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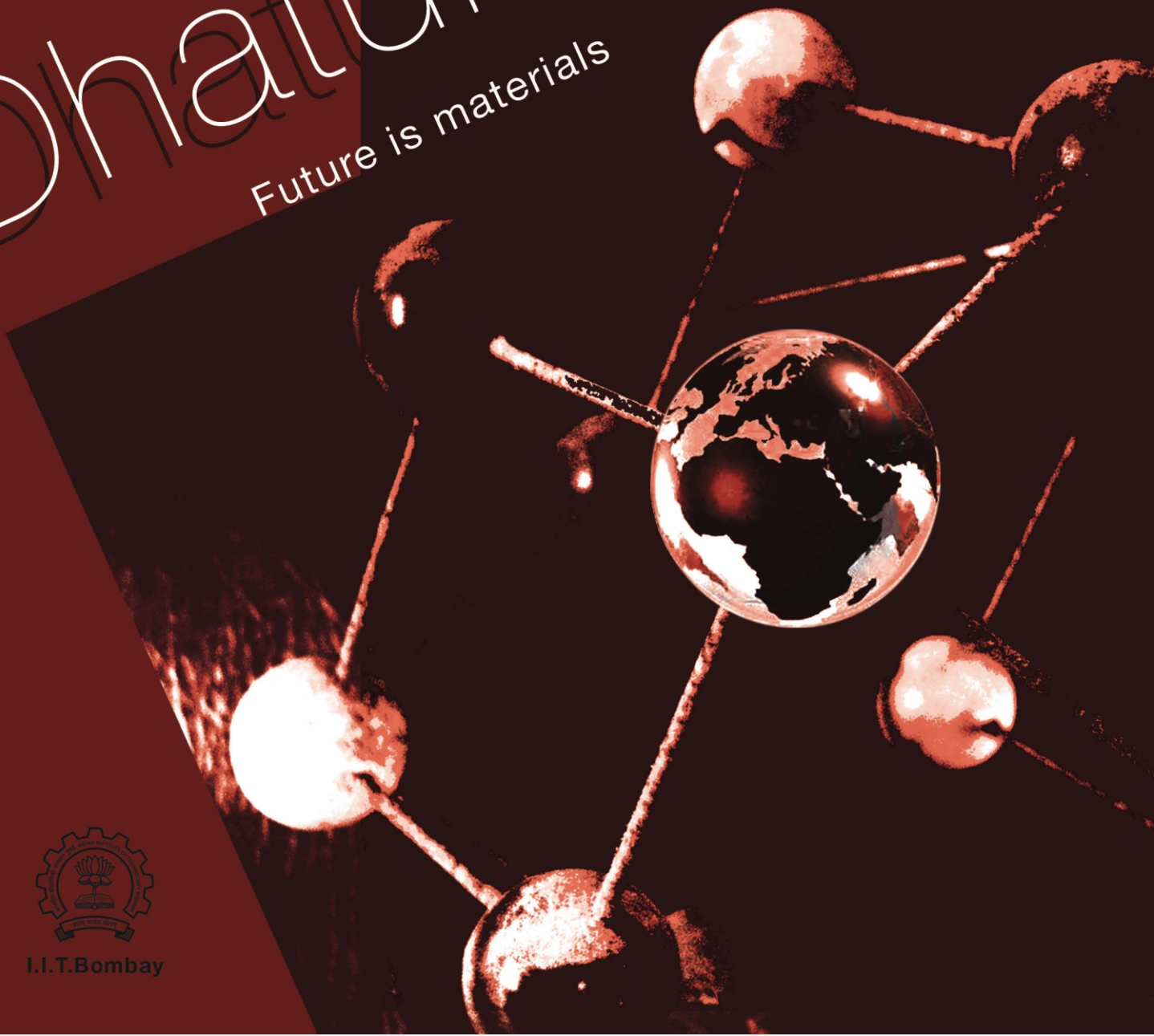
Metallurgical Engineering and Material Science

Dhatuki

Future is materials



I.I.T.Bombay

Inside This Issue

Message from the HOD

It gives me great pleasure to know that our students are bringing up a newsletter " DHATUKI " to reflect the spirit of the Department of metallurgical and materials science. This will help us all in knowing and evaluating our strengths and weakness from time to time to strive for better future of department . The challenges in the materials area have always been there and will remain so with continuing milestone achievements. The broader interactions amongst students ,faculty and staff through this magazine will help in generating enthusiasm to work together and solve impossible problems in materials processing , characterization and applications at every emerging stage of new technology. There exists ample opportunities for materials development and the department can collectively change its present status to be the one which will be known through its contributions at national and international levels in the basic and applied aspects of this wonderful area. Let everyone in the department be linked through such efforts by the students, so as to bring new and fascinating all round growth of the department . I hope the " DHATUKI "will be able to integrate all elements of the department to make them feel free to bring out best of them to have fun and love for our mission and vision of having most preferred department of current age.

The Editor speaks

The Department of Metallurgical Engg and Materials Science is one of the oldest and biggest departments of IIT Bombay. We have a glorious past and a promising future. To keep the entire meta family updated withwhatever is happening in the Department and to inspire greater interest and awareness about the global meta world , we felt the need to bring out a newsletter for the Department. A newsletter that was long due is finally shaping up .This being the first edition , errors are bound to creep in. So a sincere request from our side is to please bear with your editorial board. We would also like to acknowledge the constant support and suggestions that have been pouring in from all sides, be it the students or the faculty members. Also since this is your own newsletter , please feel free to chip in with your ideas and criticisms for making the newsletter better and more readable. Happy reading.

