ETCH 2022

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING

INDIAN INSTITUTE OF TECHNOLOGY MADRAS

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Message from the Editorial Team

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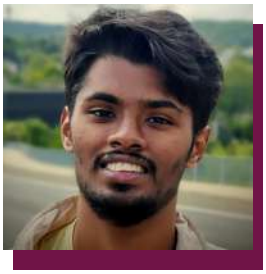
IIT Madras Research Park

We are delighted to present to you ETCH, the annual newsletter of the Metallurgical & Materials Engineering Department (previously an annual magazine). After a two-year hiatus due to the global pandemic, we have finally (almost) caught up with the times, and we have a lot of interesting articles and interviews lined up for you. As always, any feedback and comments are welcome and we look forward to it. With each passing year, we strive to keep improving ETCH and give you the best content we can, and it would not be possible without your continued support. Happy reading!

ETCH Team



Abhiram Kavikondala
M.Tech., 2023

Ganti Venkata Sai Subhash
M.Tech., 2023

Divya Jyothi D
B.Tech., 2024

Ayesha Ulde
DD, 2024
(Chief Editor)

Nandagopal P.
B.Tech., 2024

Rajamani Ananth
B.Tech., 2024

Vedasri Bai Khavala
Ph.D.

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CERATATTVA

March 2022

A pleasant surprise for the students and faculty of the Metallurgical and Materials Engineering Department of IIT Madras. The department's first start-up company, Ceratattva, was incubated in the IITM Research Park.

In this article, we will dive into the workings of the company and find out what makes it unique and why Ceratattva can potentially drive the future of the defense sector in India.

Meet the team

Ceratattva was incubated at IITM Research Park in March 2022. Dr. Ganesh Babu and Mr. Raghunath Sharma, members of the High-Performance Ceramic lab at the MME Department, saw a potential opening in the field of PDCs in India. They had unique formulations of materials and could successfully produce them at a laboratory scale. Hence they used the opportunity to move to the industrial market and apply their innovations commercially. Dr. rer. Nat. Ravi Kumar N V, Professor and the Head of the MME Department, gave them indispensible support and encouragement. This was a great boost to the team coming from a professor who had extensive experience with ceramics.

“He was a catalyst”, said Raghunath Sharma, co-founder and the COO of Ceratattva, about Dr. rer. Nat. Ravi Kumar N V.

The company recently raised a ₹1 Million seed grant from the IITM-Incubation Cell, and this sum will be employed to increase production capabilities and do further research and development. The company is also in discussion with organizations like ISRO and Carborundum Universal Limited over potential projects. Ceratattva is also in discussion with ARCI Chennai, VIT Bhopal, and IIT Gandhinagar over the possible purchase of the ‘Ultraspinner’, a machine developed and patented by Ceratattva.

Ceratattva devotes itself to making high-strength and high-temperature ceramic materials for strategic and functional applications. The company produces high-quality ceramics and preceramics through the novel, economical, and sustainable precursor-derived ceramic (PDC) route. The 'Ultraspinner', a device developed and patented by Ceratattva, allows sustainable laboratory-scale production of PDCs and aids research work. Thus, Ceratattva aims to bridge the communication gap between industry and academia through its efforts. Researchers are often not interested in converting their patented ideas into working prototypes that can be used at the industrial level. Most industries do not have access to the research and development facilities available at global universities or research facilities. Ceratattva occupies a unique position here as they have access to IITM's research facilities and connections with major industries. The team members aim to utilise their expertise as researchers in the development of a strategically relevant industry. They envisage an India that is self-sufficient in the defence and aerospace sectors and hope to be the catalyst for that future through the production of indigenous ultra-high-temperature ceramic matrix composites via the preceramic route.

Strategic and functional non-oxide ceramics are integral for driving any nation's development. These materials brim with potential for applications in aerospace, energy, electronics, and defence sectors, to name a few. Indian industries produce commonly used monolithic non-oxide ceramics such as silicon carbide and aluminum nitride. However, these ceramics are created via an energy-intensive powder route. India also lacked the ability to produce unconventional, more impactful ternary and quaternary ceramics such as hafnium and zirconium boride carbides which have an unprecedented ability to boost the avionics and defence technology of a country. The PDC route allows the production of such complex formulations, including amorphous ceramics, at low energy-utilization rates.

These materials are under embargo in the countries which produce them. Therefore, under the prevalent conditions, it is impossible to obtain the material or the method to manufacture it without indigenous effort. Ceratattva has acknowledged this issue and aims to make India self-sufficient in this field by producing high-strength non-oxide ceramics via an extremely energy-efficient PDC route, thus becoming India's first company to produce precursor-derived non-oxide ceramics commercially. "We also want to contribute through our technology to nation-building because we are serving the four strategic sectors... to make ourselves align with Atmanirbhar Bharat and Make in India", commented Dr. Abha Bharti, co-founder and advisor of the company.

PDCs are multifunctional materials - their uses range from coatings for hypersonic vehicles to fibres used in biomedical sciences. They have the incredible advantage of being easily produced as coatings, films, fibers, or any other necessary form. Ceratattva produces both precursor-derived preceramics and ceramics. This provides the customer the choice to buy the preceramic directly and then convert it into a ceramic with the required form, or buy ceramics from Ceratattva if they lack the equipment to convert the preceramic into a ceramic. “It’s based on end-user applications”, stated Dr. Ganesh Babu, the CEO and founder of the company.

The ‘Ultraspinner’ is the company’s primary revenue stream in the current period while they expand their production facilities. The brainchild of the COO, the ‘Ultraspinner’ was developed in order to overcome the disadvantages of the conventional electrospinning technique. The electrospinning machine uses extremely high voltage to produce ceramic fibers and it has a very low rate of production. The ‘Ultraspinner’ is a much safer and better method as it produces the same amount of material in a fraction of the time and utilizes a regular voltage supply. A functional model has already been set up at the Department of Physics, IIT Madras.

