



## Address by the Director IISER Mohali

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### Press Brief

June 15, 2024: Press Club Chandigarh

#### *Key Points.*

Indian Institute of Science Education and Research Mohali is a center of academic excellence to impart quality science education and inculcating the spirit of research through innovative teaching and research. The objective of the institution is to educate and train a new generation of scientists dedicated to the pursuit of knowledge in frontier areas of basic sciences. In an intellectually vibrant academic environment, IISER Mohali nurtures the basic tenets of science education and research at undergraduate and postgraduate levels. In so doing, the institute aims to emerge as a global center of learning, academic excellence, and innovative research. The institute provides students with a platform for interdisciplinary research which not only gives them a well-rounded perspective but also helps them keep in view the sociological relevance of science education and research.

In addition to imparting education, the key aim of the institution is knowledge progression which clearly seen by our numbers:

The institution has about 1700 students in the BS-MS programme and about 475 students are pursuing PhD in the Institute. This would not be possible without dedication and commitment of our eminent faculty.

On completion of the successful 2023 – 2024 academic programme, 13<sup>th</sup> convocation of IISER Mohali is scheduled on June 19, 2024. Prof. Ashutosh Sharma, President, Indian National Science Academy and former Secretary Department of Science and Technology, Govt. of India, will be the Chief Guest and Prof. J. S. Yadav Chairperson, Board of Governors, IISER Mohali will preside over the function. About 300 students will receive degrees during the convocation. I extend my invitation to all of you to attend the convocation.

Some of the achievements of the last one year are:

- More than 440 publications
- Filing of 3 new patents
- 3 previously filed patents have been granted

Let me introduce the exemplary research work being undertaken in IISER Mohali using four examples.

1. Professor Purnananda Guptasarma of the Department of Biological Sciences at IISER Mohali and the Dean of Faculty Affairs, has been bestowed with the prestigious Tata Transformation Prize by Tata Sons and The New York Academy of Sciences. Professor Guptasarma's enzyme-driven strategy demonstrates that solid PET can be broken up into its smallest molecular building blocks with high yield and ultra-high purity to enable PET's degradation and recycling into virgin plastic.
2. Dr Subhabrata Maiti and his team at the Department of Chemical Sciences have achieved a significant milestone in imitating dynamic adaptability, a characteristic often observed in living systems. These systems can revolutionize information processing, cargo transportation, and sensor technology. The

research article is published in Nature Communications, 2024.

3. Dr Sabyasachi Rakshit, Dr K. P. Yogendran, and Dr Abhishek Chaudhuri from the Departments of Chemical Sciences and Physical Sciences have developed a new understanding of how the ear works. These new findings could have profound implications for the field of audiology.
4. In a similar feat, Dr Abhishek Chaudhuri and his team have inferred the movement of the suspended passive object in the active fluids. It could potentially lead to the development of tiny nanomachines and new materials with extraordinary properties, inspiring future advancements in biophysics and fluid dynamics.

(A detailed note on these four research areas is attached for further reference.)

Our **Technology Business Incubator**, i-RISE, promotes the culture of startups and industry academia collaboration. The i-RISE has cutting edge infrastructure including labs, office, and meeting spaces as well as lab equipment worth 2 crores.

i-RISE has supported around 40 start-ups in the past three years, with 20 currently incubated across various sectors like Biotech, Agritech, Healthcare, Waste Management and IoT. i-RISE hosts the Open Knowledge Session Series. It promotes innovation-led entrepreneurship among researchers and students. i-RISE conducted a Tech Startup Mentoring Workshop to promote women in Business. It incubates and funds 20 women-led tech start-ups.

i-RISE's incubated start-ups have made notable achievements, including filing 12 patents with 9 patents granted to start-ups. Eighteen incubated start-ups have received cumulative funding of Rs 4.2 Cr from various agencies.

(A detailed note on the TBI is attached for further reference.)

**Outreach Activities at IISER Mohali.** We are very conscious of our scientific social responsibility. We are engaging with the schools in Punjab, Chandigarh, Himachal, Haryana, and Uttarakhand and provide training in science and mathematics to both school teachers and students. We equip school teachers with innovative teaching and learning strategies to help improve the overall educational scenario in the region. We are a nodal centre for the Vigyan Pratibha project by the Department of Atomic Energy. We have also contributed in designing Mathematics and Electricity Galleries in the Pushpa Gujral Science City.