Everyone is a material scientist

Throughout the evolutional process of man, he has had access to only a certain amount of “things”. Branches which are wood, bones which are a kind of ceramic material, stones, and later on metals. Man has used whatever he has had with intelligence. For example, given a sharp piece of metal, no early man would use a bone for hunting. Looking through a smaller window of time, a child also has only some “things” readily available, and some “things” he wants. Your backyard will have scrap metal pieces and chunks of wood, whereas you'd definitely like some super-plastic clay there.

Let's say you want to build a toy tank to take on your friend's toy soldiers. (You always want such a tank, don't you?) You would never try to poke glass into iron blocks, rather you'd take some nails and stick them into blocks of wood and make it look like a tank. It always is WOODEN blocks and IRON nails. Why? As you grow up, you get your hands onto more “things”. You now have a certain sharp metal piece using which you can make your tank actually look like a tank. You'd never use a broken guitar string to shape your tank. Again, why?

You always go about deciding what is going to work and what is not. You choose a material at every step of evolution, at every step of your life. Who tells you? This is just your instinct at work. You somehow always know what material to use. No questions. No arguments. The keyword is INSTINCT.

The people who hold degrees in material science are no different, except for the fact that these guys go ahead and ask questions. A lot of questions. And then, they go about looking for answers. Since everything around us is made up of materials, these answers are critical for science, technology, and everyday life. However, these people have the same instinct that you have. These answers are just the scientific explanations of what the little birdie told you in your ear.

Today, the vast array of materials being used and the amount of new materials coming into the picture afford a huge number of questions for the material scientist. For example, the question for the material for a window glass is “Can you see through this?” whereas the question for a fiber optic cable material is “Can you see through a kilometer of this?” The answer comes from the material's structure and lab analysis results. The question for a table's material would invariably be “How strong is this?” On the other hand, a material for an aircraft shell poses the question “How strong can this be while being sufficiently lightweight?” The answer comes from properties and analysis of various individual metals and their alloys.

This game of questions and answers is just instinct applied at a much advanced level based on scientific knowledge. It is just that the people whom the rest of us call material scientists have a load of fun justifying that gut feeling of yours. When the answers come out, it sure feels right in the guts. With a more general lookout, the questions asked are that how can we understand more, how can we improve, and how can we make an impact on the world, making it a much better and safer place to live in. In essence, isn't this just the thing we all want to do?

Material scientists are no nerds poring over microstructures; they are just inquisitive, curious cats who love poking their noses into things, trying to find out answers to questions which life poses at them. And no, curiosity aint killing no cat here yet!

- Mohit Gidwani

Interview

Prof . Parag Bhargava

Prof Parag Bhargava the latest addition to the faculty list of our department , was a professor at IIT KGP for 7 years before joining IIT Bombay in Jan 2005. He graduated from Meta Dept,IITB in 1991 and went to US for his PhD. His areas of specialization are mainly ceramics/powder metallurgy and other research interests include processing, gel casting , rapid prototyping and many more. We had the pleasure to a tete about various issues pertaining to research in the department and also about future possibilities of research in the department . Here are a few experts from highly informative tete-a tete Chinmay Singh and Sumeet Malik had with prof. Parag Bhargava

Q. **What is it like being colleague to the same people who have once been your teacher?**
It feels really good to be back at this place. But you see things change with time. It's been about 15 years since I was a student here, now when I look at other professors, they are still my teachers but since I am in a profession, so professionalism comes in. So that feeling of teacher-student diminishes. But everybody in the dept. is very happy to see their student back.

Q. **What motivated you to go into teaching ? What was the deciding factor?**
After I went to US and completed my PhD., I felt like coming back to India. One of the options was to join some industry but that way my life would had been very mechanical and I couldn't have done the research work I would have liked to do. So I joined IIT Kharagpur as a faculty, this way I had freedom to do research and it is much more satisfying.

Q. **15 years is a long time. What changes do you see in the department during all these years?**
In our time it was just 'Metallurgical department' but now 'Material Sciences' has also been added, and that is really good because you guys get more interesting stuff and various fields to explore. The research areas in our department have also widened. People here are now working on various other things which were not there 15 years back. Many other things have also changed. Like in our times, the general trend was to go abroad. Right after final year most of my friends went to foreign Universities.. But now I feel that that trend has changed. Not many students apply for a PhD. or MS these days. The interests of students have changed a little. Now I even find students thinking of entrepreneurship right after they pass out. This was not common in our times. The other major difference I see is the number of events taking place in the institute. The cultural fest, techfest, sports events, so many things are happening all around now, it was all there back then but on a smaller scale. Now students' enthusiasm has increased a lot.
Lastly, there is also a big rise in the number of students in the department. We were like 30-35 and now your batch is of around 70!!!! So definitely student-teacher interaction has suffered. Like even if I wanted to remember names of all of you its very difficult and I could remember names of only those students who have either talked to me or have come to me for doubts.

Q **Generally, students of our dept. are very enthusiastic about doing summer projects and many sophomores and third year students would start approaching you for projects. What is it that you look for in a student when he comes to you for a project and how do you select him?**

This is a very relevant question. Mostly what I find is that students come to a professor because they want his recommendation and are usually not interested in the project they are doing. All they want is that they should be able to mention it in their CV. So I would prefer a student who shows some interest in the topic. Having interacted with him before would be even better because then I would know his interests.. Most important thing is that a student should have some focussed future plans. So, if a student wants to go into research and he tells me that, he would definitely get a chance. I generally do not care much about CPI, because I believe that it doesn't reflect upon the capability of a student. All it reflects is how well you have gone through your courses. Now, here also comes your problem of student intake in the department. Suppose 8 students approach me for projects, it is just not possible for me to guide each one of them on different topics and simultaneously carry on my work at the same time .You see we have got some administrative work also (smiles).