Ceratattva aims to improve awareness among the Indian community about the power of pre-ceramic technology. They want to establish themselves as a manufacturer of non-oxide ceramics and precursors in India. They also aim to obtain the funding to upscale their establishment and be ready for future projects and collaborations. Ceratattva hopes to gain validation from the different stakeholders in the oxide and non-oxide ceramic industry by producing high-quality preceramics and PDCs. “Outreach, investment, and upscaling are our three immediate short-term goals”, said Mr. Raghunath. Dr. Ganesh and Dr. Abha also remarked ”We want to establish ourselves as a synonym of precursor-derived ceramics”.

New Faculty Interview I

Prof. Bhuvanesh Srinivasan

Prior to joining IIT-Madras as a faculty member, Prof. Bhuvanesh Srinivasan was a postdoctoral fellow at the National Institute for Materials Science (NIMS), Tsukuba, Japan. He did his Bachelor of Engineering in Materials Science from the College of Engineering Guindy, Anna University, Chennai and then pursued an Erasmus Mundus Master's program in Materials Science jointly with the Technical University of Munich and Ludwig Maximilian University, Munich, Germany, with a couple of exchange periods at ETH-Zurich (3 months) and EPFL-Lausanne (6 months), Switzerland. After that, he did a Ph.D. at the CNRS University of Rennes 1, France, under the Marie-Curie doctoral grant.

01

During your Ph.D., you were awarded the prestigious Marie-Curie Fellowship. Can you walk us through this journey of yours?

I had a fruitful experience during my master's thesis work at EPFL Lausanne, Switzerland, thanks to my advisor and the Ph.D. scholar who mentored my thesis activity on cement materials. During this time, my motivation to do a Ph.D. kicked in, and I started doing my homework on the potential fellowship options, institutes, research areas, etc. Though I liked the working environment at EPFL and could have done my Ph.D. in the same laboratory, I was somehow more inclined toward the area of energy materials. I came across an open position for the Early-Stage Researcher (ESR) position within the Marie-Curie ITN program, and the topic of research was thermoelectric materials. At that time, only a few groups were working in this area, and I was really keen to explore that direction.

I found the Marie-Curie ITN programs for Ph.D. to be attractive, both in terms of fellowship and the kind of exposure one would get in 3 years. I mean, the Marie-Curie doctoral programs offer you an academic advisor (from country A) and an industrial advisor (from country B), with an opportunity to do secondment periods at the research laboratories of the consortium partners. The Marie-Curie ITN consortium (CoACH-ETN), to which I got selected, comprised 5 academic and 10 industrial partners from 7 different European countries. Though the major part of my Ph.D. thesis was carried out at the CNRS-University of Rennes 1, France, I also had an opportunity to spend some secondment periods of a few months at Nanoforce Technology Ltd., a spin-off company within the Queen Mary University of London, U.K. More importantly, as a Marie-Curie fellow, one can attend many

skill development sessions, training activities, and entrepreneurial workshops periodically organized by the project consortium in different European cities. I was also the recipient of "The Bernard Coqblin Prize" by the French Thermoelectric Society (GIS-TE) for the best doctoral thesis in the field of thermoelectrics, and I acknowledge the Marie-Curie program for providing an ideal platform to nurture and shape my career.

02

You worked on thermoelectrics and ceramic materials during your Ph.D. and Postdoc. Can you briefly explain the importance of this field and its novelties?

Industrial and energy generation processes often produce a tremendous amount of waste heat that gets absorbed into the atmosphere. Among the several approaches for solid-state conversion between heat and electricity, including fuel cells, photovoltaics, batteries, and supercapacitors, thermoelectric (TE) devices have significant potential in tackling the challenges of energy sustainability and offer excellent features: extensive lifetime, highly reliable, and scalable, environmentally friendly, quiet, lower maintenance costs, etc. Thermoelectric generators (TEGs) have the potential to retrieve and produce electricity from waste heat as an input source and allow the efficient use of energy. They have been applied in highly efficient cooling and refrigeration, energy scavenging, sensing, and thermopower systems. They are also used in the seat climate-control system of certain cars that use thermoelectric devices to generate power from the heat radiated from the engine. Finding an efficient material to realize this thermoelectric effect entails fitting three seemingly different properties into a single material – high electrical conductivity of metals, high thermoelectric sensitivity of semiconductors, and low thermal conductivity of glass. This is a challenging task, and the scientists undertake several techniques to make the materials more efficient.

03

Could you tell us about your work and experience as a postdoctoral fellow at the National Institute for Materials Science Japan?

After spending more than 5 years in Europe, I was looking for a change. Though Japan was at the top of my bucket list, I must admit that I was a bit skeptical about the work-life balance, as I have heard a lot of stories about their style of working! In any case, I thought to give it a try. My postdoctoral fellowship application to the Japan Society for the Promotion of Science (JSPS) was successful, and I got ready for an adventurous life. National Institute for Materials Science (NIMS) was my natural choice, given its reputation for excellence in research. I arrived there in April, the "Sakura season" (the spring season when the iconic cherry blossoms happen), and I fell in love with Japan! My Ph.D. days in Europe required a lot of collaboration to avail myself the thermoelectric research facilities. But at NIMS, the laboratory that hosted me was exceptionally well-equipped with all the necessary facilities for thermoelectric research. NIMS was quite international; in fact, in our group comprising about 20+ members, only the head of the laboratory and a couple of administrative secretaries were Japanese nationals, and all other researchers (PhDs, Postdocs, Interns, ...) were from other

countries (Austria, Australia, China, Czech Republic, France, Germany, India, Indonesia, South Korea, Turkey, U.S.A). Hence, the working environment and the style were very flexible, and we had a good work-life balance at NIMS. At NIMS, I was hosted at the French-Japanese international platform, LINK, a joint research unit established in partnership between CNRS, Saint-Gobain, and NIMS. As a JSPS postdoc, I had my own fellowship and a decent research budget to design and execute my research plan, and that independence is something that every researcher must need, especially at the postdoctoral level. My research graph significantly improved, thanks to some good results, some of which were highlighted on the front covers of high-impact publications such as the Journal of Materials Chemistry A and Advanced Energy Materials. I was one of the recipients of the "ICYS Promising Young Researcher Award" (for the year 2021), given by NIMS. Overall, my Japan adventure was an enriching experience, and it significantly helped to boost my research profile.

