ETCH

Edition 15.2

Department of Metallurgical and Materials Engineering
Indian Institute of Technology Madras

Contents

Note from Head of Department

It is with a great delight that I present to you the 6th edition of Etch, the 15.2 issue. The Etch team has been demonstrating great passion, perseverance and skills in bringing out of each of the issue.

The current issue has interesting literature on some exciting materials. The multicomponent equiatomic alloys (the so called high entropy alloys) are making wares with their excellent properties not only in terms of their strength but also in their fracture toughness as is depicted by one of the literature report. Energy harvesting is another fascinating area of research which is quickly moving into commercialized products, which is emphasized by another literature report. The current issue also covers a wonderful educative article on grain boundary engineering from the research group of Dr. Sarma, which is fascinating to a number of researchers and technologists alike.

Dr. G.K. Dey, Associate Director, Materials Group, BARC, Mumbai, delivered a comprehensive talk on Alloy development for nuclear applications for the Prof. Rodriguez Memorial Lecture this year, which has also been covered by the Etch team in this issue.

There have been major changes in the UG curriculum at IIT Madras, which has been summarized in this issue of Etch. The new curriculum gives a lot of flexibility to the student to choose his/her subjects through a number of free electives, which constitutes almost 18% of the total number of credits in the new curriculum.

The interview with Dr. Prahl, leader of the ICME group at RWTH, Aachen Germany brings out the excitement in this new field, which is catching everyone's attention in recent years.

The current issue also gives tips on placement and experiences of our students as interns in various places, which I am sure will draw attention of all of you.

I am confident that you will find this issue educative and informative. I request you to share your feedback on the issue. I would also be grateful if you can share any information on new materials, technologies that you are working on or that have come across that can be included in the future issues of Etch. I would like to take this opportunity to express the gratitude of the Etch team to all the students, faculty and Alumnus for their continuous cooperation and support to Etch.

Prof. B.S. Murty
Head of MME

Note from Editorial Team

"The most beautiful thing one can experience is mysterious. It is the source of all true art and science." – Albert Einstein.

The primary aim behind ETCH is to produce content in a way that inspires people to pursue the vast ever-growing field of Material Science. This edition encompasses various intriguing articles on grain boundary engineering, high temperature ceramics and composites and interesting new materials. There is also an extensive 'behind the scenes' look at the placement team. The tips from students who made it to great internships and placements might prove valuable to the upcoming batches. We hope this turns out to be an enjoyable learning experience overall.


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RESEARCH

Global Research

Amazing New Alloy - CrMnFeCoNi – Closest to Adamantium so far

Nature [DOI: 10.1038/ncomms10143]

A team of researchers led by scientists from the U.S. Department of Energy Lawrence Berkeley National Laboratory has identified several mechanisms that make a new, cold-loving material one of the toughest metallic alloys ever.

The alloy is made of chromium, manganese, iron, cobalt and nickel in equal amounts. It's exceptionally tough and strong at room temperature, which translates into excellent ductility, tensile strength, and resistance to fracture. And unlike most materials, the alloy becomes tougher and stronger the colder it gets, making it an intriguing possibility for use in cryogenic applications such as storage tanks for liquefied natural gas.

In materials science, toughness is a material's resistance to fracture, while strength is a material's resistance to deformation. It's very rare for a material to be both highly tough and strong, but CrMnFeCoNi isn't a run-of-the-mill alloy. Ritchie and colleagues found that at very cold temperatures, when it deforms, a phenomenon called "twinning" occurs, in which adjacent crystalline regions form mirror arrangements of one another. Twinning likely plays a part in the alloy's incredible toughness and strength. But twinning isn't extensively found in the alloy at room temperature (except in the crack bridges), yet the alloy's toughness and strength is still almost off the charts.

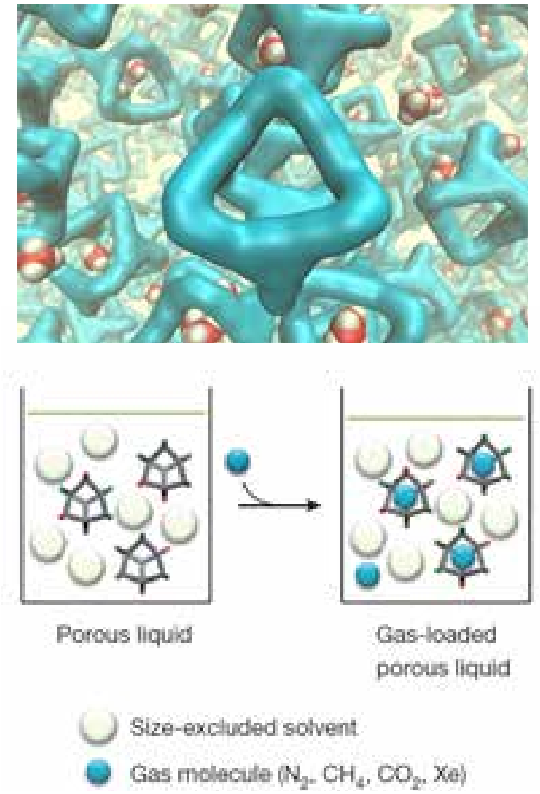
To find out, the scientists subjected the alloy to several straining experiments at room temperature, and used transmission electron microscopy to observe what happens. Their time-lapse images revealed two phenomena related to shear stress: slow-moving perfect dislocations that give the material strength, and fast-moving partial dislocations that enhance ductility. They also saw a phenomenon involving partial dislocations called "three-dimensional stacking fault defects," in which the 3-D arrangement of atoms in a region changes. These faults are big barriers to dislocation, like placing a stack of bricks in front of a growing fissure, and serve to harden the alloy.

The images also captured the nanoscale version of chewing a mouthful of toffee and having your teeth stick together: In some cases, tiny bridges deformed by twinning are generated across a crack, which help prevent the crack from growing wider. These bridges are common in reinforced ceramics and composites, but researchers found that all of these nanoscale mechanisms work together to give the alloy its toughness and strength."

RESEARCH

Global Research

Porous Liquids - Liquids could be poured, now they can be porous too



Nature, [DOI: 10.1038/nature16072]

Scientists have made a major breakthrough by creating the first ever porous liquid. An international team involving scientists based in the UK, France, Germany and Argentina has now been able to design and prepare 'permanently porous liquids' using rigid organic cage molecules. Such a strange material could be used to trap gasses for many industrial applications, such as capturing methane or carbon dioxide to reduce their contribution to global warming.

These cages have the advantage that they can be dissolved in another material without breaking any of their chemical bonds, thus serving as soluble porous units. We took these cage-like molecules, which have a hollow space inside that can be accessed through small windows, and dissolved them at very high concentration in a solvent whose molecules are too large to fit through the windows,' explains lead author Stuart James, chair of inorganic chemistry at Queen's University Belfast, UK. 'In that way we created a liquid which has empty pores floating around in it'.

The challenge in creating such a liquid was designing a molecule that is either liquid by itself or highly soluble in a solvent that cannot penetrate the molecular pores. This is not trivial, usually, long or branched alky chains are employed to increase the solubility or lower the melting point of a larger molecule, but linear alkyl chains can penetrate into the cavities of adjacent molecules, resulting in non-porous liquids. James et al used a clever trick to solve this problem: they combined a porous crown-ether-decorated molecule with a crown ether.

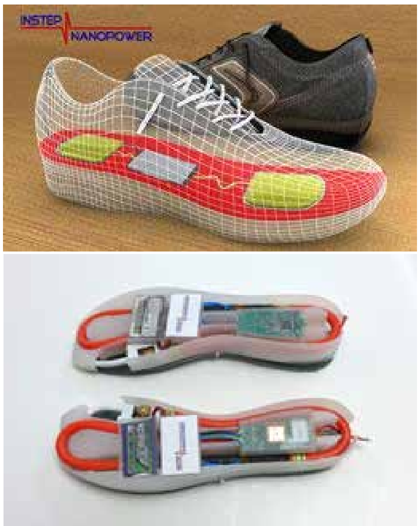
Smaller molecules of gas, however, can disperse through the liquid and be captured by the cages. As a result, the authors claim they have produced "a marked change in bulk properties, such as an eightfold increase in the solubility of methane gas" relative to the same solvent without the cages.

The surface area and the overall uptake of gases in the porous liquids are still much lower than those in most zeolites and metal–organic frameworks (MOFs). At the moment this material cannot compete with those porous solids, permanent porous liquids should instead be seen as a prototype of a new class of substance. Nevertheless, this material bears many advantages because it is a fluid and can for example be pumped through tubing and pipes. This may someday find technological applications in gas separation or transport.

RESEARCH

Global Research

Power Generating Shoes - Now running can charge up your phone as well



Scientific Reports, [DOI: 10.1038/srep16537]

When you're on the go and your smart phone battery is low, in the not-so-distant future, you could charge it simply by plugging it into … your shoe!!

That's right. An innovative energy harvesting and storage technology developed by University of Wisconsin-Madison mechanical engineers could reduce our reliance on the batteries in mobile devices, ensuring we have power no matter where we are.

Tom Krupenkin, an associate professor of mechanical engineering at UW-Madison, and J. Ashley Taylor, a senior scientist in mechanical engineering, described a new energy-harvesting technology that's particularly well-suited for capturing the energy of human motion to power mobile electronic devices. The technology could enable a footwear-embedded energy harvester that captures energy produced by humans during walking and stores it for later use.

"Human walking carries a lot of energy in it," Krupenkin says. Theoretical estimates show that it can produce up to 10 watts per shoe, and that energy is just wasted as heat. The researchers new energy-harvesting technology takes advantage of "reverse electrowetting,", a conductive liquid spreads on a dielectric surface, when voltage from an external source is applied the surface tension between the liquid and the solid surface is modified. This changes the degree with which the liquid can maintain contact with the surface (wettability). So when a surface has a low degree of wettability the liquid hardly makes contact with the surface. Applying a voltage increases wettability and causes the liquid to spread over the surface. The motion of the liquid is a form of mechanical energy.

