SFA Mumbai Chapter

Newsletter

PHCET
PILLAI HOC COLLEGE OF ENGINEERING & TECHNOLOGY

February 2023

http:// www.sfa.mes.ac.in

PILLAI HOC COLLEGE OF ENGINEERING & TECHNOLOGY RASAYANI

News at a Glance

- From the editor's desk
- MES Celebrated Golden Jubilee under the leadership of Dr. K. M. Vasudevan Pillai, Founder Chairman & CEO of MES & Dr.Daphne Pillai, Secretary MES

Dr. K. M. Vasudevan Pillai
Chairman & C. E. O
Mahatma Education Society

Dr. Daphne Pillai
Secretary
Mahatma Education Society

- Fracture & Fractography of Glass and 3D printed Thermoplastics using ESEM to determine root cause of product failure.
- Fractography of Materials using SEM & FESEM
- News and Views
- Forthcoming Events

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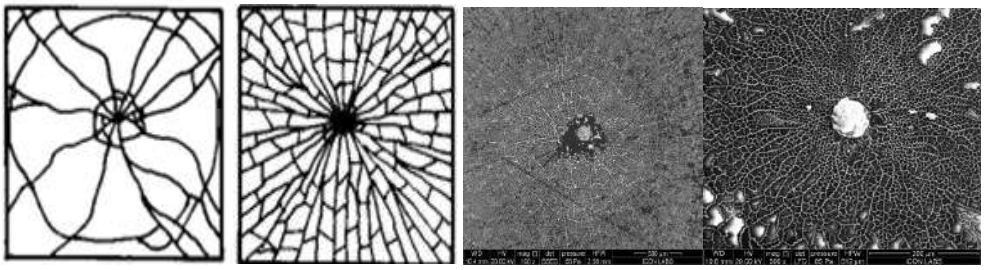
From Editor's Desk

Fractography is not taught in the course curriculum of colleges and higher engineering institutes. As a result of this engineers and scientists don't become familiar to the fascinating subject of Fractography. It involves gathering background information about design, materials selection, processing & assembly. The knowledge of material science and fracture mechanics is needed for the Failure Modes & Effects Analysis (Fishbone analysis). ASTM standard 1322 describes it "as a means and methods of characterising fractured specimens or coupons". It is considered a valuable tool for analysing failures of engineering components that eat 4% of the GDP of a developing country. Everyday millions of components in different sectors of industries fail, but only a fraction of it is analysed fractographically to find the root cause and failure modes and effect analysis that are commonly referred to as Fish Bone Analysis. Flaw type and its location are as important as stress conditions (Plane stress/Plane strain) that are responsible for the mechanisms of the fracture. It has to be borne in mind that cracks propagate in response to stresses and strains and therefore Fractography comes as a natural corollary to scientists and engineers. With a little practice engineers and scientists can be trained to analyse and interpret fractures of ductile and brittle materials. In this issue of the newsletter the Fractography of brittle materials like glass and 3D printed thermoplastics are illustrated. Terms like mirror, mist and hackle used for glasses are different than for ductile materials. Hackle lines are referred to steps or lines on the fractured surface running parallel to the direction of crack propagation. The fracture surface of 3D printed thermoplastics shows layer upon layer printing, voids and brittle fracture of rasters that should not be confused with striations in fatigue failure of ductile materials.

A typical plate & window fracture pattern available in open literature and the actual surface fracture of glass is depicted below.



A good starting point for the students, scientists and engineers is to gain experience by examining their test samples and coupons using conventional & Environmental SEMs. Skill and experience gained at this stage will help them to conduct failure analyses of components for different sectors of industries. ASTM and European commission for standardization emphasise on Fractography analyses to solve mystery of fracture. This involves not just looking at fracture surfaces but integrating knowledge of different disciplines to ascertain the root cause of failures and suggest methods to prevent them

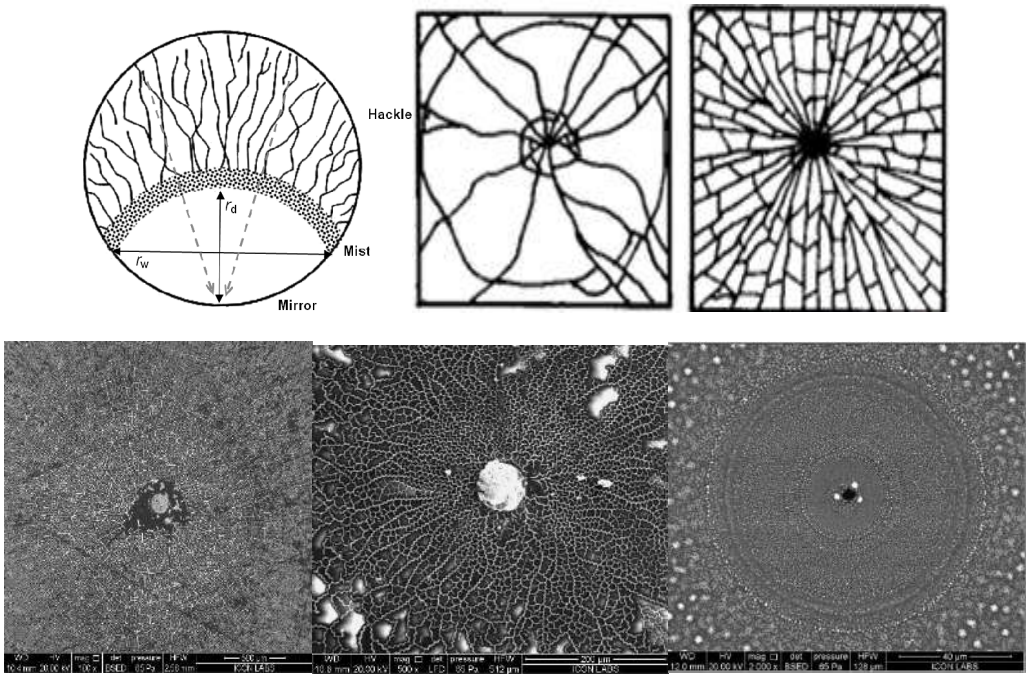
LET US LOOK FAILURE ANALYSIS THROUGH THE LENS OF RESEARCH, INNOVATION & ENTERPRENURESHIP

Fractography of Materials using SEM & FESEM

Dr. R.C. Prasad, Former HAG Professor IIT Bombay,
President IIC@PHCET & Professor, Department of Mechanical Engineering PHCET, Rasayani

Fractography of Glasses

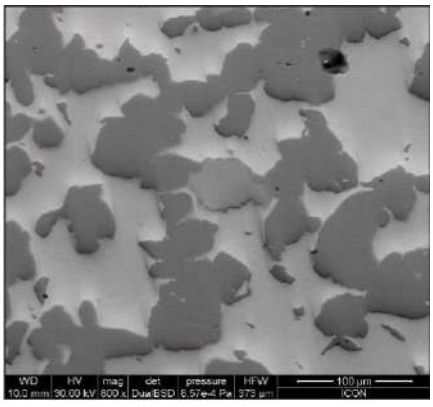
Terms like mirror, mist and hackle used for glasses are different than for ductile materials. Hackle lines are referred to steps or lines on the fractured surface running parallel to the direction of crack propagation. A typical plate & window fracture pattern available in open literature and the actual surface fracture of glass are depicted below.



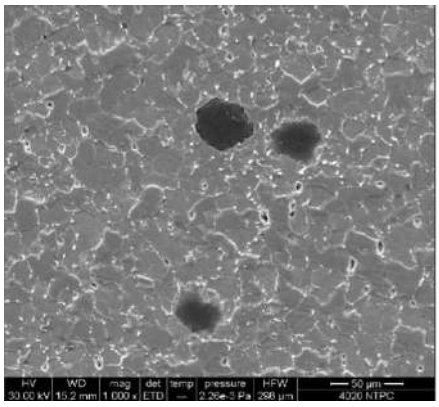
Typical fractured surface of Glass showing mirror, mist & hackles

Metallography and Fractography of Metallic Materials

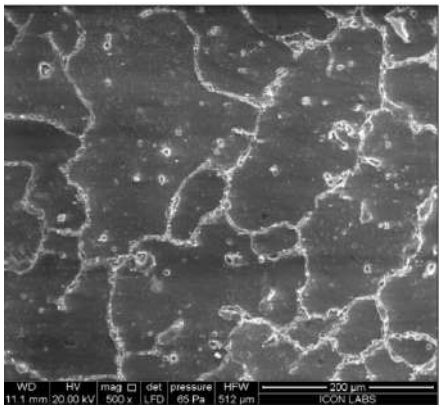
Traditionally microstructures of metallic materials seen at high magnification in optical microscope constitute of phases, inclusions, and defects. SEM has higher resolution and large depth of focus. It is widely used for identification of phases, inclusions, and defects. Some of the SEM micrographs taken are shown below:



Backscattered image showing atomic no. contrast of Cu & Zn

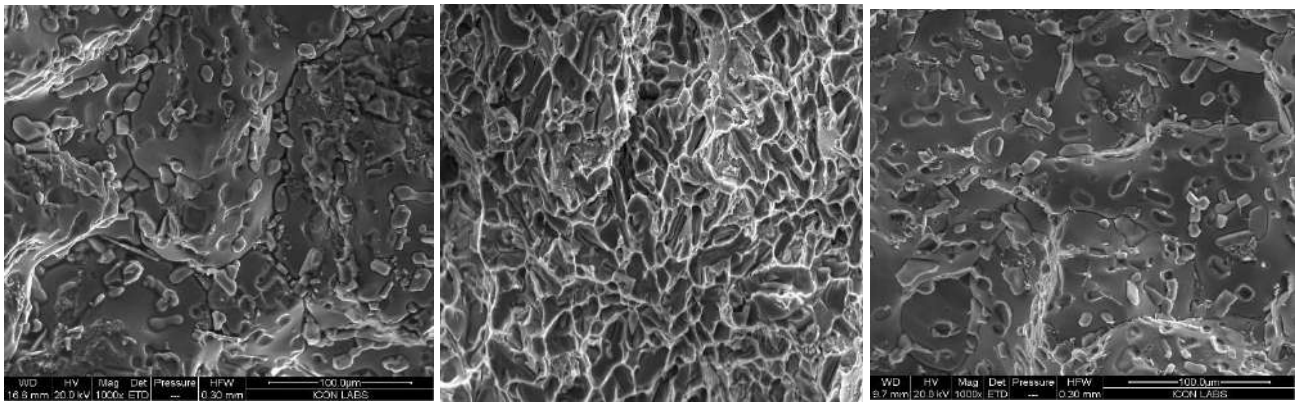


High magnification SEM micrograph shows polyhedral Grain, defects, and inclusions of Metal



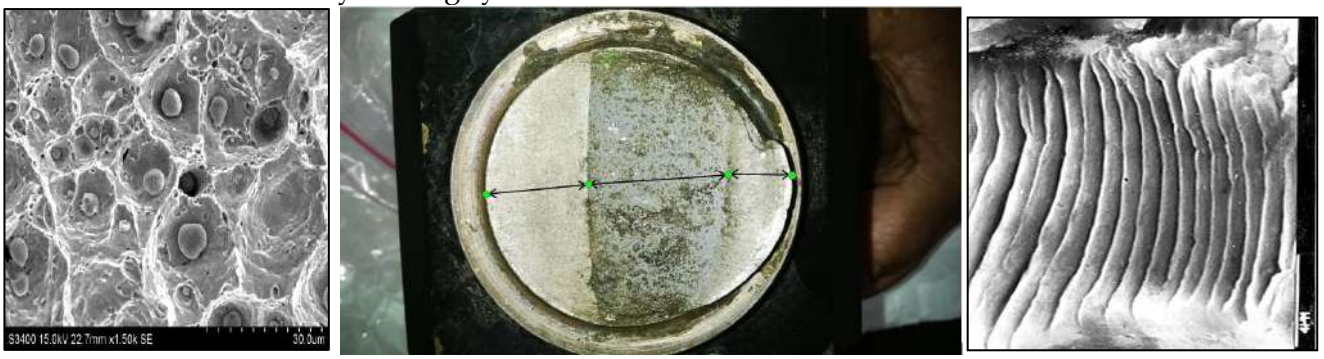
SEM Micrograph of Replica shows grains, inclusions along grain boundaries & grains

Due to the very narrow electron beam, SEM Fractography has a large depth of field yielding a characteristic three-dimensional appearance useful for understanding the surface structure of a sample. Some of the SEM Fractography of Al-Si alloys are shown below. Silicon has a very low solubility in aluminium; it therefore precipitates as virtually pure silicon, which is hard & brittle. Large particles/plates of silicon are, therefore, detrimental to the mechanical properties.



