad, coolant, control rod, structural materials, matrices for waste immobilisation, etc. A thorough understanding is needed about the behaviour of materials, in order to meet the challenges of materials related to nuclear energy. Science and engineering research related to materials is thus an important component of the research undertaken by HBNI students, and I am sure RSM-MSENM 2018 would provide a valuable platform for knowledge sharing and exchange of ideas between young research scholars from different CIs/OCC of HBNI. I am also confident that RSM-2018 would motivate the young researchers working in these multi-disciplinary research areas on materials to focus and attain higher altitudes in their research endeavours.

This meet is one of the measures taken by HBNI to add value to the research programs of the students and enhance their quality, and also provide a forum to the students to meet, compare notes and initiate collaborations. I am overwhelmed to learn that many research scholars and scientists are actively participating in this meet. I hope that we will have similar meets of HBNI students pursuing research in other domains. My special appreciation to the colleagues at Kalpakkam for making sustained efforts in organizing a meet of this nature. I convey my best wishes for the successful conduct of the RSM-2018 conference.

(P. R. Vasudeva Rao)



डॉ. अरुण कुमार भादुड़ी
प्रतिष्ठित वैज्ञानिक एवं निदेशक

Dr. Arun Kumar Bhaduri
Distinguished Scientist & DIRECTOR



सत्यमेव जयते

भारत सरकार
परमाणु ऊर्जा विभाग
इन्दिरा गाँधी परमाणु अनुसंधान केन्द्र
कल्पाक्कम 603 102, तमिलनाडु, भारत

GOVERNMENT OF INDIA
DEPARTMENT OF ATOMIC ENERGY
INDIRA GANDHI CENTRE FOR ATOMIC RESEARCH
KALPAKKAM 603 102, TAMIL NADU, INDIA



Message

Indira Gandhi Centre for Atomic Research is a unique multidisciplinary research institute engaged in broad based multidisciplinary programme of scientific research and advanced engineering directed towards the development of Fast Breeder Reactor technology. The safe and economical operation of nuclear reactor relies to a great extent, on the success of the fuel as well as on the materials. The materials are subjected to high temperature, and to radiations from high-energy particles released during fission. The development of new and novel materials for their improved performance is an important area of research which is being pursued in our Centre. Life of a nuclear reactor is also limited by the life of the materials. Understanding the material properties and behaviour is thus essential to maximize the life of a reactor, leading to better economy towards per unit cost production. The research Scholars working in different Constituent Institutions of Homi Bhabha National Institute (HBNI) provide significant contributions in the areas of Nuclear engineering and materials.

Therefore, the Research Scholar's meet 2018 (RSM 2018) on Materials Science and Engineering of Nuclear Materials derives its significance and I am glad that it brings together research scholars working in various areas of multi-disciplinary science and also provides an opportunity to showcase their innovation and cutting-edge research.

It is with great pleasure that I welcome you all to the Research Scholars Meet (RSM)-HBNI-2018 being organized at HBNI-IGCAR, Kalpakkam during May 7-9th, 2018. I expect very fruitful scientific deliberations over the next three days, and hope that the rich and varied technical contents and discussions would inspire the young researchers, motivating you all to greater achievements in your research endeavors.

I wish the RSM 2018 meet all the success. I also wish the outstation participants a pleasant stay at the campus and enjoy the serene ambience.

(Arun Kumar Bhaduri)



Dr. G. Amarendra
Director, Materials Science Group
Senior Professor,
Homi Bhabha National Institute [HBNI]
Phone No.: +91 – 44 -27480069
Fax No. : +91 – 44 - 27480084
Email ID : amar@igcar.gov.in;



Government of India
Department of Atomic Energy
Indira Gandhi Centre for Atomic Research
Materials Science Group
Kalpakkam - 603102
Kancheepuram District
Tamil Nadu

Ref. No. IGCAR/MSG/GA/2018

Date: May 01, 2018

MESSAGE

I extend a warm welcome to all the delegates of Research Scholars Meet on Material Science and Engineering of Nuclear Materials (RSM-MSENM)-2018. This is a first attempt in bringing together different Research Scholars of all the Constituents Institutions (CIs) of Homi Bhabha National Institute (HBNI) to enhance the collaborative efforts among the CIs and the faculty/students. I am particularly delighted that the first Research Scholars meeting is being held at our Centre, HBNI-IGCAR.

