Research & Devlopement Infrastructure

Dr. Rakesh Kumar Singh
Ph. D, Post-Doc, M.Sc
Head/ Prof. incharge-Establishment/Incharge-Academic, from 1.1.2014
University Centre for Nanoscience & Nanotechnology
School of Engineering and Technology
Aryabhatta Knowledge University , Patna

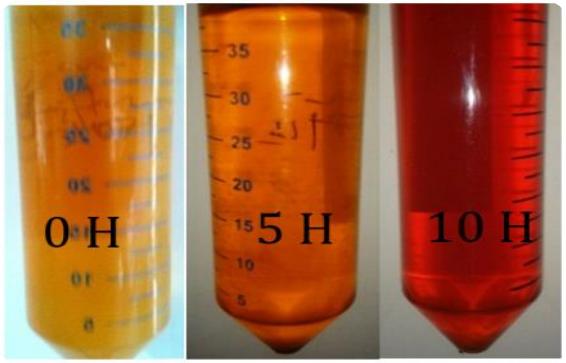
Chancellor awardee for Best Young Teacher with contributions in modern field of Nanoscience.

Scientific activities citation-www.drrakeshsingh.com
Google scholar Research profile- https://scholar.google.com/citations?user=gOZNJ-oAAAAJ&hl=en
Research gate profile- https://www.researchgate.net/profile/Rakesh_Singh44

Senior Resource Person of Utsahi Physics Teachers /Anveshika Coordinator, IIT Kanpur Initiated Project , Coordinated by Prof. H.C.Verma, IIT Kanpur

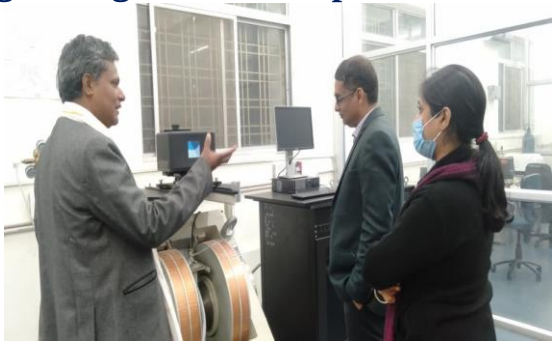
Asst. Prof. of Physics, Patna Women's College,(Autonomous) Patna University,(Aug. 2004-2013)

Multidisciplinary Cutting Edge Research and Nurturing Science & Technology activities



Ceramics Magnetic Nanomaterials, Functional Food Nanomaterials, Ayurvedic Nanomedicine

Nano silica from Rice husk, Herbal based functional nanomaterial, Teaching through low cost experiment



Science & Tech. Popularization, Guiding students at Ph.D/M.Tech/UG level and some other activities

Research Finding of about 125 Published in International/National Journals

Materials Science and Engineering B 263 (2021) 114871

Contents lists available at ScienceDirect

Materials Science & Engineering B

journal homepage: www.elsevier.com/locate/mseb

'Synthesis and properties of amorphous nanosilica from rice husk and its composites

Atul Jyoti [a], Rakesh Kr Singh [a,*], Nishant Kumar [a], Abhay Kr Aman [a], Manoranjan Kar [b]

[a] Aryabhatta Center for Nanoscience and Technology, Aryabhatta Knowledge University, Patna 800001, India
[b] Department of Physics, Indian Institute of Technology, Bihta, Patna 801103, India

Applied Physics A (2021) 127:183
https://doi.org/10.1007/s00339-020-04233-7

Applied Physics A
Materials Science & Processing

Synthesis and characterization of non-molar lithium–magnesium nanoferrite material for its applications

Rakesh Kr. Singh[1] · Nishant Kumar[1] · Dinesh Rangappa[2]

Received: 20 October 2020 / Accepted: 21 December 2020

Preparation and characterization of non-molar $Mg_{0.5+x}Li_{1-2x}Fe_2O_4$ (x=0, 0.15 and 0.35) ferrite nanoparticles, annealed at temperature 450° C for varied applications

Cite as: AIP Conference Proceedings 2327, 020003 (2021); https://doi.org/10.1063/5.0039550
Published Online: 09 February 2021

Rakesh Kr. Singh, Nishant Kumar, and Dinesh Rangappa

Contents lists available at ScienceDirect

Physica B: Physics of Condensed Matter

journal homepage: http://www.elsevier.com/locate/physb

Tuning in optical, magnetic and Curie temperature behaviour of nickel ferrite by substitution of monovalent K^{+1} ion of $Ni_{0.8}K_{0.2}Fe_2O_4$ nanomaterials for multifunctional applications

Nishant Kumar [a], Rakesh Kr Singh [a,*], Sunil Kumar [b], Prem Kumar [c]

[a] Aryabhatta Center for Nanoscience and Technology, School of Engineering and Technology, Aryabhatta Knowledge University, Pin-800001, Patna, India
[b] Pure and Applied Physics, Guru Ghasidas Vishwavidyalaya (Central University) Bilaspur, Chhattisgarh, India
[c] Sarvajanik Interstate Vidyalaya, Sarvodaya Nagar, Banka, Bihar, Pin-813102, India