Fractographs of Al-Si alloy showing detrimental effect of silicon and morphology of a typical cleavage fracture

SEM Fractographs showing dimples created around second phase particles and fatigue fracture shows that fatigue crack initiate from both ends of a shaft and when the cross sectional area is reduced by 50% then catastrophic overload failure results. High magnification SEM Fractography shows striations created by loading cycles.



Dimples formed around Second phase particles

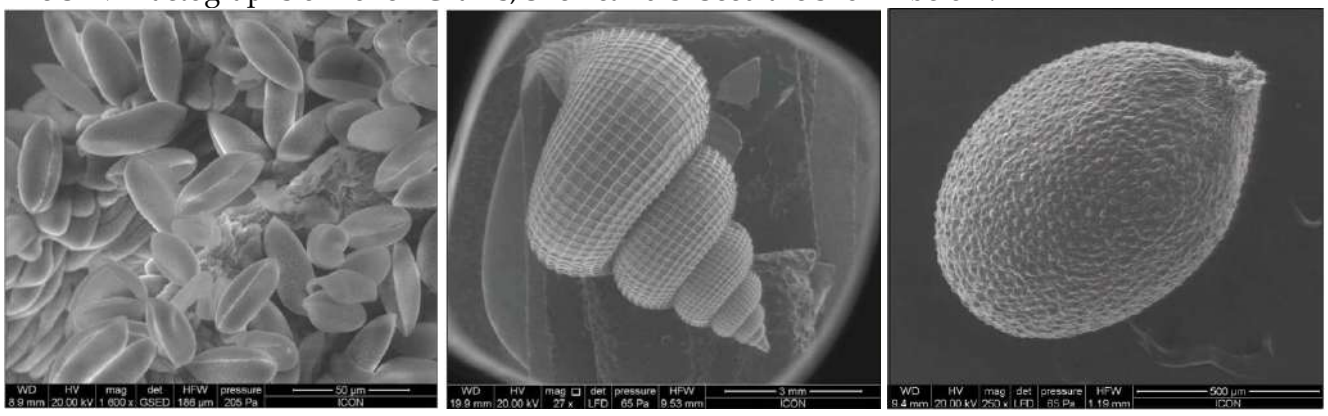
Fatigue cracks emanating from both ends of a shaft result in catastrophic overload failure

Fatigue striations caused due to each load cycling

Application of SEM in Biological Sciences

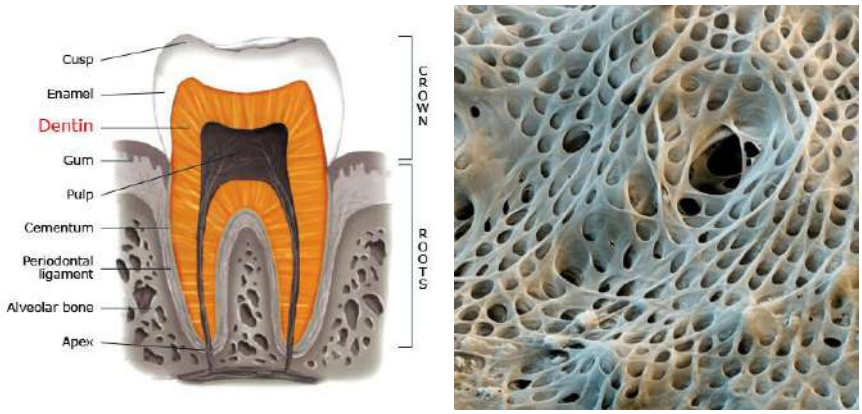
In biological sciences, SEMs can be used on anything from insects and animal tissue to bacteria and viruses. SEM Fractography of an ant, fly head and fungus on are shown below:

The SEM fractographs of Pollen Grains, Shell & Tulsi Seed are shown below:



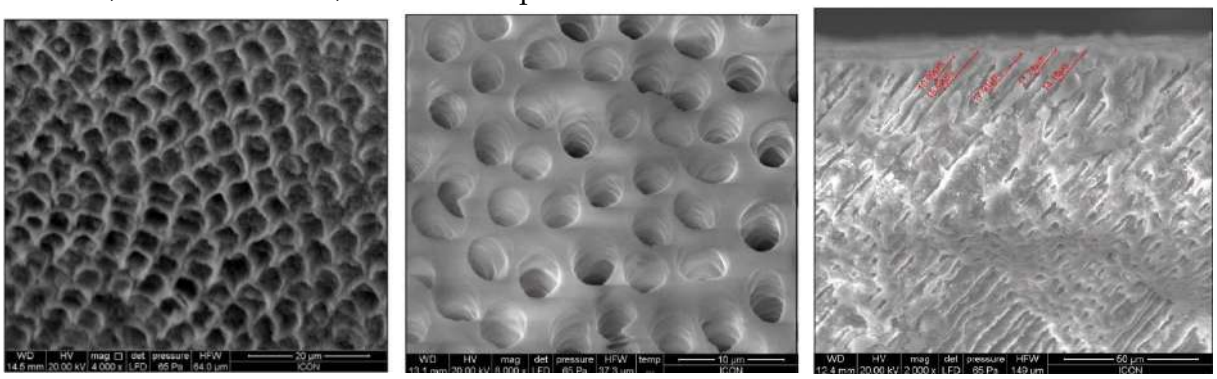
Application of SEM in Dentistry/ Trends Restorative Dentistry

A tooth structure consists of cusp, enamel & dentin. The pulp, soft tissue containing nerves and blood vessels form the inner part of the tooth as shown in figure below. A coloured SEM of dentine shows connective tissue under the tooth enamel

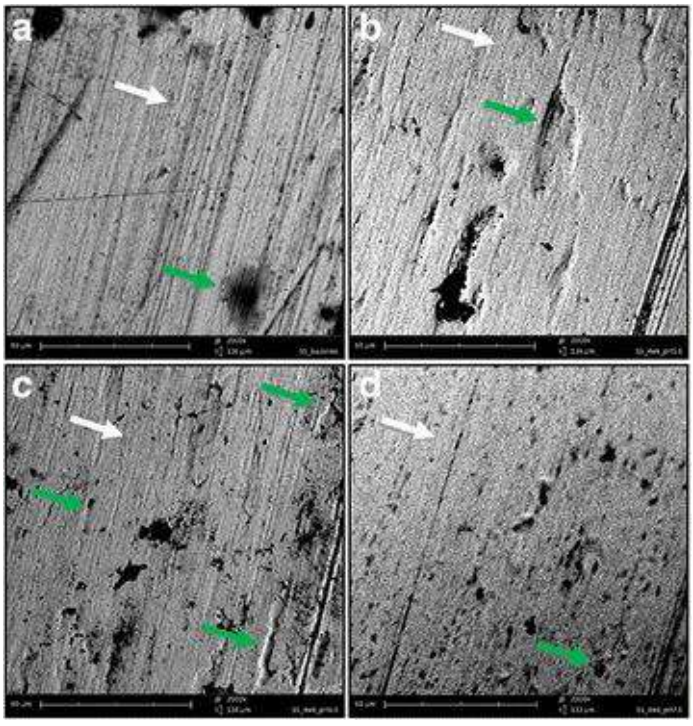


[Ref.: https://www.sciencephoto.com/media/309609/view/tooth-dentine-sem]

The strength of adhesive bonds formed between restorative materials and dentine is affected by the number & concentration of dentinal tubules per square millimetre and their diameter, as well as the amount of intratubular and intertubular dentin. The dentinal tubules are exposed after the enamel is etched in phosphoric acid. SEM micrographs of tooth after etching show honeycomb structure, dentinal tubules, their sizes & penetration of materials inside tubules.



In addition to applications above, SEMs are used to analyse Orthodontic Arch wires made of stainless steel that come in contact with saliva with different pH. Studies are conducted to investigate the corrosive behaviour of stainless steel arch wires in a more clinically relevant way by bending and exposing to various pH.

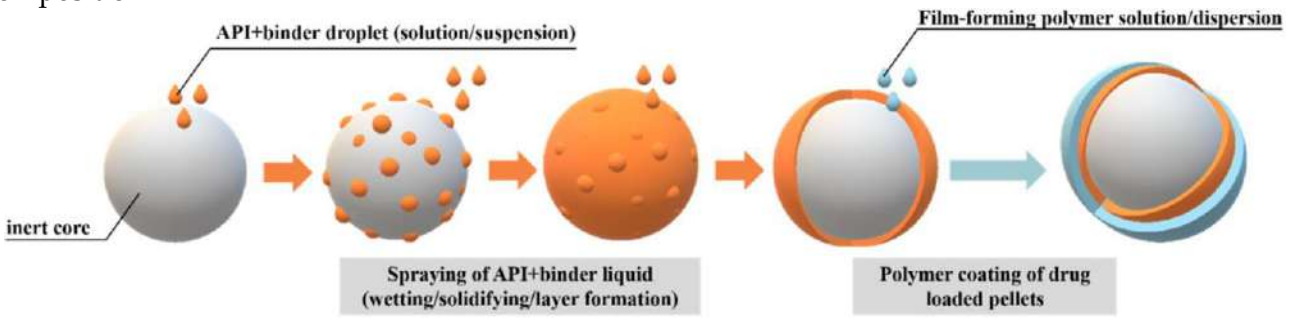


SEM images of straight rectangular SS wires at ×2000 magnification (a–d). Representative SEM images of SS wire, White arrows indicate typical manufacturing striations; green arrows indicate specific surface irregularities

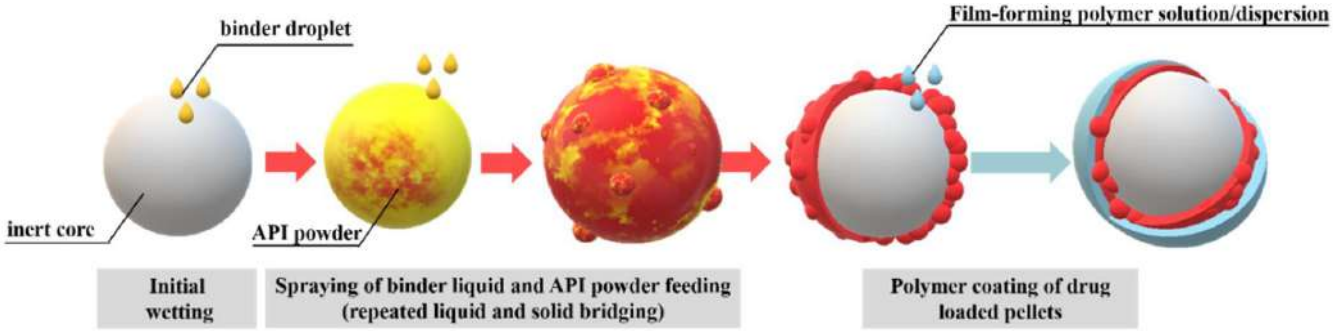
[Ref.: Marieke G. Hobbelink, Yan He, Jia Xu, Huixu Xie, Richard Stoll & Qingsong Ye Progress in Orthodontics volume 16, Article number: 37 (2015)]