The reverse electrowetting method can generate high power densities but it requires an energy source with a reasonably high frequency, such as a mechanical source that's vibrating or rotating quickly. To overcome this problem of needing a high-frequency mechanical energy source, the researchers developed what they call the "bubbler" method, the bubbler method combines reverse electrowetting with the fast process of bubble growth and collapse. The process of bubble growth and collapse creates an internal high-frequency source independent from the mechanical energy source. So the high frequency that you need for efficient energy conversion is an internal property of this bubbler approach.

Krupenkin says tapping into just a small amount of that energy is enough to power a wide range of mobile devices, including smartphones, tablets, laptop computers and flashlights.

RESEARCH

Department Research

Ultrahigh Temperature Ceramics and Composites

N.S. Karthiselva is a Ph.D. research scholar working in the area of ultrahigh temperature ceramics under the supervision of Dr. Srinivasa Rao Bakshi, Assistant Professor, Department of Metallurgical and Materials Engineering, Indian institute of Technology - Madras, Chennai, Tamil Nadu, India. E-mail: karthiselvas@gmail.com, mm11d019@smail.iitm.ac.in

NASA's X-43A was the first hypersonic vehicle reached the speed of Mach 9.6 (~11000 kph) and it was powered by scramjet propulsion technology [1].Fig. 1 (a) shows the model of hypersonic vehicle and Fig. 1(b) shows X-43 during flight. Material selection for a specific application in engineering systems is a crucial point and if the service conditions are not properly assessed catastrophic failure is inevitable. In particular, lot of examples can be given for structural failures in aerospace systems; two such examples are given here. (1) During re-entry, space shuttle Columbia disintegrated into pieces due to failure of thermal protection tiles. (2) Falcon-hypersonic test vehicle 2 (HTV2) failed during the test flight and reasons for failure still unknown. In order to avoid such failures in thermal protection systems, research on ultrahigh temperature ceramics (UHTCs) gained tremendous interest among materials researchers. Thermal protection systems (TPS) of atmospheric re-entry vehicle, scramjet propulsion, rocket nozzle, hypersonic flight are the areas where materials subjected to extreme temperatures and harsh conditions.

Borides and carbides of transition group metals such as titanium, zirconium and hafnium are considered to be UHTCs, primarily based on the melting point of (> 3000 ˚C). Among these materials TiB_2 and ZrB_2 are considered for the above mentioned TPS applications due to their superior properties such as high hardness (> 25 GPa), elastic modulus (> 450 GPa), thermal (40-70 W m^{-1} K^{-1}), electrical (1 x 10^7 S m^{-1}) conductivities and corrosion resistance. However, flexural strength, fracture toughness and oxidation resistance needs to be improved in order to meet the stringent operating conditions. Moreover, achieving full densification of UHTCsis difficult due to covalent bonding nature, Anisotropy of thermal expansion co-efficient and low self diffusion co-efficient. Presence of surface oxides such as TiO_2, ZrO_2 and B_2O_3 also hinders the densification.High temperatures of above 1800 ˚C and prolonged sintering time (> 1hr) needed to sinter UHTCs in conventional sintering techniques such as pressureless sintering, hot iso static pressing, and hot pressing.

In recent times, reactive spark plasma sintering has been used to densify UHTCs. Several researchers have fabricated composites such as TiC-TiB_2, ZrB_2-ZrC, ZrB_2-SiC, ZrB_2-TiB_2, and HfB_2-$SiC_w$with excellent mechanical properties using RSPS [2,3]. It has been reported that self propagating reactions between reactants during RSPS release large amount of heat and thus enhances densification. It has been reported that in order to fabricate ZrB_2 and TiB_2 from elemental mixtures by self propagating high temperature synthesis (SHS) route, adiabatic temperature should be above 1800 K. During SHS of the elemental powder mixtures (Ti + B, Zr + B) adiabatic temperature could reach above 3000 K. It can be concluded that ZrB_2 and TiB_2 can be fabricated using SHS process.SHS reactions are very violent and exothermic in nature; if the experiment is not carried out systematically damage to the sintering system is unavoidable.

In our laboratory, we have optimised the experimental conditions and combined SHS and SPS to fabricate dense ZrB_2 and TiB_2using RSPS method at temperatures as low as 1200 ˚C. This is the lowest sintering temperature reported as far as the author's knowledge. Main research focus of our group is on simultaneous synthesis and densification of fine grained ultrahigh temperature ceramics and composites by RSPS and to study densification behaviour, mechanical properties, and oxidation resistance. We have successfully fabricated dense UHTCs reinforced with CNT, Graphene, SiC particle and SiC whiskers with better properties. Here we present the results of low temperature synthesis of ZrB_2 by RSPS.

Zirconium and amorphous boron powder were taken in stoichiometric ratio and milled for 8h in a tungsten carbide (WC) lined vail with WC balls. Toluene was used as a process controlling agent. Ball to powder ratio was maintained as 10:1 and 300 RPM was used as milling speed. Milled powders were dried and then sintered in a spark plasma sintering unit (Model SPS-625, SPS Syntex Inc., Japan). Sintering temperature was 1200 ˚C with 50-100 MPa applied pressure and 100 ˚C /min was used as heating rate.High density graphite die and punches were used to sinter ZrB_2 compacts. During sintering of ZrB_2 there was a spark appeared from top and bottom of the die and it is due to the SHS reaction between the elemental reaction. Fig.2. shows spark phenomenon during the RSPS. After this sudden displacement the experiment was continued further and stopped at 1200 ˚C. Fig. 3 shows the displacement Vs time curve of ZrB_2 at various applied pressure. It can be clearly seen that during first stage sudden displacement and in second stage gradual displacement change occurred. In the first stage SHS causes the sudden displacement and in additional densification stage plastic flow of ZrB_2 plays a main role in densification [2]. Fig.4 (a–f) shows the SEM images of the fracture surface of the samples synthesised by RSPS. It can be clearly observed that reduction in porosity with application of 50-100 MPa pressure in the temperature range of 800- 1200˚C. In summary, fine grained dense UHTCs can be fabricated using RSPS method at temperatures as low as 1200 ˚C with better properties.

Fig. Hypersonic vehicle X-43A[1]

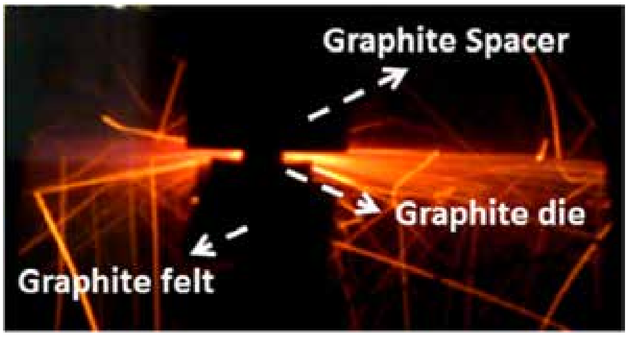


Fig. Self propagating reaction during RSPS.

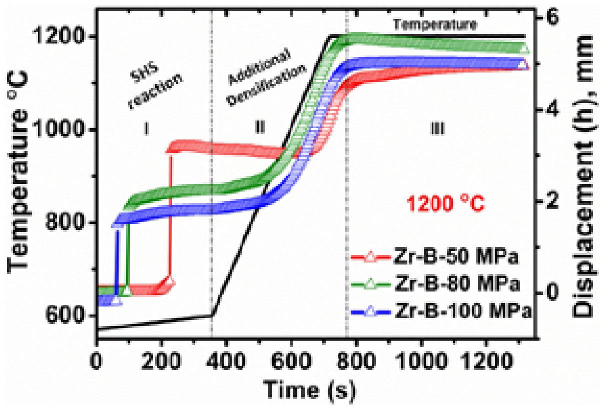


Fig. Displacement curve of ZrB_2 at various pressure

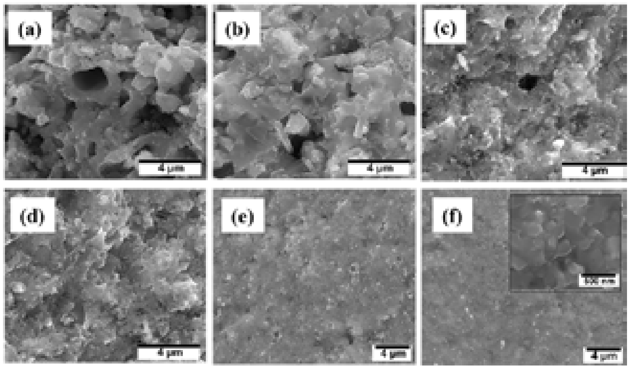


Fig. SEM images of fracture surface of RSPS samples (a) Zr-B-800C50, (b) Zr-B-1000C50, (c) Zr-B-1200C50, (d) Zr-B-1400C50, (e) Zr-B-1200C80 and (f) Zr-B-1200C100.

Ref:

1. http://www.nasa.gov/missions/research/x43-main.html

2. N.S. Karthiselva, B.S. Murty, Srinivasa R. Bakshi "Low Temperature Synthesis of Dense Ultrafine Grained Zirconium Diboride Compacts by Reactive Spark Plasma Sintering" ScriptaMaterialia. 110 (2016) 78-81.

3. N.S. Karthiselva, B.S. Murty, Srinivasa R. Bakshi "Low temperature synthesis of dense TiB_2 compacts by reaction spark plasma sintering" Int. Journal of Refractory Metals and Hard Materials. 48, (2015) 201–210.

