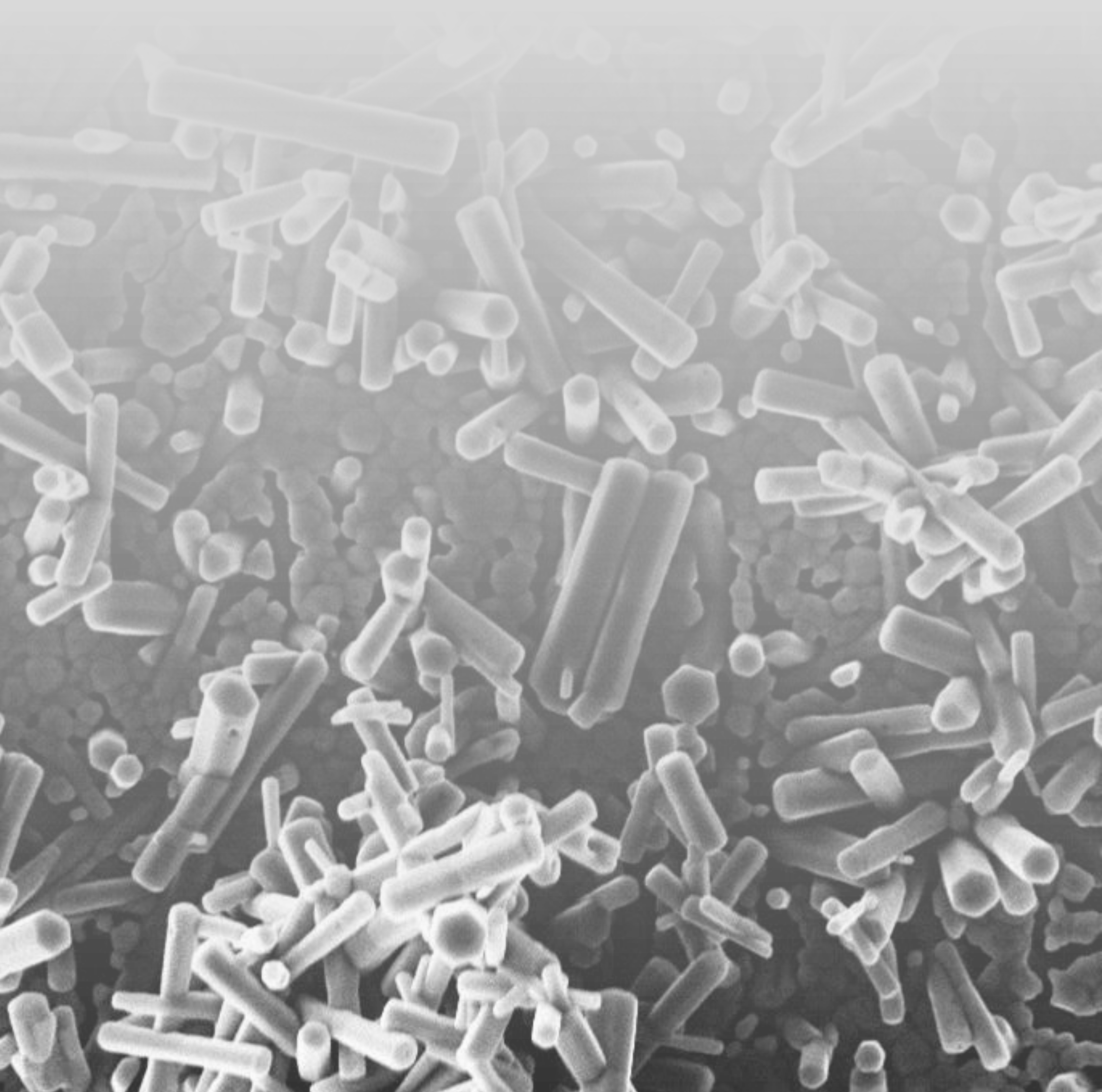
PressCeNSE

Issue: Q3 2023



Message from the Chair

"The CeNSE Newsletter is back after a hiatus!

COVID, 2020-2021, is now, thankfully, a receding sight in the rear-view mirror. Academic activities have rebounded and so has PressCeNSE."

- Srinivasan Raghavan
Professor, Chair, CeNSE

A particularly exciting development during this time that PressCeNSE has been off-air has been the announcement of the India Semiconductor Mission to bring semiconductor manufacturing to India by the Ministry of Electronics and Information Technology. In many ways COVID brought to the fore, the importance of semiconductors in our lives as the world moved to virtual work-spaces and demand for electronics rose. Academic fabrication and characterization facilities, such as the ones that exist in CeNSE, form part of the backbone of such ecosystems in the far east and the western worlds where the cutting-edge device fabs are concentrated. CeNSE is ready for the challenge.

Thanks to hard work done by many stakeholders, we're seeing some major developments after Prime Minister Shri Narendra Modi's visit to the United States. Applied Materials is investing around 400 million USD over four years to create a cutting-edge semiconductor innovation hub right here in India. Lam Research and CeNSE are embarking on a collaborative training program that leverages their software platform and our classroom experience to eventually train 60,000 Indian engineers. Micron Technology is putting 800 million USD into a 2.75 billion USD semiconductor assembly and test facility in India. Hats off to our industry affiliates, Applied Materials and Lam Research, for making all of this possible! Exciting times ahead for the world of semiconductors! Semicon India 2023 in Ahmedabad, the second gathering after the first one in Bengaluru, demonstrated that we are on the right growth trajectory.

In CeNSE we had the pleasure of hosting Shri Alkesh Kumar Sharma, Secretary, MeitY, who also inaugurated our new Vibrating Sample Magnetometer (VSM) Facility funded as part of MeitY's NAMPET project. Stan Williams, considered by many as the father of neuromorphic computing visited us and delivered the AMAT distinguished lecture. "Akanksha 2023," a program for the girl child from rural areas came and experienced the awesomeness of science right here at IISc. It was heartwarming to see their faces light up with excitement and many of them who said they wanted to become Doctors or IAS officers, wanting to consider engineering as a career post the program.

This issue includes the big strides being made by our researchers in microfluidics, photonics and 2D materials. While microfluidics is revolutionizing medicine in many ways from taking healthcare to the masses to expediting drug development, photonics is stepping out from, just being faster than electronics, to enabling spectrometers on a chip, by using the same microfabrication approaches that brought powerful computing on our palms.

But that's not all – we've got an awesome alumni story for you too! Anamika Singh Pratiyush shares her journey from CeNSE to GlobalFoundries, and it's all about adapting and learning in the world of semiconductors.

We have a new editorial team- Divya, Diggi, Aditya and Vasu- in place. We hope you enjoy reading this as much as we did putting it together. As always your feedback is most welcome.

- Prof. Srinivas Raghavan
Chair, CeNSE, IISc

CeNSE NEWS

Unlocking the Power of Nano Magnetic Materials: New VSM Facility at CeNSE, IISc

The Vibrating Sample Magnetometer Facility established under NAMPET III Program at CeNSE, IISC was inaugurated by Shri Alkesh Kumar Sharma, Secretary, MeitY, GoI on July 10, 2023.

Miniature power converters are very crucial for a variety of electronic products and technologies. This would require development of high-performance inductors with novel nano magnetic materials operating in high frequency range (MHz), so that inductor size can be drastically reduced.

Development of any such new magnetic materials requires a comprehensive test and characterization facility. The VSM facility established at CeNSE, IISc, is one of its kind facility accessible by any researchers in the country working in the area of power electronics and magnetic materials.

Versalab-3T is a cryogen free Physical Property Measurement System (PPMS) which uses a GM Cycle Cryocooler with air cooled compressor and comes with a temperature range of 50K to 400K.

Technology demos developed under MeitY, DST and MoE funded project NNetRA

theranautilus Nano-robots

AGNIT GaN Technology

ShanMukha Portable PCR Tech.

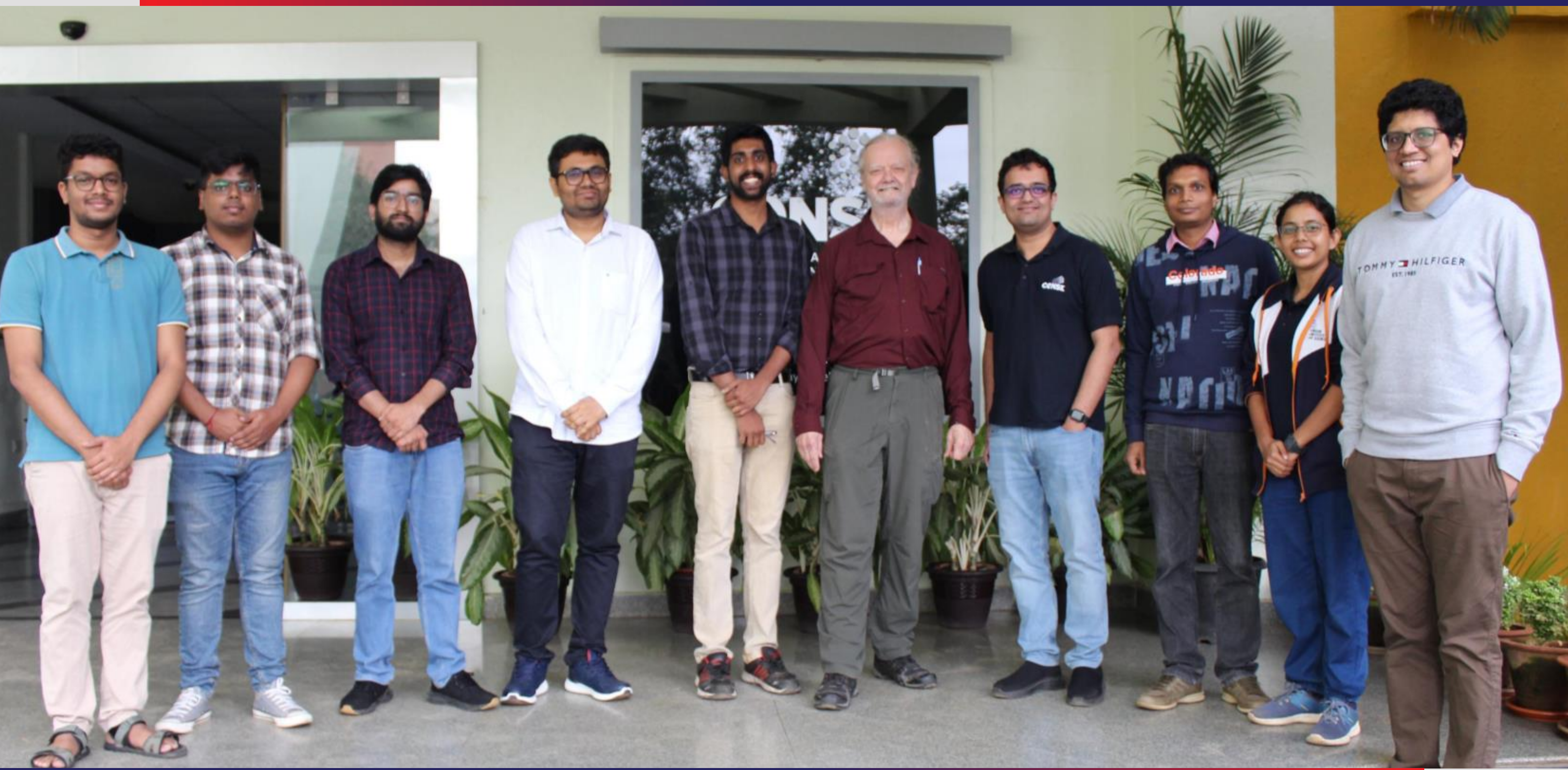
Indigenous Laser Technology & Photonics based fruit ripening sensor