Q. What have been your experiences with the research that you have undertaken so far?

After PhD , I was involved with the processing of ceramics at Rutgers university. This was followed by a project on rapid prototyping which involved making of components for aerospace applications. Piezoelectric polymer composites came next. Back home , at IIT Kharagpur, I decided to work in some areas which were not capital intensive . So I worked on gel casting . This was a new technology which had just come up in the early 90's . So we did a lot of work where we modified gel casting process and we made many improvements to that process and we did some looking at rheology. . Most of the research we did was application oriented We managed to draw the attention of the industries as well . Now , the plan is to venture into newer territories in powder processing. As far as lab is concerned, powder metallurgy lab exists here and that is my area of research . So whatever project I am going to start , I am going to build the facilities as part of that lab. Our HOD , is also showing keen interest in getting the lab upgraded . The institute is also making monetary contribution towards the upgradation . .

Q. **Sir, the scene in our dept. lately has been that now most of the guys sitting for placements opt for software jobs or consultancies but not core companies. Do you think getting into a core company might help them? What advice do you give?**

The main thing is, whatever you do, you must have interest in it. Getting a core job in India is probably not that beneficial as the chances that come up your way are not many . But if you go for multinational core companies having big markets, it's a really good and a satisfying job provided you know what interests you. That's the key. Whatever you do, be it software or any or other job, you must have some liking for it.

"Still a Dream..."

BLACK WHITE

The Department of Metallurgical Engg and Materials Science is one of the oldest departments in the institute. The department has been producing eminent and distinguished alumni with clockwork regularity .Be it in the field of science and technology or management related jobs, our students have been setting benchmarks for others to follow .However, in the recent past it has been found that students are shying from entering into the field of research which should be the trend in an institute like IIT rather than the exception. We here try to present an insight into what are the pros and cons of going into the research areas relevant to the department.

Facilities ??: The most common complain the students have against research is the lack of proper incentives and facilities in the department. Lack of the best of instruments implies students developing a sense of frustration with the system and develop a natural distaste for research oriented jobs. Research oriented jobs generally require enormous investment of time and sometimes the facilities offered are really substandard thereby increasing the time needed. The combination of these factors can nip a student's enthusiasm in the bud.

Lure of the lucre: Well IITians are definitely getting money minded but they cannot be entirely blamed for this attitude .In this world of cut throat competition , its money that fuels growth and development. Research in India seldom translates to monetary growth .Another cause for the ever-growing disillusionment with research.

Isn't that why we are here in the first place?? First and foremost, the vision behind the starting of IIT's was to promote research and development in all possible arenas to ensure that the nation doesn't lag behind the others in scientific advancements and the evolution of technical knowhow. This objective should infact act as a spur for the students to work in this direction

Eureka Eureka!!: Putting efforts into research also gives a feeling of having achieved something substantial which serves a greater common good. It touches a relatively larger section of the society and lays the foundation for future work in that field. As far as the financial aspect goes , the department oriented research offers the lure of lucre. Researching into hitherto untouched areas like nanoparticles and carbon fibres can be highly rewarding financially besides providing a sense of satisfaction and achievement

Job Security : If you are someone pursuing your research in a country like the US , you are always aware of the fact that there is a job blanket to support you once you get over with the research .There are enough companies doling out incentives and more than willing to absorb you to further the research and development they intend to carry out.But in our country there is no job gurantee once you get

Re"search": One of the commonest cribs is that there are very few new research areas to work in the Department. Mostly students end up picking some old research or related fields where the groundwork already exists. This is followed by slight modifications and reframing. The end result is " the same old wine packaged in a new bottle". This dissuades students from going for research.

Intimidating ratio : The number of entrants through JEE has increased manifolds over the years . But the increase in the number of faculties hasn't been in line with this trend. End result is a highly disproportionate increase in the students is to teacher ratio. Lesser individual attention implies students not getting involved with the course to the extent desirable to propell him into the related fields.

We don't need no education :: The faculties are to an extent definitely justified in pointing out the waning interest of the students in the different department oriented courses as the bane of the problem. The "Baazar" notes - the time tested recipe for an instant success that the student grows up with during his formative years at the coaching centers means an initial refusal to take interest in the concepts. Initial lack of interest translates into disillusionment with research at a later stage .So it becomes really imperative that students display awareness towards whatever is happening in the field of material science and technology and take deeper interest in the subject matter .This will lead to a natural inclination towards research at an advanced level.

Plethora of options: Given the territories still unexplored in the field of metals and materials, this branch affords a student the chance to take a plunge into research and development. A common refrain is that the department does not afford much scope to indulge in research related activities and not much new development has taken place to inspire the students. What the students tend to comfortably ignore is the fact that it is upto them to take initiatives and put a foot forward in this direction. The field of Metallurgical Engg and Materials Science is so vast and unexplored that there is no dearth for research and development. Nanomaterials, carbonfibres, are just a few fields to name where the research is still in its infancy.

- Arunabh Sinha

Practical Training

I am here to ask you the same question which has been bugging me since the very day i entered the hallowed portals of IIT

Ohh !! so you are also facing the same dilemma. Well to be precise, PT stands for Practical Training.

What exactly does it entail?

It's a compulsory summer internship for engineering undergraduates generally at the End of third year. It gives you a feel of toying with the engineering gadgets .

And how much of my precious time will it take?

Roundabout 2 to 3 months is all it takes

Can I apply for a foreign PT somewhere out of the country?

Yes my friend , you can provided the insti validates your PT. Why even last year around 20 of your seniors went on a foreign PT.

Which should I go for - a foreign PT or " local" PT

Both come with their own benefits. Most importantly they give you the much needed first hand exposure to the working tools and working conditions prevalent in the industry.

What is the procedure to apply for the PT?

