



भारतीय सूचना प्रौद्योगिकी संस्थान, नागपूर

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, NAGPUR

"An Institute of National Importance by an Act of Parliament"

Nano SciTech Laboratory

Department of Basic Sciences and Engineering

Welcome to Nano SciTech Laboratory

Nano SciTech Lab was established in 2018 at Indian Institute of Information Technology Nagpur by Dr. Aatish S. Daryapurkar to build up a strong research team to pursue high-quality innovative research. This lab works as a nodal point in India to bring academia, industry and public research organizations under one umbrella for research and development in nanotechnology. The lab simultaneously support research with the academia and develop products with the industry and also offers a wide range of capabilities designed to enhance the study and synthesis of nonmaterial.

Our Objectives:

The guiding mission of Nano SciTech Lab is to provide a benchmark for state-of-the-art research, learning and outreach in the fields of science and nanotechnology.

- ✓ *Establish strong connections between science and technology, Bridge the gap between research and commercialization*
- ✓ *To provide facilities to research scholars, scientists at IITN and from other Institutes and industries through collaboration to enhance the research activities among the communities.*
- ✓ *IITN strives to actively promote and participate in all aspects of nanotechnology research – education, industry standards and policy.*
- ✓ *To train research scientists and engineers to pursue high-quality innovative research.*

About Nano SciTech Laboratory:

Nano SciTech Lab is a resource formed to serve academic, industrial and governmental researchers in the field of nanotechnology from across the country. The Lab objective is to create technically sophisticated manpower for research in the field of nanoscience and nanotechnology, including inter-university network. In addition to the research activities, Nano SciTech Lab is also involved in developing technologies that can be commercially availed by the industries.

Facilities available @ Nano SciTech Lab :

Electrospinning Unit (Super ES-2)

Electrospinning technique is widely used to synthesis nanofibers of variety of materials such as polymer, ceramics, and metal oxides etc. There are more than 100 kind of polymers could be used as raw materials. Such as PEO, DNA, PAA, PLA, and also protein, collagen, organics such as nylon, polyester, acryl resin, and PVA, PS, PAN, peptide, cellulose, so on and so forth. Nanofiber Electrospinning Unit is capable of producing 20 to 1000 nm diameter fibers. The nanofibers have attracted more attention of research community because of its high specific surface area, small diameter and large porosity.



Technical Specifications

Voltage range	0-50KV.
Flow rate	0.1 μ l/min - 3ml/min.
Collector RPM	200 - 5500 RPM.
Spinneret type	Single nozzle Multinozzle Coaxial
Collector type	Rotating drum, Stationary Plate, Disk, Wire drum.
Chamber temp.	Room temp - 70°C
Syringe pump	Two channel with independent control
Spinning	Vertical, Horizontal, Co- Spinning Computer.

Drum oscillation stage
Cylindrical spinning unit supports for low vacuum and inert gas spinning operations
Computer control operation.



Principle of Electrospinning unit: A typical electrospinning technique is based on that strong electrical repulsive forces generated by AC/DC voltage source in the range of several tens of kVs in order to produce electrostatic forces. This force overcomes the weak forces like surface tension in the liquid droplet. The electrostatic forces affecting the liquid cause the shape of the droplet to change from rounded meniscus to the elliptical Taylor cone, At this critical point, the applied electric field eventually becomes more prominent and overcomes the surface tension of the liquid leading to a charge jet of the solution ejected from the tip of the Taylor cone. As the jet travels through the air with an unstable whipping of the jet occurs in the space between the tip and the collector. This leads to evaporation of the solvent, leaving behind the solid continuous 1-Dimensional nanofibers deposited over the grounded collector.

Applications of Nanofibers: Because of the unique features, nanofibers are useful in diverse applications, such as

- Energy harvesting devices
- Sensors
- Oil-water separation
- Air filtration
- Lithium-air battery
- Tissue engineering
- Cancer diagnosis
- Drug delivery
- Textiles industry

Electric Furnace (OKAY-60F4)

An electric furnace is a kind of heat producing equipment using electric power. It is used for high-temperature heating, in research for the purpose of Annealing, calcinations and sintering of the synthesized material. It is also used for heating purpose in various industrial production processes. Electric furnaces are used where more accurate temperature control is required.