Gas sensors transferred to ISRO

Soil Moisture Sensor

The review by Shri Alkesh Kumar Sharma included high TRL demos developed as part of the project and in the process of being transferred for commercialization included nano-robots licensed to a startup Theranautilus, GaN technology licensed to a startup AGNIT Semiconductors Pvt Ltd, Portable PCR technology licensed to startup ShanMukha Innovations Private limited (IISC), Photonics based fruit ripening sensor, Indigenously developed laser technology in collaboration with Bharat Electronics Ltd., Gas Sensor systems transferred to ISRO and soil moisture sensor.

Visit by Prof. R Stanley Williams, ECE, Texas A&M University



Professor R. Stanley Williams, the HP Enterprise Chair in the Department of Electrical and Computer Engineering at Texas A&M University and the Director of the US DOE Energy Frontier Research Center known as Reconfigurable Electronic Materials inspired by Nonlinear Neuron Dynamics (REMIND), graced CeNSE with his presence in July 2023.

His pioneering research in nanotechnology is characterized by a multidisciplinary approach, integrating lithography and nanoimprint lithography, with a focus on Memristor technologies intersecting with artificial neural networks, neuromorphic engineering, and resistive random-access memory (Memistor).

Professor Williams' scientific journey commenced in the realms of solid-state chemistry and physics, subsequently branching into nanostructures and chemically assembled materials, emphasizing thermodynamics in relation to size and shape. His exploration of the fundamental boundaries of information and computing eventually led to his current endeavors in nanoelectronics and nano-photonics.

During his visit, Professor Williams delivered a distinguished CeNSE IAP-AMAT Lecture titled "Turning Mathematical Concepts into Physical Reality – Realizing Edge of Chaos in Materials for Neuromorphic Computing" on July 7, 2023.

Akanksha 2023
Nurturing Young Talent: Empowers Rural Girl Students in Science and Technology

CeNSE, IISc organized "Akanksha" 2023 for ten Class XI girl students, from schools of rural Karnataka: Mysore and H D Kote districts during 17th to 21st July 2023 and Chamrajanagara and Kollegala districts during 24th to 28th July 2023. These students stayed on the IISc campus, interacted and learned from students, researchers, professors and scientific staff, and also explored student life on campus. They underwent training with a series of lectures, hands-on cleanroom fabrication and characterization sessions and visits to specialized labs. It was exciting hosting these young talented students.

CeNSE, IISc exhibited at the Semicon India 2023

The conference was held from 25th – 30th July, 2023 at Mahatma Mandir, Gandhinagar, Gujarat

The SemiconIndia 2023 event served as an ideal platform for engaging with a diverse spectrum of individuals hailing from various domains that collectively enrich the semiconductor landscape in India. This encompassed representatives from governmental bodies, esteemed bureaucrats, academic institutions, industry leaders, dynamic startups, and proficient freelancers.

Our engagement with students from schools and colleges, as well as numerous industry professionals, was indeed a gratifying experience. During this interaction, we showcased a range of technologies developed within our institution, highlighted the extensive facilities available for access, and introduced the diverse training courses tailored for both students and working professionals. This exchange of insights and knowledge proved mutually beneficial, fostering a productive exchange between our institution and the attendees.

At the event, we had the privilege of signing a Memorandum of Understanding (MoU) with Lam Research, marking the beginning of a promising partnership. Read further for more details.

Lam Research – CeNSE, IISc MoU Signing

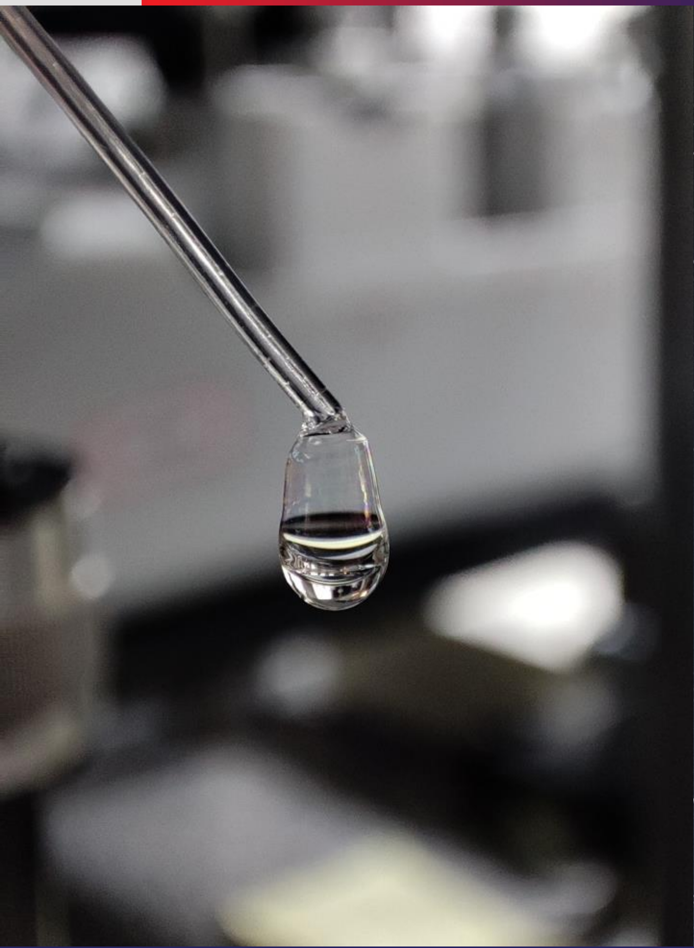
“Developing the semiconductor workforce in India using Semiverse™ solutions”

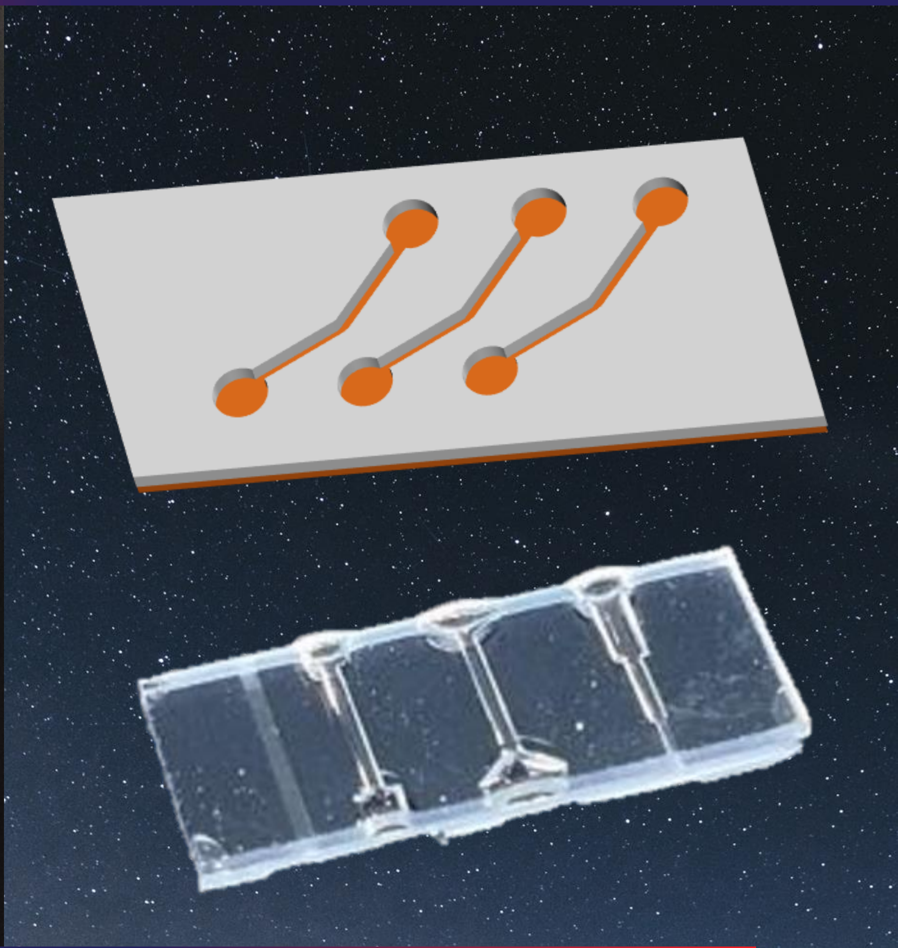
A Memorandum of Understanding (MoU) was signed between Lam Research and the Centre for Nano Science and Engineering (CeNSE), Indian Institute of Science (IISc), Bengaluru on 28th July, 2023. This MoU is aimed at jointly developing a customized pilot course offering for Indian universities to teach semiconductor fabrication technology utilizing Lam Research’s Semiverse (TM) Solutions virtual fabrication software, SEMulator3D®.