04

What are your thoughts on online teaching that happened during the pandemic? Going forward, what aspects of that would you think of including in your classroom?

Well, you may find my thoughts on this a bit old-school type! Though online classes are convenient (and we didn't have much of an option during the COVID pandemic), I feel that they lack the actual classroom environment, and it certainly misses the connection between the teacher and the students. More importantly, it is also necessary for the students to meet with each other, develop friendships, and have fun. How can they build their leadership qualities if they are not mingling with anyone and attending classes online? Life as a student is not just about attending lectures and getting a high CGPA! I'm glad the normal activities have resumed, and the students are back enjoying their campus life.

05

Significant materials science research currently utilizes simulations and computational techniques. What is your opinion on them?

Simulations and computational modeling allow us to explore 'what if' / 'why not' questions and scenarios without having to do laborious experiments. Computational materials science is an exciting field that holds much future potential and will be indispensable for materials discovery and design during the next decade. For example, in our research on thermoelectrics, we depend a lot on the computational aspects to understand the transport properties of the materials, be it the electronic band structures or the phonon vibrational properties.

06

What advice would you like to give to people who aspire to pursue research in thermoelectrics and ceramics?

Anyone who wants to pursue a research career needs to have a high level of motivation, patience, and the ability/mindset to face failures and learn from them. It's a long journey, and you will have some challenging times; success lies in how you manage those difficult situations!

Coming to thermoelectrics, this research has a vast scope, especially in a country like India. It can help the country leapfrog to sustainable new-age technologies and facilitate the journey towards the country's National Mission for Enhanced Energy Efficiency, one of the eight national missions under the National Action Plan on Climate Change, ensuring a faster transition to a low-carbon economy.

DAAD KOSPIE 2022 Awardees

B Manaswini

M.Tech., 2023

Host University: **Karlsruhe Institute of Technology**

Thesis Topic: **Spinel oxide thin films: synthesis, characterization, and functional property assessment**

The Pechini technique produced spinel-high entropy oxide (HEO) powders of (Co, Cu, Mg, Ni, $Zn)_2TiO_4$ must be mechanically compressed and sintered to create a bulk ceramic target with an HEO composition. To further investigate the impact of sintering and the suitability of the target material, structural characterization on the bulk ceramic target was carried out. Utilizing pulsed laser deposition, HEOs are then produced with the best functional features. The characterization of thin films is being performed to assess their functional characteristics.

K Alekya

M.Tech., 2023

Host University: **TU Darmstadt**

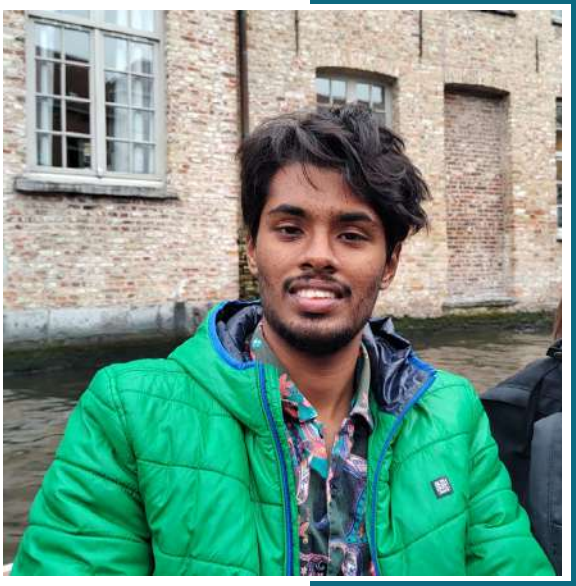
Thesis Topic: **Studying the mechanical properties of zirconia alloyed yttrium tantalate**

Due to its low thermal conductivity, high fracture toughness, better thermal stability, and resistance to corrosion, zirconia alloyed yttrium tantalate (ZYT) is a unique thermal barrier material that can replace yttria-stabilized zirconia. As part of the project, ZYT is created using coprecipitation and then densified through sintering and electron spectroscopy methods, such as XRD, Raman spectroscopy, and SEM are used to characterize the material and determine its phases. Additionally, nano-indentation is used to calculate fracture toughness and comprehend crack propagation.

K Abhiram

M.Tech., 2023

Host University: RWTH Aachen



Thesis Topic: All-Solid-State Sodium Sulphur Battery Using 3D Scaffold Structure

This project entails the creation of thin sheets of cathode, anode, and electrolyte, measuring different metrics like overall conductivity and efficiency cycle, and then assembling the battery with the optimum parameters.

Application Procedure:

Offers dual degree and master's students the opportunity to pursue a thesis-based master's program in Germany for seven months.

Interested students look for professors who can guide their thesis projects. It is highly recommended to learn more about the projects being provided with DAAD potential and the instructors providing them before applying for a DAAD scholarship.

After speaking with the professor and getting their approval for the project and the host university, the applicant can start the application process on the DAAD website under the personal financing option. The application requires one's personal information, educational background, name of the host university, information related to the project, a brief research proposal, academic records, and an invitation letter from the host university.