Well you need to keep your seniors happy for that :) .Also you must be prepared to keep spamming an infi no. of profs and industries .Keep a resume handy .For that again you need to keep your senior pleased and get a ready made format. Most importantly For a foreign PT keep praying to God b'cos luck does matter a lot in that case.

My low cpi .. will it act as a barrier ?

No , not at all. cpi doesn't count

So many questions are still wracking my brain and you already look So impatient.

Well , you are now getting on my nerves dear. Go and contact any senior with whom you are on good terms. There are so many questions that need to be answered and I'm really constrained for time. Afterall I 'm a senior you see :) But since you are pestering me then here you go !! Here is a detailed info regarding PT.

Detailed info regarding

Come September and one can see all the third year student hooked on to their computers searching every nook and corner of the web world in search of ...???Any guesses ...
Yes , the obvious answer is PT's .These two letters hold a very significant place in the career of any successful engineer .
The 7-8 week long Summer Internship or Practical Training (PT for short) at the end of 6th semester provides the first exposure to students to put their acquired bookish knowledge to ultimate test - to face the practical challenges faced by the industry .
Here comes the opportunity for the so called intellectual cream of the society to wield the magic of their brains to solve real life problems.
Now let us come to the scene of the department in this arena. Well to be frank our department has an innumerable vistas for PT, perhaps more than that of any other department. The Material Sciences and Engineering field has some of the highest capital sponsored projects .It is perhaps one of the most abundantly funded department nowadays and this can be judged by the following fact. If in completing the credits of Masters Degree from any university and for that matter any discipline whatsoever one falls short of funds then the best option is to take up courses from Material Sciences because they are deemed to be one of the most sponsored areas.

PT's after third year can broadly be classified under two categories:-
*__Industrial Training__ (This is a rigorous exposure to the industry related to the department e.g. The Iron & Steel Industry, Ceramic Industry Chip Manufacturing and related industries.
*__PT's or rather projects under professors__ . Interestingly, CPI is not a constraint for getting a good PT... Its more or less a matter of chance.

Industrial Training

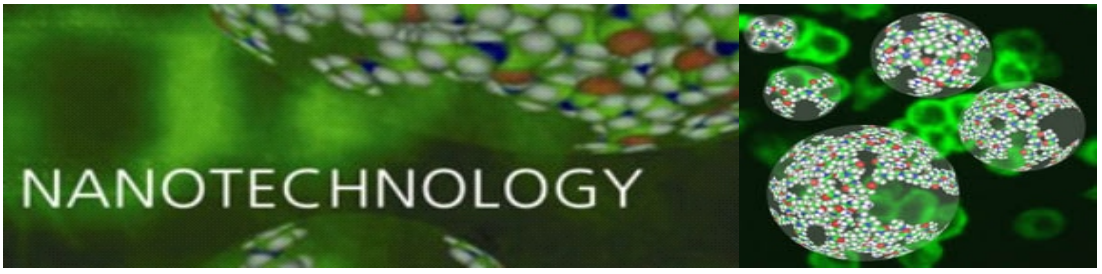
There are some good flourishing industries in India that one can apply in are
General Electronic , Delphi, Kalyani, Bhel Toyota, The steel Plants of India and Bharat ISPAT .
For abroad there is a large number of industries thriving in Northern Europe (Finland, Sweden etc.) due to their highly favorable climate for producing the finest and ultra pure steels . European Industries accept Indian students quite easily and they are also paid around 40 Euros or as per the norms of the respective governments. Autocompu is also a very prominent layer in the iron and steel industry of Europe . Daniel Lee one of the best companies of Europe has a lot to offer .It is also expected to recruit students from IIT Bombay in the coming placement season.
On the other hand PT's or Projects under professors from various reputed institutions

Can easily be scored . One just needs to find a suitable professor having the right project at the right time . In this case too an ample number of opportunities exist in India as well as abroad. Indian institutes of high stature like IISc Bangalore ,TIFR Mumbai , BARC also take students for summer training.
For applying abroad there are a lot of universities in Australia, Canada ,Singapore etc. These days students are lured a lot to go abroad to do their PT's but the point is that Indian Institutes have a lot to offer academically too as opposed to the popular belief. Though the amount of stipend may not be too high but still the quality of experience one gets is at par with that gained from abroad.

Summer Training for Sophomores

Earlier Pts were considered only to be the piece of cake for third year students but now the scenario has changed .Sophomores can also get Pts after their 4^{th} semester .The point to be taken care of is that the department recognizes only 4 weeks of training not more Than that. If the Training extends beyond 4 weeks then that extra period of training is declared to be null and void. The other point is that Pts are generally not funded in the second year so one has to incur his own expenses unlike that after third year.
But nevertheless after the second year too there are quite a lot of avenues open like Software based projects, Banking Sector, getting project (socio-economic projects) under professors from management colleges like IIMs etc. The whole motive should be to make the best possible productive and fruitful usage of the summer vacations .Here again the CPI does not play a crucial role too as it is rather a matter of chance and your know how in the market fraternity.
One point that needs to be taken care of while applying is that the RESUME should be written very professionally .It should not be exaggerated and sound unrealistic .It should try to impress upon the reader ones qualities in a convincing yet a modest manner.
COMMENTS n QUOTES :-
Raghav Goel,
Kaustubh Nadkarni,
Mandar Gadre,
Anirikh Chakrabarty

- Anubhav Verma
Vishwas Arora



If we calculate the number of scientific research publications a country produces per Gross Domestic Product (GDP) per capita per year, the top three nations are India (31.7), China (23.32) and the US (7.0). The opportunity to do cutting edge research in India has increased many fold compared to what it was a few decades back. The latest Intel chip and the latest GE aeroengine are being designed in Bangalore, For example. Indian pharmaceutical industries have increased their R&D spending by 400% in vThe past 4 years and they are now looking to hire hundreds of Ph.D's. Rather than just copying the drug molecules by others, the R&D programs of these industries now are trying to create new therapeutic molecules.
Today, Nanotechnology the buzz word revolutionizing the minds of young researchers- already has significant applications and commercial impact, a projected worldwide market size of over

$1trillion annually in the next 10 to 15 years. The term “Nanotechnology” is used to describe an interdisciplinary field wherein the critical dimensions of materials, devices, and systems are in nanometer (10^{-9} m) scale. At the nanoscale, all streams of science converge towards the same principles and tools.