"India’s commitment to delivering 85,000 engineers by 2030 requires a transformative approach towards how we educate and train semiconductor engineers. Training engineers in nanofabrication technologies in a virtual environment using industry-leading tools is a welcome step that will help address India’s semiconductor talent requirements in future. We are happy to partner with Lam Research in this regard. Lam Research has been our Industry Affiliate for many years, and this collaboration is an extension of our commitment to solving industry challenges through academic research and technological innovations,” said Prof. Srinivasan Raghavan, Chair, CeNSE, IISc.

Miniature Marvels : The world of microfluidics and its remarkable applications

Written by Ishita Bansal, Sitara Subramaniam and Prof. Prosenjit Sen

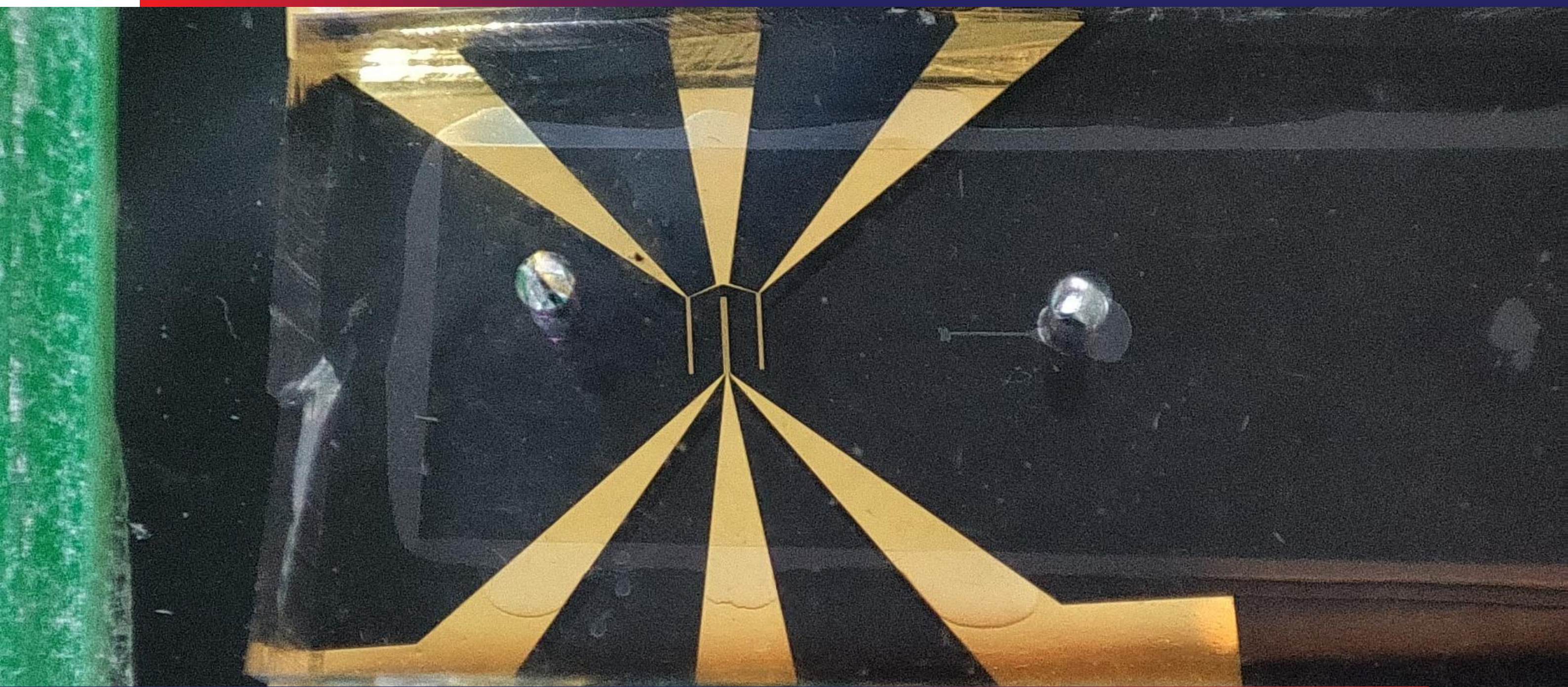




Microfluidics is an emerging technology that involves the manipulation of small volumes of fluids, where at least one of the dimensions is in the micro-meter range. So far, this technology is being developed for various applications. These include printing, testing of drugs using organ-on-a-chip technology, DNA sequencing, flow cytometry, cell sorting, sample preparation, and much more. Although most of it is still in the research phase, it has the potential to strongly impact several applications. It has the potential to revolutionize the healthcare industry because of its capability to integrate multiple functions and tests in small devices. This allows us to mimic human organs on microfluidic chips, perform a broad range of measurements and provide a wide variety of information with very small sample sizes. Microfluidics can remarkably improve testing, speed up diagnosis, and enable personalized medicine.

Microfluidic Devices

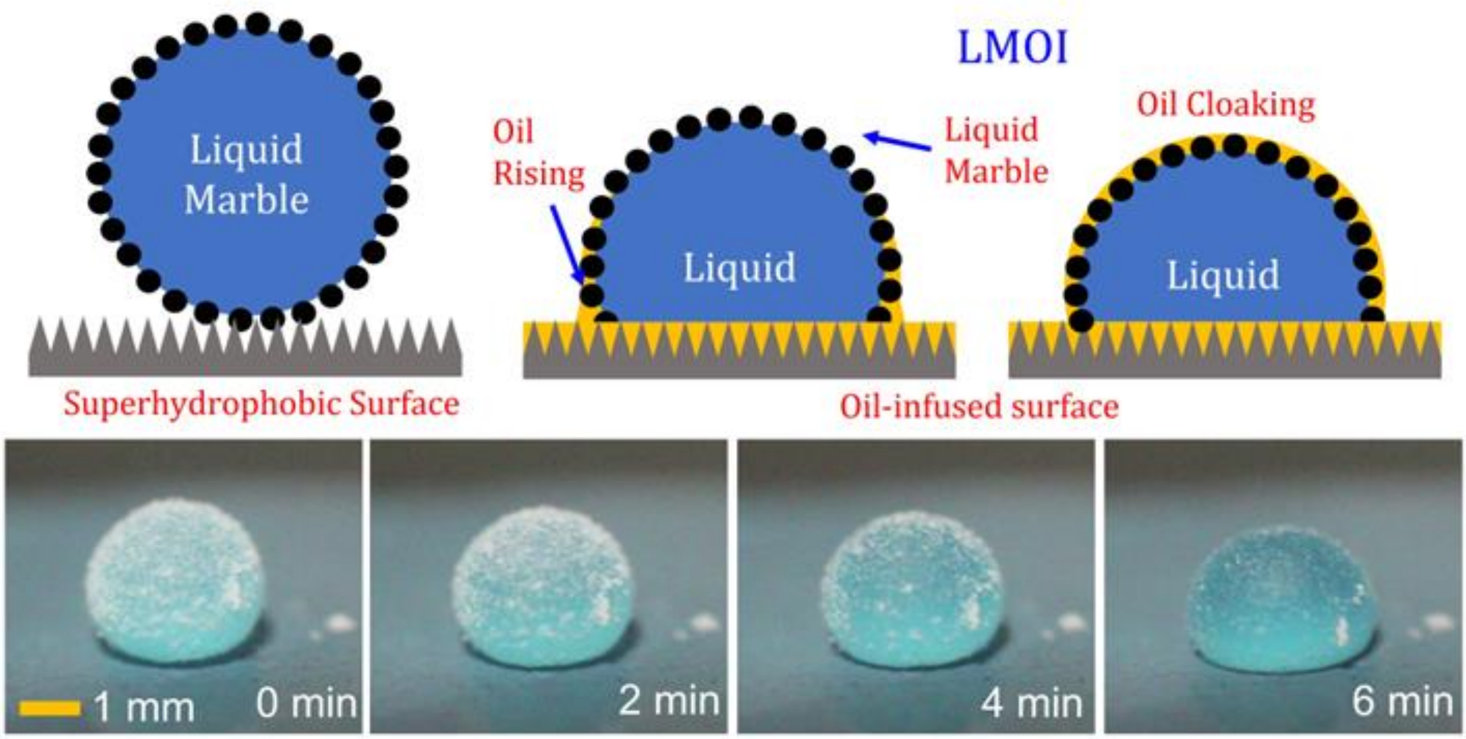
For addressing applications in various industries, the chips are often customised to provide the required functionality. Consisting of sub-millimetre to sub-micron channels and gaps, these devices are often fabricated using a wide range of materials as required by their applications. Even though silicon is extensively used in microfabrication, it is rarely the material of choice for end application in microfluidics. Glass and poly-dimethyl siloxane (PDMS) are extensively used in the academic environment, where long term storage is not a concern. Unlike silicon, glass has the advantage of being transparent, so it is easier to integrate optical detection. PDMS is extensively used to make microfluidic chips because of its biocompatibility and simple fabrication technique. Low-cost substrates, such as plastics or paper are the material of choice for applications that do not allow device reuse. For applications, where device reuse is feasible, all-glass, or fused silica substrates are the material of choice.