Source of Encouragement

Worked/Working for Strong Scientific Human Resource Development

20 Dec 2011, Mohania, Kamur, Sasaram, Bihar

ग्रामीण इलाकों से वैज्ञानिक निकालने की पहल

मोहनिया | एक संवाददाता

साइंस के बच्चों को कोचिंग संस्थानों के आक्रामक बाजारवाद से बचाने एवं उन्हें शोध तथा निर्माण आधारित साइंटिफिक सोच विकसित करने के उद्देश्य से स्थानीय एमपी कालेज में फिजिक्स की कार्यशाला आयोजित हुई। ग्रामीण क्षेत्र के कालेज में पहली बार इस तरह की कार्यशाला में इंटर, स्नातक एवं पीजी के छात्रों ने वेस्टेड मैटेरियल से फिजिक्स की प्रयोगशाला बनाने की जानकारी देश के जाने-माने वैज्ञानिकों से हासिल की।

आईआईटी कानपुर में फिजिक्स के प्रोफेसर डा. एचसी वर्मा द्वारा गठित उत्साही फिजिक्स टीचर्स ग्रुप के सीनियर रिसोर्स पर्सन एवं पटना वीमेंस कालेज के प्रोफेसर डा. राकेश कुमार सिंह ने फिजिक्स के कठिन सिद्धांतों को दैनिक जीवन में उपयोग आने वाली वस्तुओं से प्रायोगिक प्रदर्शन कर समझाया। गुरूत्वाकर्षण ध्वनि तरंग, विद्युत चुम्बकीय तरंग एवं प्रकाश के सिद्धांतों को आसान एवं रोचक ढंग से प्रदर्शित किया।

उनका कहना है कि बोतल, टूटी कलम, रस्सी, धागा आदि वस्तुओं को जिसे हम फेंक देते हैं उनकी सहायता से फिजिक्स के सिद्धांतों को समझा जा सकता है। मात्र सौ रुपये में फिजिक्स की प्रयोगशाला स्थापित की जा सकती है। चार घंटे तक चली कार्यशाला में बीएचयू एवं सासाराम के अलावा कैमूर के छात्र-छात्राओं ने भाग लिया।

भारत सरकार रक्षा मंत्रालय के अधीन डीआरडीओ में वैज्ञानिक रह चुके विद्यादान इंस्टीच्यूट ऑफ टेक्नोलॉजी के चेयरमैन डा. एसके सिंह ने कार्यशाला में बताया कि आज बच्चे मैनेजमेंट एवं प्रशासनिक सेवाओं में जाने को बेचैन हैं। यदि साइंस को नेच्यूरल तरीके से सीखाया जाए तो वे वैज्ञानिक बनकर देश की सेवा कर सकते हैं। आज साइंस ग्लोबल बिजनेस बन गया है।

इसमें अपार संभावनाएं हैं। बस जरूरत है बच्चों में वैज्ञानिक प्रतिभा विकसित करने की। कार्यशाला की अध्यक्षता कालेज के प्राचार्य डा. अनिल कुमार एवं संचालन डा. एलएस सिंह ने किया। मौके पर विज्ञान के शिक्षक डा. अभिराम सिंह, प्रो. ओपी सिंह, डा. केबी सिंह, डा. एसबी सिंह, प्रो. डीके उपाध्याय, डा. यूपी सिंह आदि मौजूद थे।

मोहनिया के एमपी कॉलेज में आयोजित कार्यशाला में फिजिक्स के सिद्धांत को समझाते युवा वैज्ञानिक व पुरस्कार से सम्मानित पटना वीमेंस कालेज के डॉ. राकेश कुमार सिंह

हिन्दुस्तान रविवार, 23 अगस्त, 2009, पटना

कानपुर आईआईटी में बिहार के प्रो.एचसी वर्मा व उनकी टीम का इनोवेशन ला रहा रंग, बिहार के स्कूलों की बदली तस्वीर

देश के कोने-कोने में साइंटिफिक फीवर

पटना | अजय शंकर

खगड़िया के अलौली ब्लॉक का हाईस्कूल। यहां साइंस की पढ़ाई तो होती है पर प्रैक्टिकल के लिए लैब नहीं है। छात्र सिर्फ थ्योरी पढ़ते हैं। लेकिन, इन दिनों यहां प्रैक्टिकल भी हो रहा है। वह भी बिना लैब और ऑपरेट्स के। महज दो कागज के टुकड़ों के जरिए बरनौली का थ्योरम समझाया जा रहा है।

