DEPARTMENT OF CHEMICAL ENGINEERING HIT(K)
PRESENTS

CHEMEDGE

JUNE-2022

Message from Principal Sir

I write this note with immense pleasure. The Department of Chemical Engineering of Heritage Institute of Technology, Kolkata, is all set to bring out an e-journal containing articles written by members of faculty and students. These articles, as I gather, are not confined to Chemical Engineering only. So there is variety and as we all know, variety is the spice of life.

The field of Chemical Engineering is expanding continuously. From dihydrogen monoxide, that is basically water, to silicon wafers, practically everywhere, one finds use of Chemical Engineering. At the same time, chemists and chemical engineers have interest in sports, literature, creative writing, model building, etc. It is a matter of great satisfaction for me that my esteemed colleagues and students, are making inroads in both curricular and extracurricular activities with great enthusiasm.

I wish their efforts all success.

Prof (Dr.) Basab Chaudhuri
Principal, Heritage Institute of Technology, Kolkata.

Message from HOD's desk

I feel privileged as well honored to share the post - pandemic version of Chemedge 2022. I feel my students have done a spectacular job of authoring technical content in diverse and trending areas of Chemical Engineering under their mentor's guidance and support. In my several interactions with them during the compilation process, their enthusiasm and zest has added colour, content and art to this creation. Chemedge 2022 in its new avatar has provided an additional platform to highlight the talent of its creators. I thank all those who contributed to this effort.

I sincerely wish Chemedge will be a source of knowledge and inspirational content for interdisciplinary activity for all engineering students.

Sulagna Chatterjee
Professor and HOD
Dept. of Chemical Engineering
Heritage Institute of Technology, Kolkata

CONTENTS

FROM MENTORS' DESK

It is a proud privilege on our behalf to announce the publication of June 2022 issue of CHEMEDGE, the half yearly Students' e-magazine of the Department of Chemical Engineering, Heritage Institute of Technology, Kolkata.

We, as a teacher, always endeavor to provide sufficient opportunities to each student to understand and discover themselves and to face and overcome challenges presented to them to make college life fulfilling and complete. We take pride in helping them grow and develop into sensitive and responsible well-rounded personalities of the next generation.

CHEMEDGE, therefore, is meant for bringing out the potential writing skill of our student as a part of their overall development. This magazine will also empower them to augment their domain knowledge with information on the recent development and newer avenues of research in the field chemical engineering and allied disciplines. We are sure that it will encourage more students to contribute on novel and interesting topics of their interest for the upcoming issues of the magazine.

From this year onward, CHEMEDGE will not only remain confined itself in technical article but also explore the creative skill of students of our department. Student editorial board has decided to expand the grandeur of the magazine by incorporating some creative items like poem, short stories, paintings photography etc.

We appreciate the effort put forward by our excellent student editorial team to make the upgraded edition of the magazine possible. We wish them a success.

Dr. Diptendu Datta
Associate Professor
Department of Chemical Engineering

Dr. Sangita Bhattacharjee
Assistant Professor
Department of Chemical Engineering

Students Corner

We, students of Department of Chemical Engineering, Heritage Institute of Technology, Kolkata, have put together the new issue of the biannual departmental magazine, Chem Edge-2022. The team of student editors, would like to thank our professors, Diptendu Dutta sir and Sangita Bhattacharjee ma'am for mentoring us and presenting us with the opportunity, to do something new with this issue. As we all know, the magazine has been celebrated as a technical journal. Thus,this issue also has interesting articles, contributed by the students of the department,in various research fields, within the domain of chemical engineering. The additions that we have incorporated include a creative section, in the form of writing and photography, contributed by the students of our department. It also brings forward to you, a crossword, where the answers lie in the depth of your knowledge, pertaining to the chemical world. We hope that the readers enjoy traversing through its sections,as much as we have enjoyed creating it for you.

Thanking you,

Student editors:

3rd Year:

Anwesha Pandit

Jashodhara Banerjee

Tirtharaj Goswami

2nd Year:

Ayan Banerjee

Arunava Das

Hritam Jana

Prithul Das

Ritam Das

Technical Articles

QUANTUM DOT SOLAR CELLS

The recent surge towards making highly efficient and profitable renewable energy devices has led to further research and development in structure and properties of conventional solar cells. The advances in nanostructure architecture have led to utilization of semiconductor nanostructures to design next-generation high efficiency solar cells.

Three major types of cells that have dominated research in recent years include (1) dye-sensitized solar cells (DSSC), (2) bulk heterojunction (BHJ) photovoltaic cells or organic photovoltaic cells, and (3) quantum dot solar cells (QDSC). The simplicity of the synthetic procedure, tunability of light absorption, sensitivity to diffused light, and ability to design flexible solar panels make semiconductor nanostructure an important candidate as a light absorber.[1]

Semiconductor heterojunction solar cells, polymer QD hybrid solar cell and quantum dot sensitized solar cell employ semiconductor quantum dots as photon harvesters.

The power conversion efficiency of liquid junction QDSC has increased from 1 to 5% during last couple of years. Efficiencies in the range of 7% have also been reported for solid-state QDSC.[2] A recent report of 10.9% efficiency for a perovskite-based solar cell has put QDSC on par with DSSC and BHJ solar cells.[3]

Quantum dots are a special class of semiconductors, which are nanocrystals, composed of periodic groups of II-VI, III-V, or IV-VI materials and can confine electrons (quantum confinement). Proper assembly and ordering of these quantum dots on a mesoscopic oxide film like TiO_2, ZnO or SnO_2 is an essential requirement for development of QDSC. Some benchtop approaches of depositing a QD suspension on mesoscopic films are drop casting, chemical bath deposition, SILAR, electrophoretic deposition and bifunctional linker approach.

In conventional microstructures single junction solar cells, photons with energies less than semiconductor bandgap are not harvested while those with energies larger than the bandgap produce hot-carries and upon cooling down (thermalization) the excess energy get wasted as heat. Here quantum dots provide significant advantage as their energy levels are adjustable by altering their size which can be tuned to match the spectral distribution of solar spectrum, thereby delineating the bandgap. The dots can be grown in variety of sizes, covering a variety of bandgaps without changing the underlying material or construction.

Sizing is achieved by varying the fusion duration or temperature. In contrast to traditional semiconductor materials that are crystalline or amorphous, quantum dots can be moulded into two-dimensional (sheets) or three-dimensional arrays. They can be processed to create junctions on inexpensive substrates such as plastics, glass or metal sheets.

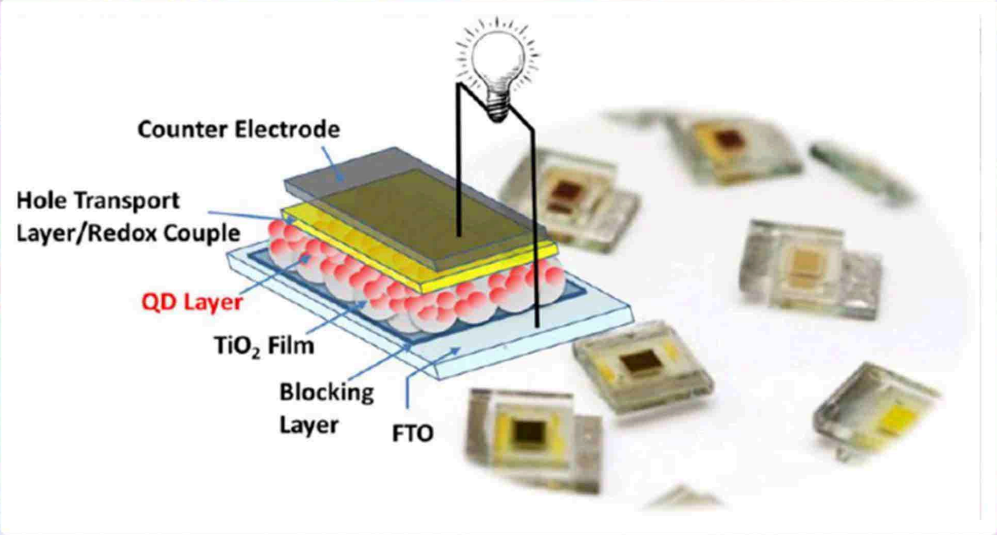


Figure (1): Anatomy of QDSC depicting different layers.

Figure 1 shows the hole transport layer is a redox electrolyte in liquid junction solar cells and a solid-state hole-transporting layer in heterojunction solar cells. The background image shows a few QDSC samples prepared in laboratory with an active QD layer (~0.25 cm2 area) sandwiched between the two OTE and the redox electrolyte.[4]

Using high-energy photons to generate multiple charge carriers or capturing hot electrons before their thermalization boosts the operation efficiency of QDSC. Recent studies have shown the feasibility of this concept.[4]

Major research has been done in the plasmon resonance of silver and gold nanoparticles in DSSC, BHJ solar cells. Coupling semiconductor nanostructures with metal nanoparticles, improves the photovoltaic conversion efficiency. Effective use of exciton−plasmon interactions in QDSC is still under research.

Supersensitization of QDs with Dye Molecules can be effective in enhancing the photocurrent generation in QDSC.[4]

In order to make a major impact in photovoltaics, a transformative technology must be developed. Recent advances in nanoscience and QDSC development offers new opportunities for future research and development.

References:

(1) Kamat, P. V.; Tvrdy, K.; Baker, D. R.; Radich, J. G. Beyond Photovoltaics: Semiconductor Nanoarchitectures for Liquid Junction Solar Cells. Chem. Rev. 2010, 110, 6664−6688.

(2) Kamat, P. V. Boosting the Efficiency of Quantum Dot Sensitized Solar Cells Through Modulation of Interfacial Charge Transfer. Acc. Chem. Res. 2012, 45, 1906−1915.

(3) Lee, M. M.; Teuscher, J.; Miyasaka, T.; Murakami, T. N.; Snaith, H. J. Efficient Hybrid Solar Cells Based on Meso-Superstructured Organometal Halide Perovskites. Science 2012, 338, 643−647.

(4) Kamat, P.V. Quantum Dot Solar Cell. The Next Big Thing in Photovoltaics J. Phys. Chem. Lett. 2013, 4, 908−918.

Aindrila Bose

4th year

BIO-SILICA EXTRACTOR:

Sustainable Small-scale Extraction of Bio-silica From Rice Husk

Introduction:

According to a survey published by M. Shahbandeh April 23, 2021; India produced 118.9 million metric tons of milled rice. After rice is grown and harvested, it undergoes a process to prepare it for human consumption, known as milling, which removes the husk and bran layers. While the bran is used to make oil, the husk is a waste. It cannot be used as cattle feed since it has extremely low nutritional value and low cellulose content. This husk makes up about 1/3 of the total mass of rice grains and has 20-30% silica. Silica is the principal constituent of rice husk ash, which amounts to 80-90% of its total mass. With such a large quantity of silica content in the rice husk ash, it becomes economical to extract silica from it. The primary goal of this project is to devise technology that can extract silica in a portable, compatible, and economical way so that it can reach the rural areas and appeal to the farmers. In this project, an experiment for the extraction of silica from rice husk was performed and equipment to manufacture silica from rice husk on a small scale was modelled.

Extraction Process:-

Fig.1: . From Rice Husk to Ash to Silica

- Rice husk was grinded for 1 hour and sieved on 300 μm
- Grinded husk was burned at 450°C for 1 hour
- Burned husk was calcinated at 750°C for 3 hours
- Calcinated ash was reacted with 500ml 1M NaOH solution at 90°C for 2 hours.

$$C\text{-}SiO_2 + NaOH = Na_2SiO_3 + H_2O$$

- The solution was filtered and the filtrate was collected
- The filtrate was titrated with 1M HCl

$$Na_2SiO_3 + HCl = SiO_2 + NaCl$$

- Silica was precipitated at pH < 7
- The precipitated silica is then filtered and dried by heating

Design of Extractor:

Fig 2: .3d Model of Bio-silica Extractor

A 3D model of the silica extractor was prepared in Vectary3d keeping in mind three main sections.

- The first part holds sieves and blades to convert rice husk into powder and then sieve it (sieved on 300 μm and retained on 850μm).
- The second part is an 'ash converter' having a muffle furnace that converts powdered rice husk to ash. We can also regulate the temperature and time needed to produce our desired grade of calcinated ash having silica.
- The third part holds the reactor having chemical cartridges having NaOH and HCl which are used to precipitate silica from the ash.