Sample Preparation and Bio-Chemical Reactors

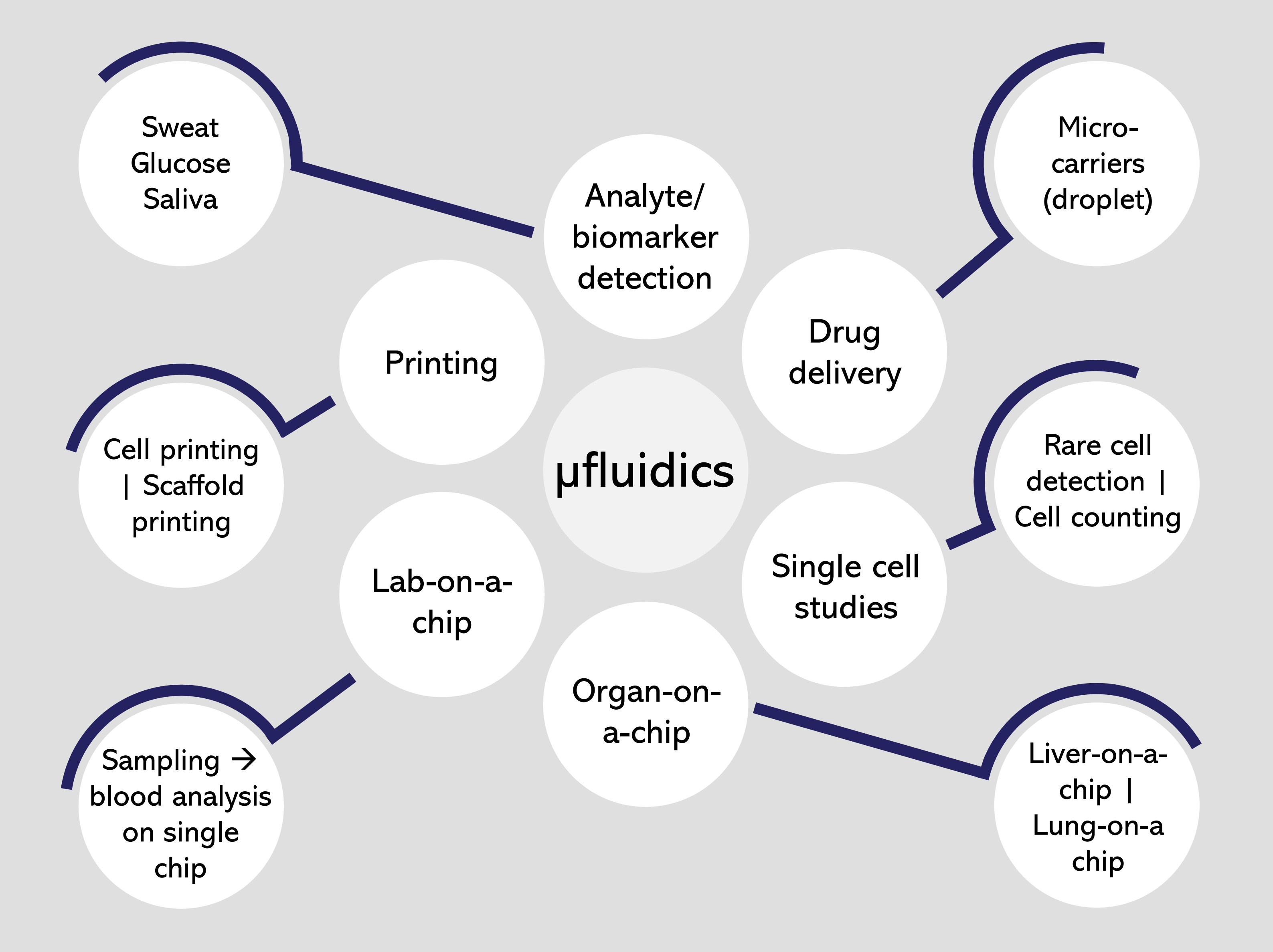
Sample preparation in microfluidics is a critical and intricate process that lays the foundation for precise and controlled experimentation at the microscale level for various biological and chemical applications. Researchers meticulously control parameters such as sample volume, concentration, and purity to ensure reliable and reproducible results. Furthermore, sample preparation often includes steps like filtration, mixing, or dilution, all of which must be miniaturized and optimized to suit the microfluidic platform's requirements.

To deal with such tasks, another kind of microfluidics platform, an open-chip droplet platform, has emerged in recent years. This approach prepares and handles the sample in discreet droplets rather than inside a channel.



This approach offers numerous advantages, including compartmentalization, sample accessibility, simple setup, better control, and parallel processing. However, evaporation is the major issue in such platforms as it can change the properties of the droplet liquids (pH, osmolality, etc.), severely affecting applications such as cell growth and material synthesis. To deal with such problems, we developed a novel droplet-based microfluidics platform called Liquid Marble on an Oil-infused surface (LMOI). In this approach, the droplets were first coated with particles (commonly known as liquid marbles), and then the stable encapsulation layer was formed by exposing them to nanostructured surface infused with oils. The particle coating promotes and stabilizes the immiscible liquid film over the droplet. The thickness of such film is tunable by changing the particle size. Additionally, the change in film thickness leads to a change in evaporation rate of the droplets. Due to the tunable evaporation rate, LMOI is suitable for single-crystal growth applications as well. The longer lifetime of the LMOI reactors also helps in many biological processes, such as cell growth, spheroid culture and drug delivery.

Applications of Microfluidics

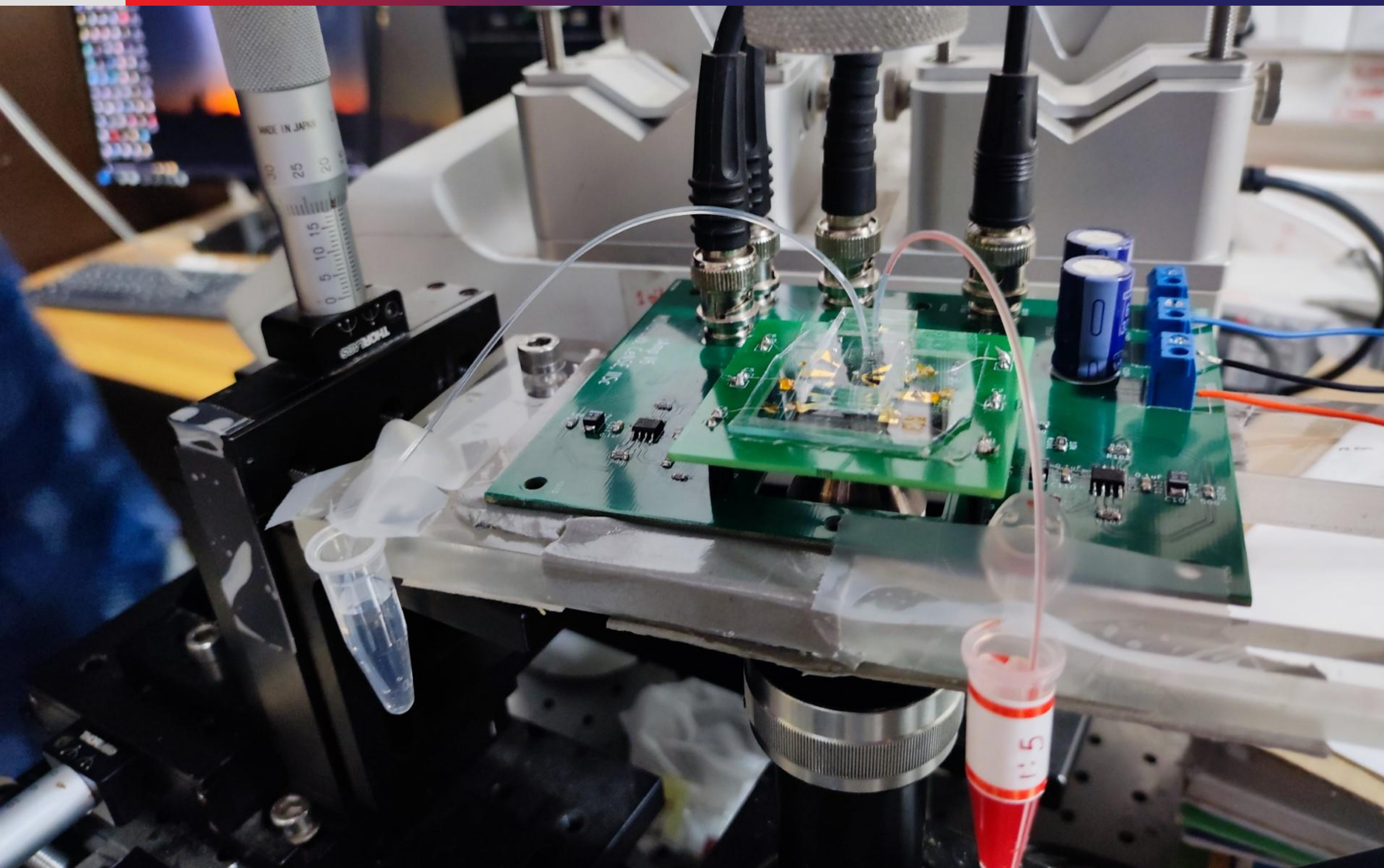


Applications in single cell studies

One of the many ways in which microfluidic technology is used in the healthcare industry is microfluidic flow cytometry. Flow cytometry is a technique that quickly analyses many cells/particles while being suspended in a buffered solution. This technique is mainly used to evaluate the peripheral blood, bone marrow, and other fluids in the body for diagnosis of diseases. One of its most beneficial uses is the detection of abnormal cells which have patterns of markers that are typically associated with specific types of leukaemia and lymphoma. The results from a flow cytometry test provide information that is required to diagnose and monitor blood cancers. Traditionally electrical and laser-based optical detection techniques are used in flow cytometry. Micro-fluidics enables improvement over the existing techniques by enabling measurement of multifrequency impedance signatures and estimation of mechanical properties at single cell levels.

For example, at the Microfluidics Lab at the Centre for Nano Science and Engineering, Indian Institute of Science, we are working on analysing the time dependent impedance data in the channel when cells pass through the channel. We use the temporal signature of the multifrequency impedance data to estimate properties of the cellular components. To image the fast-moving cells in flow, we are developing an electrically triggered low-cost imaging setup. The impedance and imaging data shall together allow for the rapid analysis of cells at a single-cell level. Ultimately, the goal is to speed up disease diagnosis and provide better insights into the disease profile of the patient. By reducing the time of study of the biophysical properties of cells, various conditions can be diagnosed at earlier stages, allowing treatment to start sooner and have a better chance of recovery.