Department Research

Grain boundary engineering: Principles and Applications

K. Deepak (M.Tech student)
C.N. Athreya (Ph.D student)
V. Subramanya Sarma (Associate Professor)

"Perfection's a gift of the gods, few can boast they possess it and most of you, my dears, don't." - Ovid, The Art of Love

The properties of crystalline metallic materials are determined by their deviation from a perfect crystal lattice, which occurs due to the occurrence of intrinsic crystal defects. Without those crystal defects, metals would never have been used in such a wide variety of applications. There are different types of crystal defects which are distinguished by their spatial dimension. One of the most important defects in metals is the grain boundary, a two dimensional planar defect, which separates two adjacent crystallites of the same crystal structure and chemical composition, but of different orientation.

It has been well recognized that grain boundaries in polycrystalline materials can possess distinct structures. It is possible to describe these distinct grain boundary structures using the so called Coincident Site Lattice (CSL) model. This model is based upon the misorientation of adjoining crystals, whereby at specific orientation relationships, a 3-dimensional sub-lattice, with points common to both adjoining crystals can be achieved. The unit volume of this coincident site lattice relative to that of the unit cell of the single crystal lattice is described by the parameter ∑ ; increasing values of ∑ correspond to a greater degree of disorder at the interface.

What is grain boundary engineering (GBE) ?

The basic philosophy of GBE is to optimize the grain boundary character distribution (GBCD) by increasing the proportion of the so-called 'special boundaries' (SBs). SBs are those that have relatively better properties when compared to the random high-angle grain boundaries (HAGBs) and are often described in terms of the coincidence site lattice (CSL) model. Although SBs and low ∑ (∑ ≤ 29) CSL boundaries are often used synonymously, there is increasing evidence that only a subset of CSLs are special. A more complete description of SB is the one which terminates on low-index planes. In practice, GBE has been extensively applied to low-to medium stacking fault energy (SFE) materials as these exhibit prolific twinning during annealing and majority of CSL boundaries in GBE microstructure in these materials are essentially ∑3 and its variants (viz. ∑9 and ∑27). Since ∑3 boundaries are generally associated with special properties (as they preferentially terminate on low-index planes), the main thrust of twinning related GBE in low SFE materials is to enhance the fraction of ∑3 boundaries. Unlike ∑3 boundaries, the higher order ∑3 boundaries (i.e., ∑9 and ∑27) generally do not show any clear preference to terminate on the low-index plane and whether or not they are 'special' depends on their terminating on the low-index planes. However, the main role of ∑9 and ∑27 boundaries is rather geometric i.e., they take part in the reconfiguration of the existing grain boundary network that eventually breaks down the random HAGBs connectivity.

Why GBE ?

Intergranular degradation processes such as intergranular-cracking, corrosion, and creep cavitation are widely occurring degradation mechanisms in numerous plant components in the nuclear, oil and gas, transportation, chemical and food processing industries. The occurrence of these degradation processes often leads to costly outages; protracted regulatory proceedings for system re-start, and reduced overall plant life. One approach to overcoming these challenges is to optimize microstructures of the materials used in the critical components. An approach that has proven effective in improving the resistance of material to intergranular degradation is through GBE.

How to achieve GBE microstructure:

GBE microstructure has been realized through various processing approaches such as application of magnetic field or mechanical stress during annealing, laser surface melting followed by annealing, and through thermo-mechanical processing (TMP). Amongst all these approaches, TMP is found to be most effective and widely employed as it well suited for scaling up to industrial processing.

Our activities in the area of GBE:

Effect of GBE on hot corrosion behaviour of Nickel base superalloy :

The superalloy 617 (with a nominal composition of 55Ni–21.8Cr–11.5Co–8.7Mo–1.07Al –0.38Ti–1.02Fe–0.06C, all in wt%) used in the present investigation was received from VDM Metals GmbH, Germany, in solution annealed (at 1448 K) and quenched condition (abbreviated hereafter as AR specimen). A 15% reduction through cold rolling and subsequent annealing at 1373 K resulted in a GBE microstructure (termed here after as GBE specimen) having high fraction of ∑3 boundaries and notable disruption in random HAGBs connectivity. The AR and GBE specimens (10 × 10 mm2 dimensions) were subjected to high temperature hot corrosion by completely immersing them inside a corrosive salt mixture (75% Na2-SO4+ 20% NaCl + 5%V2O5) in a preheated crucible at 1273 K for 24 h.

The grain boundary character map reveals that random HAGBs connectivity is significant in the AR condition (Fig. 1a) whereas it is visibly disrupted in GBE specimen (Fig. 1b). The ∑3 fraction in the AR and GBE specimen was found to be 53 ± 2.5% and 67 ± 2.1%, respectively. The distribution of these boundaries in the triple points of the microstructure (i.e., triple junction distribution) is also important. This is due to the fact that intergranular corrosion propagates from the surface into the interior of the material preferentially through the random HAGBs and the resistance to intergranular corrosion depends on the degree of connectivity of these boundaries. There are essentially4 types of triple junctions, namely 0-CSL, 1-CSL, 2-CSL and 3-CSL (n-CSL refers to a triple junction having n number of CSL bound-aries at the intersection). The analysis shows that the fraction of 3-CSL boundary triple junctions has increased significantly following thermomechanical processing (Fig. 1c).

Simultaneous EBSD + EDS scans were performed across the cross-section of the hot corrosion tested samples to analyse the elemental distribution & correlate with the grain boundary character. This would essentially give a clear idea about the type of grain boundaries that are susceptible to hot corrosion. Both the AR and GBE specimens did not show any kind of preferential segregation/depletion of alloying elements at grain boundaries before hot corrosion test. Fig. 2a shows the image quality plus grain boundary map of the cross-section of the AR specimen after hot corrosion whereas EDS elemental distribution maps of Mo, S, Co, Ni, Cr, Al, and O2 are shown in Fig. 2b through h. The hot corrosion has led to the segregation of Mo (Fig. 2b), S (Fig. 2c)Co (Fig. 2d) and Ni (Fig. 2e) at the random HAGBs (see Fig. 2a) along with a depletion of Cr (Fig. 2f) in the AR specimen. In contrast to this, ∑3 boundaries do not show any preferential enrichment /depletion of any alloying element; thus indicating that these boundaries are resistant to hot corrosion. Five parameter stereological analysis has revealed that majority of these ∑3 boundaries terminate on (1 1 1) plane and hence they have very low interfacial energy. Some of the higher order ∑3 boundaries were corroded (shown by yellow arrow in Fig. 2a through c) whereas few of them are not attacked.

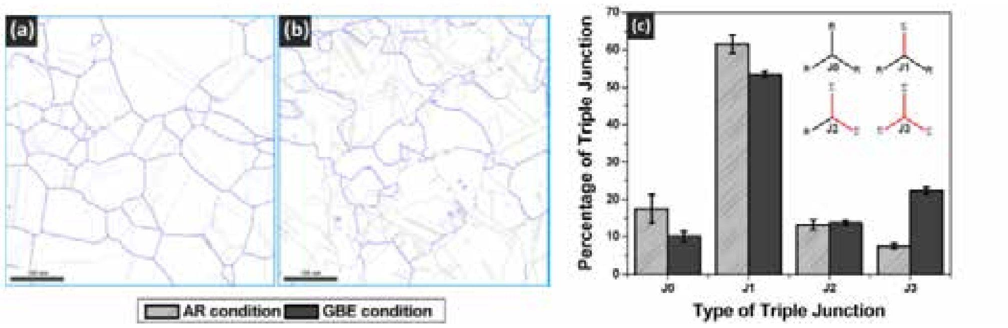


Fig. 1. Grain boundary maps showing random HAGBs connectivity in (a) AR and (b) GBE specimen (grain boundary colour code: ∑3 & its variants – grey, random HAGBs – blue); (c) Percentage of each type of triple junction in both the AR and GBE specimen.

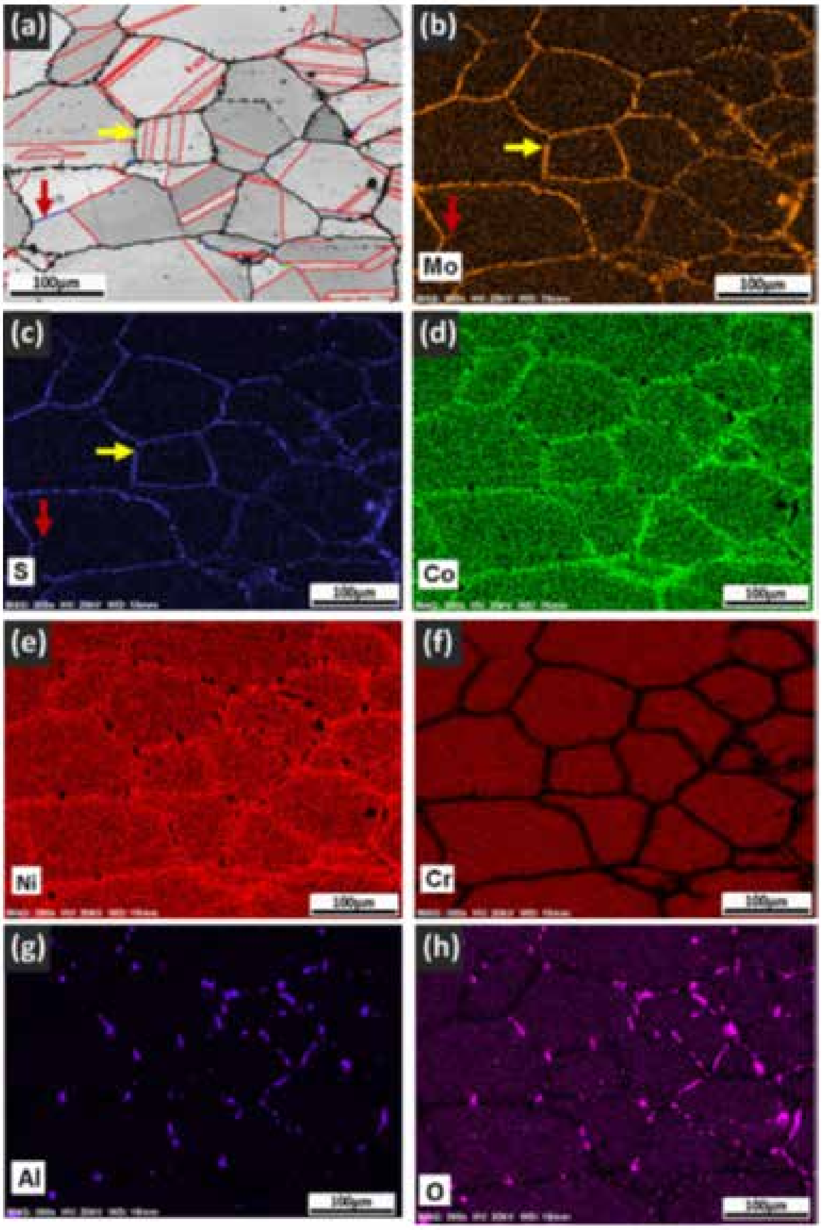


Fig. 2 (a) Image quality plus grain boundary map (colour code: ∑3 – red, ∑9 blue, ∑27 – green, random HAGBs – black); and EDS elemental map showing distribution of (b) Mo (c) S (d) Co (e) Ni (f) Cr (g) Al and (h) O across the cross-section of the AR specimen after hot corrosion testing.