Application of SEM in Pharmaceutical Industry

Pharmaceutical pellets are spherical granules. Active Ingredient containing pellets are formed from inert core by solution suspension or powder layering process. Each technique has its advantages and disadvantages. In solution or suspension layering process the active pharmaceutical ingredient (API) is dissolved or suspended in binder solution, this provides uniform smooth surface. The pellet properties are a function of the process parameters and the formulation, i.e., the composition



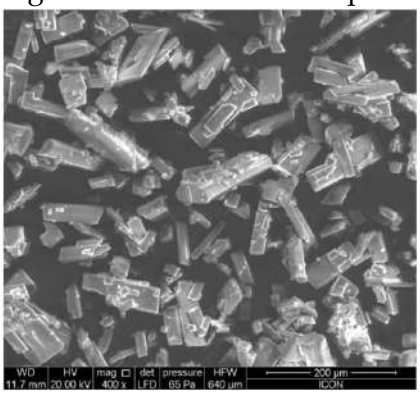
Schematic illustration of drug layering process of the active substance from solution/suspension and polymer coating



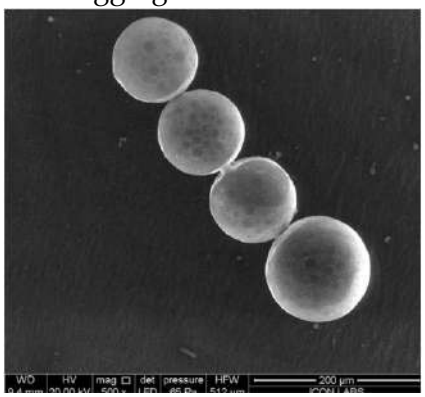
Schematic illustration of dry powder layering of starter core and polymer coating.

[Ref.: 21. Kovacevic, J.; Mladenovic, A.; Djuris, J.; Ibric, S. Evaluation of powder, solution and suspension layering for the preparation of enteric coated pellets. Eur. J. Pharm. Sci. 2016, 85, 84–93. (CrossRef)]

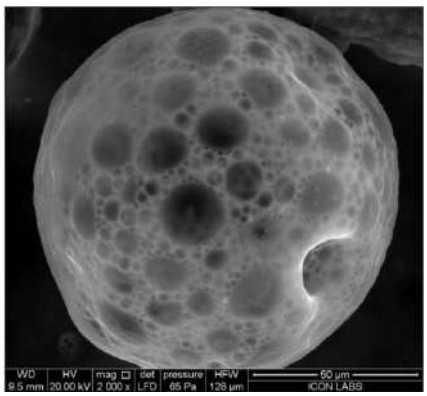
SEM is widely used in the pharmaceutical industry to investigate microstructure, surface topography and chemistry of a range of organic and inorganic ingredients. It provides visual information of micrometer and sub-micrometer particles including shape, size, morphology, and elemental composition. SEM imaging of raw pharmaceutical ingredients also reveals whether the ingredients are individual particles or aggregates.



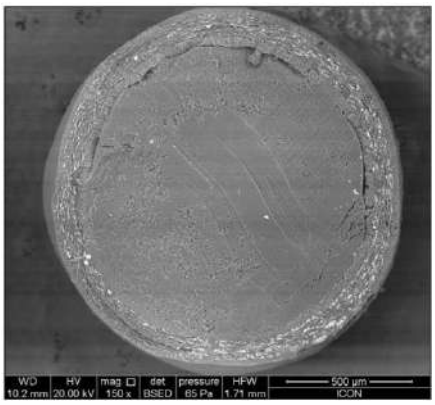
API is dissolved in binder solution



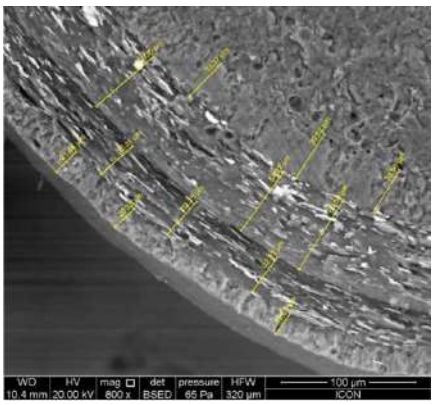
Pellet in the form of spherical granules



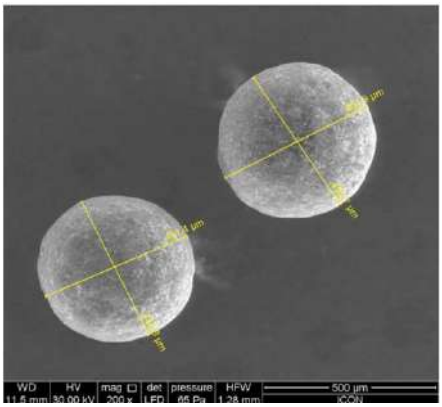
Microsphere at high magnification



Cross section of Pellet



Cross section of Pellet with measurement at high magnification

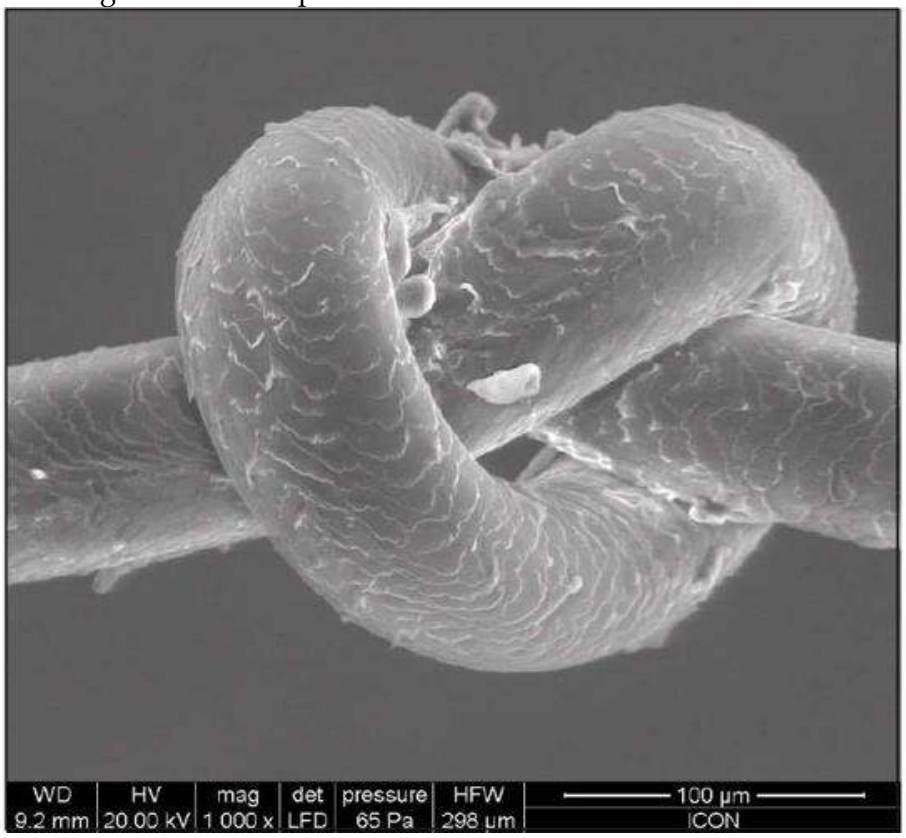


Rounded Spherical Pellet shapes are preferred

SEM imaging can be used for manufacturing process quality control to make sure each batch of excipients or active pharmaceutical ingredients are consistent. In addition, once a pharmaceutical product is formulated, SEM imaging can be used to evaluate how well the ingredients are blended (or not) in the micro environment.

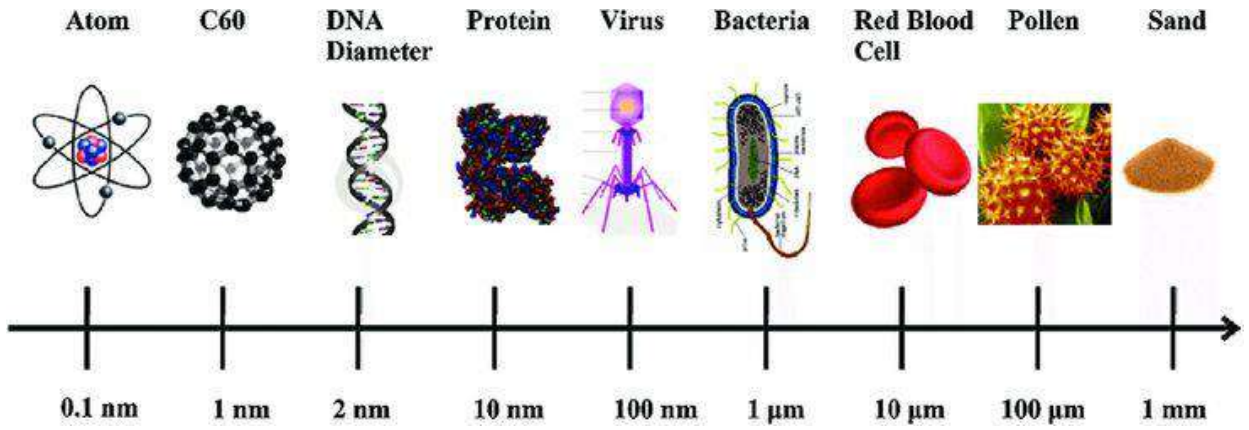
Application of SEM in Cosmetics Industry

Human hair is a biological fibre. The outermost part of hair shaft is called cuticles. A healthy cuticle is smooth and flat but chemicals in shampoos and hair dyes make them vulnerable to damage. The damage in cuticles is clearly visible in SEM at higher magnification in the form of porosity/ raised cuticles. The image of hair is depicted below



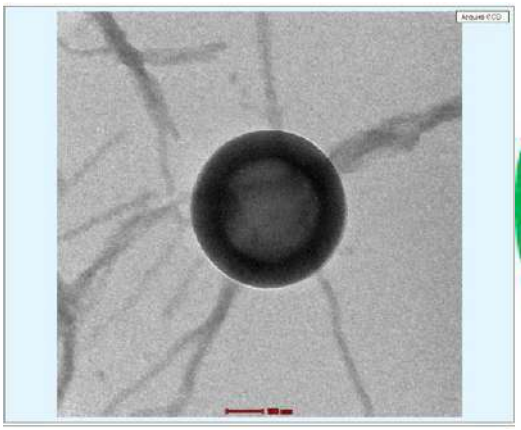
Application of SEM in Nanotechnology

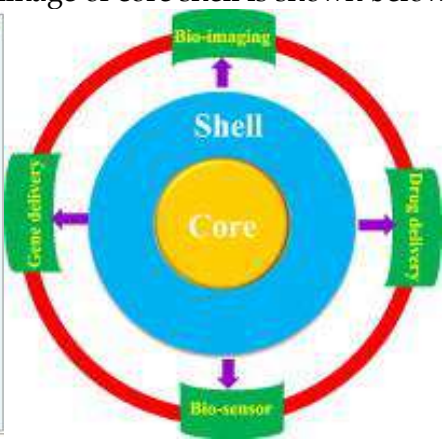
Nano technology comes from a Greek word "Nanos" which means abnormally small. 1nm is 1 billionth of a meter [10^{-9} meter]. 1nm is about 100000 times smaller than the diameter of human hair. Nanotechnology incorporates study and use of structures between 1nm to 100nm in size.