Not only can this microfluidic technology be used to diagnose certain types of cancer, but it can also be used to separate and count the number of cancer cells that still circulating in the body (circulating tumour cells or CTC), thereby playing a role in the recovery of the patients as well. However, most of these approaches involve labelling the cells with fluorescent dyes before the experiment. The pre-process is quite laborious, inaccurate, and the cell viability also gets affected. Hence, label-free approaches of identifying and separating CTC have been a goal of the community. Our lab has developed a turn based inertial separation technique, that separates larger CTC from the smaller blood cells. This technique is label-free and ensures better viability than other techniques due to lower flow induced stresses.

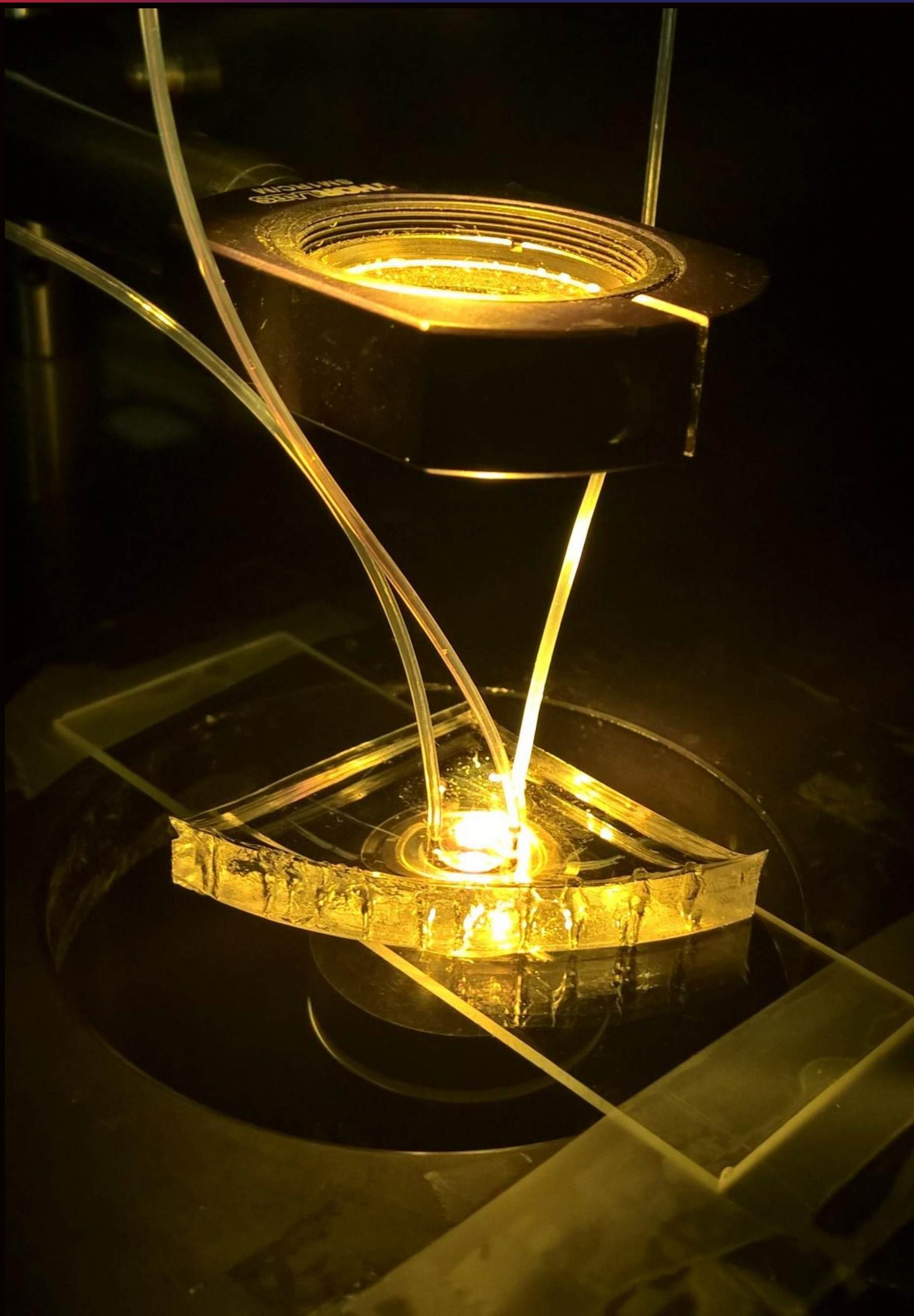


Applications in organ-on-a-chip

Organ-on-a-chip technology is a recent development that enables researchers and scientists to replicate the functions of organs and tissues grown microscopic chips. By providing the physical structure, flow and mechanical environment which mimics the physiological conditions, these devices provide an accurate mimic of the human organs. One of the benefits of organ-on-a-chip technology is that it gives researchers the ability to control the biochemical and cellular environment to observe the body's specific response to changes in stimuli. Multiple of these chips can be interconnected to mimic the human body, often called body-on-chips. These interconnected body-on-chips system is being used for testing the response of new drugs or drug cocktails. This prevents the use of animal testing and helps provide an effective platform for the development of new drugs. It is a much faster and better suited method than animal research and is cost-effective as well. This technology can significantly help develop personalized medicine because it can provide insights into the specific pathogens that are in the body, and the exact effect the drug has on the person's organs and tissues.

Applications in printing

2D and 3D printing of various materials is of prime interest for many applications. 3D Printing biological materials involving cells and matrix are of prime interest in biology. Printing a variety of materials over non-uniform curved surfaces is of interest for development of new electronic systems. In all these techniques one of the primary limitations is mass-loading of the ink. Higher mass-loading is preferred for higher throughput. However, higher mass-loading often leads to failure of the printing nozzle due to clogging. By replacing the conventional nozzle with a superhydrophobic mesh we have demonstrated a simple low-cost technique that achieves record-high mass loading. In this technique a millimetre scale ink drop impacting a superhydrophobic mesh leads to generation of a microscale droplet that is used for printing. This technique is suitable for multiple applications ranging from 3D printing, electronics, and bioprinting.



Conclusion

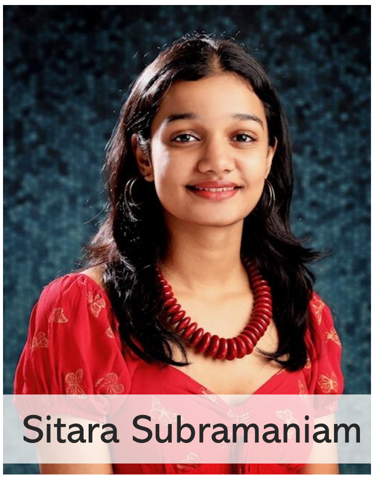
Due to the high level of accuracy and intricate design of the devices, microfluidic technology provides several benefits across all the industries it is involved in. It is easily manufactured, and efficient, and once properly developed it has a very low percentage of error. Compared to normal methods of diagnosis, this technology reduces the time taken from days to hours/minutes to get results. Having the ability to integrate multiple processes on a single chip, for example, sample preparation, cell separation and analysis, this technology is easy to use, portable and accessible depending on its function. People can also monitor certain aspects of their own health at home, for example, to check their electrolytes or to observe their blood urea nitrogen levels if they are suffering from chronic kidney disease. Another key advantage is that overall, the cost of production for these devices is low compared to other machinery and technology. Looking into the future, it has been predicted that diagnostic devices involving microfluidics and certain algorithms could even take the place of 80% of doctors at the stage of diagnosis.

In India specifically, there has been an increase in demand for microfluidic methods to find treatments for illnesses that are left untreated. This demand is expected to increase at 18.5% Compound Annual Growth Rate (CAGR) due to a rise in research and development, and a sudden increase in point-of-care devices that have resulted in the market for microfluidics to increase in India. An example of a recent development is “NanoMake” launched in February 2023 by a firm, Amar Equipment, in Mumbai. It is India’s first microfluidics platform, which can be used for the development of preclinical mRNA vaccines. In terms of the global scene, the demand for microfluidics is expected to rise at around 6% each year. Last year, in 2022, the global microfluidics market size was $10.93 billion, and is expected to rise to $50.34 billion by 2032.

Microfluidics is certainly going to be a big part of the future. The major focus here has been on its integration into healthcare and pharmaceutical industries over the past few years. However, it finds its use in the chemical industries as well. Although the devices manufactured may seem simple, the complexity and depth of data and results acquired have proven to be vital across all industries.