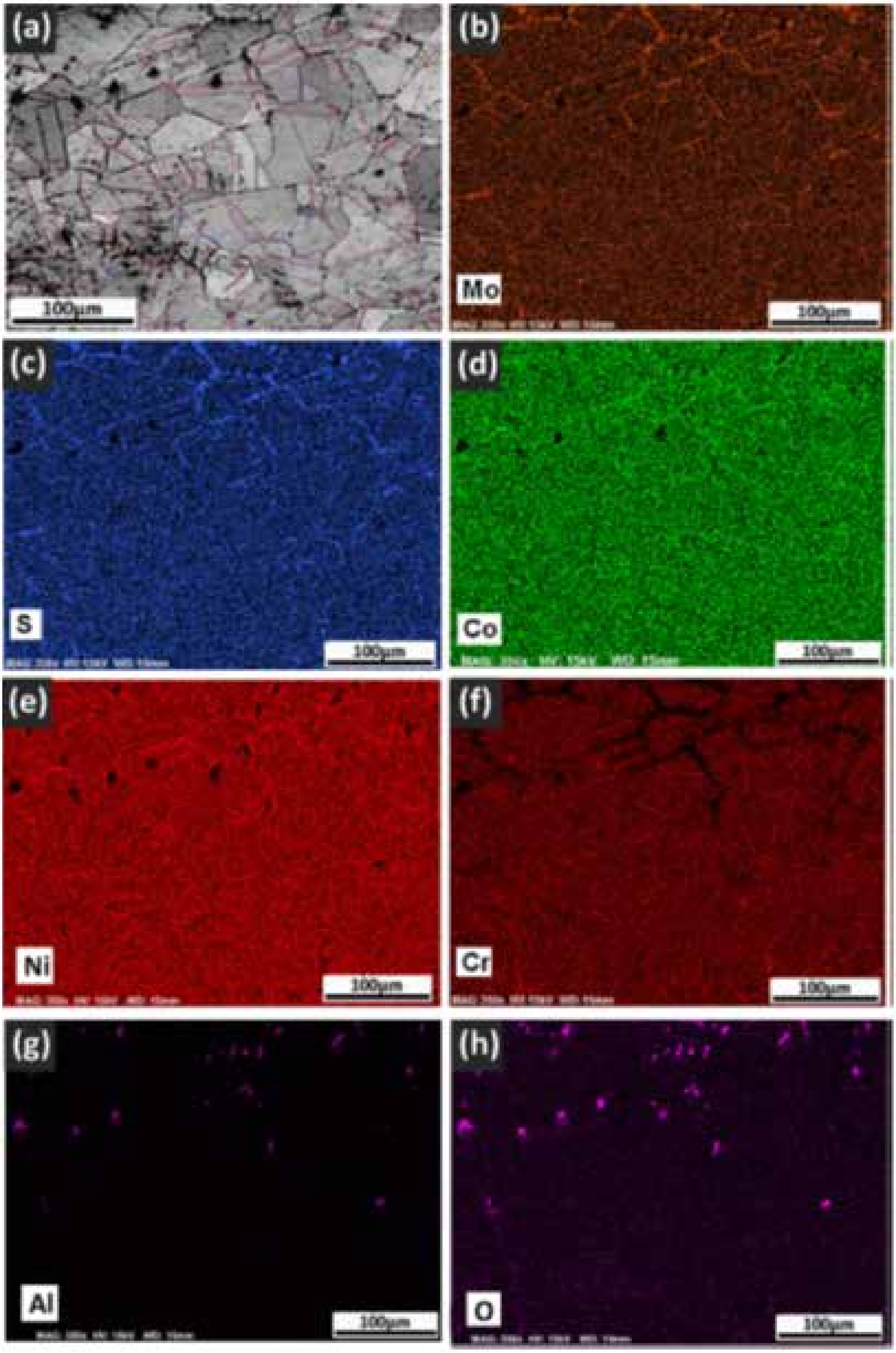


Fig. 3 (a) Image quality lus grain boundary map (colour code: ∑3 – red, ∑9 – blue, ∑27– green, random HAGBs – black); and EDS elemental map showing distribution of (b) Mo (c) S (d) Co (e) Ni (f) Cr (g) Al and (h) O across the cross-section of the GBE specimen after hot corrosion testing.

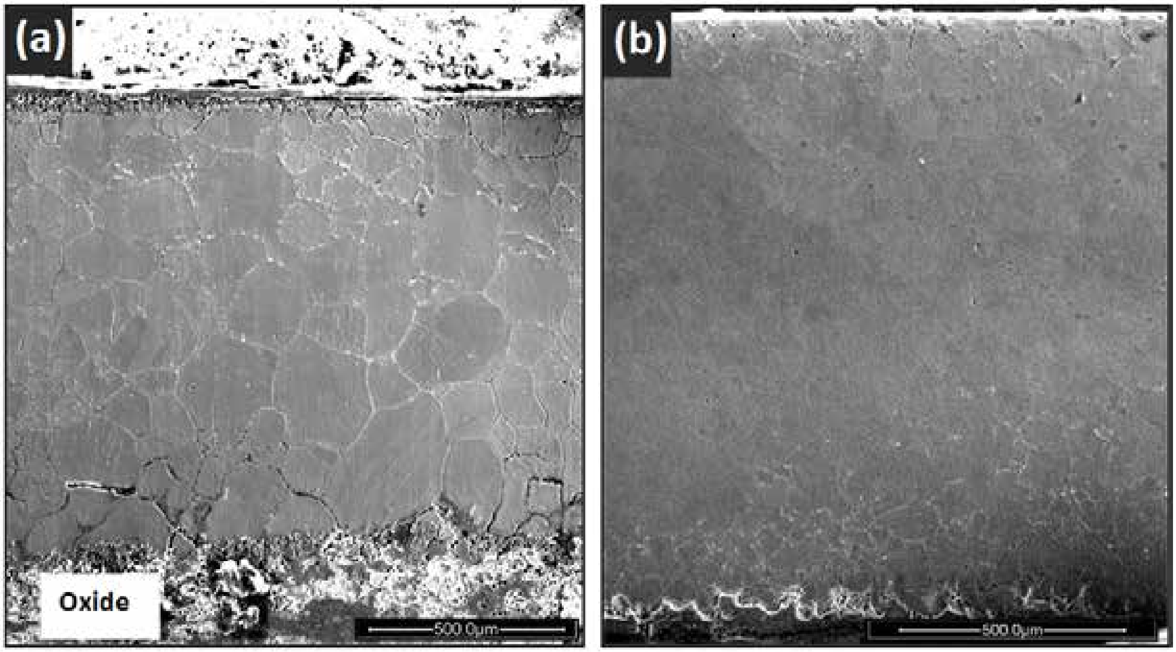


Fig. 3a shows the image quality plus grain boundary map of the cross-section of GBE specimen after hot corrosion whereas EDS elemental distribution maps of Mo, S, Co, Ni, Cr, Al, and O2are shown in Fig. 3b through h. It is observed that enrichment of Mo (Fig. 3b), S (Fig. 3c), Co (Fig. 3d), Ni(Fig. 3e) and depletion of Cr (Fig. 3f) in GBE specimen is only confined to the top few layers of random HAGBs. Comparing Fig. 3 with Fig. 2, it can be confirmed that the corrosion attack has penetrated deeper into the AR specimen whereas percolation has been arrested in the GBE specimen. In order to quantify the depth of penetration in both the specimens, the entire cross-section of the specimens was imaged in SEM (shown in Fig. 4a and b). It could be observed that intergranular corrosion has occurred across the entire cross-section (~2 mm) of the AR specimen. However, the depth of penetration and GB attack in GBE specimen estimated from secondary electron image is ~200 µm only (Fig. 4b).

The above results, demonstrate convincingly the role of GBE in enhancing high temperature hot corrosion resistance of bulk polycrystalline alloy.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Revolution 2015

A Look at the New Curriculum 2015

This article throws light into the recent curriculum changes passed by the IIT Madras Senate with effect from the current batch of 2015 and discusses how it affected the 2015 freshers.

With a view to provide a flexible learning environment to the students, in September 2014, a task force was created to examine the undergraduate curriculum at IIT Madras and suggest reforms to be in line with the IIT Madras, Strategic Plan 2020. The motive behind the initiative was to evolve a broad framework for the B. Tech/Dual Degree programs, so that individual departments could formulate the curricula for their students.