The theme of the meeting has been chosen to encompass all research topics that are relevant to the programmes of IGCAR. We have been pursuing diverse and inter-disciplinary research programs in material science and engineering, which overlap in physical, chemical and engineering disciplines. Some of the research areas include studies on defects and their influence on physical properties, superconductivity, optical properties, colloids and nanomaterials, structural and electronic phase transitions at extreme pressure and temperature and theoretical investigations of materials etc. Accelerator based materials research has been providing insights to the simulation and assessment of neutron damage to reactor materials. The pursuit of basic research has led us to take up several programs based on innovation in development of instrumentation and sensors. We also have a very vibrant research and development programmes related to development of structural materials, design of engineering components, chemical processes, development of alternate solvents and extractants etc., for the fast reactor technology and associated fuel cycle technologies.

I am particularly happy that the organization of the meeting in terms of shouldering various important portfolios is being taken up the Research scholars themselves. I appreciate and compliment meticulous efforts put in by these young researchers towards this. I believe and wish that RSM-2018 would act as catalysis to enhance collaborations across different CIs of HBNI and motivate young researchers to pursue excellence in their research endeavors.

I wish all the participants fruitful deliberations and wish the conference all success.

With my best wishes and warm regards,

Sincerely yours,

(G. Amarendra)
Chairman, Apex Co-ordination Committee of HBNI-IGCAR





Homi Bhabha National Institute

Homi Bhabha National Institute (HBNI) is a research university which educates students at the doctoral and masters level, and offers the scope for pursuance of research in cohesion with the mandate of Department of Atomic Energy (DAE). Considering the fact that DAE institutions are engaged in human resource development, the establishment of HBNI with the stature of a deemed university was proposed in the DAE Science Research Council's meeting chaired by Dr. Raja Raman, held on June 26, 2003 in Mumbai. HBNI was notified as a deemed to be university on June 3, 2005 and started its academic programme in 2006.

HBNI brings together the following eleven premier institutions of DAE called as Constituent Institutions (CIs) of HBNI, under a single research driven framework.

1. Bhabha Atomic Research Centre (BARC), Mumbai
2. Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam
3. Raja Raman Centre for Advanced Technology (RRCAT), Indore
4. Variable Energy Cyclotron Centre (VECC), Kolkata
5. Saha Institution of Nuclear Physics (SINP), Kolkata
6. Institute of Plasma Research (IPR), Gandhinagar
7. Institute of Physics (IoP), Bhubaneswar
8. Harish Chandra Research Institute (HRI), Allahabad
9. Tata Memorial Centre (TMC), Mumbai
10. Institute of Mathematical Science (IMSc), Chennai
11. National Institute of Science Education and Research (NISER), Bhubaneswar (off campus)

The CI's of HBNI have been carrying out advanced research and development for several decades in the field of nuclear energy and have made India self-reliant in the sensitive and advanced field of nuclear engineering.

Mission, vision and the guiding values of the institute are formulated in this regard as,

Mission

- To encourage pursuit of excellence in sciences (including engineering sciences) and mathematics in a manner that has major significance for the progress of indigenous nuclear technology capability.

Vision

- To provide an academic framework for integrating basic research with technology development.
- To encourage inter-disciplinary research.
- To nurture an environment for attracting high quality manpower in the sciences including engineering sciences to take up a career in nuclear science and technology and related areas.