Meet the authors


Ishita Bansal

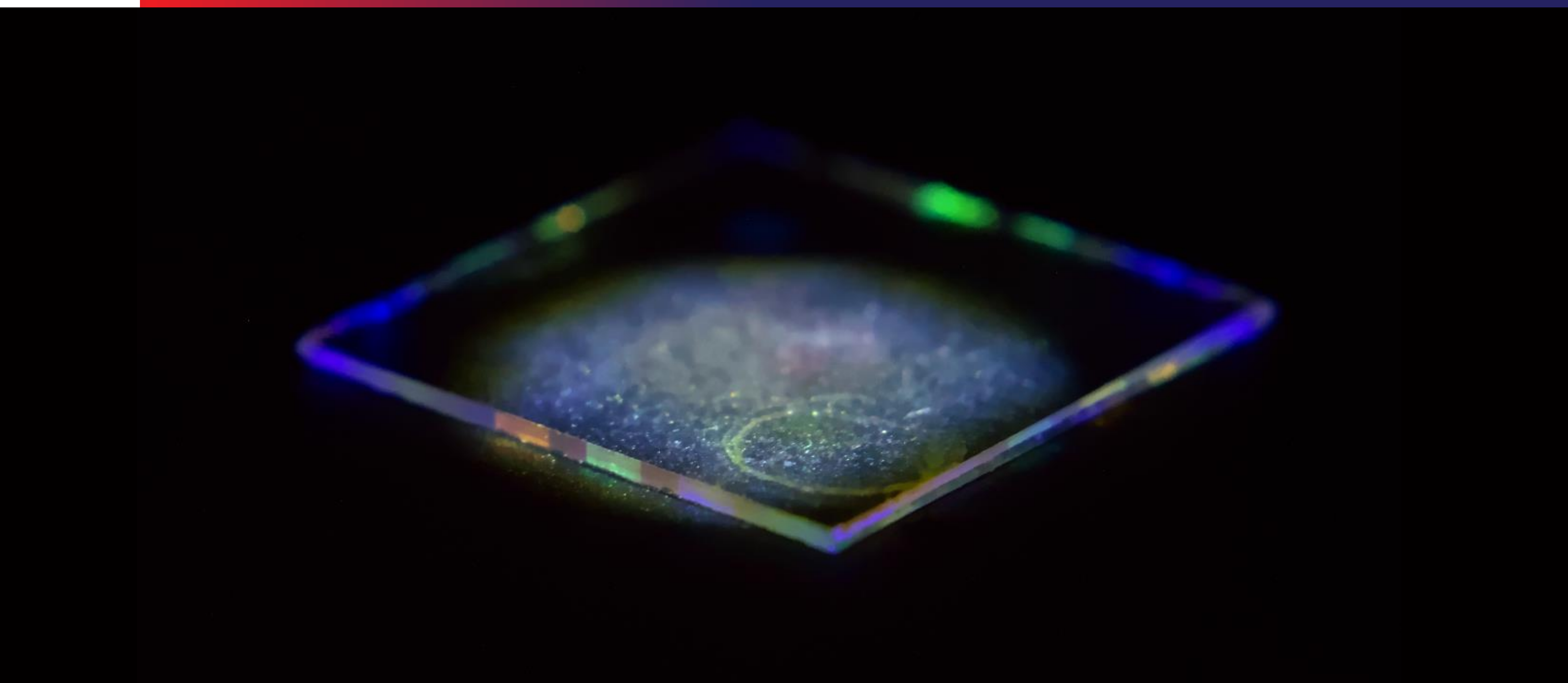

Sitara Subramaniam


Prof. Prosenjit Sen

Unlocking the Spectrum: In-Plane Spectral Filters Revolutionize Miniaturized On-Chip Spectrometers

Dipak Rout
Venkatachalam P
Radhakant Singh
Shreelakshmi KP
Prof. Shankar K Selvaraja

- Research by the group at the Photonics Research Laboratory



Though spectroscopy has been extensively studied in scientific labs and taught in classrooms, it is now frequently applied in real-world settings for a variety of purposes. To prevent accidents on snow-covered roads, civil engineers are utilizing spectroscopy to identify hydrohalite on icy roads and remove it using a sand-gravel mixture rather than just salt. Numerous other areas also use spectroscopy, including medicine to detect cancers, forensics, astronomy, agriculture to detect adulteration, the pharmaceutical business, and others. It is essential to miniaturize spectroscopic devices to make them portable and easily accessible on-site.

Most spectrometers today employ diffraction gratings for wavelength selection and operate in either reflection or transmission geometry, restricting their size. When three layers of materials with different dielectric constants are stacked upon each other infinitely, a slab waveguide is formed. When either 1D or 2D gratings are designed onto such a stack, they are called the guided-mode resonance (GMR) structures. They can produce high reflectivity over a narrowband and the wavelengths are easy to tune. Still these structures produce an out-of-plane response and can hinder the miniaturization. The GMRs have a resonance feature that can be exploited. This makes it possible to manipulate the light-matter interaction to maximize light absorption, which may then be used for chemical sensing and on-chip photodetection. The thickness of the waveguide can be altered in a GMR structure to obtain a planar spectral filter.

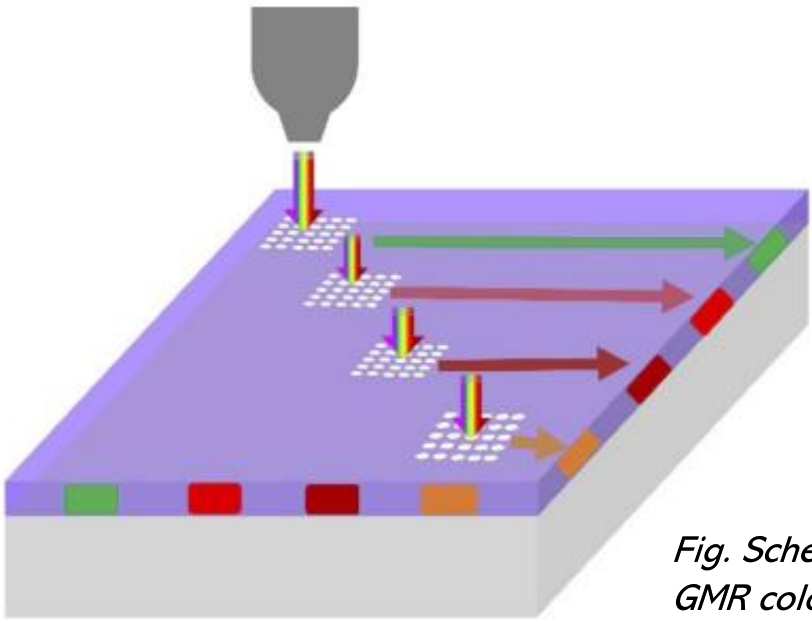


Fig. Schematic of the on-chip, in-plane GMR colour filters.

Researchers at CeNSE have fabricated a spectral filter using silicon nitride grown on sapphire as a substrate. This acts as an in-plane filter for spectrum ranging from visible to near-IR wavelengths. The wide range of wavelength detection using a single chip allows it be used in multiple applications. It has also been demonstrated that the filter is insensitive to incident polarization of light. This is the first time for a demonstration of on-chip in-plane spectral filtering from visible to near-IR using GMR structures. Such structures can now be realised on the SiN platform in a single step, opening up new possibilities for integrated photonic applications and photodetection on the CMOS platform.

The research article was published in Optics Letters, Vol. 47, No. 18, 15 Sept 2022 by the members of the Photonics Research Laboratory, Dipak Rout, P. Venkatachalam, Radhakant Singh, P. Shree Lakshmi and Prof. Shankar Kumar Selvaraja.

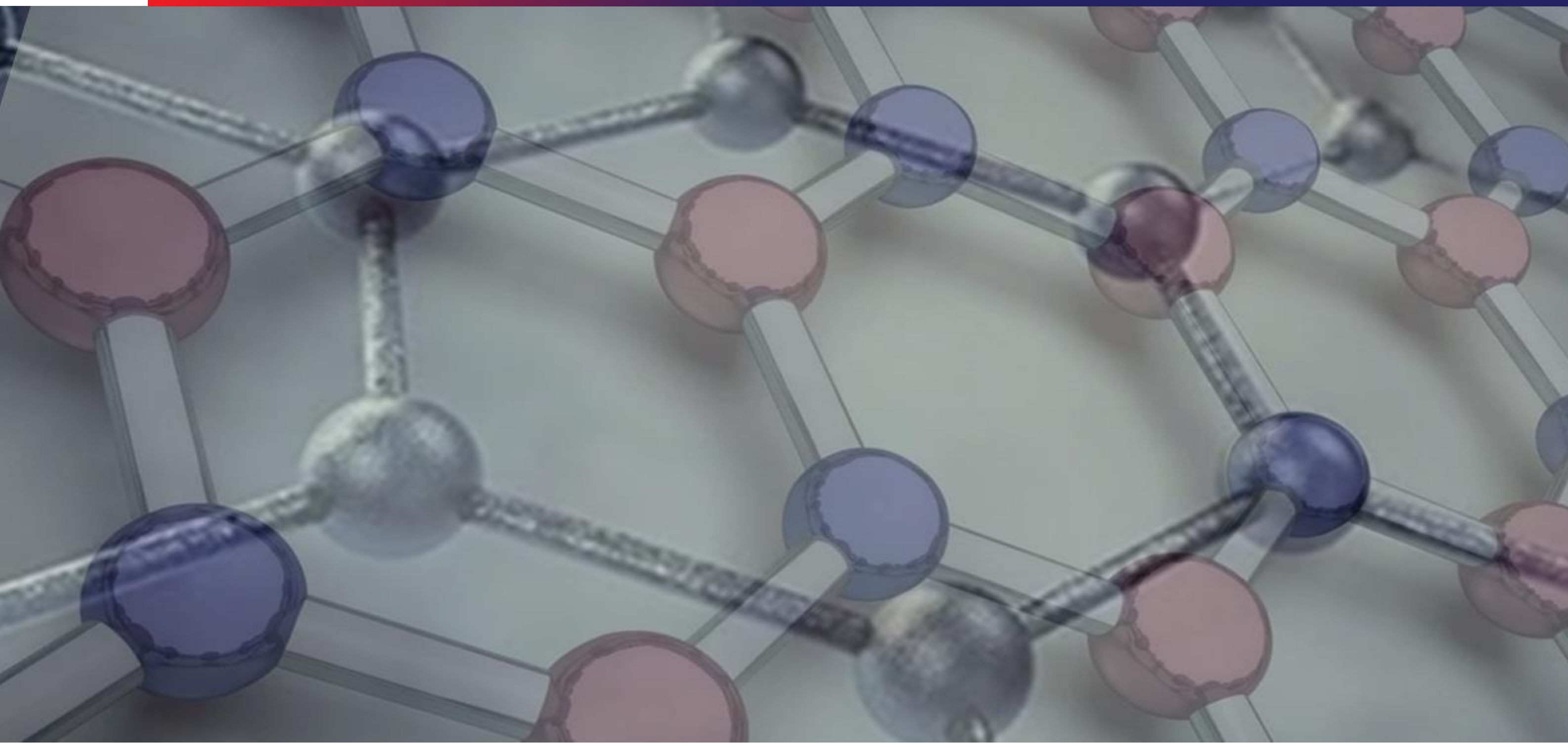
-Article by Divya C

Cracking the Code: Understanding Supersaturation-Mediated Growth of Hexagonal Boron Nitride for the Future of Graphene Electronics


Ankit Rao


S. Raghavan

- Research by the Crystal Growth Group



It has become common knowledge that the functioning of electronic devices, such as smartphones and laptops, is controlled by tiny electronic brains called “chips.” Most of us, however, might now know what forms the neurons of this so-called brain and how these neurons fire!

Chips, or semiconductor chips, are made of chemical materials layered one on top of another in various combinations, with the materials in each layer being patterned in a unique manner. The interaction of chemical materials placed in a particular combination of layers and patterns in response to electric stimuli confers chips their specific functions.