Why apply for DAAD:

DAAD provides access to new academic relationships and experiences, which would be greatly beneficial for students who are interested in pursuing a Ph.D. abroad. DAAD also offers scholarships for pursuing graduate studies in Germany.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GICAL & MATERIALS

Mitacs Globalink Research Internship 2022

Nagappan N.
DD, 2024

Worked on resistance of the low density interior of supercooled aqueous droplets to the electrostatic confinement effect at the Western University, London, Ontario under Professor Styliani Consta

Ayesha Ulde
DD, 2024

Worked on electrochemical circular process for high-value recycling of e-waste at École de Technologie supérieure, Montréal under Professor Lucas Hof

Hrishabh Srivastava
DD, 2024

Worked on predictionof photometric redshifts using a multitask network at the University of British Columbia, Vancouver under Professor Douglas Scott

Vir Karan
B.Tech., 2023

Worked on studying interface propagation during stress-induced martensitic transformations using physics informed neural networks at the University of Alberta under Professor James Hodge

Bipin V.
B.Tech., 2023

Worked on an AI integrated metal oxide semiconductor based gas sensing array for hazardous waste classification at the University of Victoria under Professor Mina Hoorfar

Shashwat Patel
DD, 2024

Worked on Development of Interatomic Potentials using Machine Learning at the University of British Columbia, Vancouver under Professor Marco Battiato

Mitacs Globalink Research Internship 2023 is a Canadian initiative that teaches Canadian research methods and procedures to international students to empower and educate them. International students can participate in a 12-week research program in Canada through the Globalink Research internship program, which is supervised by academics or researchers from Canadian universities working in science engineering, math, humanities, and social sciences. Many interdisciplinary and collaborative research projects are part of the fully-funded international internship, allowing students to look for projects in both specialized and broad areas.

Latest Infrastructure

Induction furnaces are an essential tool in many industries, used for melting, heating, and alloying metals and alloys. These furnaces are also known as combinatorial melting facilities because they can produce multiple alloy combinations at once

One of the key advantages of induction furnaces is their high degree of temperature control and homogeneity, which enables accurate thermal processing of metals and alloys. The furnace operates using an induction coil, which generates an electromagnetic field that powers the furnace. The metal or alloy is heated as a result of the current created in it by this field.

Our induction furnace has the capacity to melt 10 kg of metal in a single stroke, making it a more efficient option compared to other furnaces. In addition, the use of vacuum during the melting process helps to produce defect-free components.

Professor In-Charge: Prof. K.G. Pradeep
Metal Forming Lab, MME, IIT Madras

CALPHAD Larry Kaufman Awardees 2022

CALPHAD, Inc. offers scholarships to twenty brilliant graduate students across the world working in computer coupling of phase diagrams and thermochemistry. This scholarship offers graduate students the opportunity to participate in the annual CALPHAD meeting held in Stockholm, Sweden, and present their work.

Niraja Moharana

Advisors : Prof. K C Hari Kumar & Prof. N V Ravi Kumar

Poster Topic : Thermodynamics assessment of the Hf-Ta-N system

01

What or who inspired you to apply for the scholarship? Can you please briefly share your experience at the conference?

It was the enthusiastic and inspiring leadership of Larry Kaufman, along with the equally strong support and effort of several scientists across the world, who made it possible to shape the CALPHAD approach. So, it is always an honor to be associated with his name. This was the major driving force for my application. I was introduced to the field of computational materials thermodynamics by my supervisor Prof. Hari Kumar, and he is always a constant source of motivation for me. My senior, Dr. Soumya Sridhar, who is also a recipient of this award, has encouraged me to apply. It was a wonderful experience and, to be precise, intellectually fruitful. When people working in the same or similar areas meet, eat and discuss, it is always fun and productive.

02

How does the conference impact your career, and how do you intend to use this opportunity to influence others?

The development of a thermodynamic database is considered to be tedious and is not very straightforward. Owing to its significance and widespread application in industrial and research sectors, people should get excited about working in this area. The exchange of ideas and networking with several like-minded people opened me to other application-oriented aspects of CALPHAD that I was not aware of.

01

What or who inspired you to apply for the scholarship? Can you please briefly share your experience at the conference?

"You lose 100% of the shots which you don't take."
Based on this philosophy, I applied without worrying about whether I will get it or not. Thankfully, I got it, which eased the load on my wallet. The CALPHAD conference is one of the most well-funded conferences I have seen. You are literally living in a nice resort for 5 days with all expenses taken care of by the award. It was a memorable experience since I got to meet all the stalwarts in the field, such as Prof. Mats Hillert, who is in the same league as that J. W. Gibbs, the same person in whose name Gibb's rule is present. We went to the Nobel prize museum and the Vasa ship museum and explored the beautiful city of Stockholm. The conference is in the Gordon conference format, meaning the discussions are informal and the presentations are single-track. It is like attending interesting lectures, all while brushing shoulders with the best in the world. Since there are no parallel sessions, you are not missing any lectures. This was my first-ever international conference. It was a thrilling experience to present my Ph.D. work to such a diverse and august gathering.

02

How does the conference impact your career, and how do you intend to use this opportunity to influence others?

I was one of the only 13 recipients of the award worldwide for the year 2022. It is definitely going to be one of the important milestones of my career. There are many benefits of getting this award which I would like to highlight for future aspirants, the award literally pays for your 5 days holiday trip, and all accommodation and food expenses are paid. The CALPHAD conference, by its very nature, is designed to be an open communication conference where you can approach anyone with your research work and discuss it freely. You get to network with CALPHAD users (experts and amateurs, both), software and database developers, and people working in diverse domains all the way from iPhone to Cement, along with many other graduate students worldwide.

Sufyan Muneer Ahmed Shaikh

Advisors : Prof. Satyesh Kumar Yadav & Prof. B. S. Murty

Poster Topic : Strategies to improve deformability of entropy-stabilized refractory solid solutions

Hariharan V S

Advisors : Prof. G Phanikumar and Prof. B S Murty

Poster Topic : Kinetic Phase Diagrams - An application to Additive Manufacturing

01

What or who inspired you to apply for the scholarship? Can you please briefly share your experience at the conference?

I must thank my guides, Prof. Gandham Phanikumar and Prof. B.S. Murty, for motivating me to apply for the scholarship. I want to thank Dr. Soumya Sridar and Dr. Dasari Mohan for helping me with the details and documents needed for the scholarship application. Dr. Soumya was herself a recipient of this scholarship a few years back.