Guiding values

- Always adhere to highest ethical standards. Put good of students first.
- Value excellence in research and foster innovation and creativity.
- Recognize importance of science for the development of society.



Indira Gandhi Centre for Atomic Research (IGCAR)

Indira Gandhi Centre for Atomic Research (IGCAR), the second largest establishment of the Department of Atomic Energy (DAE) next to Bhabha Atomic Research Centre, was set up at Kalpakkam, 80 Km south of Chennai (Madras), in 1971 with the main objective to conduct broad and multi-disciplinary programme of scientific research and advanced engineering, directed towards the development of sodium cooled Fast Breeder Reactor (FBR) technology in India. This is the part of the second stage of Indian Atomic Energy Programme, which is aimed at preparing the country for utilization of the extensive Thorium reserves and providing means to meet the large demands of electrical energy in the 21st century.

Over the years, the centre has established comprehensive R&D facilities covering the entire spectrum of FBR technology related to Sodium Technology, Reactor Engineering, Reactor Physics, Metallurgy and Materials, Chemistry of Fuels and its Materials, Fuel Reprocessing, Reactor Safety, Control and Instrumentation, Computer Application etc., and has developed a strong base in variety of disciplines related to this advance technology. With experience and expertise gained by the successful operation of Fast Breeder Test Reactor (FBTR), the centre has embarked upon the design and construction of 500 MWe Prototype Fast Breeder Reactor (PFBR).

IGCAR utilizes its expertise and resources in enhancing its stature as a leading centre of research in various branches of basic, applied and engineering sciences that have a bearing on nuclear technology like structural mechanics, heat and mass transfer, material science, fabrication process, non-destructive testing, chemical sensors, thermodynamics, radiation physics, computer science etc.

Apart from the thrust areas related to nuclear technology, the centre has credential as a leader of research in various frontier and topical subjects like quasi-crystals, exotic superconductors, strongly correlated electron systems, nano structures, clusters, SQUID fabrication programmes, polymers and experimental simulation of condensed matter using colloids etc.

IGCAR has extended its expertise and facilities to other vital sectors as defence, space and other industries of India to develop techniques for reliable solutions to specialized problems. It has collaboration with educational and R&D institutions like IITs, IISc, Regional Engineering Colleges, National Research Laboratories, Public Units and Institutes abroad.

A modern library comprising 62,000 volumes of books, 28,400 back volumes, about 785 journals and 1.95 lakhs reports in all disciplines caters to the technical needs of the scientists and engineers.