Two-dimensional (2D) materials, which are set to replace or add functionality to silicon-based devices, are characterized by flat crystals with the thickness of a single atom. For their use in three-dimensional space (or layers), 2D materials need to be supported on a three-dimensional (3D) substrate, such as Si/SiO2. However, this substrate needs to be extremely smooth, as a roughness of even 1.5 nanometers can interfere with the desired functioning of a 2D material!

Hexagonal boron nitride (h-BN) is a type of 2D material that has an extremely low roughness of 0.2 nanometers. This and other unique characteristics make it a great substrate for supporting other 2D materials, including the most popular material, graphene, that are used to make nanodevices.

To build nanodevices using h-BN, this material needs to be grown over large areas of another substrate, such as copper (from where it is transferred to the widely used 3D Si/SiO2 support), with good-quality and uniform crystals. Control over the number of layers and grain size is also very important for using h-BN in nanodevices.

Due to the low cost, enhanced crystal-quality control, and commercial scalability it offers, chemical vapor deposition (CVD) is the preferred technique for large area growth of 2D materials. In CVD, a substance in the vapor phase is condensed, by modulating the temperature and/or pressure, for deposition in solid or crystalline form on a desired substrate surface. Various CVD methods have been reported to grow high-quality h-BN crystals over large areas, but none of them meet the following three requirements all at once: large-area growth, control over grain size, and control over the number of layers. Additionally, most existing CVD methods for controlling the number of h-BN layers employ precursors that are unsafe and difficult to use. They also vaporize the chemical precursor used to synthesize h-BN at the reactor inlet due to which the precursor influx and, therefore, the drivers of crystal nucleation and growth within the reactor cannot be controlled.

Addressing the limitations in existing methods to grow a desired number of good-quality h-BN layers over large areas of a substrate, Prof. Srinivasan Raghavan and, his Ph.D. student, Ankit Rao have published a report titled "Mechanistic insights into supersaturation mediated large area growth of hexagonal boron nitride for graphene electronics" in the Journal of Materials Chemistry C.

In the reported study, the team developed a commercially scalable CVD method for growing high-quality and uniform h-BN layers (up to 87) over large areas of a copper substrate in a controlled manner. The key distinguishing factor of their method is that the ammonia borane (BH3NH3) precursor is placed outside the reactor growth chamber, allowing supersaturation (the change in vapor phase free energies to a point where precursor molecules start to form crystals on the growth surface) within the reactor to be precisely controlled.

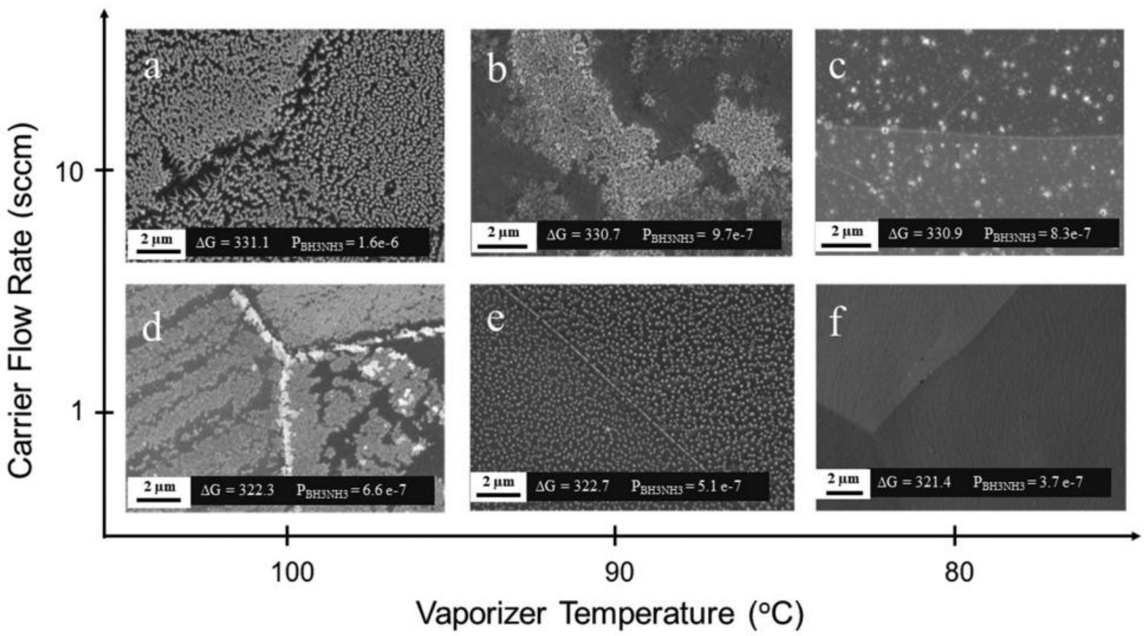


Fig. The clear difference from fig. a) to fig. f), confirms that a control on the temperature and the flow rate depicts a reduction in the formation of nano- Boron Nitride, leading to a smoother material growth over large area.

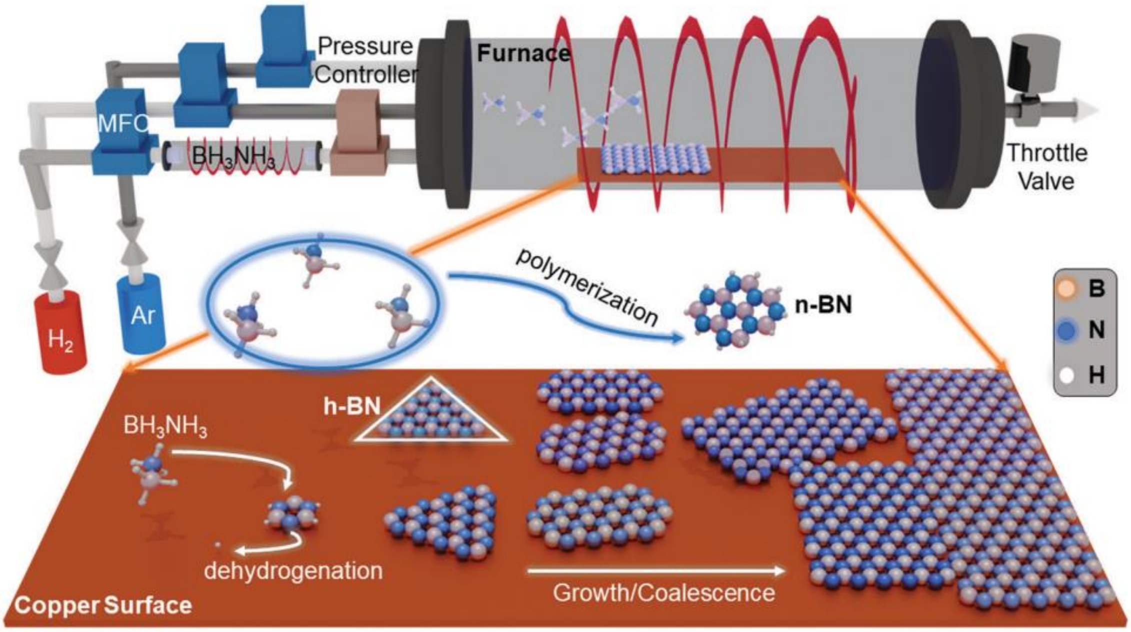


Fig. Schematic illustration of the reactor setup for a true chemical vapor deposition system, along with depiction of the two decomposition pathways leading to growth of the desirable h-BN and undesirable n-BN byproducts.

The team found that low supersaturation (obtained using very low precursor partial pressure/pBH3NH3 values) created a monolayer with triangular grains, an increase in supersaturation created a bilayer, and further increase in supersaturation resulted in vertical growth, creating multilayer bulk films (all within a growth time of 10 min).

Moreover, they found that, at supersaturation levels suitable for monolayer growth, triangles measuring 200 nm could be obtained at a 5-min growth time, triangles measuring 5 μm could be obtained at a 10-min growth time, and a complete monolayer could be obtained at a 15-min growth time!

The team additionally determined that maintaining the vaporizer carrier flow, and thus the polymerization of the precursor dehydrogenating on the growth surface, at the lowest level could reduce n-BN impurity formation by five orders of magnitude. Although the method developed by Prof. Raghavan and Ankit deposits high-quality and uniform h-BN films, these films are poly-crystalline/poly-domain in nature rather than the generally preferred single-domain films. The scientists thus fabricated graphene-on-hBN (G/h-BN) field effect transistors (FETs) using these polycrystalline films and performed electrical characterization experiments to compare them with the widely used graphene-on-SiO2 (G/SiO2) FETs as well as existing G/h-BN devices. The team's G/h-BN FETs performed 1.5 times better than G/SiO2 FETs and showed record mobilities compared with those of existing G/h-BN devices, proving that the poly-domain nature of the h-BN films developed by the team is absolutely not a hinderance to their performance!

Finally, the scientists proved the commercial scalability of their method by successfully growing an h-BN film over on a 6-inch square copper substrate and transferring it onto a 4 inch Si/SiO2 wafer support, which most semiconductor manufacturing plants are equipped to use.

This research is sure to go a long way in popularizing the use of h-BN, and similar 2D materials, in the semiconductor industry and enable the development of devices with unprecedented efficiency, functionality, and portability!

- Article written by Aditi Srivastav

ALUMNI SPEAKS

Meet Our CeNSE Alumnus !!
Anamika Singh Pratiyush pursued her Masters and PhD from 2015-2019 at CeNSE under the guidance of Dr. Digbijoy Nath. She is currently working as a Member of Technical Staff at GlobalFoundries. Read on to know more !!

Can you briefly describe your academic background?

Driven by an unwavering passion for science, my journey began with a top-ranked Bachelor's in Applied Physical Science at Delhi University's Miranda House. Motivated by my love for physics, I pursued postgraduate studies at G. D. College, LMNU. My goal was a Ph.D., inspired by Richard Feynman's work. To challenge myself further, I took the GATE physics exam, leading to an M.Tech in Nano Science and Engineering at CENSE. After rigorous preparation, I converted it into a Ph.D., focusing on fabrication and characterization of wide bandgap optoelectronics, particularly gallium oxide, and deep UV LED fabrication under Professor Digbijoy Nath's mentorship. This academic journey allowed me to contribute to international conferences, publish in journals, collaborate on research proposals, and write book chapters, enriching my experience.