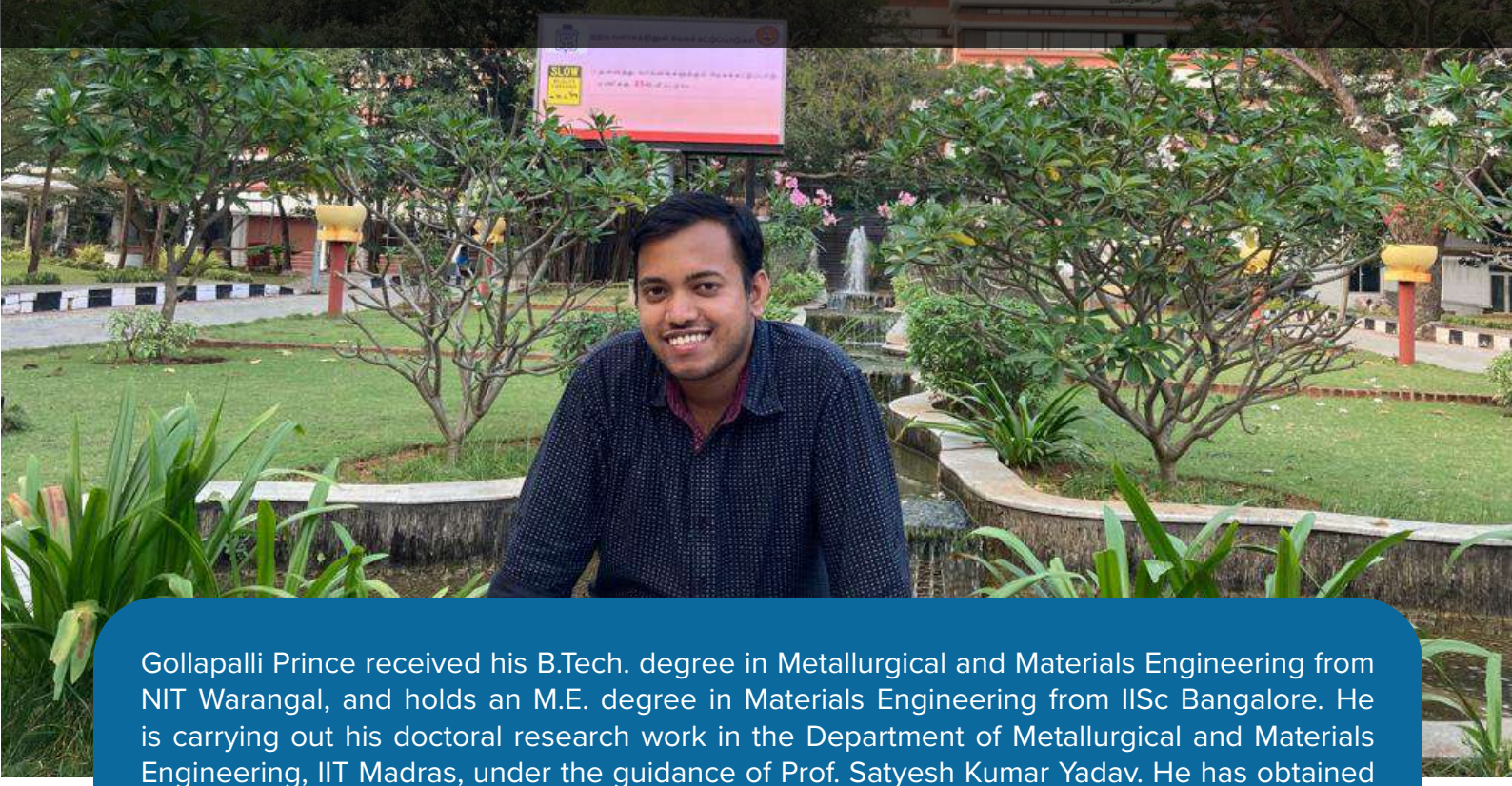
About the experience, I must say it was very engaging, and it gave me a lot of exposure to the different aspects and applications of computational thermodynamics. I met a lot of stalwarts like Prof. M Hillert, Prof. B Sundman, and Prof. John Agren in the field of computational thermodynamics. Additionally, KTH being the birthplace of Thermo-Calc, led us to meet a lot of people working with Thermo-Calc too. The sessions were single track which was very rigorous and interesting. The coffee breaks were the best time to network and socialize. We had just 2 days to roam Stockholm, and it was rather an expensive experience. We had a boat ride to Archipelago and visited Yetterby, a small island near Stockholm where elements Ytterbium, Yttrium, Terbium, and Erbium were discovered. We visited Nobel Museum and Vasa Museum. The Nobel Prize Museum illustrates a century of creativity, where visitors can follow the changes of the 20th century through the Nobel Prize and the Nobel Prize laureates.

02

How does the conference impact your career, and how do you intend to use this opportunity to influence others?

Simulations and numerical methods are still undervalued in metallurgy. I feel motivated by the award, and I hope this will give confidence to others who are working in related fields that we can also do good work (from India), and people will recognize our contribution to the field.

International Immersion



Gollapalli Prince received his B.Tech. degree in Metallurgical and Materials Engineering from NIT Warangal, and holds an M.E. degree in Materials Engineering from IISc Bangalore. He is carrying out his doctoral research work in the Department of Metallurgical and Materials Engineering, IIT Madras, under the guidance of Prof. Satyesh Kumar Yadav. He has obtained the chance to visit and continue his research work at Purdue University, USA, as a part of the International Immersion Experience (IIE) Programme.

01

First of all, let me congratulate you on behalf of the editorial team at ETCH. Can you tell our readers a bit about yourself?