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## Contact

Prof. Amit Kulshrestha (deanoutreach@iisermohali.ac.in)

Dr. Shilpa Chaudhary (shilpachaudhary@iisermohali.ac.in)

Phone: +91 172 2240 121 (Extn. 55)

[Embargo until 11:00 am on June 15, 2024]

## Press Release

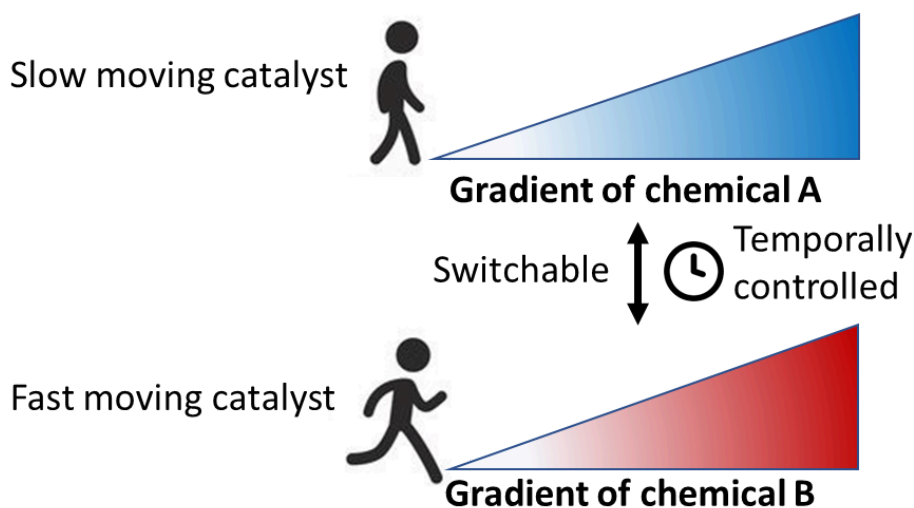
### Revolutionizing Synthetic Materials Engineering: A Leap in Mimicking Nature's Adaptability

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[IISER Mohali, June 15, 2024] – In a groundbreaking development at the forefront of materials science, researchers have achieved a significant milestone in imitating dynamic adaptability, which refers to the ability of a material to change its properties in response to its environment, a characteristic often observed in living systems.

Led by Dr Subhabrata Maiti and his team at the Department of Chemical Sciences, this pioneering research marks a significant step towards creating synthetic materials that can dynamically evolve, respond, and interact with their environment.

Synthetic materials are made by chemically changing the starting substances to create a new material with novel attributes. Syngas and plastics are simple examples of synthetic materials.



In brief, in this work, enzymes were utilized to control the movement of colloidal particles and ATP hydrolysis, a process where ATP is broken down into ADP and inorganic phosphate, was used to speed up that movement. It's like having tiny motors powered by breaking down ATP molecules.

"Living systems are masters of adaptation, responding to their environment with precision. However, human-made materials often lack this flexibility," says Maiti. "Drawing inspiration from nature's finest, such as a colony of ants, we are trying to engineer synthetic systems that mimic life-like behaviours. These systems can revolutionize information processing, cargo transportation, and sensor technology", he adds.

When fresh cucumber is placed inside salty water, due to osmosis, the water inside the fruit flows through the skin until the water inside and outside the cucumber is equally salty. As the cucumber loses the water inside it, it shrinks up and wilts, becoming a pickle. "Notice that the movement of the water did not require any external energy; it was self-propelled, induced by the high-to-low salt gradient. Several cellular processes use this mechanism of chemical gradient to switch on and off chemical reactions. We try to exploit the very same mechanism," says Maiti.

The team has introduced a groundbreaking synthetic nanomaterial named CMB. Just as the water molecules from a pickled cucumber move out, they found that the CMB particles could self-propel in a chemical gradient of nucleotides, marking a significant advancement in materials science.