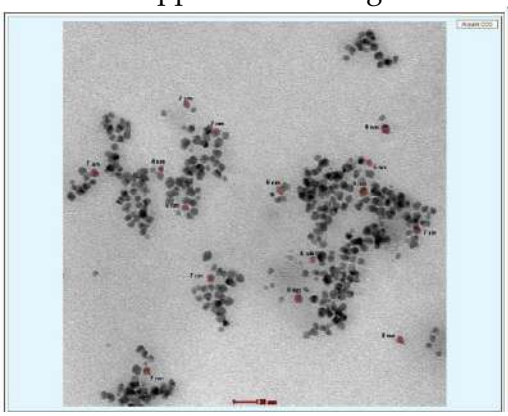
A pictorial exhibition of things in the "nano" (<100 nm) and "micro" (>100 nm) size ranges. Where DNA: Deoxyribonucleic acid, C60: Carbon 60

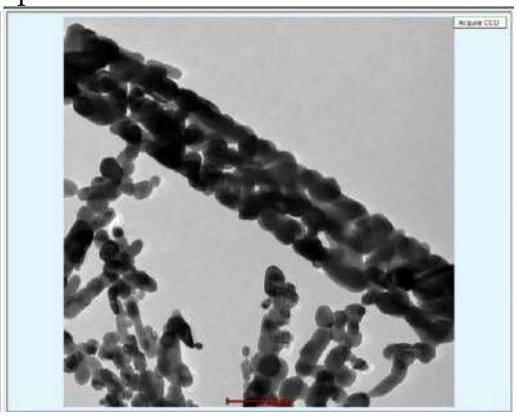
Nano technology is currently being increasingly used for all sectors including textile, food, and biotechnology. They have several exciting applications. Core shell Nano particles find most promising applications in biomedical field. The TEM image of core shell is shown below



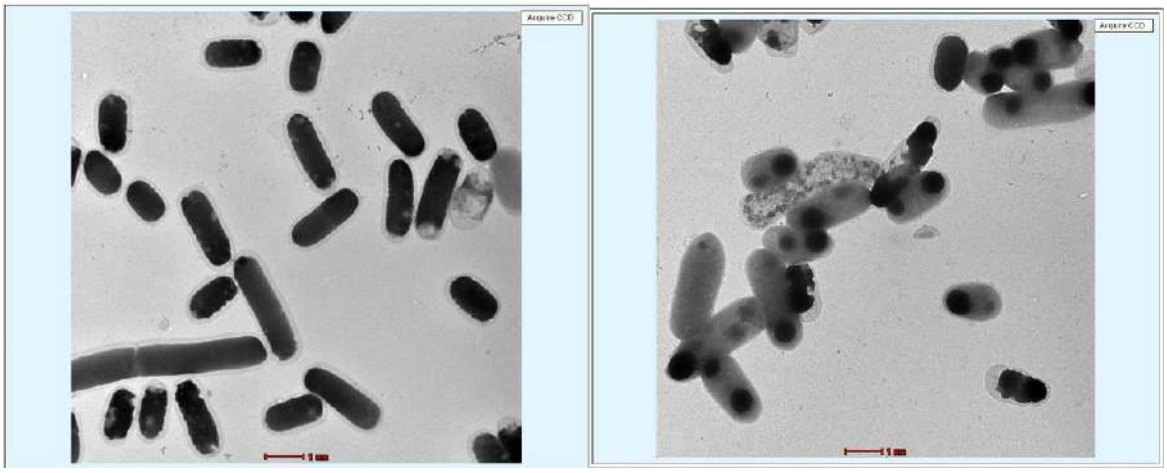


Silver and Nickel due to their antimicrobial and antibacterial nature are used in textile and for several biomedical applications. Images of Nanoparticles of Silver & Nickel are shown below.



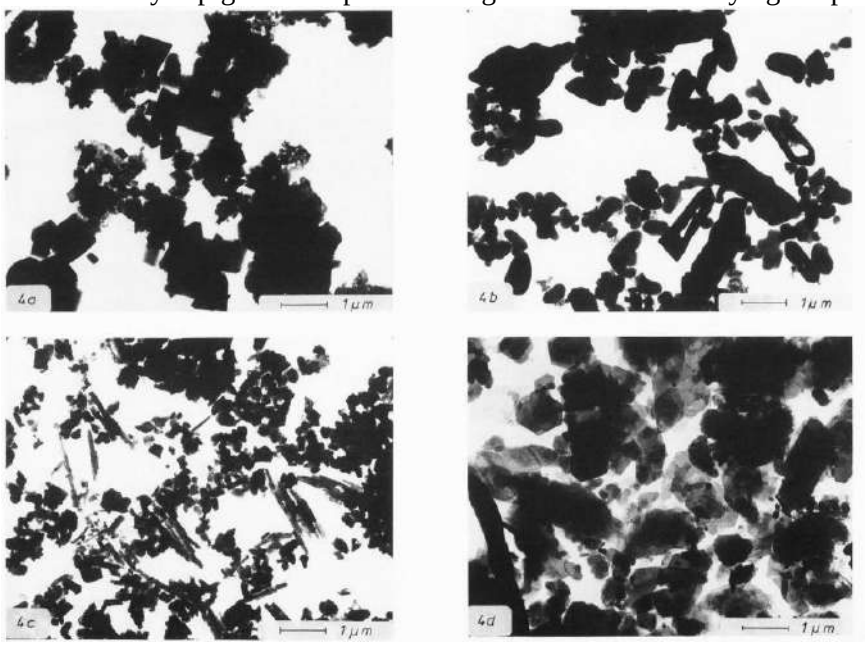


SEM & TEM are widely used to characterize the surface structure of biomaterials and to measure cell attachment and changes in morphology of bacteria & viruses that cause infectious diseases. They are useful for defining the number and distribution of microorganisms that adhere to surfaces. Some of the TEM micrographs of bacteria before and after treatment are shown below.



In addition to above applications, they are used to analyse coatings that consist of binders, pigments, solvents & additives. SEM & TEMs are used to evaluate micromorphology and chemical composition of pigment particles. Layers of paints are better visible in EM compared to LOM.

TEMs are used to analyze pigments in primers for grain size and identifying the primers and fillers



Transmission electron microscopic of 4 different primers 4a: Opel 4b: Audi 4c: Karmann 4d: Mercedes images

[Ref.: 15. Goebel, R. and Stoecklein, W. (1987) "The Use of Electron Microscopic Methods for the Characterization of Paints in Forensic Science," Scanning Microscopy: Vol. 1 : No. 3 , Article 16. Available at: https://digitalcommons.usu.edu/microscopy/vol1/iss3/16]

News and Views

Participation of PHCET at the International Conference and Exhibition on Materials Engineering & Technology and Advances in Heat Treatment at Bombay Exhibition Center, Mumbai during November 02-04 , 2022

A Report

A paper titled "3D Printing Of Thermoplastics: Mechanical Properties and Fracture characteristics of 3D Printed Biodegradable PLA" authored under the guidance of Prof. R.C. Prasad was presented by Mr. Sagar Tate on Nov. 4, 2022. Some of the glimpses of participation are given below:

Mr. Sagar D Tate on the dais presenting the paper and giving outline of his presentation

The Chairman of the session congratulated Mr. Tate for his nice maiden presentation as an UG student

The Chairman of the session presenting the Certificated to Mr. Sagar D Tate

Entry titled " Solar Powered Electric Vehicle " under Startup Category that was incubated under the umbrella " Institution Innovation Council @ PHCET was accepted for poster presentation to the Innovation Pavilion , a part of the Exhibition MET + HTS - 2022 held during November 2-4,2022 at the Bombay Exhibition Ground Goregaon , Mumbai

Mr. Joby Thomas and Prof. R.C. Prasad in the Pavilion Exhibition Stall allotted to PHCET for the display of the posters

Mr. Joby Thomas explaining the Solar Powered Electric Vehicle to the visitors from different Engineering Colleges

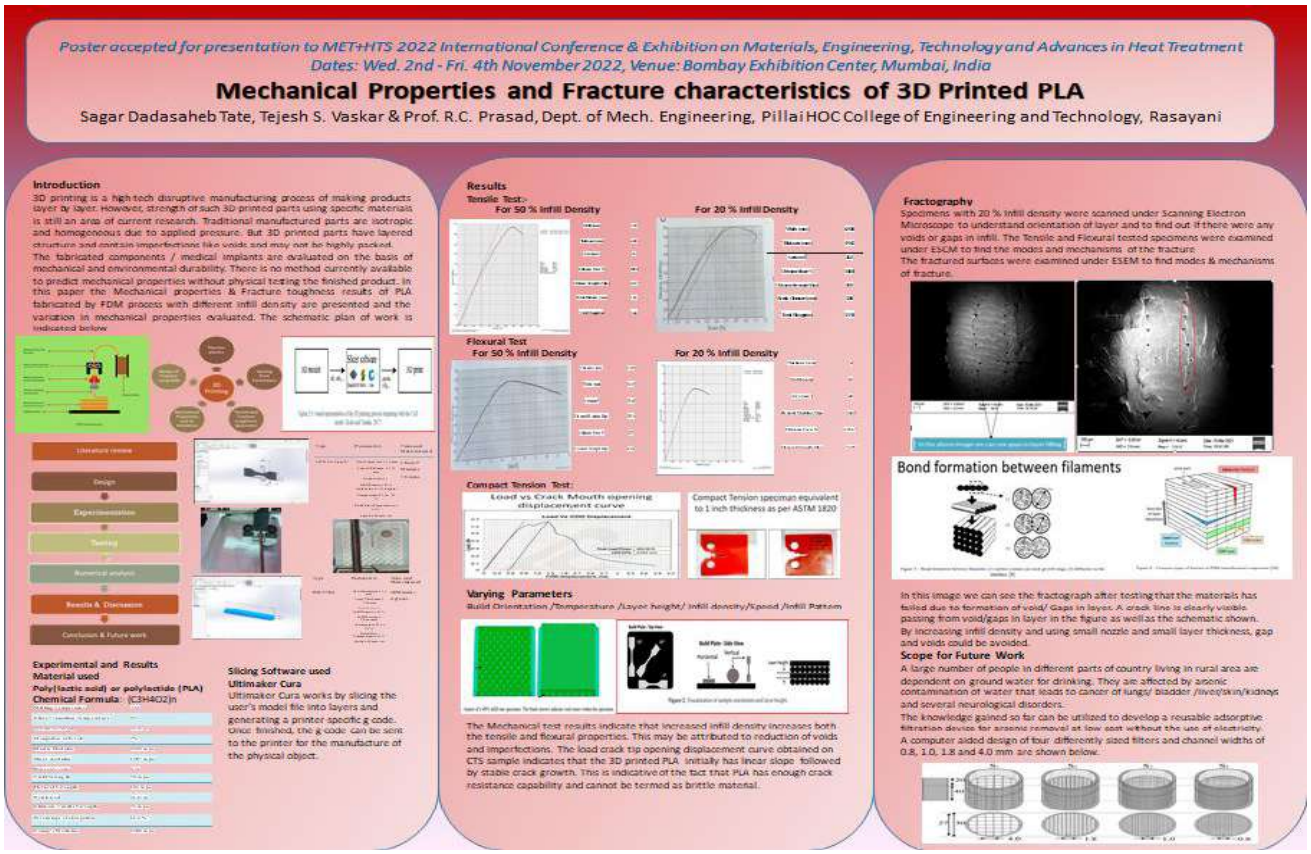
Dr. U. Kamachi Mudali, Vice Chancellor of VIT Bhopal University and Prof. V.S. Raja , IIT Bombay, Chairman of Technical Committee visited the Pavilion Exhibition Stall