यह हाल केवल इस स्कूल का ही नहीं है, बल्कि पूरे बिहार और देश के कई स्कूलों का भी है। ऐसा संभव हो पा रहा है आईआईटी कानपुर में बिहार के प्रो. एचसी वर्मा और उनके साथियों के इनोवेटिव प्रयोग की वजह से। उन्होंने 'उत्साही फिजिक्स टीचिंग ग्रुप' नाम से एक टीम बनाई है। यह टीम देश के कोने-कोने में छात्रों और शिक्षकों में साइंटिफिक फीवर डेवलप करने में जुटी है। इससे बिहार के स्कूलों में बदलाव आ रहा है। जो शिक्षक साइंस फिजिक्स पढ़ाने में रुचि नहीं लेते थे, आज वही विभिन्न प्रयोगों के जरिए छात्रों को पढ़ा रहे हैं। छात्र भी पढ़ाई भी ध्यान देने लगे हैं। 'उत्साही फिजिक्स टीचिंग ग्रुप' के सीनियर मेंबर डॉ. राकेश कुमार सिंह इन दिनों गांवों में कैंप कर खुद के द्वारा तैयार उपकरणों के जरिए शिक्षकों को फिजिक्स पढ़ाने के तरीके बता रहे हैं।

इनमें लेजर मशीन, बरनौली थ्योरम, मोमेंट ऑफ इनर्सिया, वेब, मोशन, सीबैक इफेक्ट व फिजिक्स के अन्य पहलू शामिल हैं। इस टीम के इस इनोवेशन के जरिए कॉलेज में प्रयोगशाला में भारी भरकम मशीन के बिना भी छोटे व सस्ते उपकरण से भी छात्रों को साइंस का प्रयोग दिखाया जा सकता है। इससे छात्रों व शिक्षकों में साइंस के प्रति रुचि जागृत होगी। इससे बिहार में भी प्योर साइंस डेवलप होगा व युवा वैज्ञानिक की तादाद में बढ़ोतरी होगी। इन युवा वैज्ञानिकों की मदद से भविष्य में बिहार एवं देश में मॉडर्न टेक्नोलॉजी का तीव्र विकास संभव हो सकेगा।

हो रहा है बदलाव

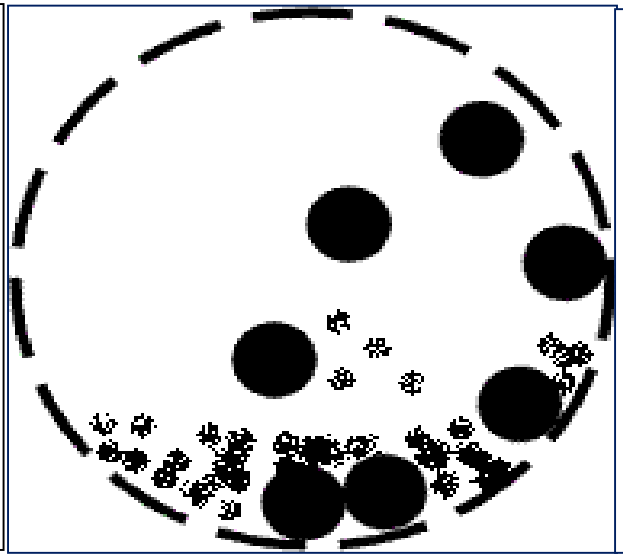
इस मिशन से बिहार के गांवों में मौजूद स्कूलों मे काफी बदलाव आया है। जिन स्कूलों में कल तक लैब नहीं थी, आज वहां है। गांव के शिक्षक भी अपने स्तर ने नए-नए प्रयोग कर छात्रों को आसानी से चैप्टर समझा रहे हैं। छात्रों की नीरसता भी दूर हो रही है।

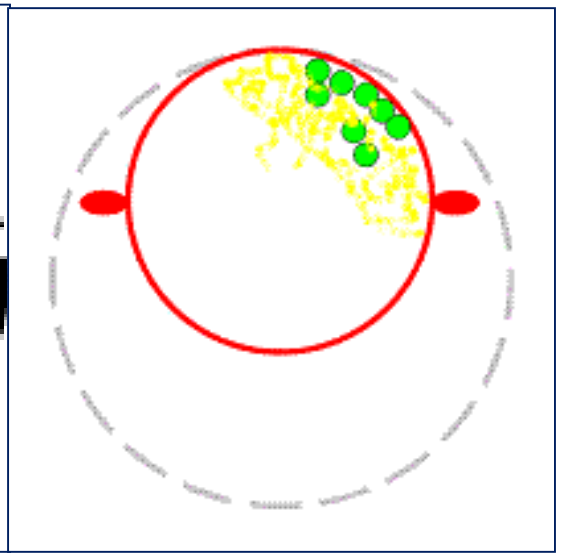
5000 शिक्षकों का बन चुका है कारवां

2004 में प्रो. एचसी वर्मा ने नेशनल लेवल पर फिजिक्स के 15 रिसोर्स पर्सन की मदद से 'उत्साही फिजिक्स टीचिंग ग्रुप' का गठन किया। इसमें बिहार के दो प्रोफेसर डॉ. अमरेंद्र नारायण एवं डॉ. राकेश कुमार सिंह शामिल हैं। आठ साल में ग्रुप ने देश के 5000 शिक्षकों को इनोवेटिव शिक्षा की ट्रेनिंग दी है। इनमें 500 शिक्षक बिहार के हैं।

Materials Preparation laboratory using high energy ball

Superfine Food materials, Electronics, Bio char materials and various similar can be prepared as new functional materials for its applications in Agriculture, Food, Electronics and various area of Science and technology.