The novel material consists of a carboxylic acid-modified polystyrene fluorescent bead electrostatically bound with cationic cetyltrimethylammonium bromide-coated gold nanorods. Just as water moves from an area of high concentration to low through osmosis in pickles (achar), the CMB is self-propelled in a mixture of nucleotides, namely adenosine mono/di/triphosphate (AMP/ADP/ATP).

The self-propelled movement of novel synthetic material, CMB, in a nucleotide chemical gradient can be exploited to modulate several processes. Manipulating the chemical gradient, a biocatalyst can be switched on and off at the right time and place or transport distinct molecules from one place to another in complex biomolecular systems. These synthetic materials mimic cellular chemistry.

The research results hold immense potential for various industries. "The findings could revolutionize the programming of colloid delivery for chemical processes (e.g. catalysis or drug release) as a function of space and time by switching on or off self-propelled motion. Moreover, these active catalysts can function as sensors in far-off places because they don't need external power sources. Currently, research is being done to explore information processing since it can pair information via directed motion in chemical or light gradients," says Maiti.

This milestone, a testament to the power of collaboration, underscores the importance of interdisciplinary teamwork in scientific breakthroughs. It paves a promising pathway towards a more sustainable and technologically advanced future as industries seek innovative materials to meet evolving demands.

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*The research team included Ekta Shandilya, Bhargav Rallabandi, and Subhabrata Maiti (smaiti@iisermohali.ac.in)*

The research publication, "In situ enzymatic control of colloidal phoresis and catalysis through hydrolysis of ATP". Nature Communications, 2024, 15, Article no. 3603. can be accessed at <https://www.nature.com/articles/s41467-024-47912-2>

Press Release [Embargo until 11:00 am on June 15, 2024]

## How can we listen to a delicate whisper yet bear with the blaring noise?

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[IISER Mohali, June 15, 2024] - A sensitive mechanism that can detect faint sounds would shatter when hit with a deafening noise. While our hearing mechanism is able to hear very low frequency sounds, scientists have long wondered what protects it from loud noises?

Dr Sabyasachi Rakshit, Dr K. P. Yogendran, and Dr Abhishek Chaudhuri from the Departments of Chemical Science and Physical Science of the Indian Institute of Science Education and Research Mohali have made a groundbreaking discovery. They have shown that a fantastic feature in our ears, known as 'tip-links', helps to both hear soft sounds and protects from loud sounds. This is a completely new understanding of how the ear works and could have profound implications for the field of audiology.

Just as the pupil of the eyes dilates in the dark and contracts in bright light, adjusting the amount of light that falls on the retina, the tip links in our ears enables us to 'see' in dim sound environments and protects us from 'harsh' sound environments.

The inner ear has a particular type of cells called hair cells that can detect sound. The hair cells have minuscule hair-like protrusions on the surface called stereocilia. The stereocilia are connected to each other by tiny protein-protein complex called tip-links. These tip links make the rows of cilia sway together in response to sounds. This swaying converts the sound's physical force into an electrical signal by opening some ion channels. Thus tip-links are very important for hearing. In addition, tip-links can also act as force sensors and force filters, protecting the hearing mechanism from loud noises.

"The tip-links act like the force sensor, balancing the incoming force and stepping in to protect us from the danger", researchers say.

When the sound is very low, the tip-link detects the subtle mechanical signals from incoming sounds, converts them into electrical signals, allowing us to hear the faint sounds. If the sound is intermediately loud, the tip-link acts as a force filter, selectively transmitting low forces to activate ion channels while blocking intermediate force levels.

In a surprising twist, when faced with highly elevated forces from loud noise, the tip-links disengage altogether, dissipating the force and thus preventing damage to our hearing apparatus. This intricate mechanism is truly fascinating.

"By unraveling the intricate mechanisms of tip-links, we are paving the way for developing innovative strategies to protect against hearing loss caused by loud noises. With further research, we aspire to unlock more secrets of this fascinating biological system. This could potentially enhance the quality of life for millions affected by hearing impairment," the researchers expressed with optimism.