Mr. Rajesh Shah, Joint Secretary of the Organizing Committee along with delegates from different parts of the Country visited the Pavilion Exhibition Stall

Mr. Shankar G Subburathinam , Engineering Manager, Advanced Material Technology, Innovation Technology and Development Division of Caterpillar India Pvt. Ltd. Thiruvallur visited the Pavilion Exhibition Stall

Mr. Samar Gupta, CEO of OHT Fasteners Rabale, Mumbai visited the Pavilion Exhibition Stall

Posters exhibited in the Innovation Pavilion Stall allotted to The Pillai HOC College of Engineering & Technology at the MET+HTS 2022 International Conference & Exhibition during November 2- 4, 2022, at Bombay Exhibition Center, Mumbai



Poster accepted for presentation to MET+HTS 2022 International Conference & Exhibition on Materials, Engineering, Technology and Advances in Heat Treatment
Dates: Wed. 2nd - Fri. 4th November 2022, Venue: Bombay Exhibition Center, Mumbai, India

Mechanical Properties and Fracture characteristics of 3D Printed PLA

Sagar Dadasaheb Tate, Tejesh S. Vaskar & Prof. R.C. Prasad, Dept. of Mech. Engineering, Pillai HOC College of Engineering and Technology, Rasayani

Introduction

3D printing is a high-tech disruptive manufacturing process of making products layer by layer. However, strength of such 3D printed parts using specific materials is still an area of current research. Traditional manufactured parts are isotropic and homogeneous due to applied pressure. But 3D printed parts have layered structure and contain imperfections like voids and may not be highly packed.
The fabricated components / medical implants are evaluated on the basis of mechanical and environmental durability. There is no method currently available to predict mechanical properties without physical testing the finished product. In this paper the Mechanical properties & Fracture toughness results of PLA fabricated by FDM process with different infill density are presented and the variation in mechanical properties evaluated. The schematic plan of work is indicated below.

Experimental and Results

Material used

Poly(lactic acid) or polylactide (PLA)

Chemical Formula: $(C_3H_4O_2)_n$

Slicing Software used

Ultimaker Cura

Ultimaker Cura works by slicing the user's model file into layers and generating a printer specific g code. Once finished, the g code can be sent to the printer for the manufacture of the physical object.

Results

Tensile Test:-

For 50 % Infill Density

For 20 % Infill Density

Flexural Test

For 50 % Infill Density

For 20 % Infill Density

Compact Tension Test:

Load vs Crack Mouth opening displacement curve

Compact Tension specimen equivalent to 1 inch thickness as per ASTM 1820

Varying Parameters

Build Orientation /Temperature /Layer height/ Infill density/Speed /Infill Pattern

The Mechanical test results indicate that increased infill density increases both the tensile and flexural properties. This may be attributed to reduction of voids and imperfections. The load crack tip opening displacement curve obtained on CTS sample indicates that the 3D printed PLA initially has linear slope followed by stable crack growth. This is indicative of the fact that PLA has enough crack resistance capability and cannot be termed as brittle material.

Fractography

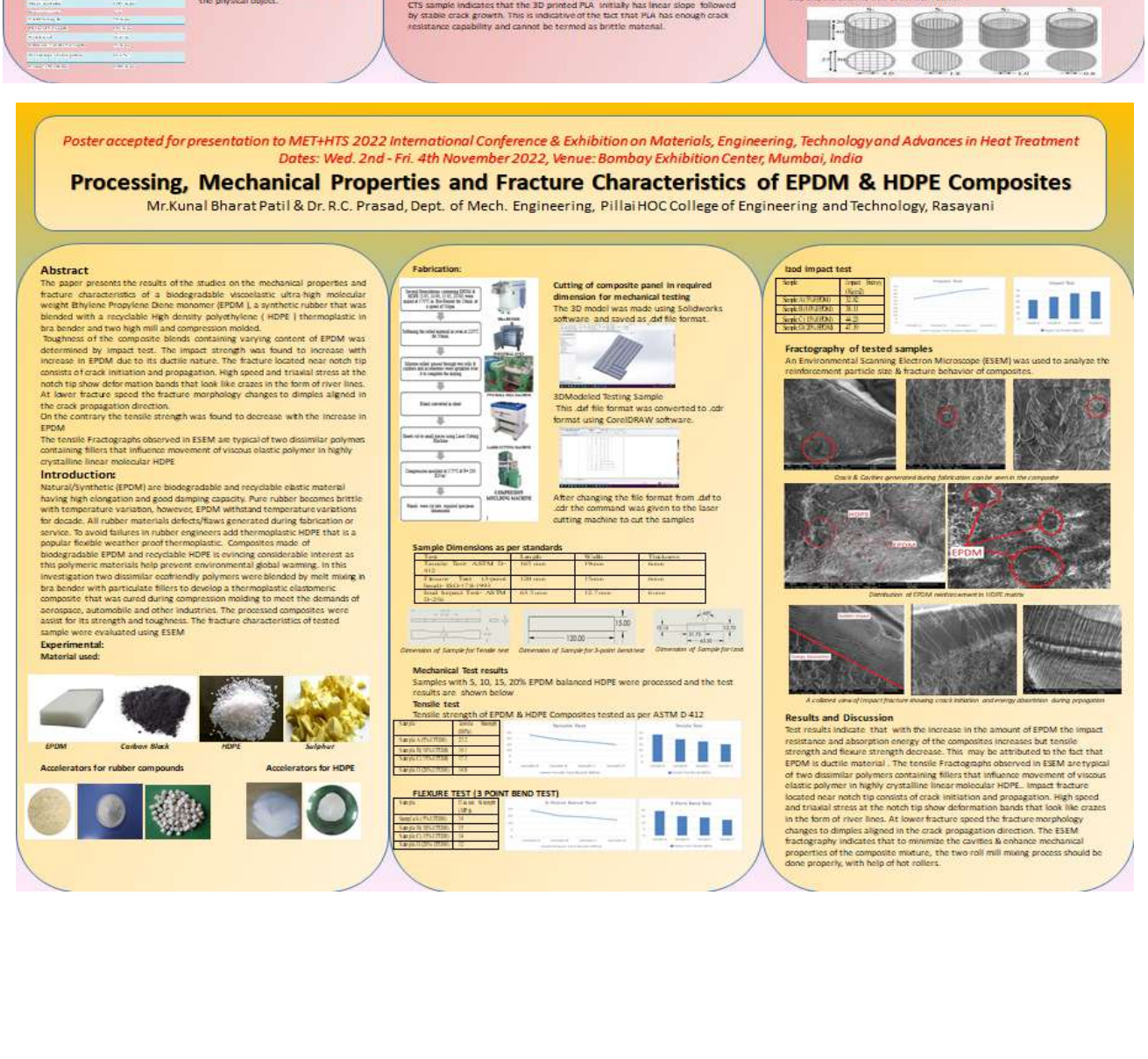
Specimens with 20 % Infill density were scanned under Scanning Electron Microscope to understand orientation of layer and to find out if there were any voids or gaps in infill. The Tensile and Flexural tested specimens were examined under ESEM to find the modes and mechanisms of the fracture.
The fractured surfaces were examined under ESEM to find modes & mechanisms of fracture.

Bond formation between filaments

In this image we can see the fractograph after testing that the materials has failed due to formation of void/ Gaps in layer. A crack line is clearly visible passing from void/gaps in layer in the figure as well as the schematic shown. By increasing infill density and using small nozzle and small layer thickness, gap and voids could be avoided.

Scope for Future Work

A large number of people in different parts of country living in rural area are dependent on ground water for drinking. They are affected by arsenic contamination of water that leads to cancer of lungs/ bladder /liver/skin/kidneys and several neurological disorders.
The knowledge gained so far can be utilized to develop a reusable adsorptive filtration device for arsenic removal at low cost without the use of electricity. A computer aided design of four differently sized filters and channel widths of 0.8, 1.0, 1.8 and 4.0 mm are shown below.



Poster accepted for presentation to MET+HTS 2022 International Conference & Exhibition on Materials, Engineering, Technology and Advances in Heat Treatment
Dates: Wed. 2nd - Fri. 4th November 2022, Venue: Bombay Exhibition Center, Mumbai, India

Processing, Mechanical Properties and Fracture Characteristics of EPDM & HDPE Composites

Mr.Kunal Bharat Patil & Dr. R.C. Prasad, Dept. of Mech. Engineering, Pillai HOC College of Engineering and Technology, Rasayani

Abstract

The paper presents the results of the studies on the mechanical properties and fracture characteristics of a biodegradable viscoelastic ultra high molecular weight Ethylene Propylene Diene monomer (EPDM), a synthetic rubber that was blended with a recyclable High density polyethylene (HDPE) thermoplastic in bra bender and two high mill and compression molded.
Toughness of the composite blends containing varying content of EPDM was determined by impact test. The impact strength was found to increase with increase in EPDM due to its ductile nature. The fracture located near notch tip consists of crack initiation and propagation. High speed and triaxial stress at the notch tip show defor mation bands that look like crazes in the form of river lines. At lower fracture speed the fracture morphology changes to dimples aligned in the crack propagation direction.
On the contrary the tensile strength was found to decrease with the increase in EPDM
The tensile Fractographs observed in ESEM are typical of two dissimilar polymers containing fillers that influence movement of viscous elastic polymer in highly crystalline linear molecular HDPE

Introduction:

Natural/Synthetic (EPDM) are biodegradable and recyclable elastic material having high elongation and good damping capacity. Pure rubber becomes brittle with temperature variation, however, EPDM withstand temperature variations for decade. All rubber materials defects/flaws generated during fabrication or service. To avoid failures in rubber engineers add thermoplastic HDPE that is a popular flexible weather proof thermoplastic. Composites made of biodegradable EPDM and recyclable HDPE is evincing considerable interest as this polymeric materials help prevent environmental global warming. In this investigation two dissimilar ecofriendly polymers were blended by melt mixing in bra bender with particulate fillers to develop a thermoplastic elastomeric composite that was cured during compression molding to meet the demands of aerospace, automobile and other industries. The processed composites were assist for its strength and toughness. The fracture characteristics of tested sample were evaluated using ESEM

Experimental:

Material used:

EPDM | Carbon Black | HDPE | Sulphur

Accelerators for rubber compounds | Accelerators for HDPE

Fabrication:

Cutting of composite panel in required dimension for mechanical testing

The 3D model was made using Solidworks software and saved as .dxf file format.

3DModeled Testing Sample

This .dxf file format was converted to .cdr format using CorelDRAW software.

After changing the file format from .dxf to .cdr the command was given to the laser cutting machine to cut the samples

Sample Dimensions as per standards

Dimension of Sample for Tensile test | Dimension of Sample for 3-point bend test | Dimension of Sample for Izod

Mechanical Test results

Samples with S, 10, 15, 20% EPDM balanced HDPE were processed and the test results are shown below

Tensile test

Tensile strength of EPDM & HDPE Composites tested as per ASTM D 412

FLEXURE TEST (3 POINT BEND TEST)

Izod impact test

Fractography of tested samples

An Environmental Scanning Electron Microscope (ESEM) was used to analyze the reinforcement particle size & fracture behavior of composites.