Hello. I am Gollapalli Prince, a PhD student at the Metallurgical and Materials Engineering Department of IIT Madras. I am a native of Visakhapatnam, Andhra Pradesh. I enjoy long-distance running and have participated in a few 5K marathons at the institute. I also enjoy playing badminton.

02

So, what is the work that you are engaged in under Prof. Satyesh?

The general topic of research I am working on is computational materials design using first-principles calculations based on Density Functional Theory and a quantum mechanical approach for finding properties of materials by modelling atoms, electrons, nuclei and their interactions.

I am engaged in addressing the long-standing problem of the nature of metal/ceramic interfaces in technologically and scientifically important combinations. If a gradual variation in chemical composition atomically chemically grades the metal/ceramic interface, that can give rise to unusual properties in the heterostructure. These properties are used in several applications, including wear and erosion-resistant coatings for turbine blades, hard coatings for drilling bits, corrosion-resistant coatings in bio-implants, etc.

I study a range of technologically and scientifically important metal/ceramic systems to determine whether the interface is thermodynamically favourable, atomically diffused, or sharp by creating point defects such as vacancies and interstitials in ceramics and metals, respectively.

03

You have obtained the opportunity to visit Purdue University, an institution that has been the second home of several great personalities, such as Neil Armstrong and Alan Moore. How did you feel when you got to know that you obtained this opportunity?

It was like a dream come true for me. I was very excited. I received this news around 8 in the evening and immediately called Satyesh sir. He was a little worried and was afraid something had gone wrong. But, he was genuinely pleased and surprised by this news. He was very happy and congratulated me.

04

What do you aim to achieve from this experience?

I wish to gain international research exposure in computational materials design by using this opportunity. I want to perform data-driven materials science using the highly reliable DFT (Density Functional Theory) data available in the supercomputers at Purdue.

05

Can you briefly describe the application process for the benefit of readers interested in availing of similar opportunities?

I got selected for the International Immersion Experience (IIE) award, which allows research scholars to do part of their PhD in any foreign university or national lab for a period of 3 months - if you wish to stay for a longer period, your guide or host professor must fund you.

The following procedure can be followed to apply for the award:

First, talk with your guide and find a potential advisor at the host university. Procure an email confirmation stating that he is willing to host you. Then, submit the form online along with a recommendation from the D.C. chairman and your guide's and HOD's approval.

A detailed application procedure can be found here: https://ge.iitm.ac.in/iie/

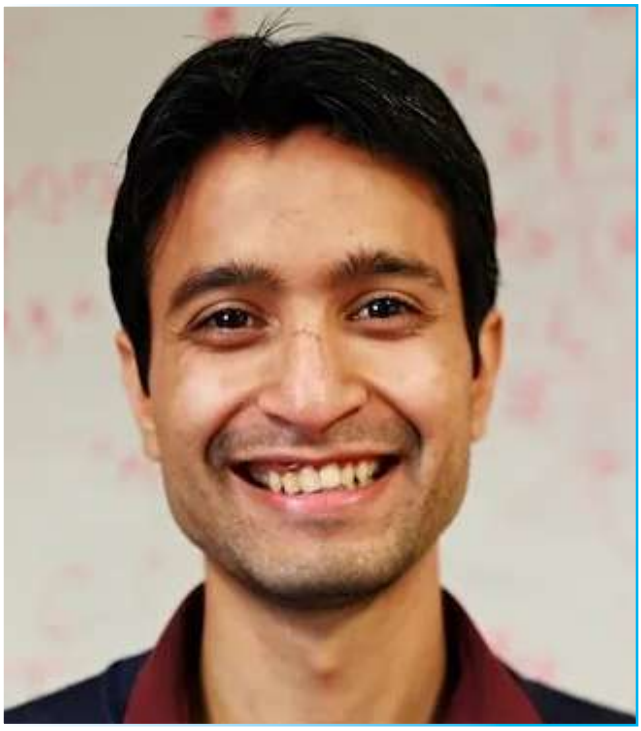
06

What advice would you like to give to research scholars who aspire to gain foreign research exposure?

There is enormous competition among students to obtain this award. So it is essential to work hard and present your aspirations and ongoing work. Since all universities are geared towards improving Q.S. world ranking, which is significant in one's professional life, I advise aspiring scholars to choose a university that ranks better than our institute or a professor with excellent citations. Additionally, the work you are expected to do should complement your ongoing research at the institute.

Thank You for your time. Best wishes on your stay at Purdue.

New Faculty Interview II



Prof. Rohit Batra

Prior to joining IIT Madras as a faculty member, Prof. Rohit Batra worked at Rivian Automotive, an electric vehicle manufacturer and a competitor to Tesla. He obtained his B.Tech. in Metallurgical and Materials Engineering from IIT Roorkee and then worked at Wipro for two and half years. Later, he earned his Ph.D. from the University of Connecticut in Materials Science and Engineering. He was also a postdoctoral fellow at the Georgia Institute of Technology and Argonne National Laboratory.

01

Can you tell us a little about your undergraduate education and how it led you to pursue a career in materials science?

During my undergraduate education, I wasn't very sincere or among the top scorers in the institute. I was an average student. I did not think too much about materials science at that time. I did learn a lot about it, but I would say that I wasn't very clear at that time that I wanted to pursue a career in this field. In fact, my priority at that time was to explore other things beyond the core area, and that was one of the reasons why I went to Wipro. One thing I would like to say is that we should not pressure ourselves to know what to do. We should also people to explore different areas. Maybe core may be outside that because you never know what your interest is until you figure that out. During my undergrad, I was in touch with Prof. Satyesh, who was my senior. I was in touch with him, and I asked him about his Ph.D. experience. I kept in touch with him but let it simmer on the side and tried to do some other things. I then decided to come back.

02

What challenges did you face while pursuing research in Materials Informatics, given your education in Materials Science and Engineering?