roduction of red turmeric superfine powder

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Effect of superfine grinding on structural, morphological and antioxidant properties of ginger (*Zingiberofficinale*) nano crystalline food powder

Archana [a], Abhay Kr. Aman [a], Rakesh Kr. Singh [a,*], Nishant Kr. [a], Amber Jabeen [b]

[a] *Aryabhatta Center for Nanoscience and Nanotechnology, School of Engineering and Technology, Aryabhatta Knowledge University, Patna, 800001, India*
[b] *Dept of Biotechnology, Patna University, Patna 800005, India*

Materials Synthesis Lab-II

For different types of composite Engineering and Biomaterials materials and structural feature of materials for its applications

Hydrothermal synthesis

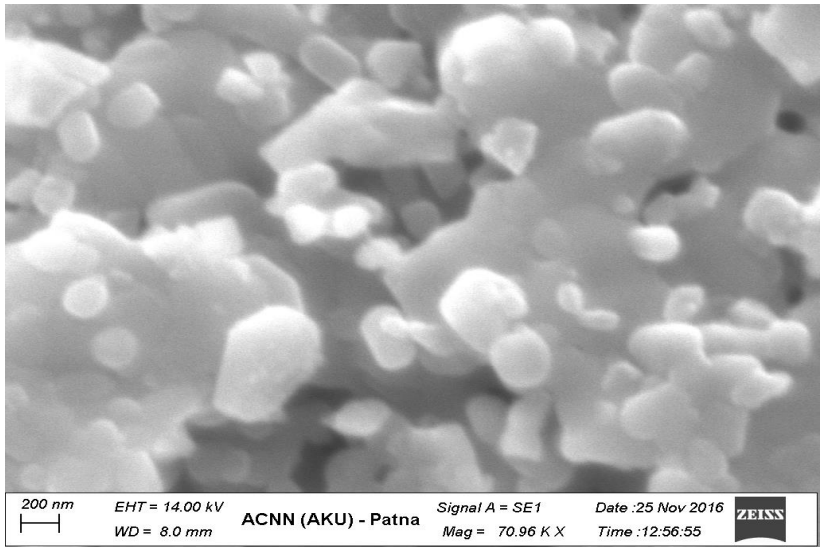
Prepared precursor for ceramic Engineering Nanomaterials

High temperature furnace

Electron Microscopy Lab for Structural characterization

For evaluation of grain size, agglomerated size and atomic size interpretation for its varied applications from medicine to Electronics

Scanning Electron Microscope and Atomic force Microscope & Scanning Tunneling Microscope



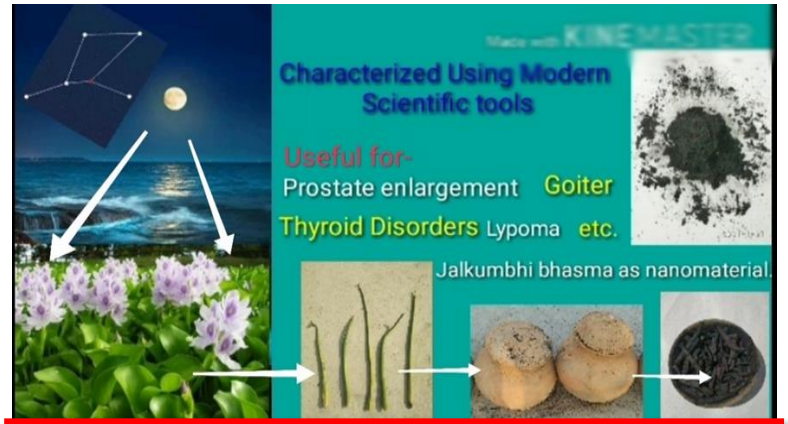
Structural, measurement of cupper based Tamra bhasma reveal uniform size distributed particles that support its medicinal value together with better action on disease treatment. This reminds our ancient Indian wisdom was so great. Hence we should not forget our root/ancestors.

Structural characterization labs

Research activities on ancient Indian Wisdom: Effect of radiation of moon on efficacy of medicine, eco-friendly Production of metal or metal oxide materials for its multifucntional uses

X-ray diffractomter (XRD)

Fourier Transform infrared spectroscopy(FTIR)



Sample Code	Wavenumber (cm^{-1})	Site	Effective Mass ($\times 10^{-26}$)	Force Constant (N/cm)	Bond length (Å)
M1	478	K^+ Ions	3.09561	2.513	1.891
	615	Cl^- Ions	3.09561	4.160	1.598
M2	488	K^+ Ions	3.09561	2.619	1.865
	618	Cl^- Ions	3.09561	4.200	1.593

Sample Code	Strain ($\times 10^{-3}$)	Crystallite size (nm)
M1	-1.630	26.66 (±1)
M2	0.445	49.51 (±5)

Material Synthesis Lab

Micro Injection Moulding Machine for preparation of Composite Materials for its various applications