Crack & Cavities generated during fabrication can be seen in the composite

Distribution of EPDM reinforcement in HDPE matrix

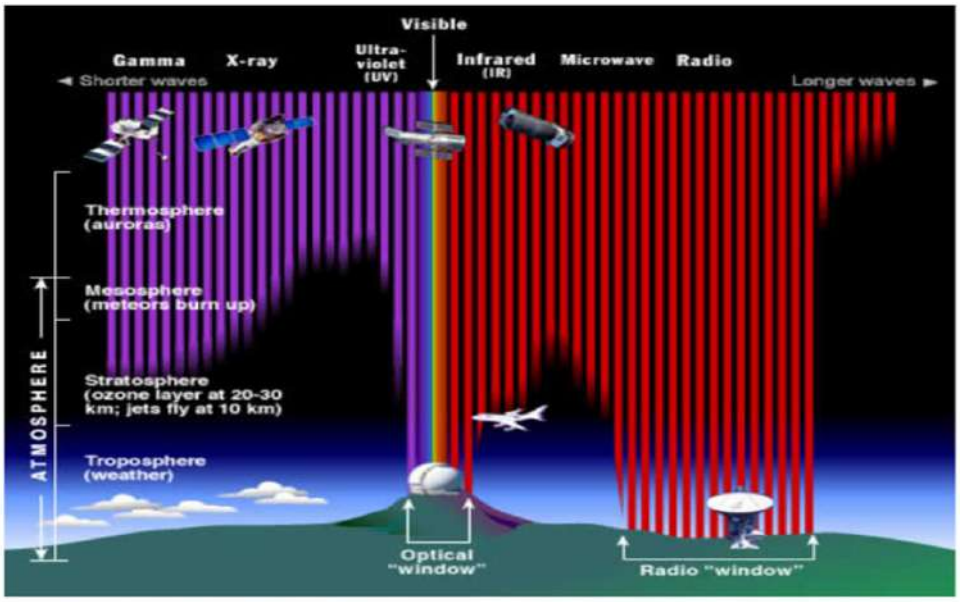
A colored view of impact fracture showing crack initiation and energy absorption during propagation

Results and Discussion

Test results indicate that with the increase in the amount of EPDM the impact resistance and absorption energy of the composites increases but tensile strength and flexure strength decrease. This may be attributed to the fact that EPDM is ductile material . The tensile Fractographs observed in ESEM are typical of two dissimilar polymers containing fillers that influence movement of viscous elastic polymer in highly crystalline linear molecular HDPE.. Impact fracture located near notch tip consists of crack initiation and propagation. High speed and triaxial stress at the notch tip show deformation bands that look like crazes in the form of river lines. At lower fracture speed the fracture morphology changes to dimples aligned in the crack propagation direction. The ESEM fractography indicates that to minimize the cavities & enhance mechanical properties of the composite mixture, the two roll mill mixing process should be done properly, with help of hot rollers.

Industry News: 5G and Industry 4.0

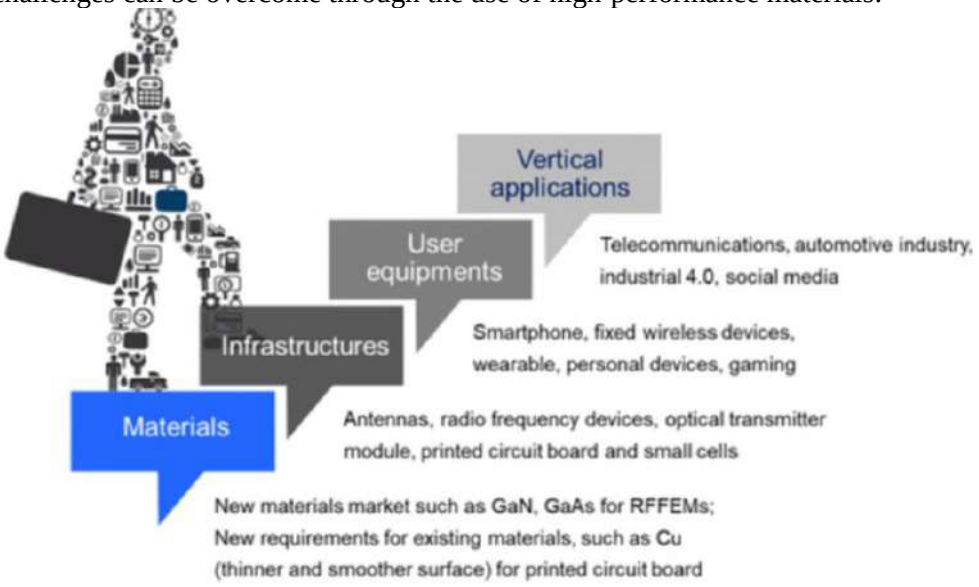
Wireless communication technology works by sending and receiving radio waves . Radio waves are made of sunlight (electromagnetic radiation referred to as) that is invisible to the naked eye,. As demonstrated in the graphic below, our sun produces radiation across a vast spectrum of wavelengths.



Visible Light and Radio Waves from Space Penetrate Earth's Atmosphere
[Credit National Aeronautics and Space Administration (NASA)]

Visible light and radio are the only parts of this spectrum that can penetrate our atmosphere to reach our earth's surface. 5G communication technology promises significant advancements, such as faster speed, lower latency, improved connection density and wider coverage; thus enabling implementation of Internet of Things (IoT), augmented reality (AR) or virtual reality (VR) applications, factory automation, vehicular communications and other applications where security, reliability, quality of service and efficiency are critical. While the lucrative 5G industry is preparing businesses to experience digital transformation, electronic manufacturers behind the scenes are at the forefront of developing high performance components to support reliable implementation.

Major challenges to be addressed by electronic manufacturers include managing extreme thermal conditions within increasing smaller encapsulated components and delivering high performance at low power. These challenges can be overcome through the use of high-performance materials.



5G Material Suppliers:

A few suppliers of 5G materials are listed below:

- Nokia Bell Labs has developed a 5G-ready lithium nanotube battery. The electrodes use a composite of carbon nanotubes and lithium storage materials. This design enables energy to be transferred at near-theoretical peak efficiency levels .
- Tokuyama Corp. engages in the manufacturing of chemicals and supplies aluminum nitride for 5G devices, particularly for semiconductors and heat dissipation materials .
- Japan's Furuya Metal works on processing technologies for Iridium and Ruthenium used for high-resolution OLED panels. It supplies materials for China's BOE Technology Group, as well as South Korea's Samsung Electronics and LG Electronics .
- Preperm® is a tradename of the Finnish Premix group, a technology leader in electrical conducting plastics and RF materials. Patented PREPERM® technology and PREPERM® low-loss dielectric materials boost antenna efficiency to new levels even at very high frequencies .
- Murata Manufacturing is a supplier of multilayer ceramic condensers for 5G base stations. Taiyo Yuden recently opened a third manufacturing facility for MLCC (Multilayer Ceramic Chip Capacitor)
- Soitec (Euronext Paris), a world leader in designing and manufacturing innovative semiconductor materials, announced that it is the first materials supplier to join the China Mobile 5G Innovation Center , an international alliance chartered to develop 5G communication solutions for China, the world's largest wireless communications market with 925M mobile subscribers. Both silicon and non-silicon engineered substrates are essential in bringing to mass deployment 5G mobile communications for various applications, including self-driving cars, industrial connectivity and virtual reality .

Today 5G and Industry 4.0 have gone beyond a buzzword to standard operating strategy (SOS) for business including manufacturing. Robotics and automation is taking over Manufacturing. However implementation of Industry 4.0 is an ever evolving Process .In Industry 4.0 the data coming from production lines is so large for any person to make any sense. 5G with increase bandwidth, high speed Promises to boost IOT by making it easy for several devices to connect to each other and communicate with zero lag, and being controlled by smartphones remotely.

Countries are competing to have an edge in this area. There is a large demand of 5G professionals worldwide. According to telecom skills body , India alone needs 2.2 crores skilled / up skilled manpower by 2025 as the Country inches closer to the 5th generation or 5G centric technologies like IOT, AI, Robotics, Cloud Computing etc. IIT Madras has developed 5G test bed that will allow startups and industry to test their products and make them 5G ready.

5G and ICT oriented courses were already in their final stages of development along with courses in m-data security and telecom business analytics. Govt has Introduced Production Linked Scheme that shall Induce Private firms to Increase / expand Production. Firms will Increasingly resort to Automation, Industry 4.0 like Practices, will Introduce Robotic and Artificial Intelligence in factories to bring efficiency. India's telecom sector currently employs nearly 4 million workers that has close to 60% direct workforce employed with telecom service providers - Reliance Jio, Bharti Airtel, Vodafone Idea, and state-run Bharat Sanchar Nigam Limited (BSNL) as well as multinational technology vendors such as Huawei, Ericsson, Nokia, Cisco, Ciena, Juniper and ZTE. India would require as much as 22 million or 2.2 crore skilled manpower by 2025 as the country inches closer to the fifth-generation or 5G-centric technologies such as Internet of Things (IoT), Artificial Intelligence (AI), robotics, and cloud computing, the telecom skills body said. "Considering technologies like IoT, AI, machine learning, big data, cloud computing, and robotic process automation, roughly about 22 million workers will be required to skill or upskill themselves to match industry demand by 2025," Arvind Bali, chief executive, Telecom Sector Skill Council (TSSC) told ETTelecom. India, according to him, is poised to become a global supplier for both electronics and human resource and to achieve this, there would be a need to create an extended skill network with both industry and academia participation.

Robotics and Automation is taking over manufacturing . In order to be a global supplier of man power there is a need for spreading awareness by panel discussion and brain storming sessions by experts and later on offer 5G and ICT oriented Mini- courses related to :

- Antennas/ Different types of antennas/ New Antenna Technology
- Can A small Size Antenna meet requirement of high frequency during fabrication and testing
- High Performance Materials used for manufacturing 5G Antennas with high frequency and bandwidth
- How increased bandwidth and speed can boost IOT
- Spreading awareness about smart manufacturing (Digital Direct Manufacturing) / Industry 4.0 for factories of future.

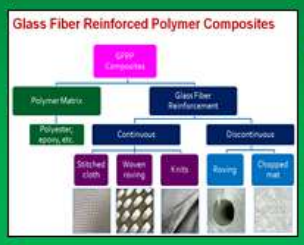
Gurugram-based telecom skills council, is a non-profit organisation set up by the Cellular Operators Association of India (COAI), India Cellular and Electronics Association (ICEA), and the National Skill Development Corporation (NSDC), to ensure availability of skilled manpower in the industry.

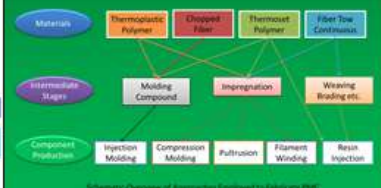
With above in view the Special Interest Groups of the Mechanical Engineering Department & the Departments of ET , IT & CSE have joined hands to work together in the interdisciplinary areas like Robotics and Automation, Advanced High performance Material used for Manufacturing 5G antennas with high frequency and bandwidth/ Materials for antenna circuit/ Power amplifiers for 5G communication /cables , circuit boards and Substrates etc. used for 4G and 5G network. under the Institute Innovation Council at the PHCET .