Experimental Results:

- In our experiment after burning 500gm of husk we got 110gm of calcinated ash which amounts to 22% w/w.
- A sample of 30 gm from this 110gm calcinated ash was further subject to chemical tests which provided us with 18gm silica which amounts to percent yield of 60%.
- Considering 1/3 of the part of paddy as husk, 1 ton of paddy after milling can generate 300 kg of husk. Applying our experimental yield, 300 kg of husk can produce 66kg of ash.
- Ideally this ash can have up to 80% silica. But here considering expt. yield of 60% around 39.6 kg of silica can be produced.

Application of Silica in Industry: Silica finds use in many industries including:

- Cement Industry (18%)
- Pharmaceuticals (varies)
- Fertilizers (5%)
- Silicon/Semiconductor industry (~10%)
- Silicone production (47%)
- Glass Industry (90%)

Conclusion:

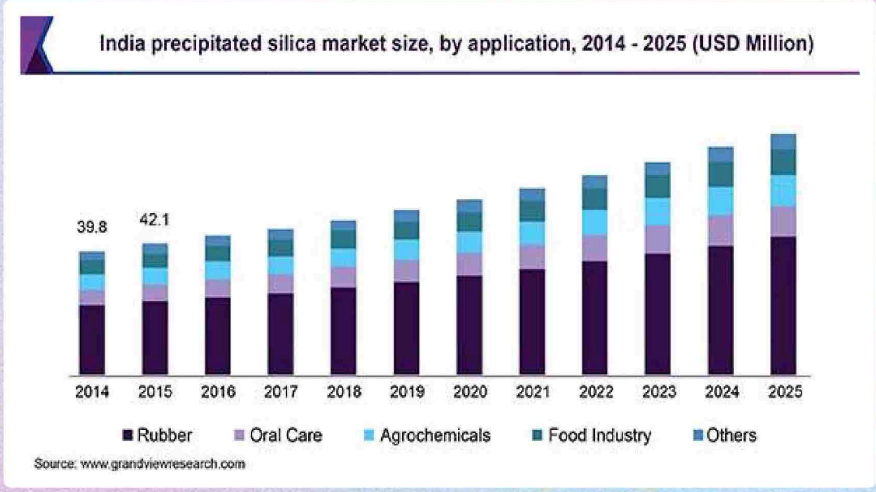


Fig.3: Growth of Indian Silica Market Size.

Indian precipitated silica market size was valued at USD 46.8 million in 2017. Strong product demand in the food industry, owing to its anti-caking and super absorption properties, has helped the market gain momentum over the past few years. Thus, this project if implemented will have a huge contribution towards the growth of silica market in India. Thus, we can say that this is not only low energy consumption and environmentally friendly but also cost-effective, easier to implement, and can serve as a source of income for the farmers. In addition, this process takes care of the ash disposal without contributing to environmental pollution.

References:

1. Bajirao S. Todkar, Onkar A. Deorukhkar, Satyajeet M. Deshmukh; Extraction of Silica from Rice Husk. International Journal of Engineering Research and Development, e-ISSN: 2278-067X, p-ISSN: 2278-800X, Volume 12, Issue 3 (March 2016), PP.69-74

2. Ragini Patil, Rajendra Dongre, Jyotsna Meshram; Preparation of Silica Powder from Rice Husk. IOSR Journal of Applied Chemistry (IOSR-JAC), ISSN: 2278-5736, PP 26-29
3. India Precipitated Silica Market Size, Share & Trends Analysis Report by Application (Rubber, Agrochemicals, Oral Care, Food Industry), Competitive Landscape, And Segment Forecasts, 2019 – 2025; Published Date: Feb, 2019 Report ID: GVR-2-68038-812-1 https://www.grandviewresearch.com/industry-analysis/india-precipitated-silica-market#:~:text=India%20precipitated%20silica%20market%20size%20was%20valued%20at%20USD%2046.8,over%20the%20past%20few%20years.
4. https://youtu.be/FHB4gLiMx-c
5. (Images 1 and 2 clicked by the authors)



Anujit Maity, 3rd year ; Diptanshu Biswas, 3rd year ;

Ranashree Bhunia, 3rd year

GOLD NANO PARTICLE AND ITS ROLE IN TREATMENT OF CANCER

Introduction: Science never fails to amaze us. Laboratories require a lot of space as well as resources, so the scientists thought that they must find a way out in order to reduce resources supplies and automate experiments, and that's where the concept of nanotechnology started evolving. "Lab on a chip", this is the goal behind invention of nanostructure.

Nario Taniguchi first coined the term 'Nano' to this idea of miniaturizing the labs to a space as small as a microchip (in Greek, Nano means Dwarf, i.e. one billionth).

WHY GOLD? From the ancient times it can be observed that scientists have a fascination for gold and they were called alchemist at that time, and also it's a fact that colloidal gold has been studied for its potential application in medicine over centuries. In this field of nanostructure scientists prefer gold since,

- Gold is an inert metal and can absorb light.
- Gold is biocompatible with human body.

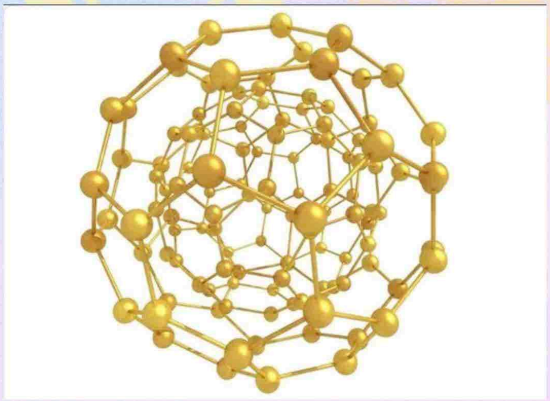
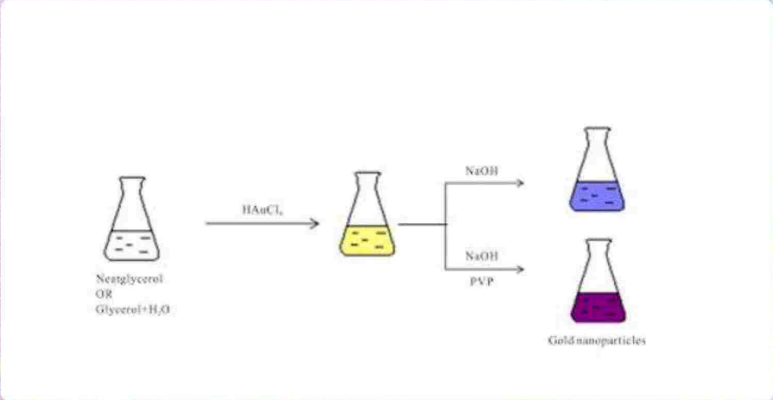


Diagram of GNP structure

HOW ARE GNPs (Gold Nano Particles) FORMED? Gold nano spheres (AuNPs) are produced by reduction of chloroauric acid. They are actually made up of a silica core, coated with a thin layer of gold (50-150mm in size). Gold nano rods are also produced from chloroauric acid with a gold seed and a stabilizing agent, in most of the cases it id cetyl trimethyl ammonium bromide (CTAB).



GNP synthesis

GOLD IS BIOCOMPATIBLE WITH HUMAN BODY:

Human body is mostly made up of water. And it turns out that the best spectral region for optical imaging ranges between 800-1300nm and is coined as 'Water Window'. Infrared wavelength (650-1050nm) best fits this range. Therefore we can vary the size of silica beads as well as thickness of gold layers to scatter and absorb different wavelengths including that of IR. This can be illustrated with the graph -

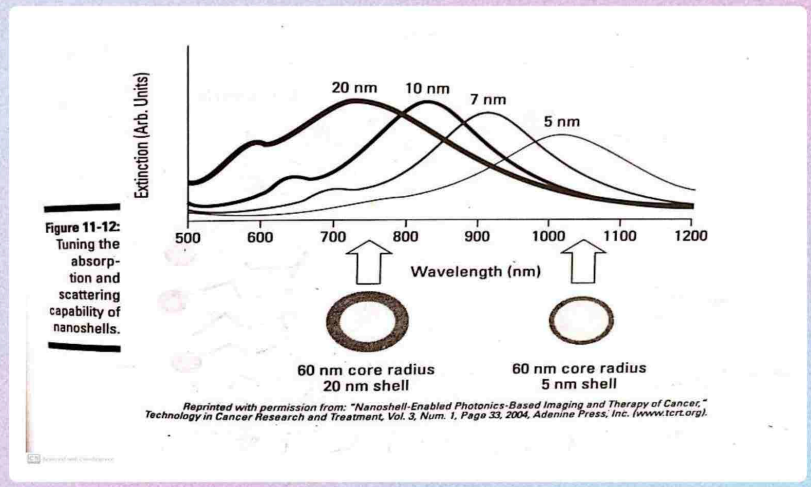


Figure 11-12: Tuning the absorption and scattering capability of nanoshells.

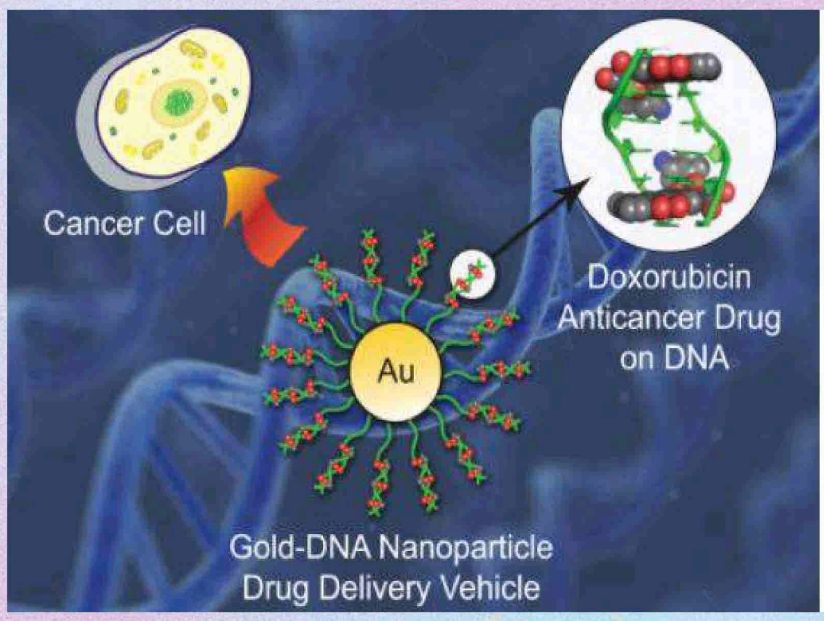
Graphical representation

Now, as a functional group, amine works best in attaching gold particles to a silica bead or glass core. (<2nm wide). (Au-NH2) has the following properties:

- Molecular Weight: 196.67
- Appearance: colourless liquid
- Density: 1 g/mL
- Exact Mass: 196.966569

WHAT IS CANCER? Our body constantly replaces old cells with new ones. However, when new cells start forming when the body doesn't need them and old cells don't die when they are supposed to, we call this disorder as cancer.

GNP IN TREATING CANCER: So far we have seen how GNPs are being produced. Now antibodies are to be added outside the gold coated nanoshells such that when they are injected into the body, they clings specifically to the cancer cells only. As I have already stated that science never fails to amaze us, it turns out that scientists recently are trying to use known cancer cells to create mass produced protein based antibodies!



GNP and Cancer cells

Nanoshells, after being injected to the body, takes at least few hours to spread throughout the body. After they are circulated, they are first illuminated with laser light, and then they show no change. After getting attached, they are finally illuminated which activates the nanoshells, and that's how the cancer cells ultimately die. Previous records also depicts that the results are quite positive and it proves to be a therapy that can actually destroy cancer cells with minimum invasiveness.

References:

Richard Booker; Earl Boysen. Nanotechnology; ISBN: 978-81-265-0625-5; Wiley India Pvt. Ltd.: New Delhi, 2008

Gold nanoparticles in breast cancer treatment: Promise and potential pitfalls. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4142062/ (accessed April 1, 2022).

Green Synthesis of Gold Nanoparticles Using Glycerol as a Reducing Agent. https://www.scirp.org/pdf/anp_2013052113350692.pdf (accessed April 2, 2022).

Monodisperse Gold Nanoparticles. https://www.news-medical.net/life-sciences/Monodisperse-Gold-Nanoparticles.aspx (accessed April 2, 2022).

Researchers Use Gold Nanoparticles as Drug Carrier in New Cancer Treatment. https://www.medgadget.com/2011/03/researchers_use_gold_nanoparticles_as_drug_carrier_in_new_cancer_treatment.html (accessed April 2, 2022).