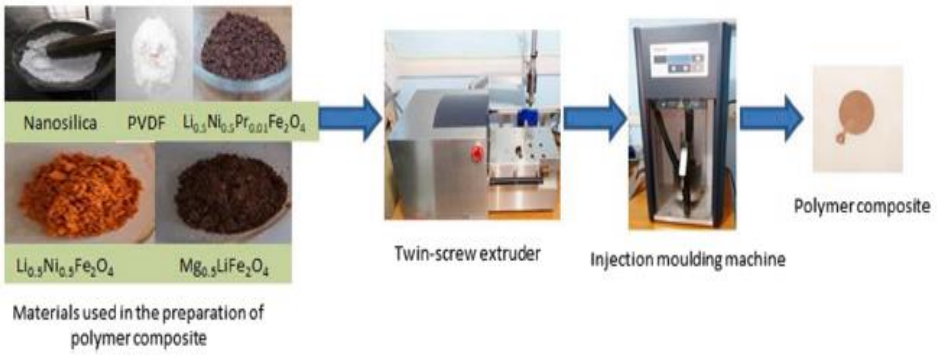


Fig. 1c. Schematic diagram of the synthesis of amorphous nanosilica/ferrite/PVDF nanocomposite.

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journal homepage: www.elsevier.com/locate/mseb

'Synthesis and properties of amorphous nanosilica from rice husk and its composites

Structural Characterization Laboratory

Instrumentation for Particle size distribution, determination of Zeta potential for stability

Nanoparticle Tracking analysis System and Dynamic light Scattering and Zeta Potential

NTA analysis of the size distribution and concentration of all types of nanoparticles from 20nm-1000nm in diameter,

Zeta Potential Provides information on particle size, zeta potential, concentration, and molecular weight, helps to determine the stability of materials

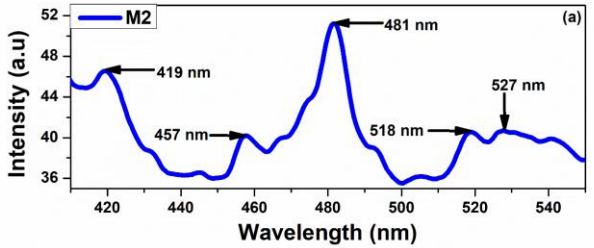
Digital Refractometer used for determination of refractive index of materials for its various applications

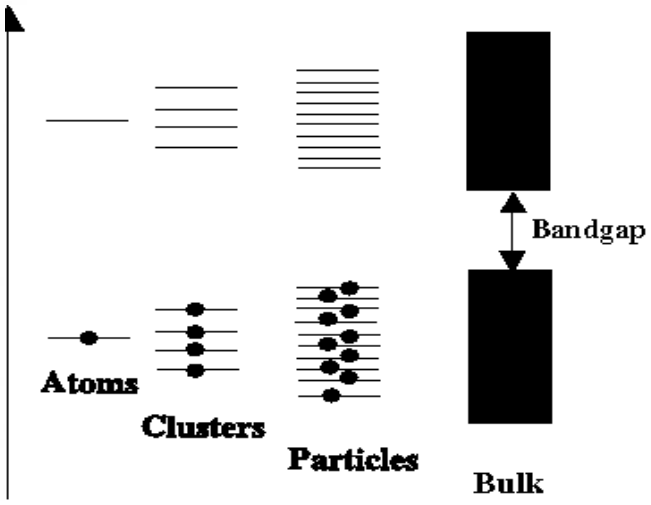
Optical characterization Research Laboratory

For determination of Electronics Structure and Light emitting behavior for its applications as LED, Optoelectronics devices