Coming to Nanocomposites and Nanoelectronics, they will yield lighter, safer, and more fuel-efficient stable materials for aircrafts, rockets and exploratory platforms. For high-efficient fuel cells including hydrogen storage in carbon nanotubes, to removal of ultra-fine fuel contaminants using mesoporous molecular sieves, nanotechnology will enable more efficient storage and utilization of energy and reduce carbon emission

The discovery of nanotubes has greatly stimulated the interests of scientists and engineers. Carbon Nanotubes (CNTs) were first discovered by Iijina and coworkers in 1991 during the course of their work on fullerenes. These tubes contain one or more graphite-like concentric layers with diameters in the range of 0.4 to tens of nanometers.
Carbon nanotubes are characterized by their surprising strength that is 5-200 times that of steel. Their electrical conductivity is more than that of copper and heat conductivity greater than that of diamond. Moreover, they are resistant to extreme heat and are lighter than aluminum. CNT's possess superior field emitting properties. Due to their unique properties , a large number of groups all over the world are working on the development of CNT's for diverse applications.
The discovery of fullerene, containing 60 carbon atoms can be compared to a soccer ball that has 60 vertices and 32 patches, in which 20 hexagonal and 12 pentagonal in shape, led to the search for other structures having C60 as the base unit. CNT is an extended version of fullerene and can be considered a one dimensional fullerene molecule because of its high aspect ratio (length to diameter ratio~1000). In structure, the carbon nanotubes is like a graphite sheet, rolled into a tube. A single walled carbon nanotube consists of one rolled graphene sheet, whereas multi-walled nanotubes are made up of concentric cylinders, with spacing between the layers close to that of the interlayer distance between the graphene sheets. The C-C bonds are shorter than the bonds in diamond, indicating that the material is stronger than

Composites and polymers: With tensile strength 20 times and strength-to-weight ratio 100 times that of steel, CNTs can be the ultimate high-strength fiber (Young's modulus around 1TPA) for futuristic manufacturing. Carbon fibers have been used as reinforcement in high strength , light weight , high performance composites; one can typically find these in products ranging from expensive tennis rackets to spacecraft, aircraft, and automobile bodies. CNTs have been used to reinforce composite materials, polymers and concrete. NASA has recently invested large amounts of money in developing carbon nanotube-based composites for the Mars mission. Real time monitoring of material intefrity and quality may be possible by incorporating CNTs in concrete and plastics. General Motors has pioneered the use of nanotubes in plastics for their cars. Other potential applications include light weight bullet-proof vests, earthquake-resistant buildings and elements for bridges.
Type of CNT is still not possible. Large scale production is not economical. Heavy investments have been made by countries, especially in the area of electronic devices, and hopefully we will soon see more products that utilize CNTs The Nanotechnology Center at IIT Bombay aims at developing various technologies in the MEMS and NEMS arena

with Nanomaterials, Nano-electronics and Nano-Biotechnology being the chief targets.
We have already discussed the aspects of CNTs which is another interesting and the most potential area of research. IIT Bombay is involved in developing therapeutic biocompatible nanoparticles for treatment, use of nanoparticles as drug delivery agents. Other areas include the work on nanocomposites for dental and maxillofacial (relating to the upper jaw and face) use and for bone replacement. At IIT Bombay, the frontiers for research in nanotechnology are now wide open. The breadth of research, coupled with facilities available, make for an interesting mix, and significant research is expected.

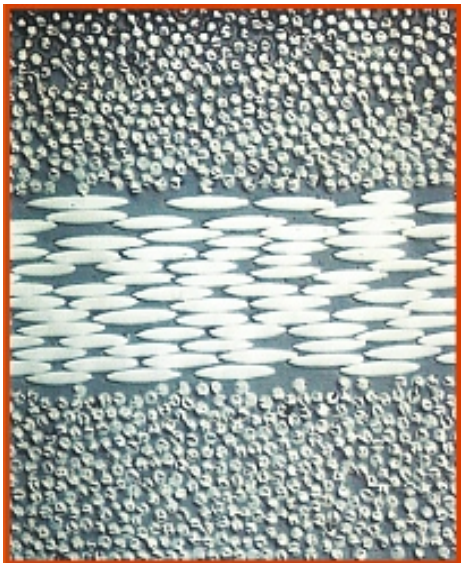
Presently some Nanotechnology work going on in department :-

1. Nanostructured magnetic materials
2. Ferrofluid for hyperthermia , drug delivery, and bio medical applications
3. Magnetic Nanoparicles for bio sensing applications
4. Colossal magnetoresistive oxides (CMR)
5. Magnetic nanocomposites
6. Magnetic recording materials
7. Magneto photonic materials

- Raghav Goel

A Case for Carbon

We live in a world obsessed with weight loss. And we're not just talking about people. It's a known fact that lighter devices make for a more efficient, compact and portable world. Enter Carbon fibres. While we might associate carbon with diamonds, this distant cousin has being making brilliant breakthroughs possible thanks to its combination of light weight and superior strength. From Micheal Schumacher to Andy Roddick, all have been at the top of their game thanks to carbon fibre.
Well, what is carbon fibre? It is defined as "Fine, black, silky, continuous filament of pure carbon (around 92%) produced by heating organic fibres, such as cellulose, in an inert atmosphere". Carbon Fibres are generally used to make composites, as they are the stiffest and strongest reinforcing fibres for polymer composites, the most used after glass fibres .In its most basic form a composite material is one which is composed of at least two elements al working together to produce material Properties that are different to the properties of those elements on their own. Carbon fibre composites fall under the category of Polymer Matrix Composites (PMC's).