Depending upon the method of heat generation, there are three types of electrical furnaces namely:

(1) **Induction Heating Furnace:** Induction heating furnaces, the induction heating of metal is used to generate the heat.

(2) **Arc furnace:** In arc heating furnace, the electric arc is used to generate the heat in the heating chamber.

(3) **Resistance Heating Furnace:** In resistance heating furnaces, the resistance heating elements are used to generate the heat in a heating chamber. The heating elements used are Nichrome wire, Kanthal wire or Graphite rods depending upon the temperature requirements. The temperature is controlled using thermostats and the temperature is monitored by thermocouples. The heating chamber is constructed by M. S. Sheets and channels and for thermal insulation, fire clay brick sand refractory bricks are used.



Technical Specifications

Operating temp.	1600°C Max for 1hr run 1500°C for continuous run
Heating rate	1°C/m-30°C/m
Temperature uniformity	±3°C
Time to reach max temp.	90Min.
Program	12 Segmented



Manual Hydraulic Pellet Press Machine (PCI)

A hydraulic press is a device using a hydraulic cylinder to generate a compressive force. In research Hydraulic presses are commonly used for molding synthesized material into pellet to study their properties.



Technical Specifications

Max. force/load	15 tons.
Max pressure holding time	10 min.
Max Size of Die	80 – 90 mm ² (Outer) 8 mm diameter (Inner)



Ultrasonicator (LABMAN)

Ultrasonic cleaning is based on the cavitations effect caused by high frequency ultrasonic wave vibration signal in the fluid. Microscopic bubbles are formed and they implode violently causing the cavitations which creates an intense scrubbing action consistently on the surface of the item being cleaned. Ultrasonic cleaning is extremely effective at removing dirt and grime which worked normally require tedious manual cleaning by hand. Sonication is commonly used in nanotechnology for evenly dispersing Nanoparticles in liquids, to break up aggregates of micron-sized colloidal particles, to speed dissolution by breaking intermolecular interactions and cleaning laboratory Utensils.



Technical Specifications

Frequency	40 KHz.
Temperature	0-80°C.
Timer	1 -99 Min.
Capacity	3 Lit.
Red LED digital display.	

pH Meter (DELUXE-101)

A pH meter is a scientific instrument that measures the hydrogen ion activity in water based solution, indicating its acidity or alkalinity expressed as pH. The pH meter measures the difference in electric potential between a pH electrode and a reference electrode.



Technical Specifications

Parameters	pH, mV and Temperature
Range	2.00 to 20.00pH
Resolution	0.01 pH/Hr
Temperature	5 to 110°C

Electronic Balance (CONTECH-CAH-223)

Electronic balance allows the user to quickly and accurately measure the mass of a substance to a level of accuracy upto four decimal digits which is impossible for traditional balances to achieve.



Technical Specifications

Capacity	200g
Accuracy	0.001 gm
Readability	0.1g
Stabilization time	4s
Linearity error	+/-0.1g
Tare range	0-200g

Hot Plate Magnetic Stirrer (REMI-1MLH)

Hot plates are generally used to heat glassware or its contents and magnetic stirrer, allowing the heated liquid to be dissolved or mixed well automatically using provided magnetic needle.



Technical Specifications

Temperature range	5°C - 160°C.
Stirrer Speed range	60 - 1800 rpm.
Capacity	1 Lit
Speed display facility.	

Rotamantle (REMI-1RML)

Rotamantle is specially designed to meet laboratory requirement of convenient stirring in flask with simultaneous uniform heating by heating mantles. These have two tier constructions with the upper compartment consisting of heating element. Accurate stepless speed control allows smooth variation up to 1200 rpm. Heating energy is controlled by energy regulator.



Technical Specifications

Temperature range	5°C - 300°C.
Stirrer Speed range	60 - 1800 rpm.
Capacity	1 Lit
Speed display facility.	

Hydrothermal Autoclave (Delta HA)

The Hydrothermal Autoclave Reactor is a pressure chamber used to carry out chemical reactions requiring elevated temperature and pressure different from ambient air pressure. Autoclaves are used to grow crystals under high temperatures and pressures in the hydrothermal synthesis.