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*The team consists of Nisha Arora, Jagadish P. Hazra, Sandip Roy, Gaurav K. Bhati, Sarika Gupta, K. P. Yogendran, Abhishek Chaudhuri, Amin Sagar, Sabyasachi Rakshit (srakshit@iisermohali.ac.in)*

The research work, "Emergence of slip-ideal-slip behaviour in tip-links serves as force filters of sound in hearing" Nature Commun. (2024):15, 1595, can be accessed at <https://doi.org/10.1038/s41467-024-45423-8>

## Understanding the dynamics of small particles in a chaotic liquid

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[IISER Mohali, June 15, 2024] - What do flocks of birds, schools of fishes, dense swarms of bacteria and fluid matrix in a cell have in common? They are all considered active fluids- densely packed soft material whose constituents can move by themselves. However, it has so far been very difficult to understand how such fluids move and what their properties are.

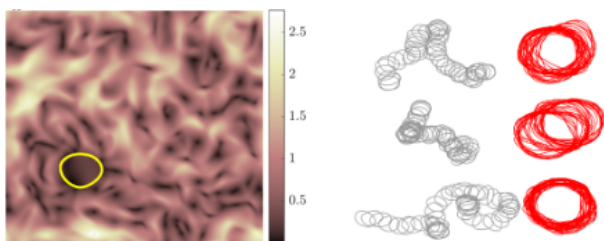
Dr Abhishek Chaudhuri is a Condensed Matter physicist with the Department of Physical Sciences, IISER Mohali. He and his team are trying to understand the hydrodynamics of soft and biological matter called microrheology.

"Active fluids encompass a wide range of phenomena. These systems share certain common features, but understanding their hydrodynamics and rheology, or flow patterns, is a highly intricate task," explains Dr. Abhishek Chaudhuri, highlighting the complex nature of the research.

"How does one understand the local and bulk mechanical properties of complex fluids such as the above? One of the methods is to suspend tiny tracer particles in the fluid and look at their dynamics," says Dr. Abhishek. For instance, the tracer particles tracked over time can tell us how vesicles and granules move inside the cytosol or the behaviour of dense swarms of bacteria.

Dr Abhishek Chaudhuri and Dr. Chamkor Singh have inferred the movement of the suspended passive soft object in the active fluids. "To investigate, we suspended a soft object with deformable boundaries, like a droplet, in an active turbulent fluid", says Abishek.

The droplet wobbles and its dynamics show periods of "runs" and "stays". At relatively low interfacial tension, the droplet begins to break and mix with the outer active bath. The researchers establish that the motion of the droplet is influenced by the interplay of spatial correlations of the flow and the size of the droplet.



This study could potentially lead to the development of tiny nanomachines and new materials with extraordinary properties, inspiring future advancements in biophysics and fluid dynamics.

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*The research team, consisting of Chamkor Singh and Abhishek Chaudhuri (abhishek@iisermohali.ac.in), has made a significant contribution to the field of biophysics and fluid dynamics with this study.*

The research publication, Anomalous Dynamics of a Passive Droplet in Active Turbulence. Nat Commun 15, 3704 (2024) can be accessed at <https://doi.org/10.1038/s41467-024-47727-1>.

## TATA Transformation Prize 2023

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Professor Purnananda Guptasarma of the Department of Biological Sciences at IISER Mohali, and the Dean of Faculty Affairs, won the inaugural Tata Transformation Prize from Tata Sons and The New York Academy of Sciences, some months ago, for research in the area of sustainability.

Professor Guptasarma's work is mainly in the areas of protein science and engineering, which is a sub-discipline of biochemistry, biophysics, molecular biology and biotechnology. The Tata Transformation Prize was awarded in recognition of some of his group's recent research on the enzymatic degradation of the plastic, polyethylene terephthalate (PET), by a novel enzymatic approach involving synergy between cutinase and carboxylesterase enzymes, for their demonstration of the degradation of solid PET polymer into pure, recyclable terephthalic acid (TPA). This research was recently published in several landmark papers, including one in the journal, Green Chemistry, which presented the best yet reported purity and yield of TPA through enzymatic degradation. The prize was awarded to support efforts to further improve enzymatic reagents and scale-up experiments. The prize consists of INR 2 crores, a medal, and a lifetime membership of The New York Academy of Sciences.