After several months of surveys, deliberations and reviews, the task force prepared a report, comprising of the recommendations and their rationale. A renewed curricular framework was proposed, along with a detailed report comparing it with institutions worldwide. The new system provides a flexible framework to the students and gives them greater freedom to pursue their interests as only about 60% of the credits have to be specific to their major stream.

The following changes were proposed to the existing curricular framework: Considering that every student is expected to put in about 2 hours of effort outside the classroom for every 1 hour of classroom work, a 9 credit course now involves 3 hours of lectures and 6 hours of effort outside the classrooms. Under this system, the courses which were traditionally 3 credit courses now carry 9 credits while 4 credit courses carry 10 credits with an extra hour of tutorial sessions. Each 2.5 hour laboratory session is awarded 3 credits and 1 credit-hour tutorial class is awarded 1 credit. In any given semester, no student is allowed to register for more than 60 credits.

The freshies studied 6 courses as opposed to 8 that their seniors took reducing the number of credits to 17 from 22 in the past year. 5 extra hours per week has allowed the students to explore the various organizations in this institution. Clubs and their events have witnessed a sharp rise in the numbers of freshie participation as compared to the previous years. Newcomers are very well informed about all aspects of the college life as a direct result of being able to attend most orientation sessions which was not be possible last year. Unlike the previous curriculum, the students no longer have to take all the basic engineering courses in their first year but only a few select courses recommended by their department. Also, the first year students could opt out of CS1100 (Introduction to Programming) if they clear a basic test similar to the O Level examination in Communicative English and do a free elective instead.

There are introductory level courses to provide the current first years with an insight into the department. Dr. Ravi Sankar Kottada, Associate Professor in the department, who took the course "MM1001 - Introduction to Material Science and Engineering" the first time it was offered, went the extra mile and designed it in a way that would help students to explore the various avenues in our department. The course was aimed at a more practical experience in labs than rigorous lectures in class. The first batch visited about 15 laboratory facilities in the department, starting with Casting and Metal Foams and culminating with the Transmission Electron Microscopy lab. The students wrote independent reports complementing these visits. A seminar on a famous Metallurgist / Material Scientist and an interesting Materials concept by every student ensured everyone got a peek at what's there ahead. The course gave an all-round experience of life both in academia and in our department.

B.Tech and DD students are expected to complete 432 and 553 credits, respectively, during their time at IIT and 40% of these credits are electives. B.Tech and DD students have the choice to choose 86 and 91 credits, respectively, worth free electives from any department, including all engineering, humanities and management departments, irrespective of their parent department. Students who convert from B. Tech to (B. Tech + M. Tech) Dual Degree program are be permitted to register for M. Tech programs in other disciplines as well, provided they meet the requirements set by the accepting department. A new programme has been introduced where Dual Degree students from all departments have an option to pursue their Masters in Entrepreneurship. The students who convert to the said program will be provided technical and business mentors. Should the idea seem promising, this program may also be well assisted by the IP Cell and Research Park. The extra year can be used by students for prototype or business development while receiving a scholarship from the institute. The minor stream is now optional and those who are interested in taking up one can chose from a pre-defined set of four courses, which has not been chosen as one of their free electives in any semester.

A new course called 'undergraduate research' was introduced, where a student can sign up with an interested faculty member, providing a specific proposal of what he/she aims to accomplish during the course of the semester. The course allows the students to get a flavor or research before taking up postgraduate research courses. Even though a lot of undergraduate research already takes place in our department in the form of student projects, the course allows the students to earn academic credits for their work, thereby giving it an impetus. The B. Tech project is now optional and is categorized outside the undergraduate research course. Students can instead take up 27 credits worth of courses from the department. Academic credits have been discontinued for non academic activities like NSO, NSS, NCC, Industrial Training and the Life Skills course, even though they continue to be a part of the curriculum.

The existing criteria for awarding an honors degree was also revised. The students no longer need to take up extra courses but have to maintain a CGPA greater than or equal to 8.5, complete a 27 credit project (wherein he/she is expected to put in 27 hours of work every week throughout the 16 week semester) and earn at least 18 of the free elective credits in their parent department.

The new framework allows students to explore areas outside their major stream thereby enhancing their ability to work on such interdisciplinary projects. For example, a student from Metallurgy can now take up more courses in the Biosciences department to work on a projects in like prosthetic arms. The new framework seems to be a step in the right direction and could go a long in redefining undergraduate experience in the MME Department.

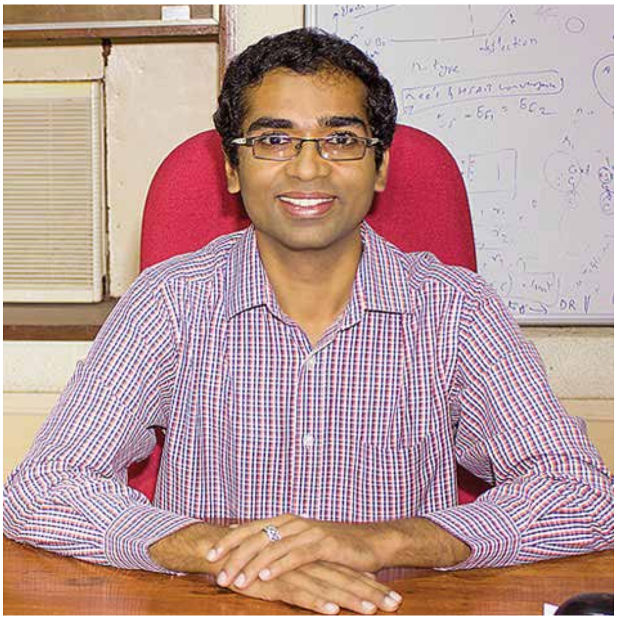
We would like to thank Prof. Preeti Aghalayam, member of the Curriculum Task Force, Sashank Sudhakar Vandrangi, Academic Affairs Secretary, IIT Madras, 2015-2016 and Anirudh Patri, member of the Placement Team, for their inputs.

With inputs from the article "Changing with the times", posted on The Fifth Estate on July 2, 2015 by Aslamah Rahman.

DEPARTMENT

Interview with Faculty

Dr. Tiju Thomas



After having one too many a Bourbon biscuit in the luxury of his office, we take a moment of Dr. Tiju Thomas's time to give you an idea about him, his research and his advice.

"I took the road less taken and that has made all the difference." This is a quote that pretty much defines Dr. Tiju Thomas. Having started off as an avid electrical engineer his journey has taken many turns. This journey of his has been spearheaded by his curiosity of electrical device. This took him into the field of applied physics. From here his journey took him to a fascination about wide band gap semiconductors. These wide band gap semiconductors unlike the other semiconductors have this amazing property of being able retain their properties even at high temperatures. He soon started to work on such semiconductors (SiC and GaN). For his Ph.D. thesis he worked on rarely doped nitrides. The ingenious of Dr. Tiju in his thesis was to come up with the need of a scale-able technology. He was able to come up with a high throughput method of producing GaN. From this his tryst with the world of materials brought him where he is today.

Dr. Tiju having studied at Cornell has experienced a different cultural environment there. We asked him to enlighten us all on the differences he perceived there. Dr. Tiju feels that the disciplinary boundaries were far fuzzier there than it is here. This he feels enables out of the box thinking. The problem in our country he feels is that there are too few opportunities and too many people jumping on it. "The only way to stop being rats is to get out of the rat race" he says. He feels that only questioning, i.e. out of the box thinking, will facilitate the growth of academia in our country. Our lack of out of the box thinking in the education system is mainly due to historical reasons. During the growth of industry, the western nations were able to better understand the supply chain problems in academia and learn from it. In India at this time most of us being trained to be clerks did not gain enough exposure. People are willing to change into out of the box thinking but systems don't change so easily. The changes are happening and will continue which is a very good sign for budding researchers. Interdisciplinary fields are coming up and our country is evolving. Another difference he notices is that of the perception of elitism. Elitism being valued here in our country is usually looked down upon in the US. His experience at Cornell gave him a strong belief of the ideology of "Any person, Any study." A brilliant advocate of this idea he has moved from his early electrical engineering days to some serious material chemistry.

Currently working on Nano-Structures and Ceramics at IIT-M he seems to be enjoying himself here. He finds the collegiality in this institute very good. He feels that most of the people he works with have been kind, helpful and eager. He has had his fair share of challenges. But as he and Bill Waterson quote "Anything that doesn't kill you builds character." His interest in ceramics was kindled by IIT-M. His work with IIT-M professors with experience in traditional metallurgy has made him take up this field. He focuses on functional properties- optical, electrical and magnetic of nanostructures and ceramics. Encompassing a variety of disciplines, he is very enthusiastic about his research.

When asked about the lowering of research on steel, he feels that there has been none. He felt that the academia research on steel is still ongoing but most research on steel happens at the industry level. The reason there isn't enough exposure of this research is that there are no papers published for industrial research.

In his opinion, the promise and potential he sees in different places has always been the same. No matter where he goes, he feels he finds immense potential among those there. When asked to offer us advice he asks us to be positive above everything. A role model at doing so, always smiling and enthusiastic he further asks us to be sincere. He feels with sincerity, dedication and not letting anything get to you will lead to one's eventual success.

DEPARTMENT

Rodriguez Lecture Series

Kalpakkam & Chennai Chapters of The Indian Institute of Metals

Dr. Gautam Kumar Dey delivered this year's lecture entitled "Development of Alloys for Application in the Nuclear Energy Sector: Some New Perspectives" on 5th October, 2015 at Sarabhai Auditorium, IGCAR, Kalpakkam.

Dr. G.K. Dey is currently a Distinguished Scientist & Associate Director, Materials Group, BARC, Mumbai. He obtained his B. Tech in Metallurgical Engineering in 1979 from the Indian Institute of Technology, BHU and was awarded the gold medal for standing first. He joined the 23rd batch of Training School in Bhabha Atomic Research Centre (BARC) and was awarded the Homi Bhabha prize for standing first in his discipline. On completion of training, he joined Metallurgy Division of BARC. He obtained his Ph. D degree from Banaras Hindu University in 1988. He was a postdoctoral fellow at University of Cincinnati from 1994 to 1996.