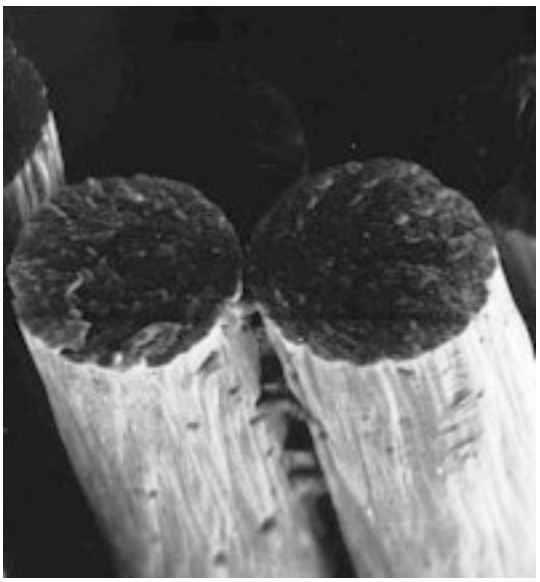


Carbon fibre composite is a strong, light material. It has many applications in aerospace and automotive fields, and notably in modern bicycles, where these qualities are of importance. Its hard to imagine Lance Armstrong winning the Tour'de France 7 times without his custom designed carbon fibre bike. It is becoming increasingly common in small consumer goods as well, such as laptops, tripods, and fishing rods.

Better still, even though there is a significant weight loss, there is no strength loss at all, and in fact crash properties of this material are outstanding. When there's a crash in a metal vehicle the crash structures bend and buckle causing a really strong force on the driver or the passenger. These materials don't buckle and therefore you get less whiplash of you're the driver or the passenger in a car. Moreover, ageing studies conducted on painted panels have shown that they perform better over time. Rust may indeed be a thing of the past.

But before you rush out to fly off on composite wings, hang on. These dreams don't come cheap. With a cost approximately equivalent to five times the cost of steel, you have to shell out that extra buck for that extra bang. Not to mention, that the process is still extremely man-power intensive, leading to more time-costs. Research is still underway for a cheaper, large-scale manufacturing process.

Nowadays, a newer process of manufacturing has been developed called the 'quickstep process. Which was invented and developed in Australia? The way it works is using fluid to heat up the composite and cook it, rather than using a gas. If you have an oven at 2000 C you can stick your arm in there for quite a while without getting burnt, you would never do that with vat of oil at 200C. That's how the quickstep process works. It uses a fluid and it's much more efficient, you have much faster



This process takes minutes; whereas previously it would take hours to make. These and other new discoveries are paving the way for a newer, lighter and more dynamic world. The world may currently be in a Silicon state of mind but watch out for the new wave -- Carbon Fibre.

- Roopali Kukreja & Rajlakshmi Purkayastha

History Of Iron & Steel

For the want of a nail, a shoe was lost;
for the want of a shoe, a horse was lost;
for the want of a horse, a rider was lost;
for the want of a rider, a battle was lost;
for the want of a battle, a kingdom was lost,
and all for the want of a horse shoe nail.

So it all ultimately boils down to iron and steel . Look around yourself and there is iron and steel everywhere . The history of iron is as old as the universe itself Steel plays a vital role in the development of any modern economy. The per capita consumption of steel is generally accepted as a yardstick to measure the level of socio-economic development and living standards of the people. As such, no developing country can afford to ignore the steel industry.

The history of steel-making in India can . be traced back to 400 BC when the Greek emperors used to recruit Indian archers for their army who used arrows tipped with steel. Many more evidences are there of Indians' perfect knowledge of steel-making long before the advent of Christ .However , there are certain definite proofs that iron and steel was made in the southern India in 200 AD by the crucible technique. In this system, high-purity wrought iron, charcoal, and glass were mixed in crucibles and heated until the iron melted and absorbed the carbon. The resulting high-carbon steel, called (pulâd) in Persian and wootz by later Europeans, was exported throughout much of Asia. For the sake of information , the first serious attempt at reviving the production of iron in India was made around 1830's by a Briton but the results were far too discouraging to continue further . It was 1874 , when another revival was started with the arrival of Bengal Iron Works near Asansol which was ultimately taken over by IISCO.

For modern India's iron and steel industry August 27, 1907 was a red-letter day when the Tata Iron and Steel Company (TISCO) was formed as a Swadeshi venture to produce 120,000 tonnes of pig iron. And then , there was simply no looking back . India was finally self reliant and the Tatas had done the greatest service to their motherland.

Gandhi was magnanimous in his praise of the Tatas admitting that they represented "the spirit of adventure" . Though it had a precarious childhood , the first world war gave the industry a great fillip. Thereafter the industry had to face stiff resistance from their European counterparts . This was coupled with the rather hostile attitude of the Britishers who wanted to nip its progress in the bud. But the resilience of the Indians held strong and the iron and steel industries cropped up in different parts of the country ; notable ones being at Mysore and the IISCO plant at Burnpur.

Post independence, the Government ensured the starting of iron and steel Industries in all parts of the nation with steel plants coming up at Durgapur , Bhilai and Rourkela.As a matter of fact, the country was dotted with steel and steel-related plants in public and private sectors,

like Alloy Steel Plant, Salem Steel Plant, Kalinga Iron Works, Malavika Steel Ltd., Jindal Vijaynagar Steel Ltd., to name only a few. About the same time TISCO launched its two-million-tonne expansion programme. This rapid "iron and steelisation" has helped India climb up the ladder .The end resut is there for everyone to see. We are amongst the leading producers of steel in the world.