This is an important question. The fundamental of Machine Learning is Artificial Intelligence, which is not taught in our undergraduate curriculum. Topics like linear algebra and probability theory are essential in machine learning. So during my Ph.D., I took graduate-level courses from other departments, and I

picked classic books on these topics and read them thoroughly by myself. Along the way, I did online courses rigorously. You need time to do all of this, and it won't happen in, say, a period of two months. It will take at least one year for these things to settle in your brain. Taking up some research problems will also help you in the long run.

03

You have spent a brief period of your life as a business analyst at Wipro. Do you think that being in the industry helped you pursue your research career?

It did help me. It helped with knowing that I did not want to continue further (laughs). One thing I have seen is that people who have always been in academia are not familiar with how the software industry works or exactly what that job is. I have full clarity on that, and I am fully confident that I do not want to pursue any of those things. I got this clarity just by going there and returning back to academia. Another important thing to know is how industries or commercialization work. I think it is important even for an academician who is doing applied research to know about such things. Ultimately you want to build a product that is useful in the community and something that can be sold in the market. If you have only been in academia, then it is very difficult to visualize or even understand what goes on behind making a commercially successful product. I always would suggest people spend some time in the industry because it would also help them with research.

04

What do you look forward to the most in your new role as a faculty member?

I haven't been given opportunities to interact directly with so many students lately, so I really look forward to teaching the students and guiding the Ph.D. and master's students. I think that would be really wonderful. I also look forward to learning from this experience. I hope I can inspire the students to do good in whatever they want to do.

05

What made you passionate about materials informatics in particular?

I can tell you what I like most about this field. The most important thing I like about this field is its versatility. Whether you want to design materials for battery applications or as classic as iron and steel making, name any subfield within material science or metallurgical science you will find the tools of AI and machine learning which are applicable in all of these fields so versatility is something that I really like. It is also a field that is growing and has the potential for creativity. I also feel that machine learning and AI are part of the future, so it's good to get into this field now.

06

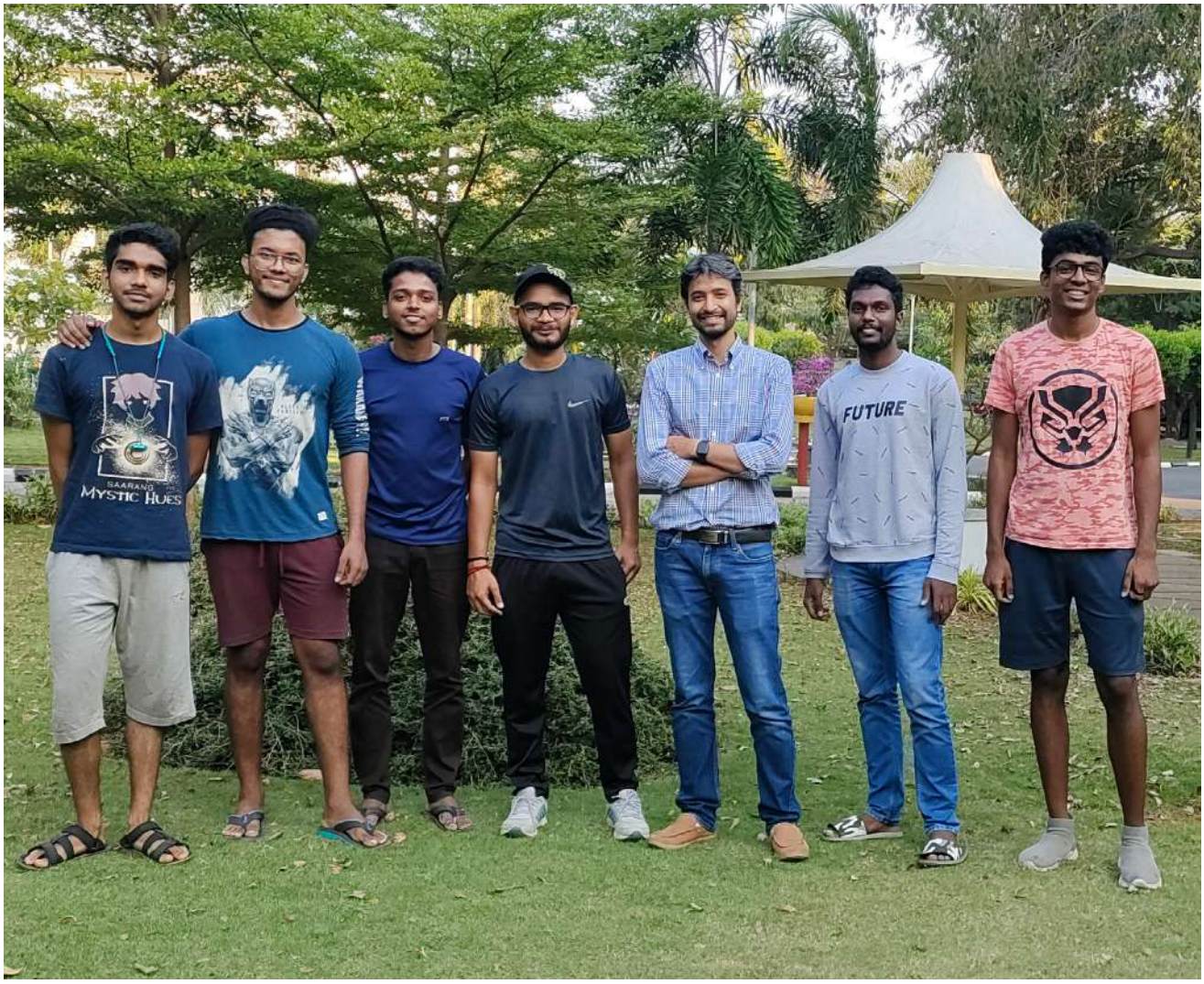
Could you briefly describe your research experience at Argonne National Laboratory?

Argonne is a really wonderful place. You have all the top minds of the world there, and you also have all the topmost facilities there. Both of these things are co-existing there, and on top of that, the funding programs prefer a lot of collaborations. Put all three components together, and they do really good science. So I had a wonderful time there, no complaints. The missing thing was students were not there, and I was unable to teach them because it's a really great atmosphere to do really good science.