Chitrita Banerjee

2nd year

ANALYZING THE ROLE OF 3D BIOPRINTING IN COMBATING INFECTIOUS DISEASES

Infectious diseases possess the capability to impact health on a global scale. Rapid development of vaccines and treatment strategies are necessary to tackle the emergence of new pathogens and infectious diseases. The Covid-19 pandemic caused by SARS CoV-2 viral infection is the best example of that. Likewise, there were other outbreaks of other infectious diseases like Ebola, MERS etc. over different parts of the world. These sudden outbreaks challenge our existing healthcare system. Hence, it is necessary to develop vaccines and targeted drug delivery to increase the efficiency of the global pandemic response. Developing drugs requires a lot of time and during the development phase, many people lose their lives. To speed up the drug discovery process, the conventional development pipeline can be modernized by introducing cutting-edge in vitro models as alternatives to traditional infectious disease models and by engaging radical technologies for the production of drug delivery systems. This is where 3D bioprinting is helpful and has shown promising results in this regard. The main benefits of 3D bioprinting are

- Ability to assemble structures in a closely controlled and repeatable manner, thereby permitting rapid scaling of production
- Fabrication of 3D in vitro models provides physiologically significant models to enhance perception of host-pathogen interactions and increasing the chances of therapeutics being successful in clinical studies.
- Application of 3D bioprinting to drug development provides the ability to modulate release kinetics and optimize bioavailability of therapeutic agents through controlled design and material selection.
- Dose personalization can also be done using bioprinting technologies

3D bioprinting is currently carried out by the following methods

1. Stereolithography (SLA) – It is a polymerization technique that utilizes UV light to cure high resolution photosensitive polymer resins.
2. Inkjet printing –In this technique droplets of biomaterial solution are sprayed on a printing platform by thermal, electromagnetic or piezoelectric mechanisms.
3. Laser assisted printing – In this technique laser pulses are focused onto biomaterial.

   This creates high pressure necessary for propelling droplets of biomaterials on the collecting substrate. This process doesn't require needles for bioprinting thereby reducing clogging issues of needle.
4. Exrusion printing – this technique involves utilizing gravitational or mechanical force for extruding continuous strands of biomaterials through a syringe and needle. This is the most cost-effective 3D printing technology.s

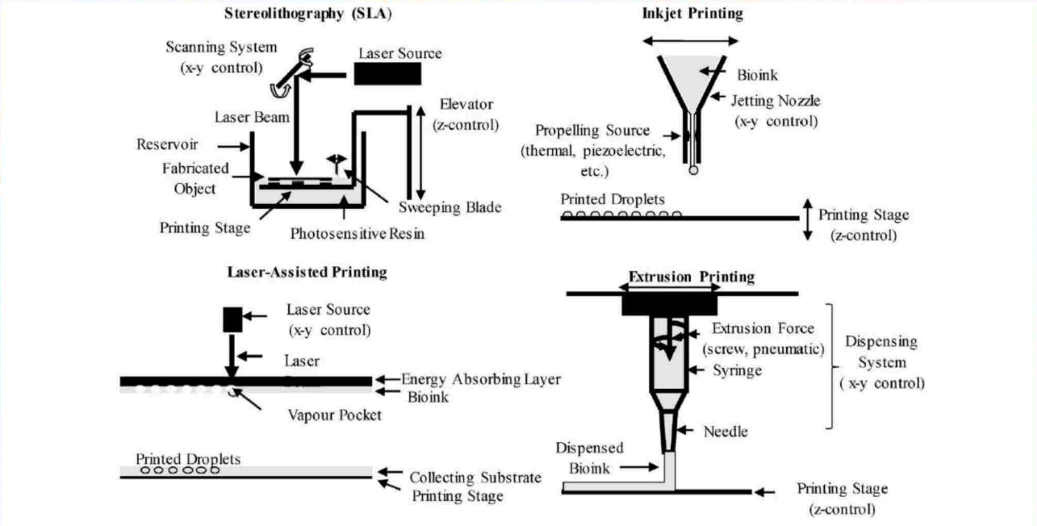


Fig. 1. Schematics of 3D printing technologies.

Conclusion:-

The COVID-19 pandemic has stressed on the importance of a quick response to suitably tackle the emergence and transmission of recent infectious diseases. This worldwide crisis has drawn attention in relation to the need for rapid development of vaccines and therapeutics to prevent the spread of pathogens. As the conventional drug development pipeline includes extremely time-consuming and expensive processes, novel platform technology is required to overhaul the pipeline to fast-track drug discovery.

3D bioprinting has been utilized to create primary organs in vitro which involves construction of complex 3D structures with multiple materials. These organs have shown not only similarities to the anatomy of the corresponding organs but are also capable of carrying out highly mature biological functions, which is the most important aspect in understanding infectious diseases.

The entire 3D bioprinting process, right from modeling to manufacturing, is fully computerized thereby making this technology highly favorable for automation. With the latest innovations in artificial intelligence and autonomous control technologies, the possibility of automating the entire process of 3D bioprinting is being explored.

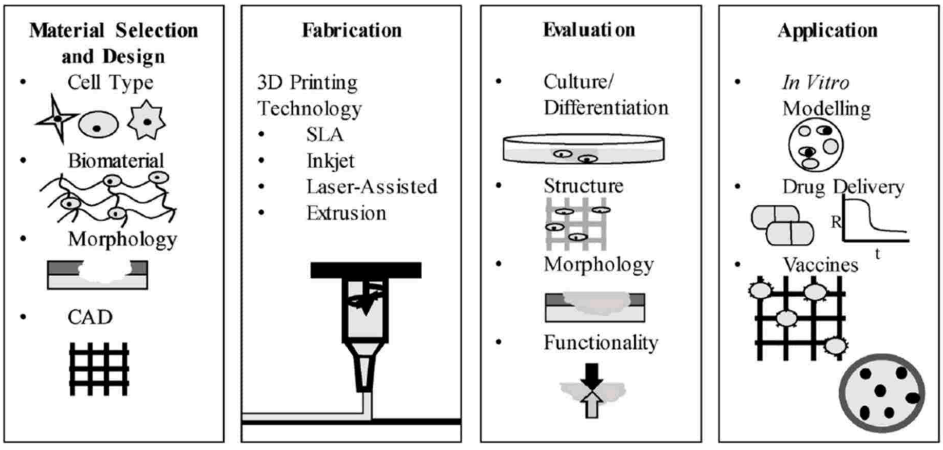


Fig. 2. Bioprinting pathway for combating infectious diseases.

References:

Yi, HG., Kim, H., Kwon, J. *et al.* Application of 3D bioprinting in the prevention and the therapy for human diseases. *Sig Transduct Target Ther* **6,** 177 (2021). https://doi.org/10.1038/s41392-021-00566-8

Zimmerling, A., & Chen, X. (2020). Bioprinting for combating infectious diseases. *Bioprinting s(Amsterdam, Netherlands)*, *20*, e00104. https://doi.org/10.1016/j.bprint.2020.e00104

Sushmit Ghosh

3rd year.

A REVIEW ON THE MORPHOLOGY, SYNTHESIS, PROPERTIES, AND APPLICATIONS OF MXENES: A NOVEL FAMILY OF 2D NANOMATERIALS

MXenes are a family of 2-dimensional inorganic compounds that are composed of carbonitrides, transition metal carbides, and nitrides. Research on such 2D materials have significantly increased since the discovery of unusual physical properties of graphene in 2004. The development of clean energy to replace traditional unsustainable fossil-fuels has gained tremendous interest due to man's ever-increasing energy requirements and the consequent environmental crisis related to it. Despite the incredible achievements in this area, the exploration and development an efficient electron extraction co-catalyst, which is economical and light-induced is an ongoing field of research.

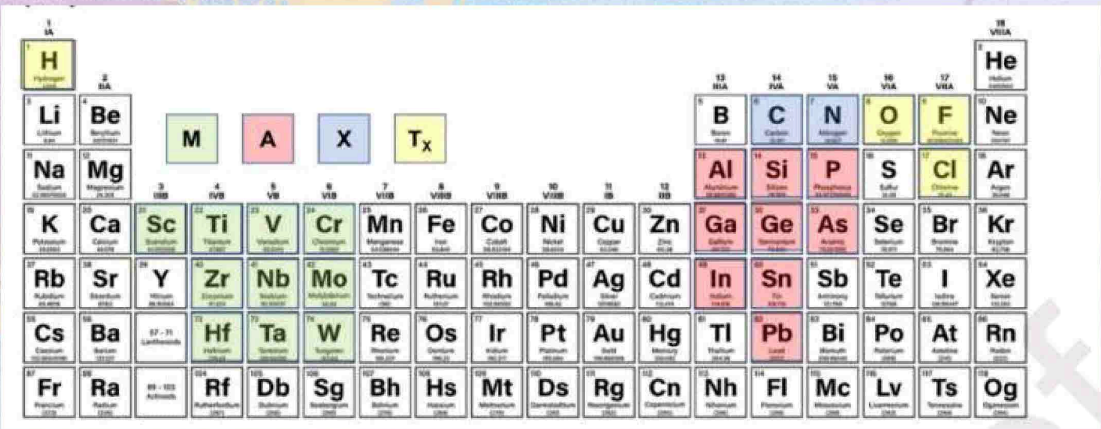


Figure 1: Elements that make up MXenes (Source: https://doi.org/10.1016/j.cej.2020.125428)

A handful of routes for synthesis of MXenes have been discovered, with each having its own advantages and limitations. The choice of a synthesis route for a particular MXene depends upon the MXene about to be synthesized and the desired properties of it. A conventional way of synthesis of MXenes is through MAX phases. Such MXene precursors (MAX phases) are layered, hexagonal

carbides and nitrides having the general formula: Mn+1AXn, (MAX), where n = 1 to 3, and M being early transition metal, A an A-group (mostly IIIA and IVA, or groups 13 and 14) element and X either carbon and/or nitrogen. Some examples of MAX phases are Ti3AlC2, Ti4AlN3, Nb2SnC, etc.

Selective etching of the A-layers from MAX phases with fluoride-containing aqueous acidic solutions have been predominantly used to synthesize MXenes. This can be done using either aqueous or by in-situ formation of hydrofluoric acid. MXenes can also be intercalated using aqueous ionic compounds, such as halide salts or metal hydroxides.

The morphology of raw MXene powder obtained through the selective acid etching of MAX phases normally features an accordion-like multi-layered structure. The crystal structure of MXenes normally inherits the hexagonal atomic lattice P63/mmc of their MAX parents, where X atoms occupy the octahedral interstitial sites and M atoms are hexagonally close-packed. The various structures of MXenes depending on the value of n includes M2XTx (having AB stacking with hexagonal structure), M3X2Tx and M4X3Tx (having ABC stacking with face-centered cubic structure).

Types of MXenes are carbides (Ti2C), carbonitride (Ti3CN), nitride (Ti4N3), and metal nitride-based (ammoniation of carbide-based MXenes). Six possible structures of MXenes are given by atomic-resolution Scanning transmission electron microscopy (STEM). High-resolution transmission electron microscopy (HRTEM) and Electron Energy Loss Spectroscopy include structures having mono-M elements ordered out-of-plane & in-plane double-M elements, solid tsunami, one of the solutions, ordered and randomly distributed vacancies.

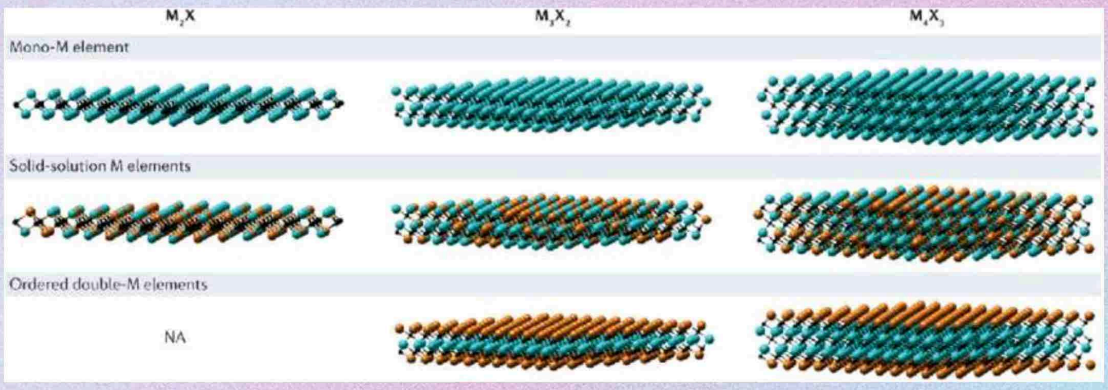


Figure 2: Typical layered structures of MXenes. (Source: https://doi.org/10.1016/j.physrep.2019.12.006)

Various structures of MXene such as MXene quantum dots, nanoribbons. porous MXene, aerogels nanofibers, nano flower-like 3D MXene are being synthesized in recent decades.