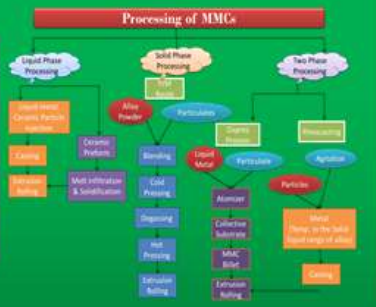
Books Published

COMPOSITE MATERIALS:

Processing, properties & Applications





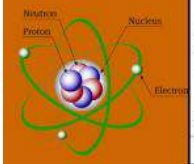


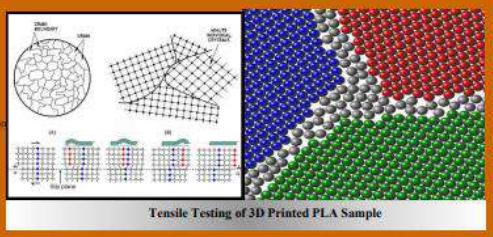
Prof. R. C. Prasad, Former HAG Professor IIT Bombay

Prof. Department of Mechanical Engineering PHCET Rasayani

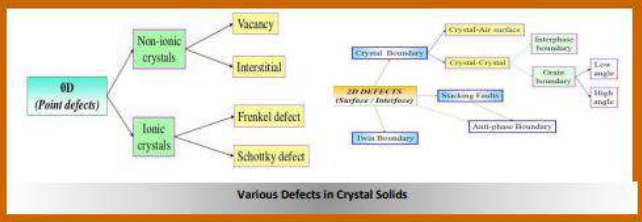
CRYSTAL STRUCTURE & DEFECTS :

Influence on Mechanical Properties





Tensile Testing of 3D Printed PLA Sample



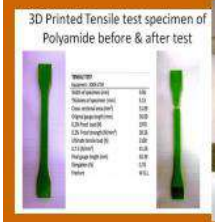
Various Defects in Crystal Solids

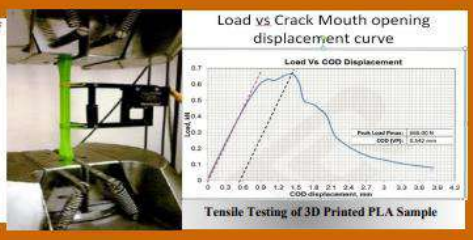
Prof. R. C. Prasad, Former HAG Professor IIT Bombay

Prof. Department of Mechanical Engineering PHCET Rasayani

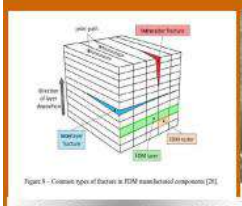
TENSILE TESTING & FRACTOGRAPHIC ANALYSIS :

Applications in Industries & Research

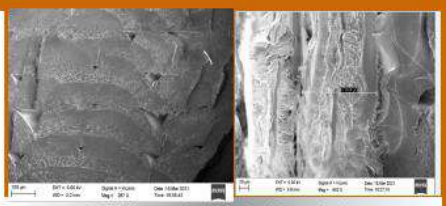




Tensile Testing of 3D Printed PLA Sample



Interlayer & Intraraster Fracture in FDM



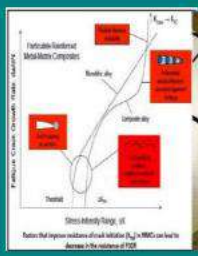
Tensile fractographs of 3D printed Thermoplastics

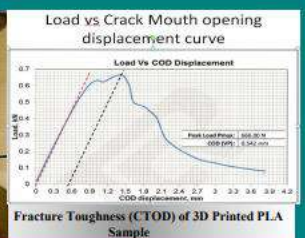
Prof. R. C. Prasad, Former HAG Professor IIT Bombay

Prof. Department of Mechanical Engineering PHCET Rasayani

FRACTURE MECHANICS & FAILURE ANALYSIS :

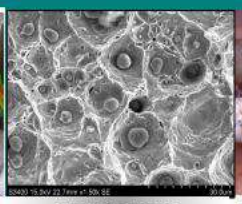
Applications in Industries & Research





Fracture Toughness (CTOD) of 3D Printed PLA Sample

Failure of a Roller Coaster Axle Rod



Microvoid Coalescence

Typical burst failures CNG Cylinder.

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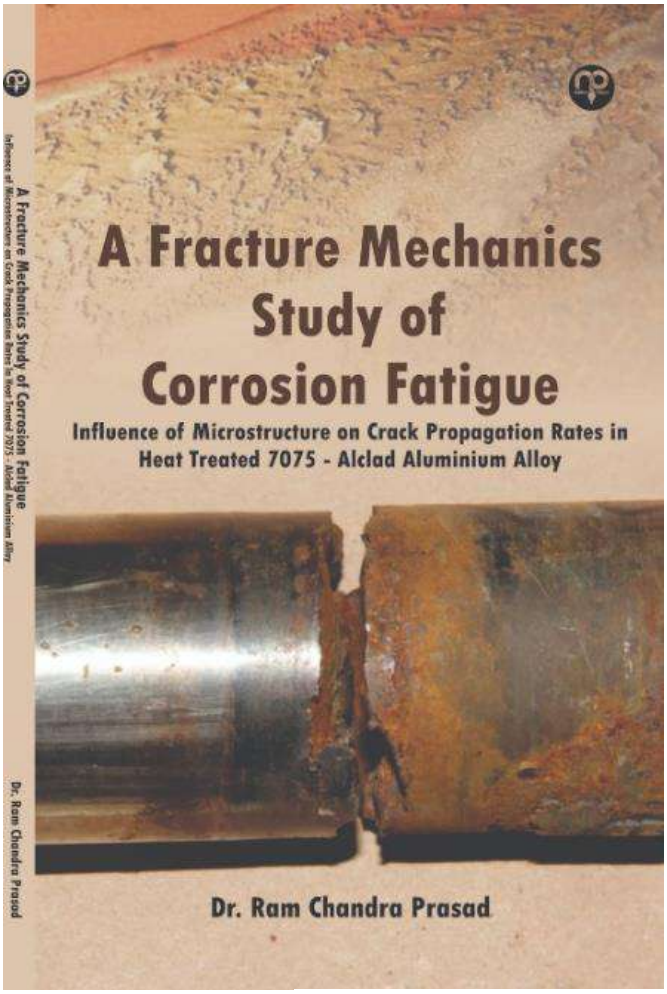
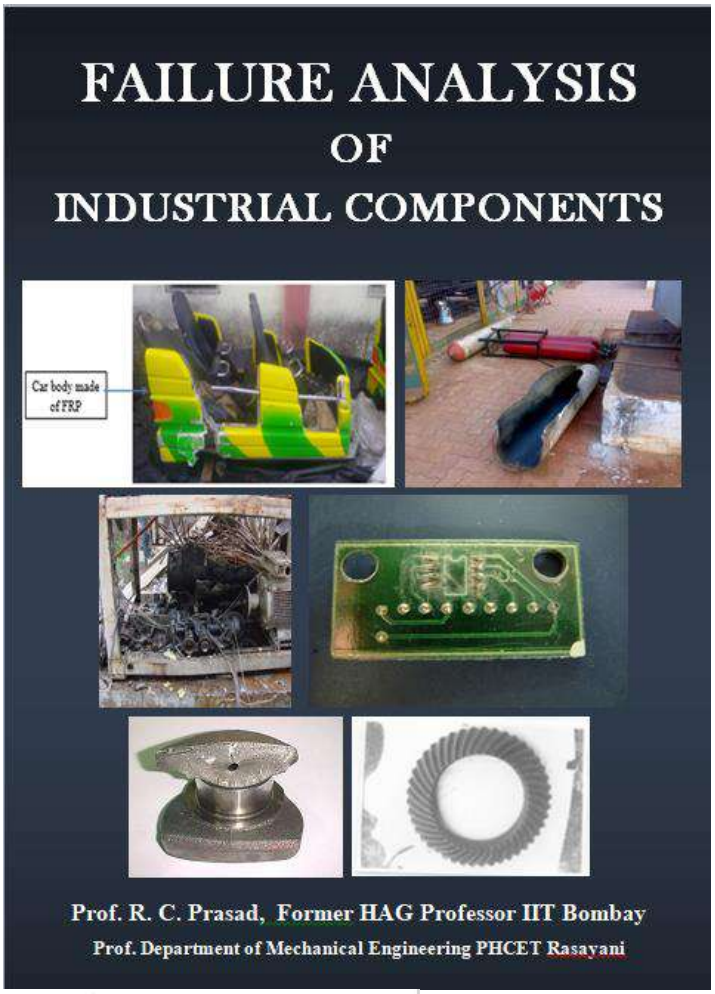
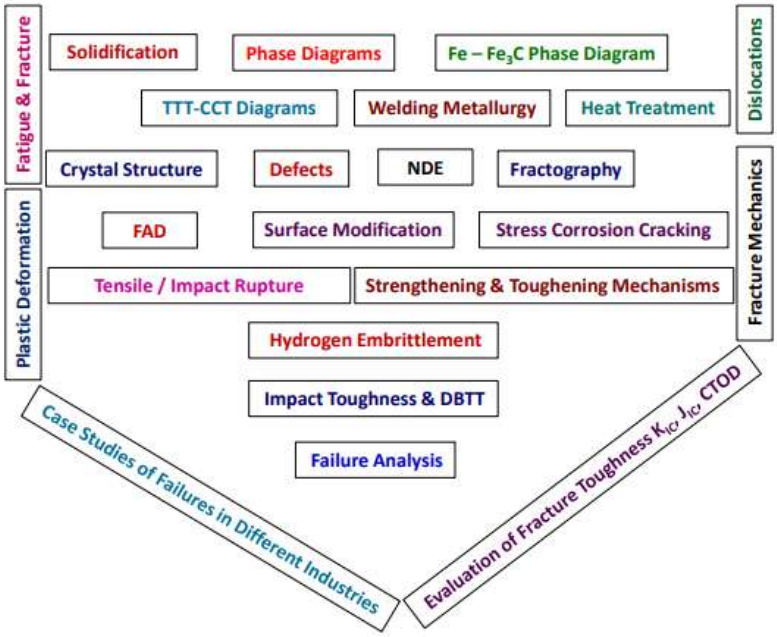
Prof. Department of Mechanical Engineering PHCET Rasayani





Practical Metallurgy for Industries

A module based training course designed for personnel working on shop floor in metallurgical industries



By

Prof. R.C. Prasad
Department of Mechanical Engineering
PHCET Rasayani

Forthcoming Events

International Students Olympiad in Hot Bulk Forging and Extrusion Technologies 2023

Students of mechanical engineering are invited to take part in the International Students Olympiad in Hot Bulk Forging Technologies, which will take place in April 2023 at universities around the world.

The competition between students will consist of the following parts: students will get a drawing of an axisymmetric part after machining and should design the hot forged part and die impression for the final forging and then determine necessary technological chain for its manufacturing and then simulate proposed forging process. Students can choose an alternative task for developing technological process of hollow aluminium profile extrusion. Simulation will be performed in QForm software for estimation and verification of the developed technology.

Organizers are asked to submit a competition entry with a list of applicant students. If the local organizer invites students from multiple universities then each university is limited to 3 participating students so if more are interested in participating, then each university must pre-select 3 most qualified participants. If only one university is involved with a local organizer, then more than 3 students may participate. On the day of the event in April 2023 competing students should arrive to assigned class room and each student will work on a personal computer with QForm simulation and CAD software installed and will have 6 hours to design the technology, to simulate it and to create a report using text editor such as Microsoft Word. Students' reports should include calculations and justification of the proposed technology, applications and drawings in text file as well as saved QForm FE-simulation file. Each report will have special random number to achieve fair and unbiased judging. The results will be judged by a local committee. Winners will get diplomas and prizes. Then 1st place winners from each country will move on to the Scientific Committee judgment between countries where three best students' reports from around the world will get special diplomas and prizes.

Designed technology will be judged by the following criteria:

- computation of hot forged part drawing;
- justification of designed bulk forging technology;
- effectiveness and efficiency of proposed technology based on the results of simulation in QForm. Optimally designed technology should provide no defects, complete filling of the die impression, consist of minimum number of technological chain steps with high forging energy efficiency and high material consumption efficiency with optimal grain flow.