07

What was the main takeaway from your experience in Argonne?

The main takeaway was, first of all, diversity. They put people from different backgrounds together, which helped with having good



relationships with them. I still have regular meetings with people at Argonne. It helped me build up the community I want to work with. I can imagine working on many projects with those people in the future. Diversity helps in building a strong group of people who can deliver good science.

08

Considering Materials Informatics is becoming very popular nowadays, what advice would you like to give to students who are keen on pursuing a career in Materials Informatics?

My general advice to students is now there are so many good quality materials available online, so if they genuinely have an interest in any field, there is plenty of stuff available online. So you don't actually need me or any department here to study. That's my personal take. There is plenty of stuff available online, and you can go and pursue it. My only recommendation is when there is plenty of stuff online, you need to choose which one would be the best one to pursue, so look for some popular courses and do not rely just on the sources and find a good book in that area and come to my class next semester. Pick up one or two books and one or two courses. No need to juggle around with many courses or books. And sometimes you may start a course online or start a book and revisit the course or the book, you may have to shuffle a little bit but don't try to go after everything.

Young Alumni Spotlight

Dr. Deepak Kamal

He is a 2016 graduate of the Dual Degree program in Metallurgical & Materials Engineering at IIT Madras. He received a Ph.D. in Materials Science & Engineering with a minor in quantum chemistry and materials informatics from the Georgia Institute of Technology (Atlanta, USA). He is currently a Research and Innovation Scientist at Solvay inc.

Experience at IITM:

I had a great time at insti., both professionally and socially. On the professional side, I can say, my passion for material science wouldn't exist without my experience at the department. Particularly, undergrad research projects with Prof. Kanjarla and dual degree project with Prof. Hari Kumar introduced me to computational materials research and provided me with the freedom and opportunity to explore the field and shape my outlook. A small community within MME that went by DCF Department Computing Facility (DCF) (ICME lab, later), added a fun social aspect to working on the Subject. This encouraged me to spend even more time at the department, even going to lab at nights and even on weekends. On the social side, I was lucky to have made several good friends and interesting memories, which of course now makes me smile.

Prof. Neeraj Mohan Chawake

He graduated from IIT Madras in 2016 with an M.Tech. and Ph.D. in Metallurgical & Materials Engineering. He received his B. Tech in Metallurgical and Materials Engineering from VNIT Nagpur (2008). He was a postdoctoral researcher at the Erich Schmid Institute for Materials Science in Austria (2017-2020). Currently, he is an assistant professor in the Department of Materials Science and Engineering at the Indian Institute of Technology Kanpur, where he also heads the Mechanics and Materials Research Laboratory.

Experience at IITM:

I attended IIT Madras between 2009 and 2016, for my M.Tech and a Ph.D. When people would inquire about my stay, I would always respond rhetorically, “I have seen trees growing here.” I can go on and on about many specific incidents and recollections. Still, words fall short when trying to convey emotion. The best part, though, was staying in the laboratory to work late with other Ph.D. students, brainstorming ideas with my supervisor (Prof. Ravi Kottada), and then putting them into practice. I used to sit in HSB 134, which was the TEM room at the time. The enormous banyan tree and Ramanujan’s bust in front of CLT provided the right nourishment for research (i.e., to excel in one’s profession) and philosophy (i.e., to give back to society in whichever way one can). Another great benefit of working in the department was the opportunity to speak with bright young minds (especially undergrads) and stalwarts (who used to visit the institute or during EML). The institute and the city fostered me, giving me numerous options for achieving a healthy work-life equilibrium. I took up the flute in Madras and have kept up with it all these years. It’s wonderful to know that ETCH was active at the time and is still doing so. My warmest wishes!

Nandri!

Dr. Nitesh Raj Jaladurgam

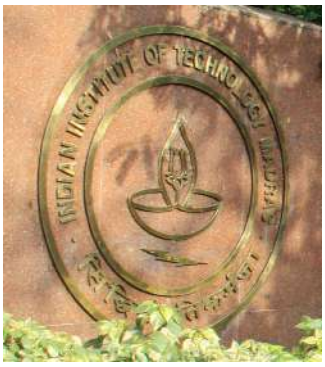
He is a 2017 graduate of the Master of Science (Research) program in Metallurgical & Materials Engineering at IIT Madras. He received his Ph.D. in Material Science from the Chalmers University of Technology, Sweden. He is currently a Materials Analysis Engineer at Volvo Cars.

Experience at IITM:

It was early December 2016; I was keen on applying for PhD positions in Germany and US universities as I have planned to graduate in June 2017. Coincidentally a German professor was in the campus for a course, and I had an appointment to discuss the potential PhD position in his research group at Bose-Einstein guest house in the campus. I was eagerly looking forward to the meeting and just started from my hostel room to reach my bicycle. It was a very windy afternoon and just about to seemed like rain can pour down anytime soon. As I approached the hostel entrance, I witnessed a huge tree falling on the parked bicycles, it was scary, and we were instructed not to go out of the hostel as the flood situation was raging across the campus and Chennai. This situation was followed by power blackout for the next four days and we all lost contact with our families back home as there was almost no way to charge our mobile phones and telecommunication was stranded. Fortunately, the mess in Himalaya has an extra ration to cook and serve the meals for all students who remained in the campus as there was no way that they get supplies from outside the campus. Suddenly, we all were in a survival mode, these tough situations made friends around me as family, being away from technology, phones, internet made us open up to many untold stories and memories. Those four days taught me how surprising the life could be in IITM and how people stick together during the difficult situations. The outside world of the campus has suffered a lot, but I feel very fortunate of having friends around the campus and bonding together. This memory is always treasured in my heart.

PS: The interview with the German professor went well in the next week and had a good discussion of my work and potential PhD position with him. However, I ended up in Sweden for my PhD.

Meta Premier League



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