What motivated you to transition from academia to industry, and how did this transition feel like?

The transition from academia to industry was motivated by a desire for real-world application of my research and a different set of challenges. It felt like a thrilling shift towards practical problem-solving and a fresh perspective on my skills and knowledge.

What is your current role at your job and how does your everyday work look like?

I'm currently working as an MTS (Member of Technical staff) at GlobalFoundries, a semiconductor foundry. In my role, I serve as a compact model modeler for various devices, including digital, analog, and LNA (Low noise amplifier), which are crucial for different RF (Radio Frequency) applications. Being a bridge between the foundry and the industry, my daily work involves a significant amount of collaboration and independent tasks. Depending on project deadlines and workload, some days can be quite fast-paced.

Can you give a brief of the industry you work in, and its significance?

I work at GlobalFoundries, a significant player in semiconductor manufacturing. This industry is pivotal as it produces the integrated circuits that power a vast array of electronic devices, from smartphones to automotive systems. My role involves compact modeling for RF (Radio Frequency) devices. It significantly speeds up the design and development process, reducing costs and time-to-market for cutting-edge RF applications. In essence, compact modeling for RF devices is the backbone of innovation in wireless communication technologies, enabling the development of faster, more efficient, and smaller electronic devices that have become an integral part of our modern world.

Describe any challenges you faced while transitioning to industry and how did you overcome them?

Transitioning to my first job in the semiconductor industry presented several challenges:

1. Change in Job Profile: My job was vastly different from my academic pursuits during my Ph.D. This transition required me to adapt to a new role as a compact modeler for RF devices.

Overcoming: I approached this challenge by conducting extensive research and self-study to familiarize myself with the new job requirements. The strong foundation in semiconductor knowledge from my Ph.D. courses proved invaluable.

2. Lack of Industry Experience: As a newcomer to the industry, I had to bridge the gap between my academic background and the practical demands of my job.

Overcoming: I actively engaged with my colleagues and sought mentorship from experienced professionals within the company. Their guidance and insights helped me understand how things work differently in the industry compared to academia.

3. Initial Learning Curve: The semiconductor industry has its own set of complexities and nuances, and I faced a steep learning curve in the beginning.

Overcoming: I embraced this challenge with a proactive attitude. I continuously updated my knowledge, attended industry-related workshops, and learned from hands-on experience to quickly adapt to the intricacies of my new role. In the end, this transition not only broadened my horizons but also underscored the importance of resilience, adaptability, and the willingness to learn in the ever-evolving landscape of the semiconductor industry.

How easy is it to maintain a healthy work-life balance in your job, and what do you do, to achieve it?

Balancing work and life is a challenge I've tackled with effective strategies. Planning my day ahead aids task prioritization and efficient time management. I've also made the shift from being a nocturnal worker during my Ph.D. to becoming a morning person, allowing me to allocate time for work and personal activities more effectively. Regular physical activity, conscious disconnect from work over weekends help me maintain balance. Balancing deadlines and personal pursuits is an ongoing journey, but with practice, we can improve our work-life harmony. It's quite amusing to note that if you were to ask me what I was doing during the 72nd week of my work, I'd actually have an answer.

Any advice you have for the current students who might want to choose this career path (courses, certifications, networking, myths/ misconceptions of the industry, and any advice in general)?

1. Educational Foundation: Build a strong educational foundation in relevant fields like electrical engineering, physics, or materials science (if that's what interests you). Courses in semiconductor physics and device engineering will be invaluable.

2. Certifications: Consider pursuing industry-recognized certifications or those related to specific software and tools used in semiconductor design and manufacturing.

3. Networking: Establish and nurture a professional network. Attend industry conferences, workshops, and seminars. Join relevant online forums and engage with professionals in the field. Networking can open doors to job opportunities and collaborations.

4. Internships and Co-ops: Seek internships or co-op programs with semiconductor companies. Practical experience is highly valuable and can help you understand the industry dynamics better.

5. Adaptability: Be open to learning and adapting. The semiconductor industry evolves rapidly, so staying updated with the latest technologies and trends is crucial.

6. Work-Life Balance: As mentioned earlier, maintaining a work-life balance is essential. Learn to manage your time effectively to avoid burnout.

7. Myths and Misconceptions: Don't be swayed by myths like "you need a Ph.D. to succeed." While advanced degrees can be beneficial, the industry values practical skills and experience as well.

8. Continuous Learning: Embrace a mindset of continuous learning. The semiconductor field is dynamic, and your ability to adapt and acquire new skills will be a significant asset.

9. Passion: Finally, follow your passion. The semiconductor industry is challenging but immensely rewarding if you have a genuine interest in it. Let your enthusiasm drive your career choices. Remember, your journey in the semiconductor industry will be unique, and it's essential to remain resilient, curious, and open to new opportunities along the way.

What are your future/ long-term career goals?

My long-term career goal is to contribute to the growth and innovation of the semiconductor industry. I aim to do this by sharing my knowledge and experiences, particularly with the upcoming generation. I want to be involved in teaching and mentoring to equip students with the skills and insights needed to excel in this cutting-edge domain. Ultimately, I hope to inspire and empower future innovators to make significant contributions to the field of semiconductors and drive technological advancements.

Any other advice/ words of wisdom you have for the current student community in India, specifically IISc and CeNSE, maybe?

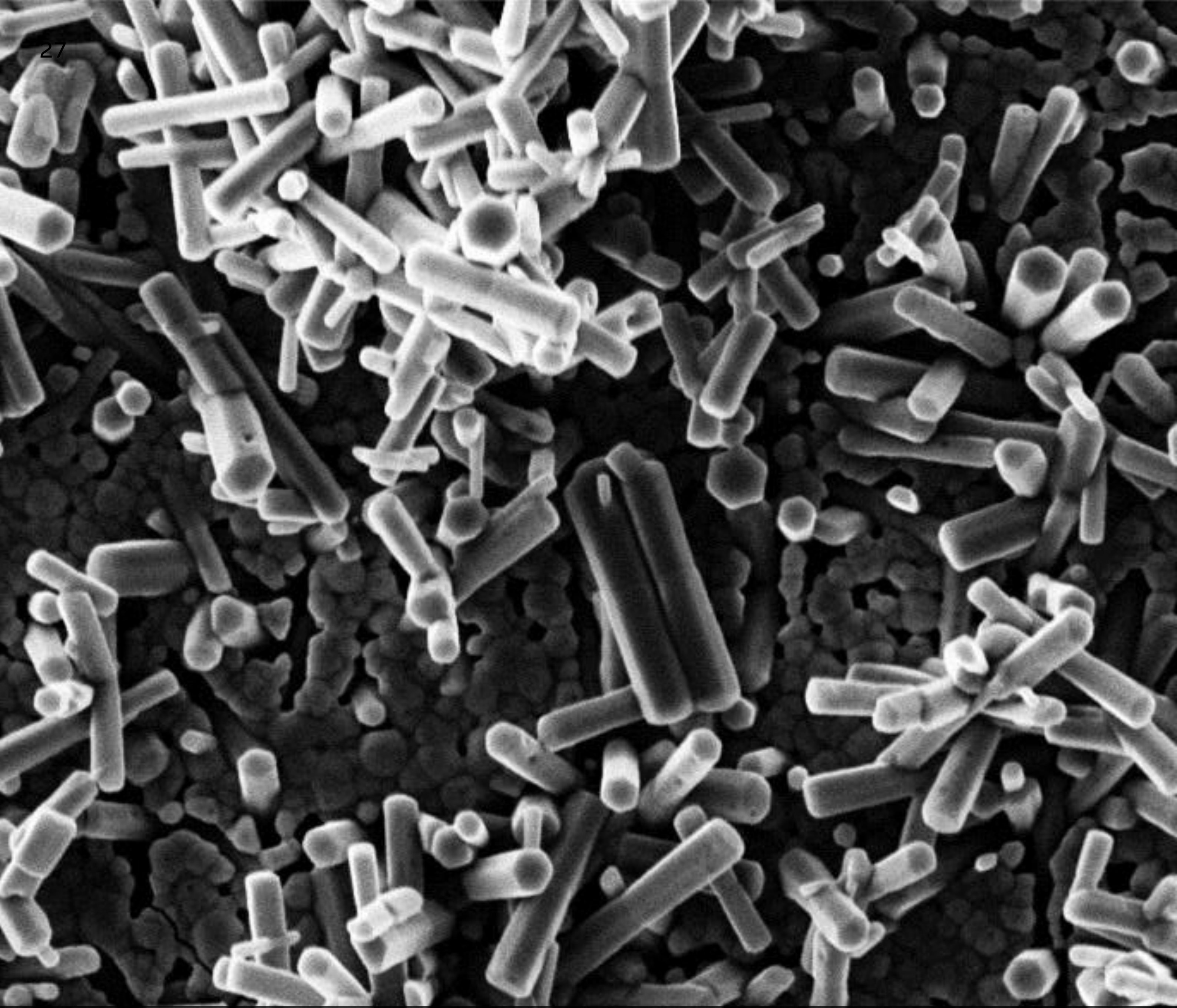
For the current student community, especially at institutions like IISc and CeNSE, I have some words to share:

1. Recognize the Privilege: Understand that being part of IISc and CeNSE is a privilege. These institutions offer world-class resources, faculty, and research opportunities. Make the most of this privilege and soak in all that they have to offer.

2. Proudly Represent: IISc doesn't need any introduction; it has a rich legacy of excellence. As students, you are not just part of an institution but also ambassadors of its reputation. Take pride in representing IISc and maintain its high standards.

3. Innovation: Remember the concept of "room at the bottom." It means there's always space for exploration and innovation, even in the smallest details. Don't shy away from exploring the uncharted territories of knowledge and pushing the boundaries of what's possible.

4. Keep Marching Forward: Keep a forward-focused mindset. The journey of research and innovation can have its challenges, but persistence is key. Keep marching forward, even when faced with obstacles, and your efforts will lead to meaningful discoveries.



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