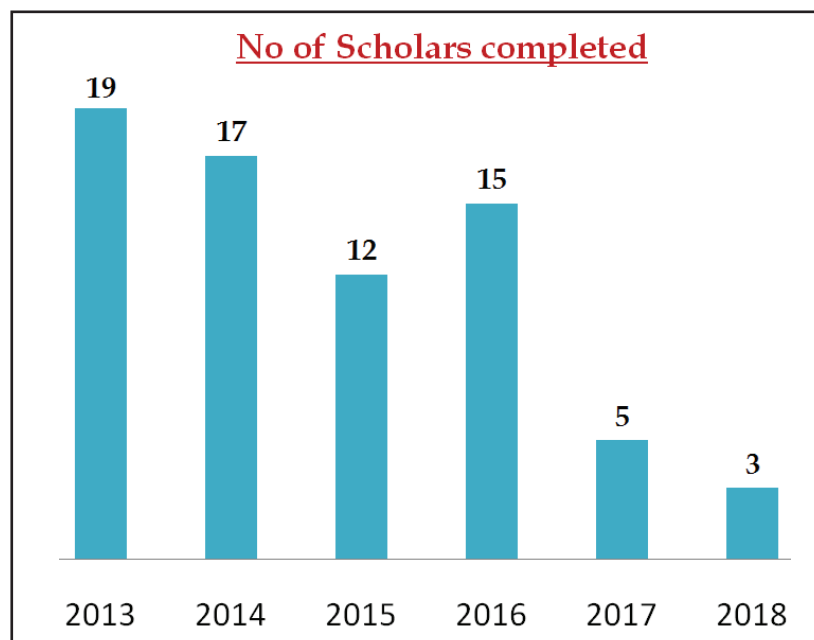
Research Scholars at IGCAR

Most of the R&D programmes require solid foundation of Physics, Chemistry and Engineering. This approach would enable to achieve breakthroughs and also provide for an adequate resilience in frontline technologies. In order to provide momentum to the R&D activities, young research scholars have been inducted in to HBNI's research programme. They are recruited through GATE/CSIR/JEST or written exam conducted by IGCAR, Kalpakkam followed by a technical interview. The research areas pursued at IGCAR include

- Fast Reactor Physics and Engineering,
- Chemistry and Chemical Engineering,
- Electrical, Electronics and Control Instrumentation and Computer Science,
- Material Science and Engineering and
- Reactor Safety.

These are challenging topics with high opportunities of original research and potential for breakthroughs, in which research scholars have been enthused. The first phase of research scholars who joined prior to 2006 were registered with University of Madras. Subsequently, the research scholars have been registered with the HBNI which is deemed to be university of DAE. HBNI has emphasised course work as a part of their academic curriculum and classes are being conducted by experts from IGCAR. Along with academic activities, HBNI-IGCAR provides facilities for extracurricular activities.

HBNI-IGCAR had started with only about 15 research scholars in the beginning and currently 153 research scholars are pursuing their Ph.D. in different laboratories of IGCAR. The challenging interdisciplinary projects of IGCAR are proposed as research topics for students. About 160 students have completed their Ph.D. Post Ph.D, many scholars are successfully continuing their research in prominent academic and research institutes. Below are number of research scholars who have completed their doctoral work at HBNI-IGCAR in the last five years i.e. 2013-2018.



Research Scholars Meet on Material Science and Engineering of Nuclear Materials - 2018

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Co-Chairman

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Research Scholars Meet on Materials Science and Engineering of Nuclear Materials-HBNI-2018

May 7-9, 2018; IGCAR, Kalpakkam

Date: 01.05.2018

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Dr. K. Ananthasivan
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Dr. N. Sivaraman

FOREWORD

Dear Participant

It is a great pleasure to receive you all to the Research Scholars Meet on Materials Science and Engineering on Nuclear Materials -2018. This meeting aims to bring together a diverse range of interdisciplinary research scholars working in various CIs of HBNI and offer a common platform to showcase innovative and cutting-edge research in the Physical, Chemical and Engineering sciences. The event is proposed to be entirely organized by the PhD scholars of the HBNI, working at IGCAR. This meet is organised to promote inter-institutional collaborative ventures. It offers an excellent opportunity for doctoral students to present their findings and work-in-progress and receive valuable feedback from peers and experts alike. The entire contributions of research scholars will be in the form of oral and poster presentations. In addition, it is proposed to organize a few invited talks by eminent faculty of HBNI. We thank Board of Research in Nuclear Sciences for providing the funding for conference. We thank all the authors and participants for their contributions and wish that participating delegates have an academically satisfying period during this conference.

N. V. Chandra Shekar (Convener, Academic)

T. S. Lakshmi Narasimhan (Convener, Organisation)

Contact Address:

Dr. N. V. Chandra Shekar,
Convener (Academic),
RSM-HBNI-2018, CMPD,
MSG, IGCAR, Kalpakkam-
603 102 T.N

Email: rsm2018@igcar.gov.in

v.in

Ph:

044-27480015

044-27480500-2217

Technical Programme

Time	Programme	
May 7, 2018 (Monday)		
09:30 - 10:30	Inaugural Function	
10:30 - 10:45	High Tea	
10:45 - 13:00	Technical Session - I - Physical science, Sarabhai Auditorium	
	10:45 - 11:30	SPECIAL INVITED LECTURE - 1 (Dr. A. K. Bhaduri, Director, IGCAR)
	11:30 - 13:00	Oral Presentations (O - 1,2,3,4,5,6)
13:00 - 14:00	Lunch	
14:00 - 15:00	Technical Session - II - Physical science, Sarabhai Auditorium	
	14:00 - 15:00	Oral Presentations (O - 7,8,9)
15:00 - 15:15	Coffee/Tea Break	
15:15 - 19:00	15:15 - 16:30	Poster presentation (P - 1 to 25)
	17:30 - 19:00	Cultural Programme
20:00	Dinner	
May 8, 2018 (Tuesday)		
09:00 - 11:00	Technical Session - III - Nuclear Engineering, Sarabhai Auditorium	
	09:00 - 9:45	SPECIAL INVITED LECTURE - 2 (Dr. Paramita Mukherjee, VECC)
	9:45 - 11:00	Oral Presentations (O - 10,11,12,13)
11:00 - 11:15	Coffee/Tea Break	
11:15 - 13:00	Technical Session - IV- Nuclear Engineering, Sarabhai Auditorium	
	11:15 - 12:00	SPECIAL INVITED LECTURE - 3 (Dr. Sanjay Kumar Rai, RRCAT)
	12:00 - 13:00	Oral Presentations (O - 14,15,16)
13:00 - 14:00	Lunch	
14:00 - 15:00	Technical Session – V - Chemical Science, Sarabhai Auditorium	
	14:00 - 15:00	Oral Presentations (O - 17,18,19,20)
15:00 - 15:15	Coffee/Tea Break	
15:30 - 18.30	Visit to Mamallapuram	
20:00	Dinner	
May 9, 2018 (Wednesday)		
09:00 - 11:00	Technical Session - VI - Engineering Science, Sarabhai Auditorium	
	09:00 - 9:45	SPECIAL INVITED LECTURE - 4 (Dr K. Madanagopal, BARC)
	9:45 - 11:00	Oral Presentations (O - 21,22, 23,24)
11:00 - 11:15	Coffee/Tea Break	
	11:15 - 11:45	Oral Presentations (O - 25,26)
	11:45 - 13:00	Poster presentation (P - 26 to 51)
13:00 - 14:00	Lunch	
14:00 - 15:00	Technical Session - VII - Engineering Science, Sarabhai Auditorium	
	14:00 - 15:00	Oral Presentations (O - 27,28,29,30)
15:00 - 15:30	High Tea	
15:30 - 16:30	Valedictory function	

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P-22	Near room temperature methane sensing by ion beam synthesized Al _{0.07} Ga _{0.93} N nanowires	SantanuParida, A. Das, Arun K. Prasad, and Sandip Dhara
P-23	High Pressure Phase Transformation Studies of DIPAB using Synchrotron x-ray diffraction	Shradhanjali Sahoo, T. R. Ravindran, V. Srihari, and K. K. Pandey
P-24	Investigation of vibration response in cantilever plates partially immersed in a fluid	Sumathi V, S. Jalaldeen, P. Selvaraj, and S. Murugan
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P-28	Applicability of Microstructure Based Creep Damage Mechanics Approach for 9% Cr Tempered Martensitic Steels	J Christopher, and B.K. Choudhary
P-29	Effect of temperature and multiaxial state of stress on creep deformation and rupture life of 304HCu Austenitic stainless steel	K. C. Sahoo, Sunil Goyal, and K. Laha
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P-35	Estimation of high temperature thermal diffusivity and thermal conductivity of Sigma (σ) and Alpha (α) phases of Fe ₅₆ Cr ₄₄ alloy	Raj Narayan Hajra, Hara Prasanna Tripathy, C. Sudha, S. Raju, and S. Saroja

P-36	Optimization, welding and evaluation of hybrid laser-TIG 316LN stainless steel weld joints	M. Ragavendran, and M. Vasudevan
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