The redeeming feature is the cost competitiveness of Indian steel in the global market. According to World Steel Dynamics, the total cost of steel production in the USA is $510 per metric tonne while in Japan it is $550, in Germany $557, in Canada $493 and in India It is $497 .This is because of high material cost due to high excise and import duties. Reduction of cost on these accounts will make Indian steel more competitive in the world market. Indian steel can reasonably expect a good market in the neighbouring countries now that the Asian economy is looking up.

In conclusion, it can be said with a certain measure of confidence that India's iron and steel industry which had a glorious past and has an uncertain present may now look forward to a bright future.

Arunabh Sinha

Message from Seniors to Juniors

"Spirit of Meta" ? Why is that the department has become dull? Are we talking of the ***"Spirit of Meta"?,*** precisely not. What is questionable is the ability, the strength and the imagination. Why not My Department? We can go frenzy with the imagination We keep looking for shortcuts like software where money comes real quick. We have lost our foresight and have become myopic, thinking only of the next few months. We swerve from what our primary purpose is. Some may say, I took up this department because of my JEE rank, or some may say this was the only option for Bombay. Now that you are there , what are you then going to do with it? Let your four years go over a serpentine path, without a goal ?. Have we ever given a thought as to why have we never produced a scientist from IIT with a Nobel Prize? Don't question the talent pool (! :D)

For the freshies and the sophies ,firstly, welcome to your department. Bring in a new light,a new hope . Foresee and contribute to this department. Imagine what 70 brilliant people sitting in a classroom, in one place can do . It all lies upto you. Get to know your department, what kind and what level of research is going on, which professor is doing what, where is it that you can contribute? Resume, credentials and lukhhagiri is what you need to keep off your mind.(though the last one might not be a piece of cake). If you can think outside this realm then you are surely on the Right path. Think of how you can mould yourself as to how can you develop your skills(as the time is too short, you will not know how your time here passed by)... Taking up a project under a professor is what goes in everybody's mind. There is no problem in it but are you conscious about the word project.? Is it necessary to take a project (again don't look for credentials)) or I can also pick up a problem statement and do the same, learning more from my latter choice.

So we would like to emphasize the fact that its not taking up a project / assignment just for the sake of it. What finally counts is the time and efforts that one puts in his project .If you are really sincere about your job, it automatically gets noticed by one and all. You no longer need to seek recos .They are there for the taking. Do not be mislead vainly working for credentials but rather actually work hard to earn them. Enjoy your life @meta.iitb.

- Raghav Goel

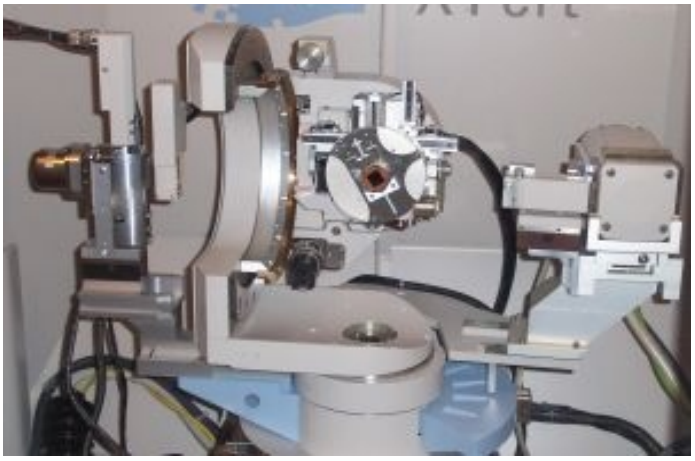
Orientation Imaging Microscopy & X-RAy Bulk Texture Lab

In this section we are going to introduce the laboratory facilities available in our department. We begin with the prestigious National Facility of "Orientation Imaging Microscopy and X-Ray Bulk Texture Lab." Prof. N.B. Ballal is the principal investigator and Associate Prof. I. Samajdar is the co-investigator of this lab. Dr. S.L. Kamath is TA and Dr. V. Pancholi and Rajesh Khatirkar (PhD. student) are the Research Associates in the lab.

In any crystalline material, three microstructural features are of critical importance grain or phase size, shape and orientation. In polycrystalline solid materials, such as a wide class of metals and ceramics, the orientation of the crystallites is not usually distributed randomly, like in an ideal powder specimen. In most cases, a preferred orientation of the crystallites with respect to the sample reference frame is present. In materials science this is referred to as texture.

Knowledge of the texture is important factor in understanding the mechanical, physical or chemical behavior of the material investigated. Global or bulk as well as local texture measurement is of critical importance.

Based on the principle of X-ray diffraction (Bragg's law: në = 2dsinè), a wealth of structural physical and chemical information about the material investigated can be obtained.Plotting the angular positions and intensities of the resultant diffracted peaks of radiation produces a pattern, which is characteristic of the sample. Where a mixture of different phases is present, the resultant diffractogram is formed by addition of the individual patterns.



PANalytical MRD System for Bulk Texture and Residual Stress Measurement and Fei Qunata 200 HV SEM with TSL-EDX OIM system for the microtexture measurement were bought about 1.5 years ago by the department. The cost of the PANalytical MRD system was about 70 lakh rupees.

- Shruti & Mudrika

Research

Currently , our Department's principal areas of research are :

!Prof. D Bahadur

* Novel Synthetic methods (self combustion process , Microwave Refluxing , Sol-gel, Microemulsion , Mechanical alloy etc.)

Prof . Om Prakash

* Synthesis and Characterization of nano to micron sized powders of magnetic, dielectric & superconducting materials.