UV-Visible-NIR spectroscopy

Photoluminescence spectroscopy



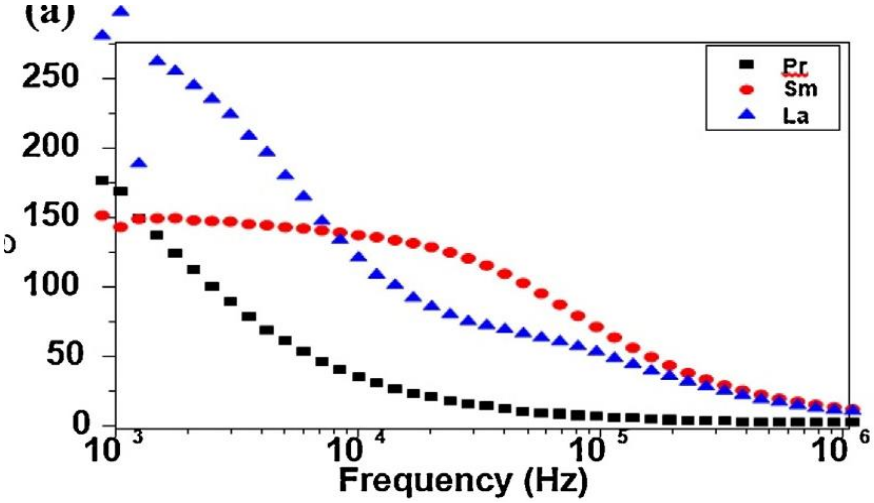


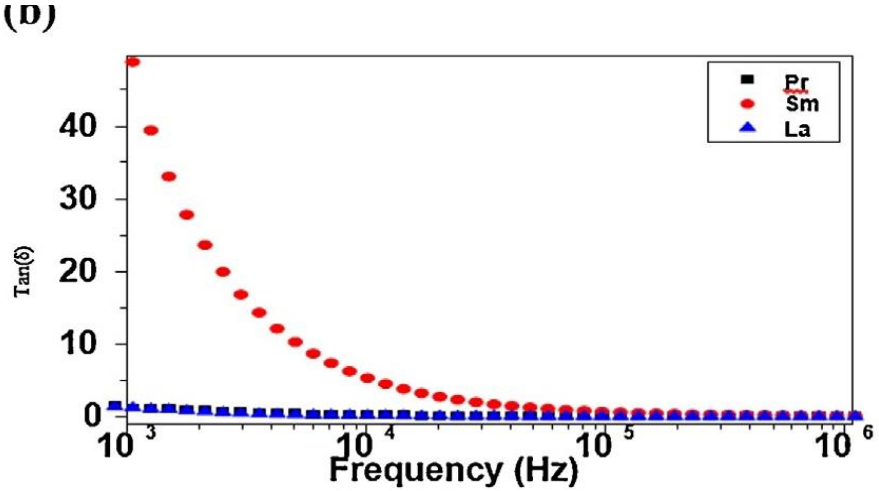
Electrical Measurement Lab

For measurement of electrical properties of materials for its applications in transformer core, high frequency applications and other area of electrical engineering and technology sectors.

Precision Multiferroic Test System (*P-E*, piezoelectric, piezoelectric, magneto-electric for bulk and thin-films) with temperature variation facility (Make: USA Radiant Technologies Inc., USA

Impedance Analyser

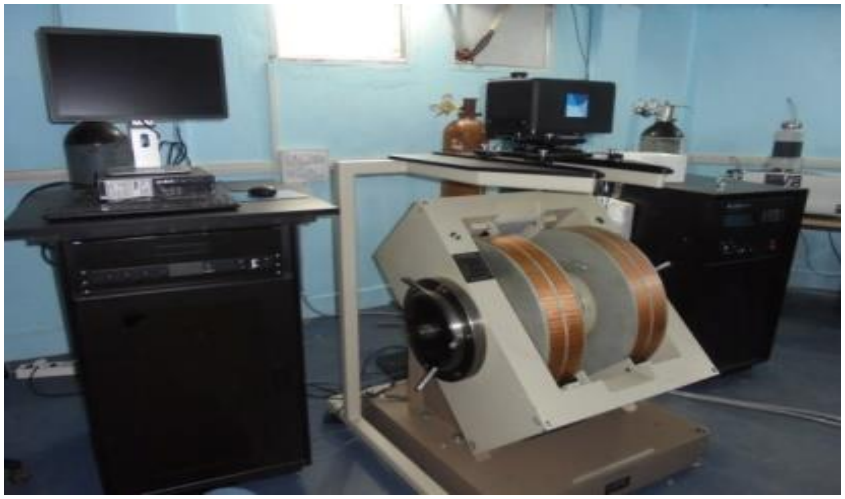




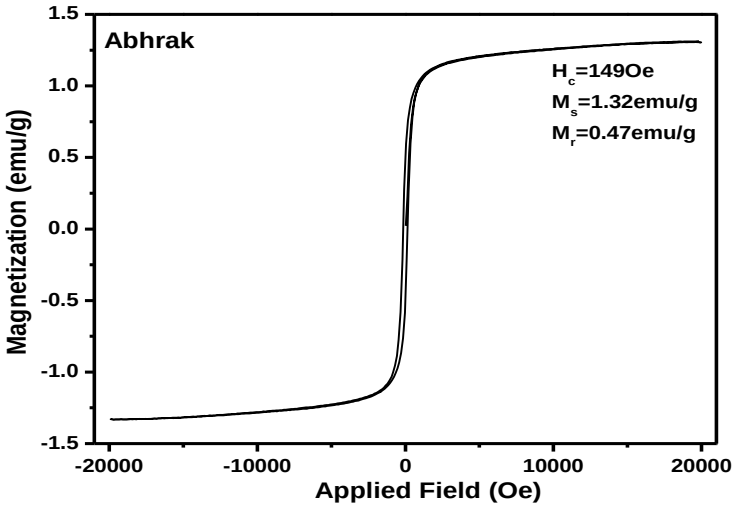
The dielectric measurements at higher frequency range (100 Hz–1 MHz) shows that these substituted ferrites exhibits low dielectric loss, which is suitable for high frequency applications. © R.K. Singh et al. / Materials Science and Engineering B 210 (2016) 64–69