He is a fellow of the Indian National Academy of Engineering (INAE), Indian Academy of Science (IAS) and Electron Microscopy Society of India (EMSI). Areas of his research interest are Phase Transformation in Zirconium and Nickel Base Alloys, Amorphous Alloys, Rapidly Solidified Crystalline and Quasicrystalline Alloys, Electron Microscopy and defect Characterization and High Resolution Electron Microscopy. He has more than 300 scientific publications in peer reviewed journals to his credit.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INTERVIEWS

The Mathematics of Materials

An Interview with Dr. Ulrich Prahl

Dr. Ulrich Prahl is the Group Leader of the Integrated Computational Materials Engineering group at RWTH Aachen University. His research interest is integrated modeling of microstructure evolution and properties of steels and metallic materials during production, processing and manufacturing.

Where does computational research stand vis a vis experimental research? With experiments requiring lots of funding, how much can we model systems theoretically?

(Laughs) That's a heavy question to start with. Simulations are a discipline by itself but they are highly simplified and hence you have to check it against reality. We can't rely on simulations alone for the future and simulation modelling has to be based on experiments. Though we can qualitatively and quantitatively predict more and more questions to be answered, we are far from doing it just by simulations. Moreover, the scenario depends on the type of the question also. We need to see if it's a mathematical one or if it's based on the complexity of the material. For example, in systems with about 10 alloying elements with their concentrations ranging from some parts per million to tens of percents, our simulations cannot predict the material's behavior. We can still contribute to these questions, but the real influence of the chemical make-up on mechanical properties of materials as a function of temperature, strain rate, etc. is far away from being predicted by simulations. We can still make empirical models using experimental data and these simulations can provide hints on where to go. We are on the way and nowadays, every material department has simulation rooms and they are growing faster than experimental rooms.

How do we integrate levels of simulation?

On the macroscopic level, usually, we need information and input parameters. For example, we tried to analyze forging and we try to get flow curves, and the more you think about it, the more you realize that constitutive modelling is a question of microstructure. It is the state variable, microstructure, grain size, dislocation density and not temperature, not strain rate that play a role. So when you want to investigate microstructure, you need energy, mobility, nucleation energy and pressure data, these can be got from small scale models. When you want to analyze something, for the necessary input parameters, you need data corresponding to smaller length scales, and you go deeper to the next smaller length scale. So this is how simulations can be assisted : by offering a scale-hopping approach to the higher scale. At the end of the day, we're explaining materials properties on a microscopic scale. So we can actually get multiscale models using combinations of simulation data and experimental ones.

You had a background in mathematics, before you shifted into materials engineering. What was the motivation for the shift?

When I started study out of school, I joined a tiny and unscientific department. My reasoning was that I wanted a department far away from home, as I wanted to be independent and live alone. The topic of engineering mathematics was upcoming then and not many institutes offered it. I joined an institute which isn't known for mathematics but is one of the three big places in Germany for metallurgy. I continued studying mathematics till my diploma, and I looked around for topics to do my PhD thesis on. That's when I came across continuum mechanics of heterogeneous microstructures, it had a mathematical aspect to it, and the heterogeneity. I found that it was something that excited me. By the end of my PhD, I had done continuum mechanics, damage mechanics for heterogeneous materials and was invited to do my Post-doc in the steel department. So mathematics is a good background to go elsewhere. I had good luck, every time I made a decision it was for the better.

What mathematical skill sets helped you in this line of work?

Mathematicians are known for one skill - their ability to organize their world and thereby find similarities between completely different worlds. So for instance, the mathematical formula describing phase transformations is the same type as that has been applied in a completely different area, the numerics behind which had been explored 20 years ago. So I can apply the numerics of something else to help me find similarities here. The second point is a very powerful one. Using arguments about convergence, I can make large complex multiphase systems converge, and when we know people are discussing the non-convergence of a damage model of a complicated material, then I can discuss the gradients of the model from the parameters, and can find optimization of the algorithms being used. Thinking logically is a big plus from doing mathematics.

What motivated you to come into research?

I have three motivations. One is I'm continuously working with new things and always trying to explore new phenomena. Although I may be old, the people around me and the surroundings are always young. So when I engage in discussions with them and interact with my surroundings, it keeps me young. The second is a very unscientific argument - I like to be the leader of a group, and to be with a group of people who will follow you, and know where to go. The third is that we have very good experiments and we have very good expertise and equipment, we therefore have good options to go into the world. It is the type of work that never gets boring. So one day if you realize you don't want to work on something, you can just move over to a different materials system. For example, one day I was thinking about teeth and why they break. I wanted to learn about them and apply damage mechanics to teeth. No one will stop you from doing this. And they won't stop you also from seeking your own collaborators, and people to work with. There are no boundary conditions my professional life. I am autonomous, and can work anywhere I want. Of course not for fun, but I can attend conferences, collaborate in other countries.

Just for an idea of scale, how many students, including PhDs, are at RWTH?

We count a little different from how it's here. We count a student, only till his Masters degree. After that, he is no more a student, he is working at the university. We don't say "doctoral student", we say "doctoral researcher". So with my counting system, we have approximately 43000 bachelors and Masters students, and approximately 7000 doctoral researchers. If I were to split it according to your system, I would say we have between 35000 undergraduates, plus 7000 Masters students and 7000 PhD's. Besides engineering, we have faculty in economics, medicine, mathematics and natural sciences, but RWTH is, as a whole, dedicated to engineering. 80% of my simulation group are from abroad, but there are also groups where no one is from abroad. So it's a big scale. Even in Germany, it's one of the biggest technical universities.

Why would anyone study engineering if they want to do, say, banking?

In Germany, usually, most students decide what they want to do by their bachelor's degree itself. It is very rare that you do a bachelors in a technical topic and later decide to go to a pure economic job like banking. Maybe you can to combine the two and decide to head a small enterprise, start your own company, which would require engineering and economic skills. You would not go into a banking job being engineers. Usually, most people starting with engineering are thinking technically.

These days, our focus is shifting from metals, to energy materials, solar materials and others. Any thoughts on this?

Materials are always on competition, and here, in your country, steel is a growing economy. In the very developed countries, the situation is slightly different, in particular for metals, because we have very old equipment. We have become a society that is not accepting investment in new equipment because the new equipment is bigger and will take time to install. It also makes noise and dust and will inconvenience others. Everyone asks for a more efficient plant, but not in their yard, not near their homes. In Germany we have no free space anymore, and the equipment requires tricky maintenance and we are not in a position to replace it with new equipment. There is no political support for it. Your country however, is developing. You are willing to produce your own steel on a higher level than you need, and you get support from society and politics. I'd say smart materials is also a great topic to go into, but materials are, in general, a great topic. You can't do anything without materials. Who knows, maybe next generations T-shirts will have smart phones built into them!


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Intern Diaries

Asmita Jana is a Dual Degree student in the Dept of MME. Her research interests are first-principles calculations and computational thermodynamics. On the days when she isn't a zombie in lab, she can be found watching anime elsewhere.

Vishal Subbiah, a B.Tech student of Metallurgical and Materials Engineering (Batch of 2016), is currently pursuing Master of Sciences at Stanford University.

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Intern Diaries

Asmita Jana

Canada Research Internship- Mitacs Globalink-2015 internship:

Sometimes, in life, one wants a getaway, to visit an exotic place and get refreshed. For me, this wish got fulfilled in the summer of 2015. I had the golden opportunity to go to Canada for a summer internship. It was a break from the usual routine of everyday life. It was almost as if the 'normal' life got 'paused' and I got teleported to Heaven!

Getting to work, I got a project on Thermodynamic Modeling of Ionic Liquids in Ecole Polytechniqe de Montreal. The work environment there is very professional and very well balanced. Everyone is friendly and yet very professional, something I thought could never get mixed. Canada is a very multi-cultural region and even in the university, you could find people from across the globe. (I have a pal who is from Jordan). Interacting with them makes you feel how similar and yet how different our culture is.

So, every weekend, all of the interns in Montreal used to pack up and head towards the nearest place where 'things' are happening. During the summer, a lot of festivals happen in Montreal and famous people across the Globe seize their chance to be here. There are a lot of fests that happen in the summer like: the Ribfest, the Jazzfest, the Beerfest etc. There was Comic Con and the Canadian Grand Prix which happened in Montreal. There were also fireworks festival called the -Festival de l'International des Feux Loto-Québec which I got to see.

Canada day was on 1st of July, and Ottawa being near Montreal, all of us got there to see the Canadian parade and the Prime Minister too. I also went to Quebec City, and have seen the Montmorency falls and toured the citadel of the Old Quebec City with its beautiful french buildings.

Not to mention, I went to Toronto and Niagara. And yes, I have seen those Falls and those majestic waters are indeed a treat to the eyes; I recommend the boat ride- 'Maid of the Mist' as something one must see atleast once in a lifetime. And these are just the major tourist spots that I covered...

So, you see, I had a trip of a lifetime in Montreal and I was so sad when I had to leave the place. Montreal had taught me to be independent and not be shy to be yourself. Love you, Montreal!!!