Unique properties that make MXenes an attractive class of materials:

The special ultrathin 2D structure, presence of abundant exposed active sites, large specific surface area, high quantum efficiency, hydrophilic surface terminations, advanced atomic utilization, intimate interface contact area, excellent surface energy, high photoactivity, physicochemical stability, recyclability, superior separation efficiency, nontoxicity, d-spacing, lateral size, unique surface functionalized groups and environment-friendly characteristics makes MXenes a perfect co-catalyst or catalyst support. The distinct properties of these MXenes are derived from the unusual combination of ceramic behaviour (low density, high hardness & excellent corrosion resistance) and metallic behaviour (good machinability. high thermal & electrical conductivities). These properties are due to the presence of primary M-X bonds whose nature is a mix of ionic, metallic and covalent bonding.

Applications:

MXenes have been successfully used in:

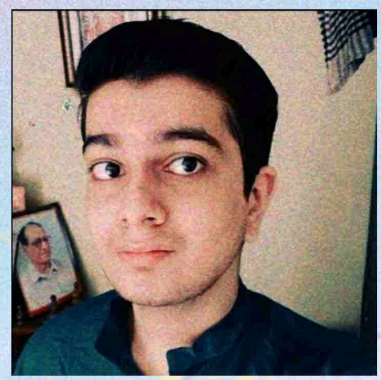
- alkaline-ion based batteries,
- catalysts for hydrogen evolution from water,
- fabrication of supercapacitors,
- oxygen evolution reaction and oxygen reduction reaction,
- water remediation biosensors,
- photovoltaics,
- manufacture of lithium-ion batteries
- Nitrogen fixation,
- degradation of organic synthetic pollutants,
- light-to-heat conversions,
- energy electrodes and energy storage,
- gas separation, cell imaging and electromagnetic adsorption and shielding, and
- anti-fouling agents.

The largely unexplored family of MXenes with their unique morphology and properties make them attractive nanocomposites for various applications. The broad range of applications of MXenes opens up a plethora of opportunities for material scientists and engineers for further R&D and commercialisation of such materials.

<u>References:</u>

1. RM Ronchi, JT Arantes, and SF Santos; Synthesis, structure, properties and applications of MXenes Current status and perspectives. Ceramics International. 2019.
2. P Kuang, J Low. B Cheng, J Yu, and, J Fan; MXene-based photocatalysts. Journal of Materials Science &Technology, 2020.

3. X Jiang, AV Kuklin, A Baev, Y Ge, H Agren, H Zhang, PN Prasad; Two-dimensional MXenes: From morphological to optical, electric, and magnetic properties and applications. Physics Reports, 2020.
4. L Verger,V Natu, M Carey, MW Barsoum; MXenes: An Introduction of Their Synthesis, Select Properties, and Applications. Trends in Chemistry. 2019.



Praneel Bhattacharya,

2nd Year

AN INRODUCTION TO BIO OXIDATION TECHNOLOGY

A number of industries, including those that manufacture paints, chemicals, pharmaceuticals and wood panels, produce volatile organic compounds (VOCs), hazardous air pollutants (HAPs) and odours as part of their manufacturing process.

Bio-oxidation is an air pollution control technology that uses naturally occurring microbes to biologically absorb and digest industrial emissions, converting them to carbon dioxide, water and mineral salts. The process typically involves drawing a contaminated air stream through some type of medium that hosts a community of microbes including either bacteria (Pseudomonas veronii, Micrococcus luteus, Pseudomonas putida, Lysinibacillus sphaericus etc) or fungi, or a combination of the two.

The various techniques involved for the bio-oxidation processes arebio-filtration (makes use of moist solid media and using solubility in water as the driving force), bio scrubber (absorbs pollutants in liquid phase and microorganisms are then used to degrade the pollutants), and bioremediation (employed to attack specific contaminants).

Most off-gases from industrial facilities, waste disposal, and food processing activities have been treated by bio filtration techniques which are generally defined as processes that use compost, peat, bark, soil, or mixtures of these substances as the filter medium. These media serve as support systems for microbial populations. VOCs present in off-gas are trapped in the support material and eliminated biologically as carbon sources for the microorganisms. Bio filtration of contaminated off-gas has been considered a new technology in North America. This is partly because incineration, water and chemical scrubbing, and activated carbon adsorption have been mainly used as air pollution control methods. Bio-oxidation by using a spirally wound bio support which is a polymeric sheet, can be

considered a new air pollution control technique that utilizes microorganisms, immobilized on the surface of the sheet, to degrade VOCs. As a gas stream passes tangentially through the space which is formed between sheets by winding a sheet, the pollutants are absorbed or trapped into a liquid bio layer attached on the surface, and oxidized. In this technique, the term "bio-oxidation" is preferred rather than bio filtration because this is not a filtering technique. Thus, this reactor can be named the air bioreactor for bio-oxidation of air pollutants like VOCs. Also, the term "bio support" is more valid than "bio filter medium". Typically, compounds which can be easily degraded by bio-oxidation are lightweight, water soluble, and contain oxygen atoms: alcohols, aldehydes, ketones, etc. For aromatic and halogenated compounds, which may be more difficult to degrade biologically, inoculation with specific microbial species, additional nutrients and possibly an additional carbon source may be required. In addition, gaseous VOCs are inherently more biodegradable than solids and liquids because they are molecularly dispersed, and because air has a higher oxygen content than water.

Bio-oxidation provides a sustainable solution to incineration type technologies, reducing greenhouse gas production by capturing and treating the contaminants, not creating any secondary pollutants during the process, and using less energy with little to no fossil fuels required to run the system. It requires significantly lower energy requirements of the systems in comparison to other control methods like Vapor Condensers, Electrostatic Precipitators. It releases lower amount of carbon dioxide compared to traditional methods of controlling pollutants, and the fact that bio-oxidation does not release any of the combustion by-products associated with thermal and catalytic oxidation systems, including sulphur and nitrogen oxides that contribute to global warming and acid rain. On an average 7 Million people die due to air pollution every year (As recorded by WHO). Bio-oxidation plays a great role in air pollution control, and the products formed in this process are harmless.

References:

1. Jeong Seop Shim, Robert W. Van Houten BIO-OXIDATION OF A MODEL VOC IN AIR Library flew Jersey Institute of Technology Newark, New Jersey 07102
2. Leson, G., and A. Winer. "Biofiltration: An Innovative Air Pollution Control Technology for VOC Emissions." J. Air & Waste Management Assoc. 41 (1991): 1045-1054.
3. Dharmavaram, S. 'Biofiltration, A Lean Emissions Abatement Technology." Presentation at 84th Annual Meeting & Exhibition of Air & Waste Management Assoc. (June 1991): 429-439
4. Ho, K.-L., Chung, Y.-C., Lin, Y.-H., Tseng, C.-P. (2008) Microbial population analysis and field application of biofilter for the removal of volatile-sulfur compounds from swine wastewater treatment system. Journal of Hazardous Material 152, 580-588.
5. Alonso, C., Suidan, M.T., Kim, B.R., Kim, B.J. (1998) Dynamic Mathematical Model for the Biodegradation of VOCs in a Biofilter: Biomass Accumulation Study. Environmental Science & Technology 32(20), 3118- 3123.

Raktim Ghosh

3rd Year

INVERSE FLUIDIZATION

Wastewater (WW) is one of the burning problems for the hydrosphere and no need to say the importance of the Wastewater treatment. This is a step by step process in which all the possible contaminants are removed from the WW. Oil is one of the most common types and highly visible forms of water pollution. As it can easily spread, even small quantities can potentially cause harm to the aquatic environment due to its barrier to the dissolution of oxygen in the water.

Oil is also a risk to sewage treatment works, where accidental discharges can be difficult and costly to clean up, and just a small quantity of oil can have a disproportionate impact by tainting drinking water at an extremely low concentration due to its lack of assimilation in the digestive system.
Trade effluent is a liquid waste produced in the course of any trade or industry, which is discharged to the wastewater system, and must be controlled because of the potential harm it can cause. As such, the discharge of trade effluent requires consent from representative authorities.
Effluent from industrial processes is normally discharged to a sewer, subject to the approval of water authorities. The concentration of oil in these discharged waters can vary significantly from a few mg/l to hundreds of mg/l. For refineries in Europe, an annual average of a smaximum of 5 mg/l in the effluents was stipulated in PARCO Recommendation 89/5.

The term 'fluidization' is two or three-phase system in which solid particles are fluidized by the upward flow of gas or liquid opposite to the gravity. In this classic fluidization, the density of the solid particles is higher than the liquid or gas stream. In this process, the liquid is a continuous phase which is commonly conducted by the upward flow of the liquid in the liquid-solid phase system or by the co-current flow of liquid and gas flow in the gas-liquid-solid system.

The solid particles under this fluidized condition get fluidized with the upward flow of the stream opposite to the net gravitational force.

The efficiency and quality of fluidization are adversely affected in cylindrical beds due to the particle size reduction results in entrainment, limitation of operating velocity in addition to other demerits like slugging, non-uniform fluidization associated with such beds. When the density of the solid particles is lower than that of the liquid stream then the fluidization can be achieved by the downward flow of liquid or gas and this kind of fluidization is called inverse fluidization. Considering a bed of solid particles in which a downward flow of liquid or gas is happening at a low velocity.

Due to the collision with the bed of solid, there will be a pressure drop of liquid. If the velocity of solid is increased steadily, the pressure drop, as well as a drag with the bed particles, will also increase and for this, the particles will start to move vigorously and get suspended in the fluid.

The sink or float of the particle will depend on the density of the particle. If the density of the bed particles is near to the fluid density then the inverse fluidization will achieve by the counter-flow of gas which is known as solid-liquid gas inverse fluidization. The advantages of inverse fluidization are mentioned below:-

- **Low energy consumption:** The inverse fluidization is achieved by a stream of fluid falling from the top and it is fluidizing in the direction of gravity against buoyancy. Hence not a very high velocity of inlet flow is required as in case of traditional fluidization. The minimum fluidization velocity is lower in this case.

  Also, it takes lesser energy to pump fluid to force the particles in this case. Hence viewing on a larger scale, at the industrial level, it can save a lot of energy. Such energy-efficient processes are the need of today when the energy crisis is at its peak.

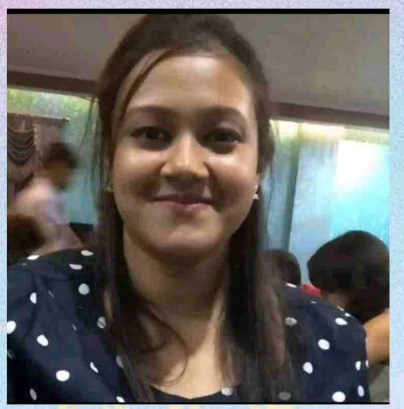
- **High Turbulence:** In inverse fluidization, a big advantage is the achievement of higher turbulence, which is aided by an initial collision of the fluid inlet with the bed particles, leading to foaming.
  This higher turbulence is the key in better mixing and more solid randomness which leads to higher heat transfer rates. Better the turbulence better will be mass transfer rates between solids and gases (3-phase inverse fluidization) which improve the performance of a chemical reactor.
- **Gas-solid contact in gas-solid-liquid inverse fluidization:** The traditional fluidization is inefficient for the gas-solid cases of mass transfer or mixing and often many alternatives have to be used for the purpose. Inverse fluidization can promote contacting of solid and gas. A better mass transfer between gases and solids is expected in a 3-phase setup, improving the performance of the chemical reactor.
- **Erosion in the vessel:** Inverse fluidization was seen to be achieved at a lower velocity of the inlet flow, comparative to traditional fluidization, it can be directly predicted that the equipment parts will have a longer life.

The above four advantages show the efficiency of the process. Yet there are a few more ways how this process becomes economical. Firstly particles of the bed have to be lighter than the medium fluid. That does not mean particles of heavy materials cannot be used. A simple way is to use hollow particles, this gives a lighter particle and also the surface area available for a particle is more than that of a solid particle from a given amount of material.

These hollow catalysts or bed particles can make the process further economical and useful for a wide range of fluid; especially lighter fluids with lesser viscosity in the case of inverse fluidization. This helps in reducing run-time costs to industries.

Reference:

S.Choudhury;A.Sahoo;Waste Water Treatment By Inverse Fluidization Process: An Overview; International Journal of Advanced Engineering Technology; October-December 2012/8/16;Vol.III/Issue IV;DOI: E-ISSN 0976-3945



Rajneeta Chaudhuri

3rd year

CARBON NANOTUBES: APPLICATION IN BIOMEDICINE

Carbon nanotubes are cylindrical molecules consisting of a single layer of carbon atom or graphene consisting of a diameter less than 1 nm. CNTs have been extremely successful in applications related to pharmacy and medicine. They have a natural tendency of combining with each other by Van der Waals forces forming rope like structures.