Technical Specifications

Max. Operating temp.	≤240°C.
Safe temperature	200°C.for 1 hr
Working Pressure	≤3MPa or 30 Bar.
Heating and Cooling Rate	≤5°C/min
Capacity	200ml
Material used	Shell made of high-quality nonmagnetic stainless steel 306

Reflux condenser

Reflux is a technique use to supply thermal energy to the reactions over a long period of time at an elevated, controlled temperature (i.e. the solvents boiling point) and ambient pressure. The vapors produced from the mixture are condensed by the condenser equipped with the water-cooler system, and return to the vessel through gravity.



Technical Specifications

Temperature range	5°C - 300°C.
Stirrer Speed range	60 - 1800 rpm.
Capacity	500ml
Speed display facility.	

Group Information

Our group is active in the broad area of Materials Science, Nanoscience & Nanotechnology.

Group Members

Group Leader

Dr. Aatish S. Daryapurkar

JRF/Project Fellow

1) Jan 2018 to April 2018 – **Neha Manmode**, Current Position:

2) June 2018 to present – **Roshan Raut**,

PhD Students

Post-Doc Students

Technical Staff

Group Research Interest

- Investigation of ceramic nanofiber of various lead free ceramic materials, such as Dielectric, Ferroelectrics, Piezoelectric and Multiferroics synthesized using electrospinning technique for energy harvesting and Gas sensing applications
- Investigation of multifunctional oxide thin films including multiferroic, dielectric, ferroelectric and piezoelectric thin films grown using various PVD and CVD techniques for various nanoelectronic applications.
- Explore the perovskite materials for Resistive Switching Devices.
- Piezoelectric and magnetoelectric energy harvesting possibly for battery materials.

Associated Projects

A research projects extensively use NANO SciTech Lab resources as well as contribute to its expansion. There is a major project currently associated with our facility.

- ✓ **Electro spinning of lead free NBTBT₆ based materials for sensors and energy harvesting applications.**

Our association

We actively encourage and participate in research association with academic institutes and industry across the globe.

International association

- ✓ **Dr. Frank Clemens**, EMPA, the Swiss Federal Laboratories for Materials Science and Technology, Switzerland, Dubendorf.

National association

- ✓ Indian Institute of Technology (IIT Bombay), India
- ✓ Indian Institute of Technology IIT Kanpur, India.
- ✓ VNIT Nagpur, India.
- ✓ Department of physics, RTM Nagpur University, Nagpur, India.
- ✓ etc.

List is not limited.....

Who can apply?

We welcome and encourage the candidate to apply in the research Lab who are passionate towards research and who have outstanding academic credentials. They can send their CV along with statement of purpose/ Interest to group leader. The selected candidates will be asked to submit all the necessary documents and verify with original.

Prospective Students and Research/Post-doctoral Fellows

- ✓ DST inspire faculty
- ✓ National Post-Doctoral Fellow (N-PDF).
- ✓ Scheme for Young Scientists and Technologists
- ✓ Scheme Women Scientists
- ✓ Interns

You can show us your interest through email, However, you would still need to formally apply to the Department of Basic Sciences and Engineering, IIIT Nagpur. Those interested may look out for the advertisement on the IIIT Nagpur website time to time. We welcome candidates under above listed categories or other fellowships to work in our laboratory based on mutual agreement on research topics and interests which is also bound to the Institute policies.

Duties and Opportunities

Successful candidates are required to make significant contributions in research and through publications in International/National journals and conferences.

Postdoctoral and other Fellows: Nano SciTech Lab aims to develop a strong science research and manpower base. It runs initiatives to attract scientists, support competitive funding of research, establish research centres and engage eminent science and technology leaders. We place very high importance on internships as a key talent pipeline. We look for candidates with technical background and have a passion for pursuing a research career.

Internships: Nano SciTech Lab motivates and encourages young undergraduate students to take up science and technology as a career by providing research experiences in our research lab. The students get to meet our researchers and get invaluable practical exposure and training. Throughout the internship period they will receive excellent guidance and technical support. Please find details about internship on IIIT Nagpur website.

Contact us/ Visit us:

Dr. Aatish Daryapurkar

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Maharashtra 440006

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Call - +91 9867245331



How to get here:

The temporary campus is located in green area of Nagpur known as Seminary hills. It is centrally located and well known area.

Its distance from all respective public transport facilities respectively is as follows,

Nagpur main Railway Station: 5.5 Kms

Nagpur Airport (DBAIAP): 12.5 Kms

Nagpur Central Bus Stand: 7.2 Kms. The nearest landmark is TV Tower or Balaji Temple.