Intern Diaries

Vishal Subbiah

Summer Internship in Canada:

Last summer I had a wonderful opportunity to go to Canada for a research internship under the Mitacs Globalink Program. I went to the University of Saskatchewan in Saskatoon. I worked on the project 'Rational Design of Advanced Materials'. I believe Mitacs gives you a great opportunity to try out many new things. Apart from the cooking and living alone for the first time (Insti doesn't really count) in a new land, some of my friends even tried skydiving and zip lining. A very surprising thing for me was the fact that I had access to Wi-Fi everywhere I went, including the long distance buses, that I never missed or needed an actual phone. For me, one of the greatest take aways was working with people around the World. Though similar to working in any new environment it was even more pronounced as no two people in the group were from the same country or had the same background or knowledge. Apart from this I also learnt a lot during the course of the project not only academically but also about myself and what are the topics which I find interesting and would like to pursue. Though Saskatoon isn't really a city in terms of population by Indian standards, it was very interesting to be in a place where everyone knew everyone and perhaps due to the small population, the people were extremely nice, so much so I found people in other parts of Canada rude in comparison (Though they were also polite). The icing on the cake was the trips to the 'The Innovation Clinic' which introduced me to the start-up scenario in Canada and 'The Canadian Light Source' which is the only synchrotron in Canada. I also was fortunate to be able to participate in the PIMS workshop joining computer scientists, mathematicians and statisticians in solving Industry related problems based on optimization, analytics and big data. Overall it was wonderful and eye opening experience and I would recommend it to everyone, irrespective of your interests as Mitacs offers projects in all disciplines and it is not necessary to apply to your field of study.

STUDENTS

Placement Series

Placements. For most students, this word entails the final goal-post of their life in insti and all that therein is. Considering its importance, surprisingly not everyone is aware of the intricacies of the whole placement process. We decided to talk to two major stakeholders: the department placement team and a few students who landed their dream job in their preferred domain, to give you an overview of the placement scenario straight from the horse's mouth.

STUDENTS

Placement Team Article

"On the morning of 1st December we had all the timelines set and everything had to go according to what had been planned. To be honest we weren't expecting the situation to get that bad. Everything was fine until the power went down. Handling the impending chaos was one of the more difficult things we have had to do as part of our job as the Placement Team".

One of the most indispensable teams of our department, the Placement Team consists of the Branch Councillor, Placement Coordinators and Deputy Placement Coordinators. They take care of all the placement activities pertaining to core companies. The non-core companies are taken care of by the IPR Team.

The whole placement process starts with calling the companies. "We first need to identify the companies that are relevant to the profiles of the students. So we make a list of the different areas in which the students are working, for example some specialize in the computational field and some concentrate on doing experimental work, and look at which companies fit their bill". Students are asked to list their preferred companies and after a bit of their own research the Team tries to get companies in their field. Their aim is to ensure that there at least three to four companies of each student's choice (relating to their interest) coming for placements.

At the same time, the Team also organizes a lot of pre-placement activities. They have a lot of fundae sessions about various things like coding, different job profiles and kinds of companies, whether or not to pursue higher studies and how to handle interviews well. They serve to address the questions that the students have and give them valuable inputs so that they can take an informed decision.

The next stage is contacting these companies. They either call them up directly or reach them online. It is also possible to contact them through alumni if they have had any relationship with the company before. Once contact is established, the next big task is to convince them to come for placements here. "We pitch the profiles of our students and the department and give them a fair idea about the number of students who are interested in their company. This is more or less like a negotiation between us and the company, where we depict a good image of our department and institute and make them feel that it is indeed worth coming here". Once the companies have been finalised, timelines and schedules are meticulously prepared.

During the placements, their job is to ensure that the process goes on smoothly without any glitches. They manage the students, making sure they move from one interview to another without any hassles. They more or less form the necessary interface between the recruiters and the students.

Making this whole process a success is definitely not an easy job. There are many challenges they face along the way. The major underlying problem according to them is that not many students are aware about what they want to do. "Getting companies for these students is a sort of painful process, especially when it comes to core. When a student does not have enough knowledge about what line of work they are willing to pursue, or are not definite about what kind of companies they are looking for, it becomes very difficult to match companies to the student's interests".

Generally, the pay accorded by core companies does not match the student's expectations. The ones that do pay well look for students with high CGPAs and a certain level of experience. Also, a sizeable chunk of companies that come for placements look for those with a mechanical background and end up recruiting many students from mechanical engineering. This means that unless one has a good CGPA and some experience, students from our department at times do not get a chance to get placed in such companies.

Another challenge is to convince companies about the capabilities of those with a B.Tech degree. There are many companies that feel that they aren't committed enough when it comes to placements and only look for those who have completed their masters. "Other departments face this problem too but this is especially true for our department. Also, many good companies want candidates who specialize in the field they are working in, so it is tough to convince them that a B.Tech candidate is equally competent".

The Team also feels that the enthusiasm among students themselves needs to increase. Most people don't start working seriously until the very end. Most of the placement related activities that organized a few months before the placement season don't see a lot of participation. "Placements are definitely not a place where one can afford to procrastinate. People realize this only around a month before the placements, by when they have already lost a lot of valuable time".

One of their biggest challenges was handling the placements during and after the Chennai floods that perfectly coincided with the placement season. "On the morning of 1st December we had all the timelines set and everything had to go according to what had been planned. To be honest we weren't expecting the situation to get that bad. Everything was fine until the power went down. Handling the impending chaos was one of the more difficult things we have had to do as part of our job as the Placement Team".

There was no network, no Wi-Fi, the LAN was down. The few Skype interviews that were supposed to happen could not take place in such a situation. Companies were still willing to continue with the interviews though – they had arranged candlelight interviews too! But they were also concerned about whether they could carry on with the placement activities if the climate continued to be non-conducive. They needed to ensure that the companies didn't leave. In that scenario, with most people without network coverage on dying phones, communication with the companies turned out to be a Herculean task. They had to let them know about the condition on campus, and though nothing could be said about the near future they tried to convince them that the situation would be brought under control. "Day 1 went on somehow, but yes the statistics did get affected due to the rains. Many of our department students who would have got placed easily on Day 1 got placed on later days. Apart from this the rains did not bother us too much".

Come rain or shine, we can rest assured that Placement Team does its best to help us fulfil our dreams. At the end of the day, it is the hard work put in by both them and the students that pays off.

STUDENTS

Shifting Modes - Academia to Industry

Praveen | Ph.D

Dr.Praveen is the Institute Best Research Scholar for the academic period 2014-15. He did his thesis on the topic "Mechanical Behaviour of High Entropy Alloys" under Dr. Ravi Shankar Kottada. He has also published papers in collaboration with Prof. B.S. Murty and Dr. Ravi Shankar Kottada, whose presentation has won two IIM Best Oral Presentation Awards. He hails from Tamil Nadu.

Which company are you placed in? What is the profile?

I am placed in Sundaram Fasteners Ltd. I am recruited for a program in their plant in Hosur. I will be joining as an Assistant Manager.

How was the overall placement experience? How did you apply for it and how was the interview?

I applied through placement website. It was my second interview that day. I had my first interview, for a company with a Technical Centre at Banglore and a plant at Pune, a couple of hours before. I got placed in both the companies and I chose between them. Had I chosen the other company I would have worked at the Technical Centre.

What role did the placement team play in the process?

I don't have a very good idea because PhD Placements didn't fall in their coverage. But I can see that they have put in a lot of effort. Only a few core companies come for the MME department. I hope they keep trying their best to improve that.

You have been in academia for a while now, with your MS and PhD. Is there any particular reason you chose to get a placement now?

I had chosen to do higher studies as soon as I was done with my undergraduate. Now, I have a very clear idea of how things work in academia. But before I go into post doctorate, I want to get a feel of the industry also. I would like to have an experience in the field maybe for two or three years . Then depending on whether or not I like it, I will either stay or go for a post-doc.

How has the department and institute changed you as a person over these years?

I joined IITM in 2009 for a MS degree, so I have been here for almost six years now. I can see a very drastic change in my communication skills and also in my personality. Since I have spent a long time here, I have also gotten quite attached to this place.

Is there anything you'd like to say to your juniors?

Well, I feel most of the undergraduate students regret that they've taken up Metallurgy and they mostly go for Financial or Marketing and other Non-Core jobs. But there is plenty of scope in the department! Now, there is a new excitement in functional materials and energy related materials. If they try to do their project in such fields, they have a good scope for interesting core jobs too!

STUDENTS

A Metallurgist in the Automotive Industry

Thinesh Kumar | M.Tech

Firstly, why did you opt for a core job as opposed to a non-core one?

I have been in this field for six years, four for my BTech, which I pursued in PSG, Coimabtore and 2 for my MTech which I am pursuing here. Even as an undergrad, I did not want to go for a non-core jobs. I'm not sure why, but after entering the field and reading, I got interested in metallurgy. It is quite fundamental- we can't survive without metals. I particularly like studying how metals behave.

How was the whole experience sitting for the interviews?

I have some experience in interviews, as I sat for a few in my undergrad itself. As expected, they asked from my project, mainly. They know you have some funda from your BTech itself and they want to know how you've applied that to your project. You need to help them in your manufacturing systems. Knowledge alone isn't enough to get good placements. Of course, it'll help you. But you collect most of your knowledge as an undergrad. These two years are to develop that, and apply that in the field, in real life. When I do a project, there should be some practical value to it. And my project matched with their needs, so they were interested and asked me almost exclusively from my project.

Tell us a bit about your company and why they recruited you.

I have joined Inteva Products. They manufacture automotive component manufacturers like motors. They are actually developing metallurgy now. They don't have any people who deal with metallurgy there. This is the first time they're recruiting metallurgists. They want to develop their Research and Development Section in metallurgy. They have two plants, one in Pune and one in Bangalore, and they want to develop facilities related to metallurgy like metal processing. I did my project in sheet metal forming. They are also working on sheet metal forming and plastics. I thought of my project as metallurgy related automotive manufacturing.

Why didn't you want to do a PhD?

As of now, I want to join a company and groom my profile. PhD means another four years of study. I am interested in working now.

How did you prepare for your placement interviews?

I knew that they would ask mainly from my project. I did it well and focused only on it. But as I had already studied for four years, I was confident knowledge to answer their questions. Seniors and others repeatedly drilled into me that for MTech placements, companies are really interested in your project, and as long as you answer well based on it, you will get placed well. I attended three interviews that day. All asked from my project.

How did the floods affect placements?