Magnetic Research Laboratory

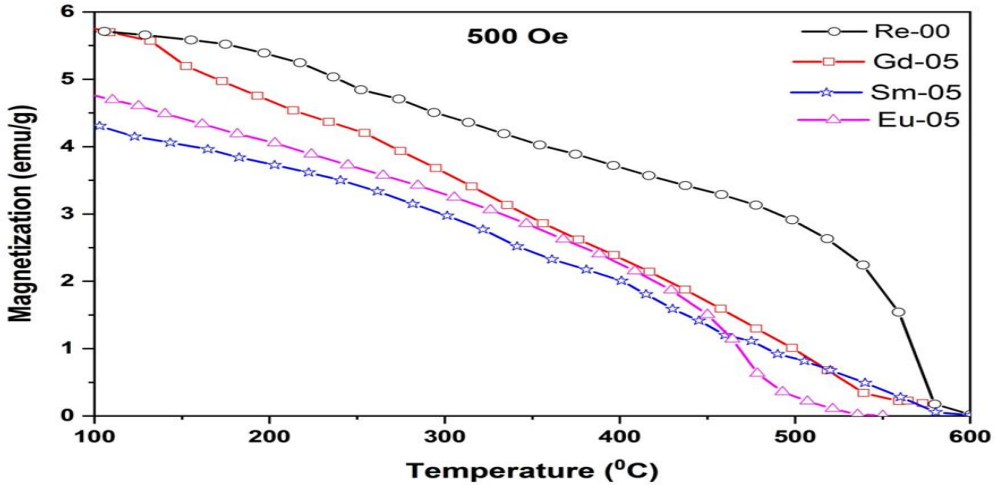
For its magnetic property measurement for its applications to agriculture based materials, Engineering materials to medicine.



Vibrating Sample magnetometer(VSM)

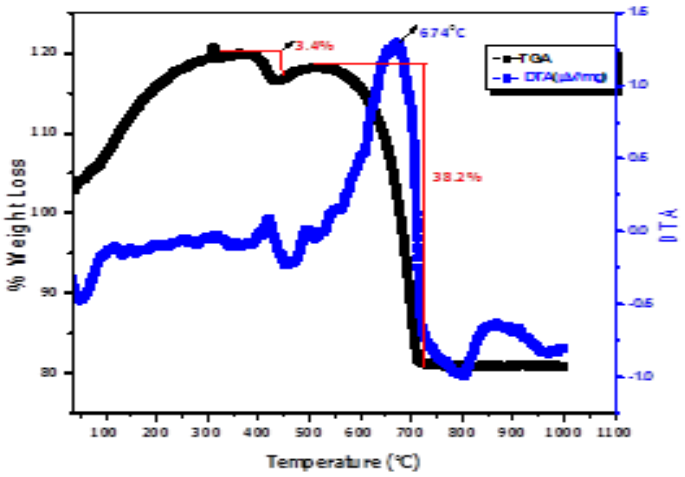


Magnetic measurement of Cu based Tamra bhasma reveal that bhasma are Nano crystalline super paramagnetic, support its medicinal value with magnetic storage devices.



Thermal analysis characterization Lab

For evaluation of enthalpy, activation energy, thermal decomposition temperature for food, agriculture, engineering and various others materials.



JOURNAL OF NATURAL REMEDIES
DOI: 10.18311/jnr/2021/26225
RESEARCH ARTICLE

Preparation and Exploration of Physical Properties of Calcium based Indian Origin Ayurvedic Medicine-Shankh Bhasma (Marine Drug) as Nanomaterials for its Applications

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Anveshika Activities - Initiative of Prof. H.C.Verma, IIT Kanpur

Natural process of Learning through low cost experiment and Inspire for innovations at all levels of Study

An open laboratory to nurture Young Minds at all levels of study

- ✓ Impact -We have demonstrated these experiments under various situations including regular classrooms/ special lecture session and found that when combined with right type of questions, they are very effective tools for concept-building and interest generation in Basic Science and Scientific Research of Interdisciplinary nature.
- ✓ About 25 teachers and 100 students are in came in close contact and working for science education, Research. Such activity also foster growth in higher education
- ✓ Low cost learning science at all levels of study laboratory was established as Community science

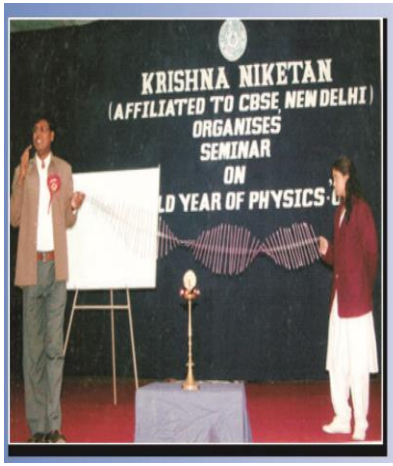
Best Practices- Laboratory for all for Natural process of learning

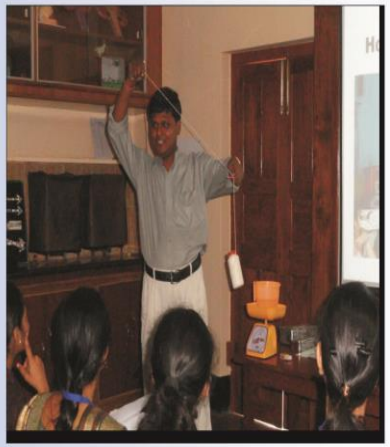
National Anveshika Experimental Skill Test (NAEST)- Research driven learning