*The photograph shows Prof. Guptasarma receiving the prize medal from Shri. S. Somnath, Chairman of the Indian Space Research Organization, at a prize ceremony held on December 15, 2023, at Taj Lands End, Mumbai.*

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For further information, please see:

<https://www.nyas.org/shaping-science/awards/tata-transformation-prize/>





## **Society of Technology Business Incubator, IISER Mohali**

Mohali, Punjab – The Society of Technology Business Incubator (TBI) at IISER Mohali promotes innovation, supports start-ups, and enhances the country's entrepreneurial ecosystem.

With Cutting-Edge Infrastructure, i-RISE features a 10,000 sq ft facility, housing lab equipment worth Rs 2 Cr. The infrastructure includes dedicated office spaces, co-working stations, activity, seminar, and conference rooms, all designed to support incubated start-ups.

Comprehensive start-up support is provided through their IISER Start-up Incubation Program. i-RISE TBI IISER Mohali has supported around 40 start-ups in the past three years, with 20 currently incubated across various sectors like Biotech, Agritech, Healthcare, Waste Management and IoT.

Through their Educational and Networking Initiatives, i-RISE hosts the Open Knowledge Session Series in collaboration with partners such as Punjab State Council for Science and Technology, Innovation Mission Punjab, Chandigarh Angels Network, TiE Chandigarh and Rotary Club Chandigarh.

TBI IISER Mohali launched Ideaphied 2.0 to promote innovation-led entrepreneurship among researchers and students. Over 100 teams applied, with 80 teams shortlisted for a three-day mentoring workshop. The event culminated in 35 finalists pitching their innovative ideas to a jury, with winners receiving cash prizes and incubation support.

Promoting Women in Business, i-RISE conducted a Tech Startup Mentoring Workshop under the SHE 2.0 Program in association with PSCST. This two-week extensive mentoring program included 24 sessions and with over 30 mentors and industry experts. The program concluded with a pitch day in March 2024, providing incubation and funding support to 20 women-led tech start-ups.

i-RISE has provided funding support up to Rs 1.2 Cr to six start-ups under the Startup India Seed Fund Scheme.

i-RISE's incubated start-ups have made notable achievements, including filing 12 patents with 9 patents granted to start-ups such as Scicraft Innovation Pvt Ltd (Founder: Dr. Sanjeev Bhardwaj), Breww Therapeutics Pvt Ltd (Founder: Dr. Sudip Ghosh), and JV Scan Pvt Ltd (Founder: Dr. Maheish Hukmani). Eighteen incubated start-ups have received project support grants under various government schemes, with a total cumulative funding of Rs 4.2 Cr.

Incubated start-ups have had opportunities to network and showcase their innovations at various events, including Startup Synergy in Ludhiana, Life Sciences Startup Meet in Chandigarh, The Bhartpreneurs Conference and Exhibition Event in New Delhi, Samridhi Conclave by IIT Ropar, BIRAC Biotech Startups Expo in Jammu & Kashmir, TiE CON Chandigarh 2024, Startup Samagam 2024 in Ludhiana, and Startup Mahakumbha by DPIIT. Notably, Breww Therapeutics Pvt Ltd was selected from among 1500+ start-ups to interact with the Prime Minister of India at Startup Mahakumbha 2024.



TBI IISER Mohali has formalized partnerships and collaborations through MoUs with Innovation Mission Punjab, i-HUB AwaDH IIT Ropar, Sri Guru Govind College, Chandigarh, and Post Graduate Government College for Girls, Sector-11 Chandigarh.

As i-RISE moves forward, it remains dedicated to nurturing the next generation of entrepreneurs and innovators, ensuring sustainable development and prosperity. By providing robust infrastructure, diverse programs, and numerous networking opportunities, i-RISE continues to empower start-ups, drive technological advancements, and facilitate economic growth.

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For more information, please contact:

Satyendra Singh Choudhary, CEO-TBI IISER Mohali [ceotbi@iisermohali.ac.in](mailto:ceotbi@iisermohali.ac.in), +91 9696218778  
<https://www.iisermohali.com/>