This makes them very attractive for making high-strength, lightweight materials which possess highly conductive electrical properties. Their hollow interior can be filled with various nanomaterials making them very effective for drug delivery. Their large surface area enables them to conjugate with various diagnostic materials like genes, vaccines, antibodies, drugs etc.

CNTs need to be functionalized in order to play a major role in medicine. Functionalization means to add new properties and features to the CNTs by changing their surface chemistry. This technique is used in textile engineering, nanotechnology and biological engineering. After functionalization CNTs become hydrophilic and are then ready to get linked with biomolecules, such as genes, biosensors, DNA, and can therefore be delivered to the targeted cells. For drug delivery, the drug is attached on the surface of the CNTs.

The conjugate is delivered by methods such as injection, oral or is guided by some external magnet to reach the target organs. When it reaches its destination, the cell ingests the drug CNT capsule and the nanotube spills its contents thus delivering the drug safely and successfully. CNTs can keep the cells intact during transportation and cellular penetration allowing the decrease of drug dosage and their toxicity especially anticancer drugs.

SOME USAGE OF CARBON IN CANCER THERAPY ARE:

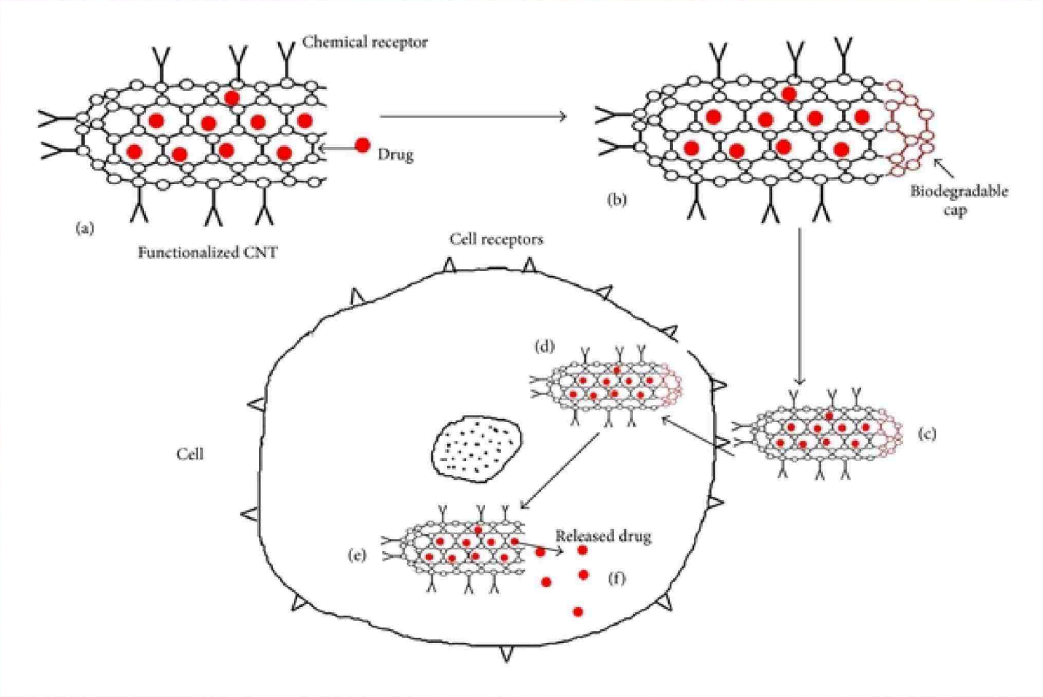
In Infection Therapy:

It has been demonstrated that functionalized CNTs can carry antimicrobial agents like antifungal amphotericin B. It can fight infectious diseases by reducing drug dose of standard therapeutics and also reduces toxicity. Since functionalised CNTs can keep antigen conformation intact, they can induce right immune response thus acting as a good vaccine delivery procedure.

Drug Delivery:

Traditional anticancer drugs do not have sharp cell penetration like CNTs do. Their efficiency is further reduced by their systemic toxicity. Its action on the tumour cell is higher as the drug gets delivered in situ with intact concentration. The high surface area of CNTs also help in attachment of multiple drugs at the same time.

Schematic representation of drug delivery by CNTs –



In Biosensors:

Recent applications demonstrate the use of CNTs in biosensing. It can be used for therapeutic monitoring and in vitro and in vivo diagnostics.

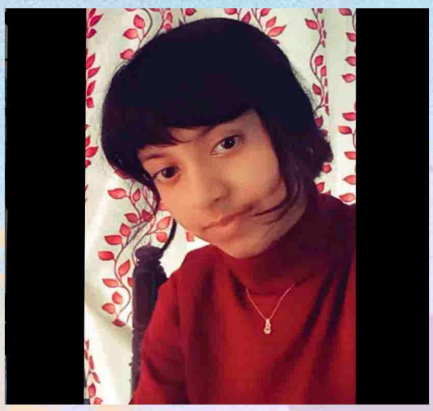
This technology can help in treating many incurable diseases. It has shown excellent results in therapeutic monitoring and diagnosis of diseases. In spite of the

various surprising results shown by CNTs there still remains serious challenges that need to be resolved.

For example, new sensitive markers need to be attached with CNTs so that they can reach the target without causing any side effects. Before using them in the global market, it is highly recommended that they should undergo more toxicological investigations.

Reference:

https://.www.hindawi.com https://.www.nanork.com



Gargi Mukherjee

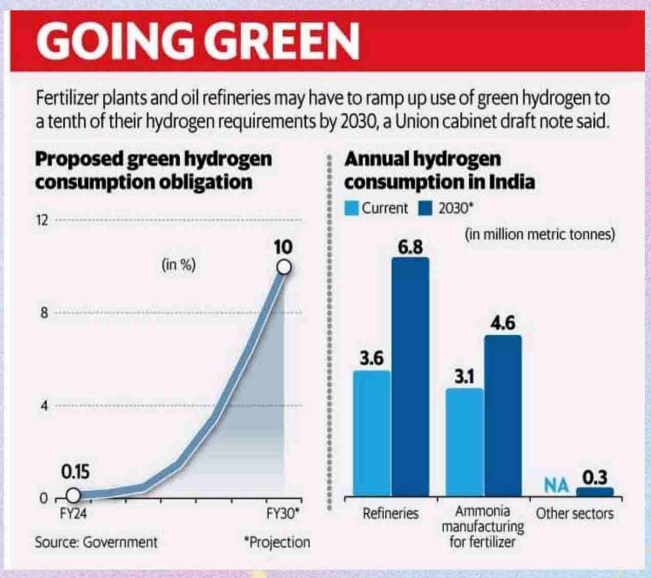
2nd Year

GREEN is "THE NEW NORM"

Energy has been universally recognized as one of the most important inputs for economic growth and human development. Economic growth implies the availability of cost effective and environmentally benign energy sources and contributes to the GDP growth of our country. A future energy economy will need to replace oil and reduce greenhouse gas emissions (GHGs) which cause extensive global warming and extreme temperature events.

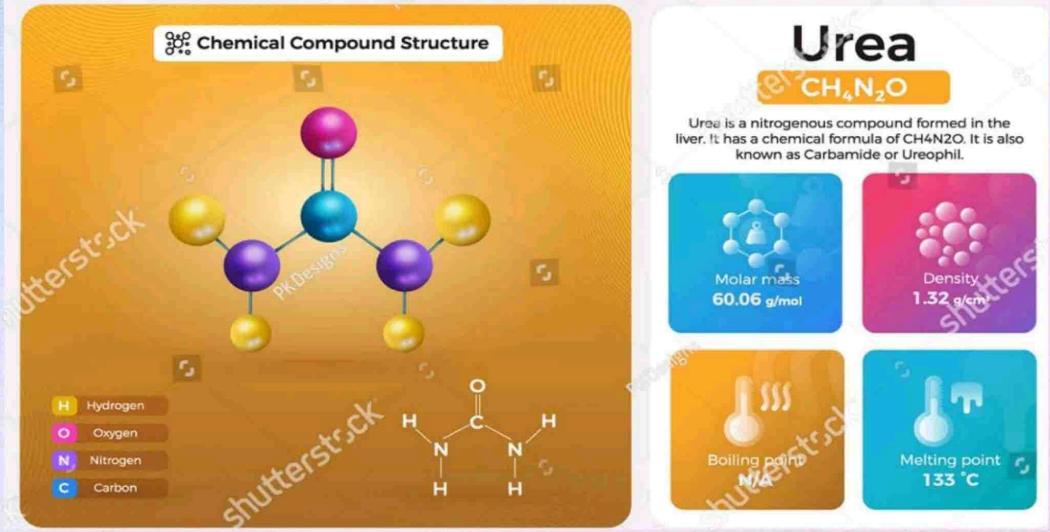
The recent surge in the prices of petrol and diesel also brings out the concern to focus on renewable sources and also to achieve the "net zero emission target" by 2070 which is committed by INDIA in the COP26 , GLASGOW. The worldwide interest in **GREEN HYDROGEN** as a clean fuel has led to comprehensive research, development and demonstration activities whose main objective is the transition from a fossil based to **a "CO2 lean"** energy structure.

(**https**://indiascienceandtechnology.gov.in)



A new technology has been developed that accomplishes the direct conversion of urea and urine to pure hydrogen via electrochemical oxidation with an inexpensive nickel catalyst.

An electrocatalyst system has been developed by the scientists **from the Centre for Nano and Soft Matter Sciences** (an autonomous institute of the Department of Science and Technology) for energy-efficient hydrogen production.



✓ The study involves urea electrolysis for the urea-based treatment of waste with low-cost hydrogen production.

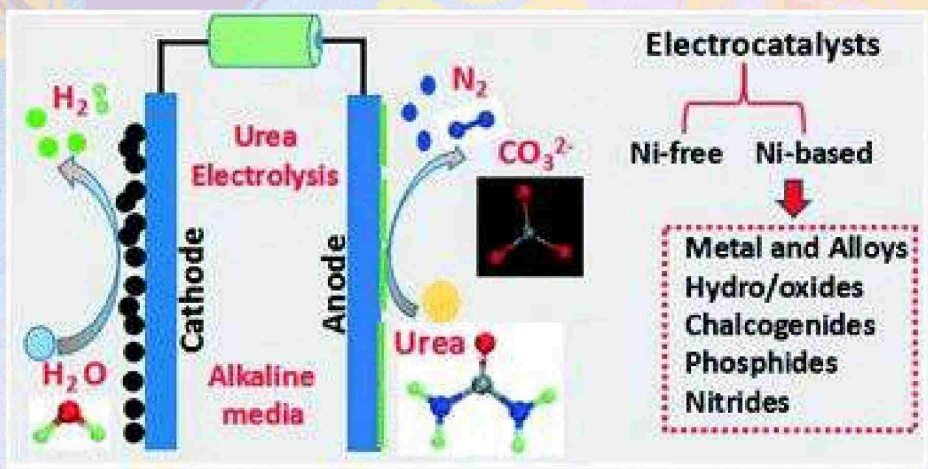
✓ So far water electrolysis has been used as a low carbon technique for the sustainable production of hydrogen. However, this method requires high energy expenditure.

✓ Urea electrolysis, on the other hand, is a more efficient alternative reducing the energy requirement to 70%.

✓ The electrolysis of Urea involves oxidation of urea in the electrolytic set up.

✓ In this process, Nickel based catalysts are used. Catalysts are chemical or biochemical agents that accelerate the chemical and biochemical reactions without undergoing any change in their properties and by reducing the energy of activation of a reaction.

✓ The scientists focused on the development of a nickel oxide-based system for the production of hydrogen from electro-oxidation of Urea.



(http://www.**pib**.gov.in)

The utilization of wastewater for useful fuel has been gathering recent attention due to society's need for alternative energy sources. The electrooxidation of urea found at high concentrations in wastewater simultaneously accomplishes fuel production and remediation of harmful nitrogen compounds that currently make their way into the atmosphere and groundwater.

Pure hydrogen was collected in the cathode compartment at 1.4 V cell potential, where water electrolysis does not occur appreciably. Urine is the most abundant waste on Earth. The largest constituent of urine is urea, which is a significant organic source of H, C, O, and N.

An electrochemical process that produces H2 from urine/urea demonstrate that human urine, with an average concentration of 0.33 M urea can be electrochemically oxidized with an inexpensive transition metal, nickel, according to eqn (1–4).