Working for uplifting Science Education and related Innovations at all levels of Study

Initiative of Padam Shree Prof. H.C. Verma, Dept. of Physics, IIT Kanpur

Experiments are integral part of science. History shows how careful observations and suitably designed experiments have changed the course of human development in all aspects. To promote these skills among students, National Anveshika Network of India (NANI), a unit of Indian Association of physics Teachers, conducts a competition NAEST (National Anveshika Experimental Skill Test) based on Physics Experiments each year since 2014. This is probably the only test of its kind in India. In the First round which is called Screening Round, 8 to 10 short videos of some innovative experiments related to natural phenomenon and beyond class room activities/ daily life will be shown to the students and questions will be asked to test their observation skills and basic understanding of the subject. Selected students from the Screening round will be allowed in the Prelims round which will be conducted by the 26 Anveshika across the different parts of country. This round focuses more on performing experiments and analyzing the data by the participants. This activities are being carried out in last 12 years across the nation





Achievements of the Centre at National/International Level

National linkage from Faculty/Research scholar for promoting/Sharing teaching and research programme.

- Nalanda university Rajgir
- Indian Institute of Technology, Kanpur.
- School of Materials Science & Technology, IIT, BHU, Varanasi.
- Indian Institute of Technology, Patna.
- Magnetic Measurement Laboratory, National Physical Laboratory, New Delhi
- Dept. of Physics & Ferroelectric Material research center, A N College Patna
- P.G. Department of Physics, Patna University, Patna
- Nalanda University, Rajgir, Bihar
- Interuniversity Accelerator center(AUAC) New Delhi
- Indian Institute of Information Technology and Management(IITM), Jabalpur
- VTU Banglore and RMRI Patna

Require potential Collaborators / support for R & D activities

- ✓ **We have all 6 advanced materials science and nanotechnology laboratory. For sustainability, support for AMC & maintenances is urgently required.**
- ✓ **Industries on production of silica nanomaterials from agriculture waste rice husk, ecofriendly production of ceramics magnetic nanomaterials, evidence based Ayurvedic nanomedicine and Food materials are possible for Atma nirbhar bharat. We require help of potential industries parterner.**

Plan to set up Hydroelectric Cell institute for Green energy source
Require Industry partener and Collaboartors

- Pride of India: Path Breaking Invention from India
- Offers safe, clean, low cost, reliable power generation
- Useful by-products (H_2 gas as clean energy & $Zn(OH)_2$ nanoparticles for industries)
- Portable (Easy to carry)
- Uses few drops of water as fuel
- Environment friendly
- Safe for human health
- Green Energy Source Made in India

Applications

Table lamp or fan, Mobile charging, Torch, Video camera, Laptop charger, etc.

Publications and International Recognitions

❑**R. K. Kotnala, and Jyoti Shah, Green hydroelectrical energy source based on water dissociation by nanoporous ferrite, International Journal of Energy Research, Int. J. Energy Res., Vol. 40, issue 11, 2016.**

❑**Jyoti Shah, Ravinder Kumar Kotnala, Rapid green synthesis of ZnO nanoparticles by hydroelectric cell without using any electrolyte, Journal of Physics and Chemistry of Solids 108 , 15–20, 2017.**

•US Patent Application No.**US 20160285121 A1,**

•Indian Patent # 792/DEL/2015

For more technical details contact: ***We have been associated with Prof. Kotnala since more than 15 years***

Dr. R.K. Kotnala*, Head of Environmental Sciences & Biomedical Metrology Division, CSIR-NPL, New Delhi*

Email : rkkotnala@gmail.com Webpage :http://www.drrkkotnala.com, Phone :9811237051;

**For demo visit www.youtube.com/watch?v=P0BTHFF8ENI*

Europe to bet up to €1 billion on quantum technology- Frontiers area of Science

Two similarly ambitious schemes showering money on a single topic, called Flagship projects, have been underway in the European Union since 2014. One focuses on the study of graphene, the other on a computer model of the entire human brain.

Youth must be made to understand the beauty of doing science, the pleasure of doing science, and the ultimate bliss when results of science make you understand nature, master it, control it, and finally make things that improve the quality of life of humankind.

Advance in Nanotechnology not Nanoscience-?

Scientific values for Scientific Infrastructure

- According to Article 51-A (h) of the Indian Constitution the duty of every citizen is to develop scientific temper along with humanism and a sprit of inquiry and reforms.
- It has also been stated in The Bhagwat Gita that our world civilization and societies have risen to a higher level not through mechanical or technological efficiencies but practicing sound moral and ethical values.

1. Dr. Rakesh Kr Singh 2. Dr. S. Prasad, 3. Dr A.K.Bhomik, Director, I.I.T Patna
4. Dr. S.Lal, V.C, Patna Univ 5. Dr. K..L. Chopra, Director- I.I.T Kharagpur
6. Dr. Kotnala, Dy- Directoir, NPL-Delhi 6. Dr.Sister D' Souza, Principal, PWC

Happy

Science & Technology

There is plenty of room at the bottom


THANK YOU