Basic language of the Olympiad is English. Each Organizer may use different languages for reports but the students' reports for International Committee judgment have to be translated into English.

Deadlines:

- January 2023: Organizational Committee membership confirmation (including contact person) to market@qform3d.com
- January 2023: Competition entry from universities (including request for QForm license if needed)
- March 2023: List with applicant students
- April 2023: Recommended date of the Olympiad at universities

Additional conditions:

All universities taking part in the Olympiad will get a free 3-month network QForm software license for 3 places to practice before the Olympiad by request. The universities will also get the solved example from the previous Olympiad for review as well as a training course of simulation in QForm.

Several participants of the past years:

Coordinator

Micas Simulations Ltd., QForm Group
www.qform3d.com
market@qform3d.com

QFORM

Scientific Committee 2022

Budapest University of Technology and Economics (Hungary),
Department of Material Science and Engineering
www.bme.hu
PhD student, József Bálint Renkó

Bauman MSTU (Russia),
Department of Metal Forming
www.bmstu.ru/en/
Ph.D., Asst. Professor Yuri Gladkov

Politecnico di Torino (Italy),
Department of Management and Production Engineering
www.polito.it
Professor Manuela De Maddis

University of Belgrade (Serbia),
Faculty of Mechanical Engineering
Production Engineering Department
www.bg.ac.rs
Ph.D., Associate professor Mihajlo Popović

University POLITEHNICA of Bucharest (Romania),
Materials Processing and Ecometallurgy Department
www.upb.ro
Vice President of the Romanian, Forging Association, Assoc. Prof. PhD. Nicolae Serban

OmSTU (Russia),
Institute for Continuing Professional Education
www.omgtu.ru
Head of Institute, Ph.D., Asst. Professor Igor Markechko

PHCET, Rasayani (India),
www.phcet.ac.in
Dr. R. C. Prasad, Professor Department of Mechanical Engineering

Hebei University of Science and Technology (China),
Materials Science and Engineering Department
www.english.hebust.edu.cn
Professor Shibo Ma

Two Days Intensive Workshop

On

Fracture Mechanics & Failure Analysis: Research Opportunities to Solve Industrial Problems

Organised by

PHCET

INSTITUTION'S INNOVATION COUNCIL

SFA Mumbai Chapter

Supported by

ASM INTERNATIONAL INDIA CHAPTER

IIM

IIW INDIA

Preamble

The Industry today faces challenges to prevent degradation and failure of its ageing infrastructure. Failures eat 4-5% of the economic output of a developing country by reducing the production efficiency and the increasing the cost of production. Fracture performance is a matter of serious concern. Systematic analysis of the cause of failure and taking suitable preventive methods is essential for the economic growth of the country. Fracture control based on conventional design using charpy and tensile tests are considered no longer adequate to ensure safety and reliability. A large number of components are retired prematurely because of lack of our knowledge in determining useful life. The industries ensure structural integrity by periodic inspections. However the decision on inspection, repair and maintenance so far has been made based on experience. This needs to be rationalized through integration of Fracture mechanics, NDE and Failure analysis. The combined advances in these areas have radically changed the approach to design and manufacturing in recent times. Fracture mechanics and Failure analysis have emerged as powerful tools in designing processes and products to enhance operational efficiency and safety. Industries today need a skilled manpower conversant with Fracture mechanics and Root cause failure analysis. This Workshop is designed to provide training and learning to cover the gap between the syllabus prescribed by Universities and the Graduate attributes required by the Industries. The objective is to bridge the knowledge gap between existing course curriculum and connect academic research with Industrial problems. It intends to develop a skill and sound understanding of how to evaluate products and processes, predict and eliminate defects, increase productivity and quality at decreased cost.

Course coverage (SEPTEMBER 26-27,2023)

The following topics are tentatively planned to be covered

- Defects leading to fracture, Role of Failure analysis in design
- Basic approaches to failure analysis
- Overview of Fracture Mechanics and Defect tolerant design
- Determination of material toughness parameters like K_{1c}, J_{1c} and CTOD
- Application of Fracture mechanics for Fatigue and Environmental assisted cracking
- Detection and characterization of defects using NDT techniques
- Degradation monitoring, Life assessment and its extension
- Quantitative NDE for fitness for purpose assessment.
- Modes and Mechanism of Failure and Root cause failure analysis
- Corrective and preventive measures to minimize failures in different sectors of industries
- Application Fracture mechanics in failure assessment diagram and industrial problem solving

The theory lectures shall be supplemented by hands-on training on fracture toughness testing and fracture characterization using optical and electron microscopy

Faculty

Faculty will be drawn from educational institutes and research establishments like IITs and Department of Atomic Energy as well as from outside research establishments including industry.

Registration Charges

Category	Fees
SFA & Members of other professional societies	3000/-
Non Members	5000/-
Faculty Members	1500/-
Student Participants	500/-

The event can be sponsored by donating Rs. 25000/-
Sponsorship entitles mention on banners and free registration for two delegates.

Coordinator
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Mobile :- 09869236812 Fax :- 2748 3208
Email :- rssppa@gmail.com / rcprasad@mes.ac.in
Web :- www.sfa.mes.ac.in

Payment may be made through DD / Cheque drawn in favor of'R&D PHCET.
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MAHATMA EDUCATION SOCIETY

A TRUSTED NAME IN EDUCATION SINCE 1970

INSTITUTIONS CONDUCTED

SCHOOLS

(S.S.C. PROGRAMME)

- **Chembur English Pre-Primary & Primary School** - *Chembur*
- **Chembur English High School** - *Chembur*
- **Chembur Marathi Madhyamik Shala** - *Chembur*
- **Powai Marathi Madhyamik Shala** - *Powai*
- **Mahatma School of Academics and Sports** - *Khanda Colony, New Panvel* (Pre-Primary, Primary & Secondary, English & Marathi Media)
- **HOC International School** - ***Rasayani*** **(English & Marathi Media)**

(CBSE PROGRAMME)

- **Mahatma International School** *Khanda Colony, New Panvel*
- **HOC International School** - *Rasayani*

JUNIOR COLLEGES

- **Chembur English Junior College** - *Chembur*
- **Mahatma Night Junior College** - *Chembur*
- **Mahatma School of Academics & Sports, Junior College of Arts, Science & Commerce** *Khanda Colony, New Panvel*
- **HOC Junior College** - ***Rasayani*** (Junior College of Arts, Commerce, Science with Vocational)

TEACHERS' TRAINING INSTITUTIONS

D.T.Ed. B.Ed. B.P.Ed. M.Ed. Ph.D.

Approved by National Council for Teacher Education (NCTE) (Affiliated to the University of Mumbai & Recognised by Govt. of Maharashtra.)

- **Mahatma Junior College of Education (D.T.Ed.)- *Chembur*** (English & Marathi Media)
- **Pillai College of Education & Research (B.Ed.),** Chembur **Re-Accredited 'A' Grade by NAAC**
- **Pillai College of Education & Research (B.Ed.),** Accredited 'A' Grade by NAAC *Khanda Colony, New Panvel*
- **Pillai HOC College of Education & Research (B. Ed),** ***Rasayani***
- **Vidyadhiraja College of Physical Education & Research (B.P.Ed),** *Khanda Colony, New Panvel*
- **Pillai College of Education & Research (M.Ed.),** Chembur
- **Pillai College of Education & Research (M.Ed.),** Accredited 'A' Grade by NAAC *Khanda Colony, New Panvel*
- **Pillai College of Education & Research (Ph.D Centre),** *Khanda Colony, New Panvel*

INTERNATIONAL SCHOOLS & INTERNATIONAL JUNIOR COLLEGES

(CIPP / IGCSE/ICSE/IB SCHOOLS) — 'AS' / 'A' level and 'IB' Programme

- **Dr. Pillai Global Academy**
- **Gorai**
- **New Panvel**

POLYTECHNIC (3-Year Diploma Programme)

AICTE Approved, Recognized by Govt. of Maharashtra & Affiliated to MSBTE

- **Pillai HOC Polytechnic** - ***Rasayani***

Diploma in Computer Engineering
Diploma in Electronics & Tele- communication Engineering
Diploma in Mechanical Engineering
Diploma in Civil Engineering

DEGREE COLLEGES

Bachelor and Master

(Affiliated to the University of Mumbai & Recognised by Govt. of Maharashtra.)

- **Mahatma Night Degree College of Arts & Commerce-** Chembur
- **Pillai College of Arts, Commerce & Science** - New Panvel **Re-Accredited 'A' Grade by NAAC**

B.Com.
B.Com. (Accounting & Finance)
B.Com. (Financial Markets)
B.M.S.
B.M.M.
B. Sc. (I. T.)
B. Sc. (Computer Science)
B.Sc. (Biotechnology)
M.Sc. (I.T.)
M.Sc. (Biotechnology)
M.Com.(Business Management)
M.Com. (Accounting & Finance)

- **Pillai HOC College of Arts, Science & Commerce** - ***Rasayani***

B.Com.
B.M.S.
B.Sc. (I.T.)
B.Sc. (Computer Science)
B. Com. (Accounting & Finance)
B.M.M.
B.Sc. (Maths, Chemistry, Biology & Physics)
B.A. (English Ancillary, History & Economics)

ARCHITECTURE

Bachelor and Master

(Approved by the Council of Architecture and AICTE) (Affiliated to the University of Mumbai & Recognised by Govt. of Maharashtra.)

- **Pillai College of Architecture** - New Panvel
- **Pillai HOC College of Architecture-** Rasayani (B.Arch.5-year degree course)

***M.ARCH.* (Urban Design)**

- **Pillai College of Architecture** - New Panvel
- ***Ph.D.***

MANAGEMENT COURSE

MMS

(Approved by AICTE) (Affiliated to the University of Mumbai & Recognised by Govt. of Maharashtra.) *NBA Accredited* *'A' Grade by DTE, Govt. of Maharashtra*

Pillai Institute Of Management Studies & Research - ***New Panvel***

- (MMS: 2-year Post-Graduate Course) **Executive MBA**
- **Pillai HOC Institute Of Management Studies & Research** - ***Rasayani*** (MMS: 2-year Post-Graduate Course)

ENGINEERING COURSE

Bachelor, Master & PhD

(Approved by AICTE) (Affiliated to the University of Mumbai & Recognised by Govt. of Maharashtra.) *NBA Accredited*

- **Pillai College of Engineering- New Panvel**

B. E. in Information Technology
B. E. in Computer Engineering
B. E. in Electronics Engineering
B. E. in Mechanical Engineering
B. E. in Electronics & Tele- communication Engineering
B. E. in Automobile Engineering
M. E. in Information Technology
M. E. in Computer Engineering
M. E. in Electronics Engineering
M. E. in Mechanical Engineering (CAD/CAM, Robotics)
M. E. in Mechanical Engineering (Thermal)

PhD (Technology)
Computer Engineering
Mechanical Engineering
Information Technology

- **Pillai HOC College of Engineering & Technology,** ***Rasayani*** **Accredited 'A' Grade by NAAC**

B.E. in Mechanical Engineering
B.E. in Electronics & Telecommunication Engineering
B.E. in Automobile Engineering
B.E. in Information Technology
B.E. in Computer Engineering
B.E. in Civil Engineering
B.E. in Electrical Engineering
M.E. in Mechanical Engineering (Machine Design)
M.E. in Electronics & Telecommunication Engineering
M.E. in Computer Engineering
M.E. in Civil Engineering (Construction & Management)

PhD (Technology)
Civil Engineering
Computer Engineering

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