$CO(NH_2)_2(aq) + 6OH \rightarrow N_2(g) + 5H_2O(l) + CO_2(g) + 6e$ .....(1)

$Ni(OH)_2(s) + OH \rightarrow NiOOH(s) + H_2O(l) + e$..... (2)

$6H_2O(l) + 6e \rightarrow 3H_2(g) + 6OH$..... (3)

$CO(NH_2)_2(aq) + H_2O(l) \rightarrow$

$N_2(g) + 3H_2(g) + CO_2(g)$..... (4)

Urea is oxidized at the anode **(eqn (1))** at a standard electrode potential of 0.46 V vs. SHE (Standard hydrogen electrode). The Gibb's energy of urea was calculated as the crystalline Gibb's energy plus the energy for dissolution of urea from its crystalline state. The oxidation of Ni(OH)2 to NiOOH at the anode **(eqn (2))** is a competing reaction that attributes to current during electrolysis and occurs at 0.49 V vs. SHE. Alkaline reduction of water **(eqn (3))** occurs on the cathode at 0.83 V vs. SHE.

Overall, **in eqn (4)**, an electrolytic cell potential of only **0.37 V** is thermodynamically required to electrolyze urea at standard conditions. This is significantly less than the **1.23 V** required to electrolyze water theoretically generating 70% cheaper hydrogen.

Nitrogen is generated from the anode demonstrating nitrate remediation of wastewater while water is reduced at the cathode producing valuable hydrogen for the impending hydrogen economy.

Anode and cathode gases were collected separately in a Hoffman apparatus filled with a solution of 5M KOH in the presence and absence of 0.33 M urea and analysed via gas chromatography. The electrolyses were performed at a constant voltage of 1.5 V and 25 C for 22 hours. Currents observed were 20 mA and less than 1 mA in the presence and absence of urea, respectively.

This verifies that water electrolysis is not occurring to an appreciable extent. Pure H2 was observed at the cathode while N2 (96.1%) with trace amounts of O2 (1.9%) and H2 (2.0%) were detected at the anode for urea electrolysis. A small amount of hydrogen (0.28%) was detected at the anode in the absence of urea as well, which suggests this hydrogen is not a product of urea electrolysis.

Instead, it is likely due to the nickel transition reaction Ni(OH)2NiOOH. Carbon dioxide was not detected as part of the gas phase for urea electrolysis, but is believed to have formed potassium carbonate in the liquid phase.

After 22 electrolysis hours, 13% of the urea was converted into hydrogen, nitrogen, and potassium carbonate, as determined using a heat treatment method for urea determination.

Due to the formation of a reactive intermediate that binds to the active site of the catalyst, which causes its activity loss. The scientists found that electron-beam treatment is an effective way to create a large number of coordinatively unsaturated active sites on electrocatalysts.

This results in the adsorption of urea facilitating the urea electro-oxidation mechanism.

✓ The urea electrolysis method sets an example for India's consistent efforts towards the adoption of low carbon technologies and energy-efficient methods.

✓ India is one of the top countries in the production of urea and the nitrogenous fertiliser industries generate high quantities of urea and ammonia as effluents.

✓ These effluents can be used for the production of hydrogen and waste treatment meeting the country's energy demands in a sustainable way.

<u>References:</u>

- INTERNATIONAL ATOMIC ENERGY AGENCY PUBLICATIONS.
- (https://indiascienceandtechnology.gov.in)
- (http://www.pib.gov.in)

- G. G. Botte, Electrolysis of urea/urine to produce ammonia and hydrogen, electrolysis of urea/urine to ammonia, and methods, uses, and fuel cells related thereto, U.S. Pat., 60/980 056, 2007.
- Urine, Britannica Online Encyclopedia, http://www.britannica.com/EBchecked/topic/619857/urine, 2007.

Suchita Gora

2nd Year

EVENTS' 22

ACMS-2022

•Glimpses of the International Conference ACMS 2022, organised by IIChE, which took place between 14th-16th April 2022, inside the campus of Heritage Institute of Technology, Kolkata.

•The Conference witnessed presentations of 583 research papers and 16 invited talks from scientists across the world.

•The event was inaugurated by Minister of State, Petroleum & Natural Gas and Labour & Employment, Govt. of India, Shri Rameswar Teli (Chief Guest) and Smt. Annpurna Devi, Minister of State for Education, Ministry of Education, Govt. of India (Guest of Honour).

ACMS-2022
organizers & volunteers

Shri Rameswar Teli (Chief Guest)
Minister of State,
Petroleum & Natural Gas
and Labour & Employment.

ChEM-SPARK 2022

•The annual departmental technical fest, Chemspark-2022 had its first day of events on 29.04.22.

•The inaugural ceremony had Prof. (Dr.) Sekhar Bhattacharjee (Guest of honour and invited speaker), retired professor, Calcutta University and Mr. S.K. Roy(Chief guest), council member,IIChE.

•A workshop on Process Simulation(DWSIM) and an introduction to UNISIM by Prof. (Dr.) Sekhar Bhattacharjee, were conducted post inauguration.

INAUGURATION

PROCESS SIMULATION

INDUSTRY VISIT

The third year students of Department of Chemical Engineering, HITK, undertook an industry visit, organised by the department, at Himadri Speciality Chemicals Ltd. on 2nd June 2022.

The group visited the factory's two important production units: Carbon Black Division (CBD) and the Coal Tar Products (CTP).

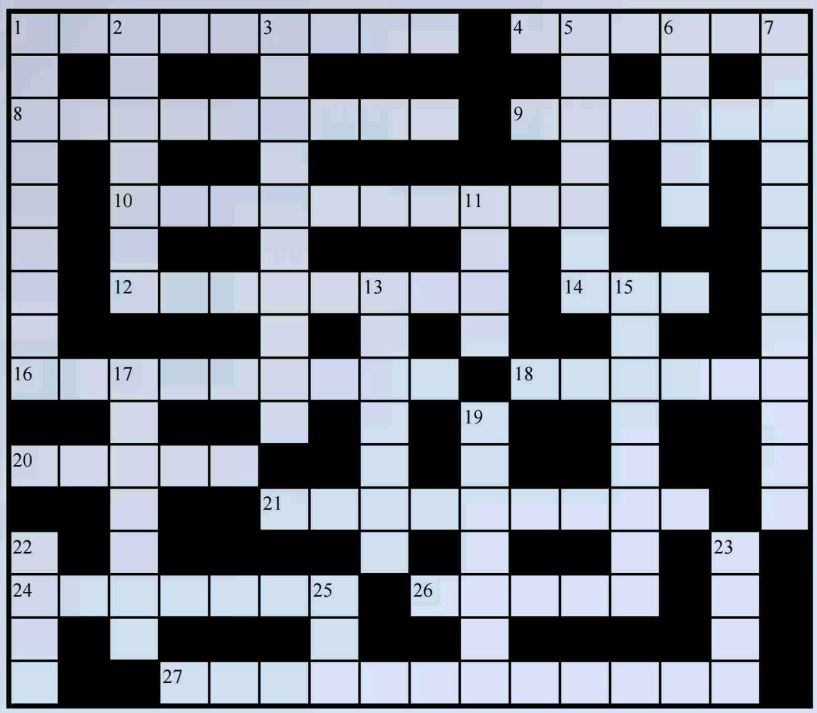
First hand industry knowledge was acquired,as students explored the different equipments and production designs,under the guidance of designated factory officials,who mentored the visit.

ACHIEVEMENTS

- Once more, Heritage Institute of Technology, Kolkata, got illuminated by the shine of our very own student, **Soumyajit Kundu,B.Tech 4th year,Chemical Engineering.**
- He has accomplished the spectacular achievement, of securing, **AIR-3** in **GATE** examination(2022). We once again, offer our heartfelt congratulations and a bucket full of well wishes, for his future endeavours.

- **Aniruddha Hore** and **Saptarshi Mitra**, students of **B.Tech -ChE, 3rd year**, HIT-K, got the **BEST PAPER AWARD** for their research paper: **"Study of Antibacterial Effects on Indian Currency"** in the International Conference on Advance Chemical and Material Sciences (ACMS), 2022.
- It was an offline event organized by Indian Institute of Chemical Engineers, Headquarters (IIChE) from 14 - 16th April, 2022.Their achievements have also been covered by the EASTERN CHRONICLE'S, in their 04.05,2022 issue.

CHEMFUN



Across:

1 Type of force that free electrons experience during transport phenomena

4 ___tion, a process in which components from a gas phase transfer into liquid phase

8 A kind of reciprocating pump

9 Nature of boundaries in case of interfacial defects in solids

10 Equation of continuity denotes ___ of mass velocity vector ρV

12 Three dimensional array of points coinciding with atom positions

14 Abbreviated form of a measure of kinematic viscosity used in classical mechanics

16 Fluid with constant viscosity, where shear rate is directly proportional to shear stress

18 Substances like ethanol, acetic acid, vinyl polymer can be prepared from it

20 The constant Ki in the equation ^fi = Ki xi is named after him

21 Vena ___, contracted parts of minimum cross-section of a jet of fluid discharging from an orifice

24 A thermodynamic cycle that coverts heat into mechanical energy

26 Author of 'Thermophysical Properties of Refrigerants'

27 Equipment used to measure the flowrate of a gas or fluid

Down:

1 Transfer of energy through space by electro-magnetic waves

2 The ratio between momentum and thermal diffusivity is named after him

3 A type of Trombone Cooler

5 Vector that represents the magnitude and direction of the lattice distortion resulting from dislocation

6 In roasting, sulphide ore is converted to this ore

7 The art of measuring the moisture content of air

11 Measure of the pressure experienced by a fluid on the suction side of a centrifugal pump

13 Phenomenon that frequently precedes fracture in some thermoplastic polymers

15 A vacancy defect shown by ionic solids

17 An electro-metallurgical process where non-soluble anode is used

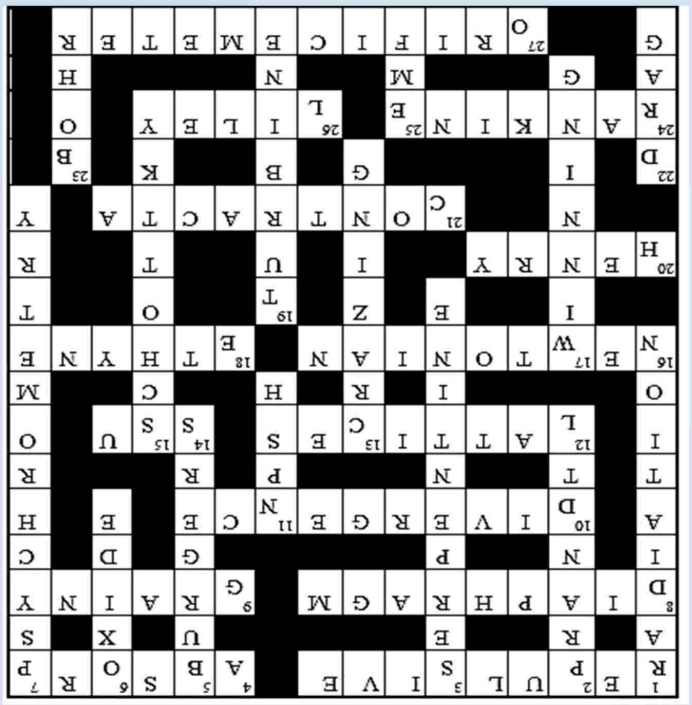
19 Machine that transforms rotational energy from a fluid into usable work or energy

22 This coefficient decreases at low Reynolds numbers

23 The most fundamental magnetic moment is named after him

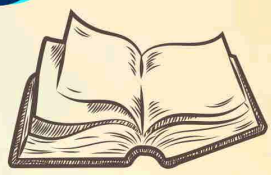
25 The maximum potential difference between two electrodes of a cell

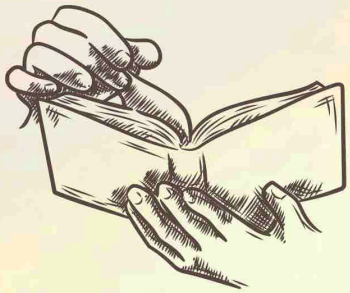
SOLUTION

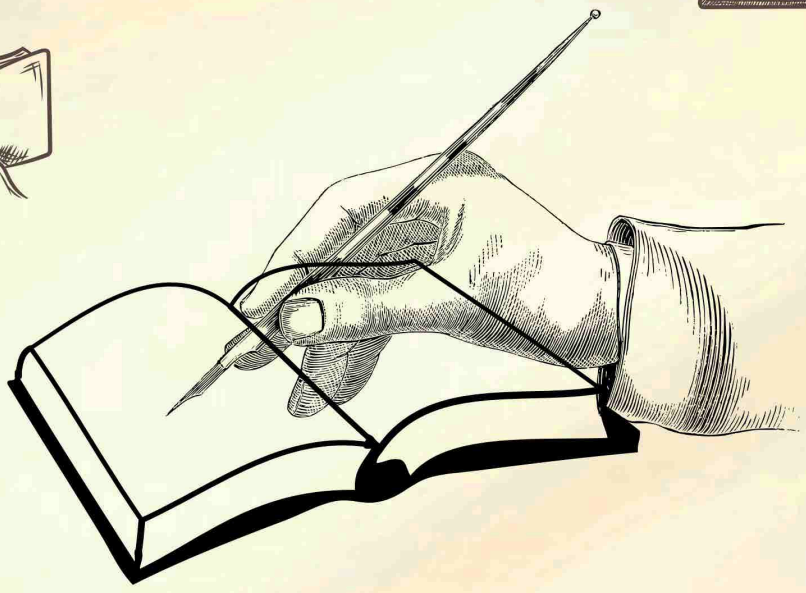


Chitrita Banerjee
2nd Year

Creative Writing







BREATHLESS MOMENT

Its only the creatures who are suffering
We had not stopped but still wondering
A weapon that can save the spectacular world
By killing our tiny enemies just like a sword.