Prof . N N Vishwanathan

* Modelling of Blast Furnace

Prof. Arup Bhattacharya

* Polymer Blends, Polymer Nanocomposites

Prof. B. T Rao

* Chemical Characterization of Materials, Advanced Ceramics(Bioceramics-hydroxy appetite, nonmetallic systems like zirconia, alumina)

Prof. A.R Kulkarni

* Materials for sensors.

Prof. K.Narasimhan

*Prediction of forming behavior and experimentally validating it.

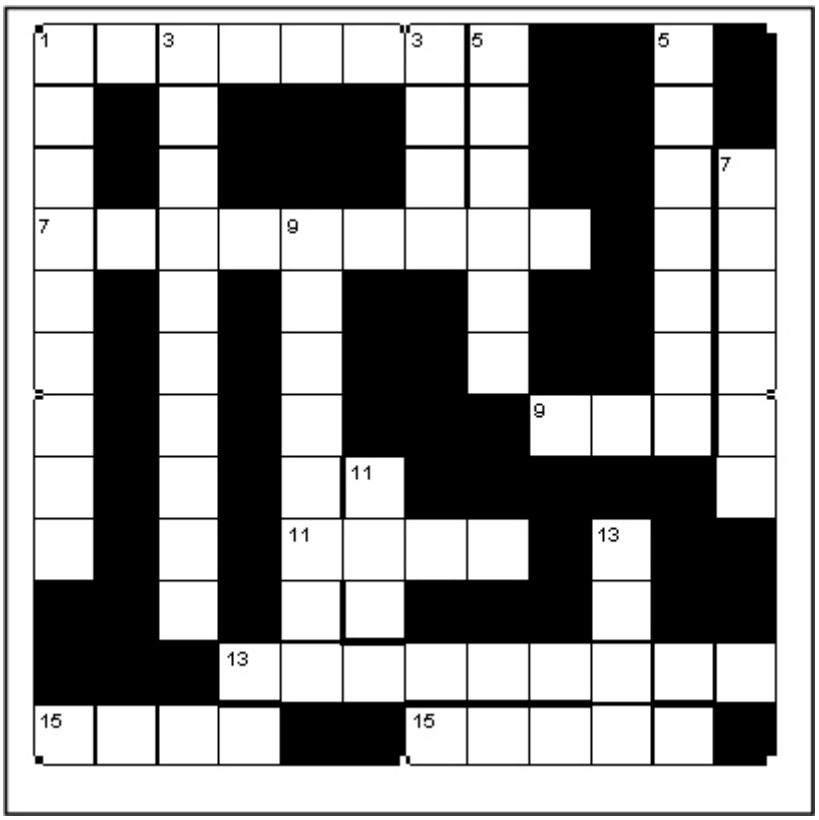
*Major Project(funded by Govt of India-joint venture of Prosim bangaloreand ARCI Hyderabad) the project is to develop expertise of the two technologies : hydroforming and use of Taylor Welded Blanks(TYB) for Tata motors and Mahindra and Mahindra.

Awards

AND the Honour goes to

Mr. Aditya Prakash, Dual Degree student of our Department has been awarded the K. Suryanarayan Rau Memorial Junior Student Award 2005 for Research and Development in Smart Technology from the Indian Society for Advancement of Materials and Processing Engineering, Bangalore, for his contributions in the development of piezoresistive nano-Si: H thin film for various sensor applications. Mr. Aditya Prakash worked on this problem as his DD project with Prof. R.O. Dusane.

Shruti
Upadhi
Sindhura
Subhash Mali



ACROSS

1 (3-4) an intermediate enclosed chamber through which an object may be passed without materially changing the vacuum or pressure of the system.

7 (9) a unit cell having 3 axes of any length with none of the included angles being equal or 90 degrees.

9 (3) a metal form used as permanent mold for die casting.

11 (4) the bottom half of a horizontally parted mold.

13 (9) a polymer chain configuration with all side groups on the same side of the chain molecule.

14 (4) any group of crystal planes that are all parallel to one line.

15 (5) time dependent permanent deformation under stress.

DOWN

1 (9) face centred cubic iron.

2 (10) tendency of a material to return to its original shape after the removal of a stress that has produced elastic strain.

3 (4) furnace in which ceramics are fired

4 (6) a high temperature heat treatment that increases the strength and density of a ceramic piece.

5 (7) an austenitic transformation product with microstructure containing alpha-ferrite and fine dispersion of cementite.

6 (6) continous phase ina composite or 2-phase alloy structure in which a second phase is dispersed.

8 (8) the lowest temperature at which a metal or alloy is completely liquid.

10 (3) a natural mineral mined and treated for the extraction of its components.

12 (4) the portion of the runner where the molten metal enters the mold cavity.

- Sindhura & Shruti

Team Dhatuki

Incharge Newsletter	Sumeet Malik
Chief Editor	Arunabh Sinha
Executive Editors	Sumeet Malik and Mohit Gidwani
The Design Team	Varun Verma(Front Page), Gaurav Vijh and Sumeet Malik
Cartoonist	Ankur Joshi
Editorial Board	Chinmay Singh , Upadhi Kabra,Shruti Thombare, Subhash Mali, Sindhura Gangireddy, Vaibhav Vishal Mudrika Khandelwal ,Palak Ambwani , Roopali Kukreja, Rajlakshmi Purkayastha , Vishwas Arora, Manshu Bansal , Akash Agrawal Anubhav Verma

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Feel Free to send your suggestion , ideas and criticisms for making the newsletter better and more interesting to any of the following

Dhatuki dhatuki@met.iitb.ac.in
Sumeet Malik smalik@iitb.ac.in
Arunabh Sinha arunabhsinha@iitb.ac.in

Metallurgical and Material science Department
IIT , Bombay