Yes, it hit us bad. Especially us metallurgy MTech students. For instance this company S and AM were supposed to come during December and we had even given them dates for that. Then we gave them a separate day in January. As they wanted to interview only Metallurgy MTech students, we were sure at least one student would get placed for sure. But later we found that they had finished their placements in December itself. Similarly, TATA Steel finished their placements early too, they took six students from Metallury MTech from IIT Bombay. We didn't even get a chance to appear for our interviews. So yes, it hit our department badly.

Were you nervous at all?

After hearing all this, yes. We were all nervous. But in December before the floods, we were confident. TATA Steel was coming, L&T was coming, TVS was coming, many more. We were confident that we would all get placed. Then TATA Steel rejected us first, even without interviewing. They shortlisted based on CGs.

Is there a difference between a Dual Degree student sitting for placement as compared to an MTech student?

Yes, to some level, because we have 6 years of experience as opposed to just 5, but it depends on the individual's capabilities. Another thought process seems to be the idea that dual degree students have procured both their degrees from IIT. For instance, some companies gave shortlists of students who got CGs of below 6.5 from IIT and did not shortlist students with CGs above 8.5 from other institutes. They claim that the job profile must match with only an NIT or IIT background.

Lastly, what do you think of the Metallurgy department of IIT Madras?

I had a great time here. The communication between us and the professors is really fast. Here, we can easily contact the professors and talk to them. They are also highly qualified and have better exposure, having done work in very good institutes inside India and around the world. So with their exposure and the resources here, I feel I have really improved my knowledge and skill set. There are also lots of labs and facilities that are available here like TEM, SEM, XRD. There are a lot of opportunities available here. We can also freely approach PhD scholars and get their help for our experiments. Here, we have the chance to show recruiters what differentiates us from others. Like we may know XRD and Stress Analysis and there are specific jobs for people with experience in those areas. So it helps to show our talents to the greatest extent.

STUDENTS

Getting into Reliance with Resilience

Teslin | Dual Degree

Hi, I'm Teslin a dual degree metallurgy student. I have gotten placed in Reliance. I'll try to share something useful to you all about my experience.

How were the placement days and interviews?

Our placements had two sessions due to the floods. The floods had a very serious impact on our placements. Having gone to all other IITs already the companies had already taken employees. The companies that came for core took very few people. I went to 4 interviews out of which I think three just took one person. It was pretty tough. In many of the companies we were competing against electrical, and physics. These companies were searching for an electrical background which made the competition tough for the metallurgy students sitting for placements. I was pretty tense because I had to sit in the rounds after the floods. We were unsure of our placements, but we had expectations that it would be difficult and prepared accordingly.

With many people nowadays going for non-core jobs, why did you choose core?

I was interested in metallurgy. Very interested actually. Right now I didn't want to start a career in research because I wasn't sure of which topic my interest was in. So I wanted to explore the Industry. I felt exposure to an R&D in the industries would also help if I wanted to pursue research. I felt I needed to take a break then figure out what exactly I want to do.

Would you advise a dual degree student to sit for placements?

It's based on the person's interests. As a dual degree students you'll be exposed to higher level courses which go deeper into the subject matter. Normally an interest in research might develop. Dual degree chances in placement are the same as any B.Tech student. In fact in core jobs being a dual degree student is an advantage. A little caution about some core companies. You might not get work in the field you are expecting. There might some manual work or product design which might not relate to what you have studied. There are good non-core job offers as well. Research is also very prospective. In my preparation for GATE, I noticed they test based basic B.Tech knowledge. Some simple math is also there. With a couple of previous year papers practice you can crack the GATE. It's all based on the person's interest there are ample opportunities no matter what you choose. Just keep your mind open to all options.

How did you prepare for your placement for interviews?

I only prepared for core interviews so I'll tell you a little about what I did. As far we have companies like Applied Materials, TATA steel, Reliance, etc. There are some interdisciplinary based companies as well. Companies like reliance and TATA steel ask questions mainly based on concepts in physical metallurgy. They ask about the kinds of steel, heat treatment, etc. Physical metallurgy is very important for placements. Applied Materials, since it's a semiconductor company will be a bit different. Courses like physics of materials, materials characterization and electronic devices (elective) are usual to brush up on. Check the company profile and while putting a resume highlight the courses you think they maybe looking for. Also the courses you highlight make sure to be well versed in them. For every placement there will an aptitude test. It should be simple for us. Our speed might decrease a little since our JEE days. We also tend to make mistakes in calculations. So it's a good idea to practice and revise these as well. Also it's a good idea to revise a few formulas from topics like permutations and combinations and compound interest, etc.

Last but not least, are you happy with your placement? What are your future plans?

Sometimes in placement you apply for multiple companies, and you get placed before you can even attend the interview for the company you wanted more. This happened to me. I'm still happy with my placement but I am a bit disappointed I couldn't sit for placement interviews of those I wanted. I'm slightly apprehensive about not having to do something involving my field of study.
As for my future plans, I intend on writing GATE to open up opportunities to apply for public sector companies. This will give more opportunities. In core it is likely to give better salaries and job security.

A Metallurgist from Neptun(us)

Vikram Raja | B.Tech

Climbing three flight of stairs and beating gravity, I knock on Vikram Raja's door to get some placement "fundaes". After exchanging a few jokes, I capture a bean bag.

Please tell me about yourself.

HI. I'm Vikram Raja, a B. Tech student, currently I'm studying in final semester.

Where have you been placed? What is the job profile?

I've been placed at Neptunus Power Plant. It's a core job. They are industry front runners in steam and gas engines. And the biggest copper alloy exporter in India. My role at the company is to provide technical solutions to the customers and increase their productivity. The company focuses on students with good technical background and are not branch specific.

In which years and where did you intern?

For metallurgy students, only steel companies like Tata Steel and Jindal Steel offer internships. The scope is very less. I did my summer internship at Tata Steel. I think my Tata internship helped me get the job. In my second summer I did an internship in SAIL – Steel Authority of India. I didn't do much; just managed the technical software for a blast furnace but it was great exposure. I was introduced to different furnaces, their working and application. Tata Steel came the following
summer to hire interns. After a test they called 3 out of some 20 applicants for an interview. After an exhausting one-hour interview, the interviewer asked me: "Your core knowledge is very good but your marks are very low. Why?" I told them I didn't study in my first year. I had a passion for engineering. Physics and Chemistry, I could not digest. My father is an electrical engineer so I wanted to be an electrical engineer. So I was a bit depressed. But my brother, who is also a metallurgical engineer, motivated me and later I started loving metallurgy. Actually, my father is working in a steel plant so I got enough exposure. The Tata Steel interview was very technical. I thought I didn't know much about metallurgy. But I answered everything and thumped it. I realised apart from knowledge from books you need exposure to industries.

"I realised apart from knowledge from books you need exposure to industries."
"You shouldn't lose hope"

Tell us about your placement interview.

There were about 98 people shortlisted. 56 for interview and the rest on the waiting list. It was a day 4 company offering a 10 lakh package. This was their first time in IIT Madras. They were asking question based on your resume and asked me about my Tata internship - what I did there, how I did it, what technology did I use, how was my experience, how was my R&D. They also asked a few other questions about engines and their company. When you're going for an interview you should know about the company, their history and their product. That's very essential. I had to explain the principles of one of their engine product

How was your 6th Semester?

This placement season was a terrible experience. Thanks to the Chennai floods. In our 6th semester we started preparing for placements. Companies conduct their first test in September and declare their results in Novemver end, one week before the interview. You need to be prepared. Between these companies tests there are quizzes and assignments apart from which there was intern viva, BTP viva and grand viva. Grand viva they ask you everything – all that you have learnt in 3 years. BTP viva is about your 7th Sem project and in intern viva you explain what you have done in your internship. These interview with professors is not always a good experience, especially if you haven't studied. On day 1 of placements I was called for an interview by a analytics company. I didn't know anything. I hadn't prepared any case studies. And I didn't get the job. Even today I'm glad I didn't get that job. On day 2, placements were postponed due to the floods. When placements resumed in January. I didn't sit for Day 3. I was preparing for my Day 4 companies.

What are your thoughts on placements?

You shouldn't lose hope. If you don't get a job here, you can try off campus. As far as I've seen people just want a job and a good package. If you aim for the best and never give up you will definitely get it. I like metallurgy. I worked hard to get a core job, and I did it.

What made you one of the few guys to get a core job?

I felt my industrial exposure helped me get my job. That is very important for a core company. If you get a 10-day vacation in your college life don't plan a journey, try to get exposure in a small scale industry. There are numerous such industries in Chennai. I have a decent industry exposure. I feel that practical knowledge is most important. Bookish knowledge is not that helpful. If you get a chance, do a research project with a professor. I didn't get a chance because my CG was low. So I tried to get industrial knowledge by doing field internships.

Lastly, what are your future plans?

I would like to study further definitely. Beyond that, I want to work in research organisation such as BARC, DRDO and give back to our country.

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ETCH

Edition 15.2

In Materials Science, etching is done to a observe a microstructure better. "To etch" is to bring out what is beneath and to see beyond what we can otherwise see. We, at Etch, believe in the same philosophy, when bringing out the best from the world of materials. The department of Metallurgical and Materials Engineering is one of the core departments of IIT Madras and is as old as the institute itself. The department is extremely diverse in terms of the research work done, the people involved and the culture, offering a lot for one to explore. Etch aims to grow into a medium that leaves no stone unturned in bringing out the diversity of the department.

Etch was rejuvenated a few years back when we decided to dig into our own backyard, and discovered amazing stories from the faculty, students, alumni and so much more. Starting out from a team of three students with a bi-annual magazine, the team has grown and we now have our website (https://mme.iitm.ac.in/etch/) where articles get updated regularly. We, at Etch, work with dedication to bring you the best of Metallurgical and Materials Engineering, hopefully inspiring everyone around, because one just has to look around to see everything's materials!

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