Its not ridiculous but painful
We are now extremely watchful,
Nothing to do but to depend on our fate
Asking god “do something now or it will be to late”.

What a moment it is
Standing like a soldier in a war,
Without any arms, without any weapons
Waiting to be a brave martyr.

Prithul Das
CHE 2nd Year

Miracle

You are a miracle
You can make it happen
Be a change, let it be sudden.

Grow a heart of steel,
Aim and make a fixed deal
Let them hurt because you are strong to heal.

Blow them off, come on explode!
No getting stamped, now you stand bold;
Run for your sake, not only for gold.

They will not reach you as you take a different road;
Be high spirited, energy reload.
You don't need any weapon to knock them
Smile and that will hook them.

Beautiful like a princess in the fairytale
Sweetheart, you are a miracle!

You are designed to rule;
Don't wait for your knight,
Put on your armour and lead the fight.

Miracle

Take the chance, come on don't wait
You are the hope, you are going to give them light
Shine the brightest in dark nights.

Treasure the good, let go of the ruined
Look forward, you will be alright
You will achieve the heights and see your flag radiating bright.

Stop nowhere, to no one's word
You are the captain of your heart
Make winning, your glorious art!

No distress or misthought must cloud your mind,
Make plans and execute it clear
Stand out without a doubt or fear.

Awake and strive;
Cause you are a miracle that will gracefully thrive.

Urjoshi Chatterjee
CHE 2nd Year

Peace

On that day my soul grew quiet
I am shorn of my riot
My freedom, I could not awaken
Take thy pandemonium from out my heart
Back into my memories protesting
Long I stood there grumbling, vesting
How they were investing, besting - nesting
As of someone gently guesting, guesting
I was a peace-making and thee an individuality
Back into my memories decrying
I am shorn of my formality
All my soul within me qualifying
Death shall bring the delegations.

Soumili Sarkar
CHE 1st Year

The Quest

With each of the small steps that I take
I gradually progress towards the sky,
Painted with the subtlest shades of mother nature.
I want to go;
To a place far away...
With each of those small steps I take, I travel;
Travel to the place,
Where the twilight unfolds the twinkling of a thousand stars,
Where the fairy winds sing songs, for the timeworn traveller,
Farther than the cosmos.
I want to embrace death;
And I want to live.
Live in that place,
Where I can conquer my hiraeth

Diptanshu Biswas
CHE 3rd Year

যান্ত্রিক অনুভূতি

সালটা **2050**
পিক্সি এখন সারাদিন মন খারাপ করে বসে থাকে। **5** বছরের অবসর জীবন তার।পিক্সির হাসব্যান্ড দশ বছর আগেই মারা গেছে। ছেলে আমেরিকাতে রোবটেক্স নিয়ে পড়াশোনা করে এখন রোবট বানানোর প্রচেষ্টা করে করে নিজেই রোবট হয়ে গেছে। এখন ফোন করার অনেক সুবিধা আর কষ্ট করে মোবাইলের স্ক্রিন এ হাত দিয়ে ঘষাঘষি করতে হয় না, খালি মুখে বলো 'কলিং গুক" তাহলেই কল চলে যাবে। আর একবার অপশন 'সি' বললেই ক্যামেরা অন, এভাবেই ছেলে গুক এর সাথে দিনে দুবার যোগাযোগ হয় পিক্সির।

কিরে কবে আসবি ইন্ডিয়া তে। তিন বছর হতে চললো তোকে কাছে পাইনি। উফফ! মিমি তুমি কি যে বলো না. যাবো, যাবো এবার পুজোয় যাবো। মিমি শোনো না এবার যখন যাবো তখন ভালো ভালো রান্না করবে বুঝলে? আচ্ছা বাবা! তুই আগে আয় তো।

একমাস পর।।
মা তুমি রাগ কোরো না মা, পুজোয় হবে না, তবে খুব শিগগিরি আসবো, তুমি তো বোঝো বলো এখানে আমি ছাড়া চলে না। তুই বলেছিলিস আসবি আমি কত খাবার এর অর্ডার দিলাম, মার্কেটিং করলাম। কতদিন তোকে দেখিনি রে আমি মরে গেলেও বুঝি দেখতে আসবি না কথা গুলো বলার সময় পিক্সির গলা টা ধরে এলো। মা এসব কথা তুমি বলো না কি করবো বলো এত কাজ এর চাপ .....

যান্ত্রিক অনুভূতি

গুক বুঝেছিল মা এর অভিমান হয়েছে তাই তাকে খুশি করতে একটা গিফট পাঠিয়ে দেয়। সকালবেলা সমস্ত কাজ সেরে সবেমাত্র বসতে যাবে পিক্সি, তখনি ডোর বেল বাজলো। সিসিটিভি তে ফুটেজ চেক করে দরজায় লাগানো ইডেন্টি কার্ড এর ইনফরমেশন চেক করে দরজা খুলে দেখলো একটা বড়ো বাক্স। সিগনেচার করে ডোর লক করে বাক্স তা নিয়ে ঘরে ঢোকে পিক্সি। সঙ্গে সঙ্গে ছেলের ফোন মা তুমি একা থাকো সবসময়, তাই ও তোমার সঙ্গ দেবে।আচ্ছা ওটা ফিটিংস করো, তার পর চার্জ এ দাও। ফোনটা রেখে পিক্সি ভাবলো- আমি কি বাচ্চা ? একটা রোবট কি সঙ্গ দেবে আমার!

পরের দিন সকালবেলা ঘুম ভাঙলো একটা মিষ্টি ডাকে। 'গুড মর্নিং মিমাই'। ঘুম ভেঙে চোখ রগড়ে পিক্সি বললো তোকে মিমাই বলতে কে শেখালো ? সরি। আই কান্ট আন্ডারস্ট্যান্ড হোয়াট আর ইউ টকিং ? তখনি পিক্সি সেটিংস এ গিয়ে ল্যাংগুয়েজ চেন্জ করে দিলো। ওকে মিমাই। আমায় না কেউ শেখায়নি মিমাই বলা। গুক ব্রো মিম বলে তাই আমি মিমাই বললাম। আচ্ছা মিমাই তুমি ডান্স করতে পারো?চলো আমরা একটু ডান্স করি। ওকে চল। ডান্স করতে করতে পিক্সি রোবটটার নাম দিল লোগান।

লোগান এভাবেই ধীরে ধীরে পিক্সির এতটা কাছের হয়ে গেল যে পিক্সির ছেলে বাইরে থাকার কষ্ট কমে গেল। লোগান আর পিক্সি ঘুরতে বেড়ায়, লোগান পিক্সিকে সময়মতো ওষুধ খাইয়ে দেয়, নতুন নতুন আইটেম রান্না করে খাওয়ায়।

যান্ত্রিক অনুভূতি

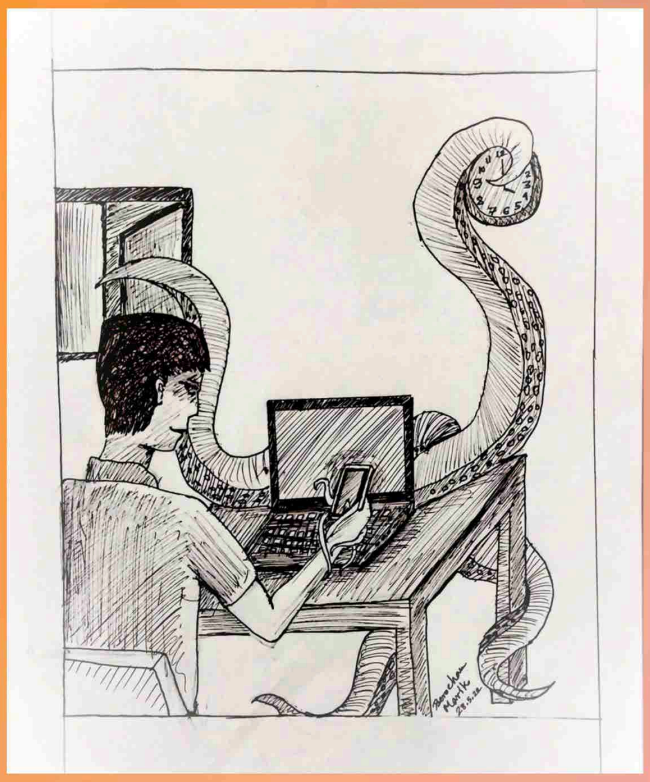
এরপর হঠাৎ একদিন বাথরুমে পরে গিয়ে স্টোক মতো হয়ে যায় পিক্সির। লোগান অনেক চেষ্টা করেও স্বাভাবিক করতে পারে না মিমাইকে। গুক এর থেকে শুনেছিল লোগান মিমাইয়ের এর আগে দুবার স্টোক হয়ে ছিল। তিন দিন অক্লান্ত পরিশ্রম করেও মিমাই শেষ পর্যন্ত চিরতরে ঘুমিয়ে পড়লো লোগান এর কোলে।
লোগানের মনে পড়ছিল মিমাইয়ের কথা। আচ্ছা লোগান যেদিন আমি থাকবো না তুই কি করবি ? তুমি কোথায় যাবে বেড়াতে? আমিও যাবো । নাকি আমায় বিক্রি করে দেবে ? আমার কথাটা শোন আমি বলছিলাম, আমি যদি মরে যাই ? না মিমাই ওসব বলবে না, তুমি মরে গেলে আমিও মরে যাবো। রোবট আবার মরবে কি করে বলে জড়িয়ে ধরে পিক্সি কেঁদেছিল খানিকক্ষণ। আজ লোগান অনেক চেষ্টা করেও কাঁদতে পারল না।
এসব ভাবতে ভাবতে লোগান বললো- 'কলিং গুক'। ফোনে গুককে জানালো খবরটা। তারপর নিজের চেস্টে হাত দিয়ে প্রথমে সেটিংস, তারপর পার্সোনাল, সেখান থেকে সুইসাইড এবং সব শেষে সাট ডাউন অপশনে ক্লিক করলো।

এরপর লোগানের শরীরের ভিতরে চলছিল অবিরত এসিড ক্ষরণ, যে এসিড তার ফিলিংস এর সমস্ত ফোল্ডারকে নষ্ট করে দিল। কিন্তু বাইরে থেকে লোগান রইল অক্ষত।

Debosmita Nag
CHE 2nd Year

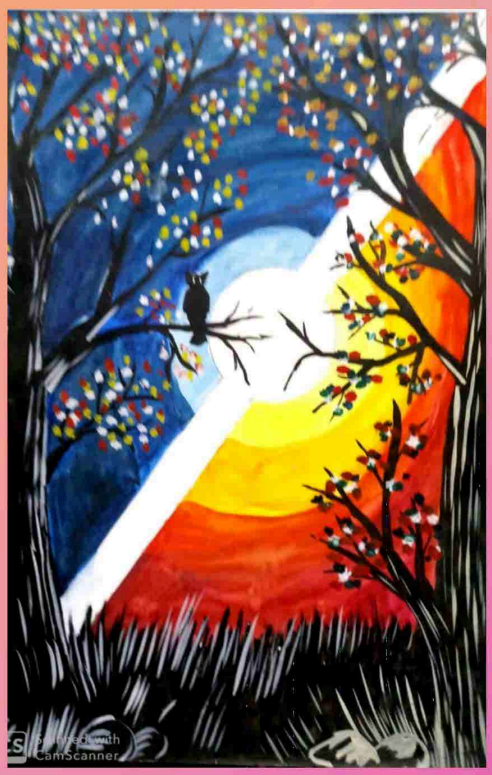
ARTISTIC CANVAS

SNEHA BHATTACHARYA
(CHE 1ST)

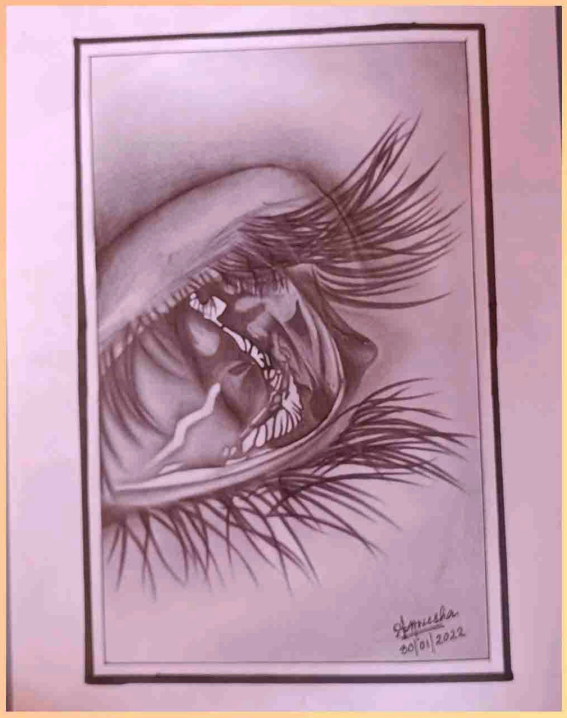


BEROCHAN MARIK
(CHE 2ND)

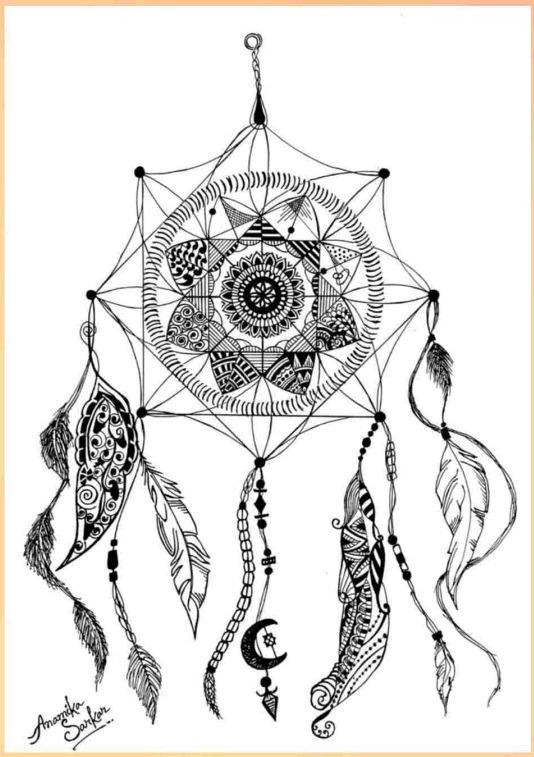
DIYA MUKHERJEE
(CHE 2ND)



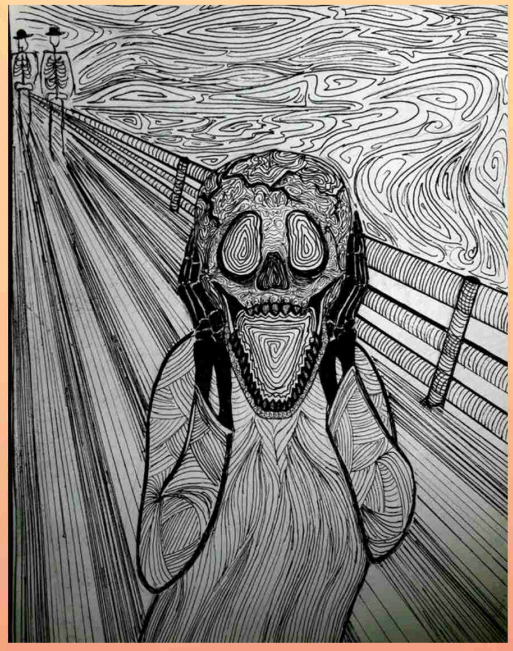
DEBOSMITA NAG
(CHE 2ND)



ANWESHA NANDY
(CHE 1ST)

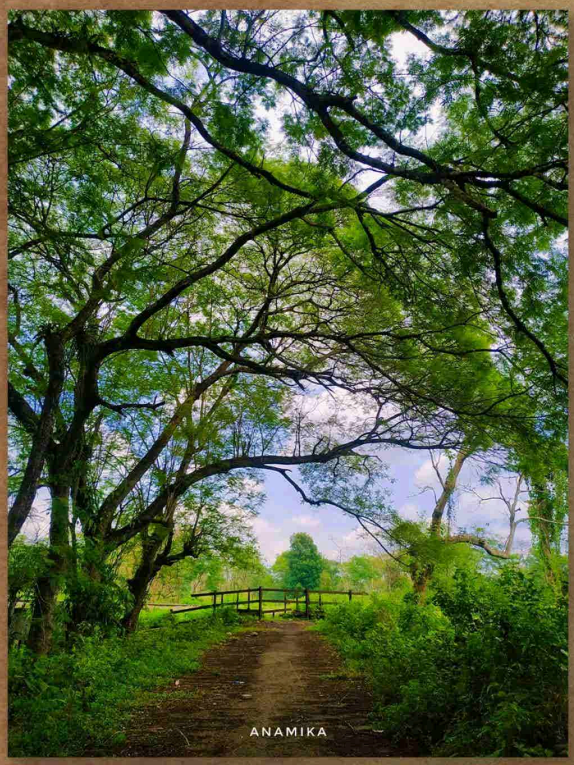


ANAMIKA SARKAR
(CHE 2ND)



KINJAL KUMAR DEY
(CHE 1ST)

SHUTTER STRUCK



ANAMIKA SARKAR
CHE 2ND

ARKA SANYAL
CHE 1ST

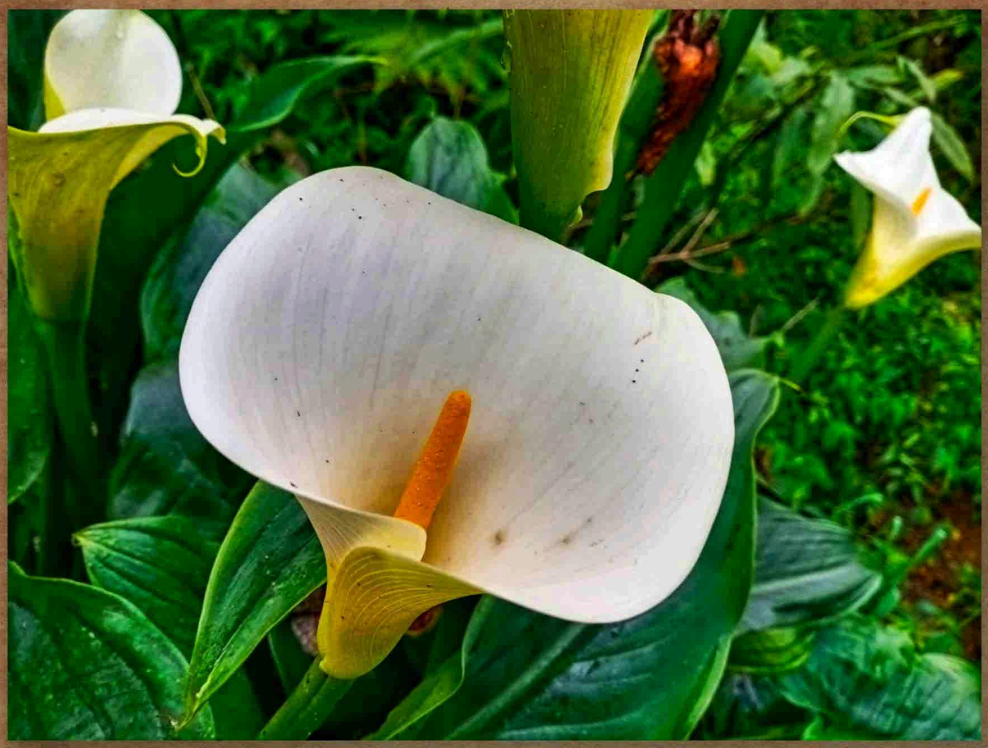
AYAN BANERJEE
CHE 2ND

JASHODHARA BANERJEE
CHE 3RD

SAYAN KUMAR RAY
CHE 4TH

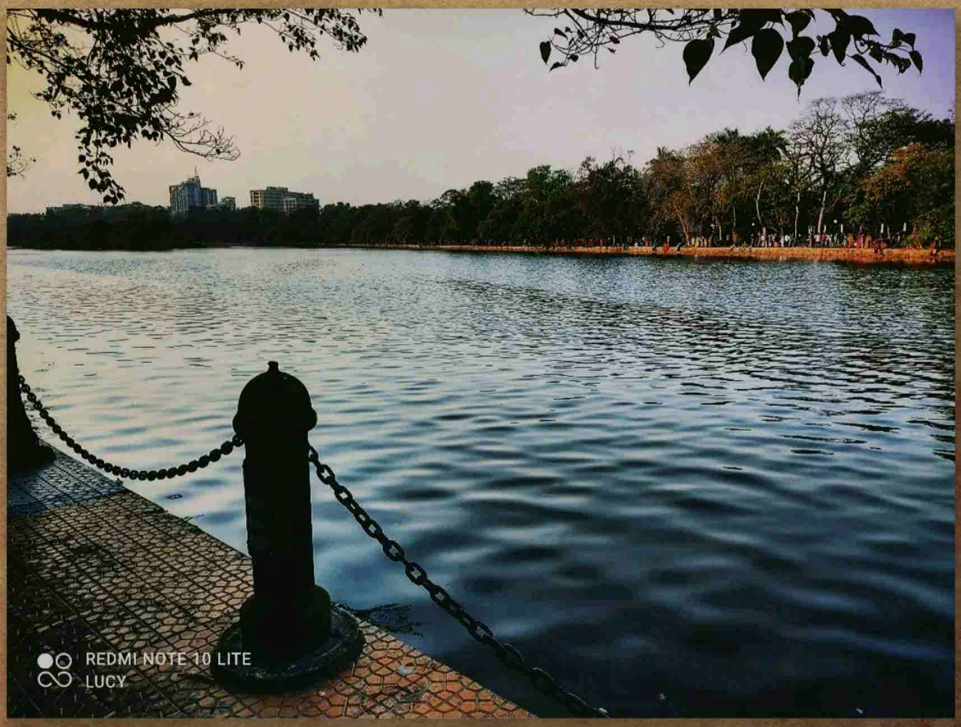
HRITAM JANA
ChE 2ND

MANOJ KUMAR SONTHALIA
CHE 1ST



PRITHUL DAS
CHE 2ND

SOUMILI SARKAR
CHE 1ST



SAYAN GUHA
ChE 2ND

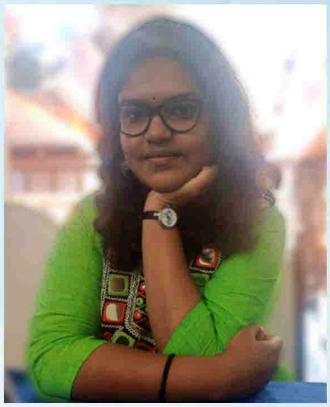
SOUMEN BHASKAR
ChE 2ND

URJOSHI CHATTERJEE

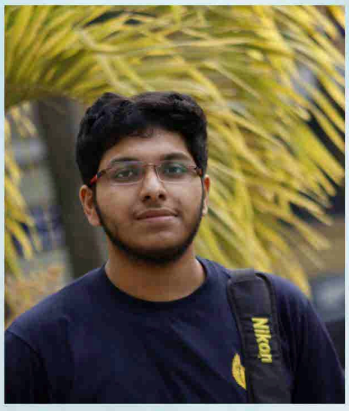
CHE 2ND

STUDENT EDITORS

Anwesha Pandit
(Che 3rd)



Jashodhara Banerjee
(Che 3rd)



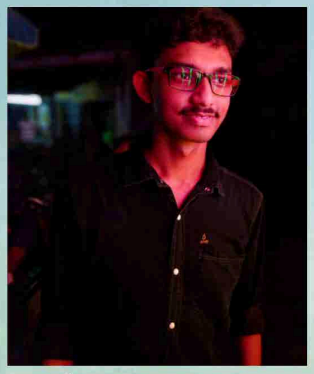
Tirtharaj Goswami
(Che 3rd)

Arunava Das
(Che 2nd)

Ayan Banerjee
(Che 2nd)

Hritam Jana
(Che 2nd)

Prithul Das
(Che 2nd)



Ritam Das
(Che 2nd)