

## *Message from the Chairman*

Greetings to all the members of the IIM Kalpakkam Chapter!

The year 2011 has been very fruitful and eventful for the Kalpakkam Chapter. Our Chapter took a lead in organising three major events namely, Structure and Thermodynamics of Emerging Materials (STEM 2011), Clinic for Failure Analysis (CFA-2011) and 6<sup>th</sup> International Conference on Creep, Fatigue and Creep-Fatigue Interaction (CF-6).

This year we started new theme meeting series called 'All about' for the benefit of young members of the Chapter and research fellows working in Kalpakkam complex. As part of this, we successfully organised 'All about- Electron Microscopy' and 'All about - Laser Materials Processing'. Exceeding the last year's performance, we arranged so far more than 10 colloquium lectures by eminent professionals and experts visiting Kalpakkam. We successfully conducted the 3<sup>rd</sup> Placid Rodriguez Memorial Lecture, jointly with the IIM Chennai chapter. I and my Executive Committee members express sincere thanks to all members of the Chapter for their co-operation and commitment that enabled us to take forward the Chapter.

In the coming months, we have planned BPMM Quiz, theme meetings, workshops, lectures and membership drive. We have to strive for excellence and exceed our own targets with respect to organising the events and activities towards giving much higher visibility of our Chapter. This requires more dedication and involvement of the EC members and more importantly, active participation of all the members.

We are committed to work towards successful execution of all the activities. I urge one and all to join us and extend their best co-operation and support.



**Dr. B.P.C. Rao**

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## IIM-KC Activities

### Prof. Brahm Prakash Memorial Materials Quiz

The flagship programme of the Chapter, Prof. Brahm Prakash Memorial Materials Quiz and Elocution Contest was held on 17<sup>th</sup> September 2011 in Convention Centre, Anupuram. This programme which is conducted with an intention of popularizing Materials Science and Engineering education among the young generation attracted 40 teams comprising of 80 students of class XI and XII, including two teams from Srilanka this year. 24 chapters of the Indian Institute of Metals from all over India supported the quiz programme by ensuring participation of their teams.

The programme started on 16<sup>th</sup> September 2011 with 'Metal Camp', a visit to the nuclear power facilities at Kalpakkam. On the same day, Prof. Brahm Prakash Memorial Lecture was delivered by Dr. S. Banerjee, Chairman, Atomic Energy Commission and Secretary, DAE, Govt of India at Vikram Sarabhai Auditorium by video conferencing.

The Quiz was held on 17<sup>th</sup> September 2011 at Convention Centre, Anupuram. 6 parallel sessions of preliminary rounds were followed by semifinals. Finals conducted by Dr. Sumanth C. Raman was closely contested between 6 teams from Bangalore, Trichy, Trivandrum and Khetrinagar. In a closely competed final, team from Trichy comprising of Masters A. S. Pon Aravindhnan and U. Vignesh of Sri Jayendra Swamigal Silver Jubilee Matric HS School, Tirunelveli were the winners and Masters Sagar Honnungar and M. Amernath of National Public School, Bangalore were the runners up. Both the winners and runners up were presented O.P.Jindal Award for the quiz, carrying total cash prize of Rs. 25,000/-, trophy, and Certificates of Merit by Shri. S.C. Chetal, Director, IGCAR. The winners and runners of the quiz event were also invited to receive their awards in NMD celebrations held in Hyderabad on 14<sup>th</sup> November 2011.

Along with the quiz an essay competition was held in three different topics namely 'Why Nanomaterials are Interesting?', 'Conductivity and Reflectivity of Metals' and 'Synthetic Materials'. Totally 23 essays were received out of which five were selected for an elocution contest judged by a panel of three judges, Dr. G. Sasikala, Dr. B.V.R. Tata, and Dr. R. Diwakar, of IGCAR. Master M.R. Prajot from Delhi Public School was adjudged as the winner and Masters. Damonjodi and Parthasarathi Panda of DAV School, Bistupur were declared as the runners up. Shri. S.C. Chetal, Director IGCAR awarded cash prize of Rs. 10000 for the winner and Rs. 5000 for the runners up along with trophy and certificates. The awards were sponsored by the Kalpakkam Chapter. To mark this event, a quiz digest was also brought out containing edited versions of selected elocution entries.

### Placid Rodriguez Memorial Lecture

The third PRML-2011 lecture jointly organized by the Kalpakkam and Chennai chapters of the Indian Institute of Metals was held on 5<sup>th</sup> October 2011 at SRI Convention Centre, Anupuram (Kalpakkam). Dr. S. Srikanth, Director, National Metallurgical Laboratory, Jamshedpur delivered the PRML lecture on "Modelling the Thermodynamics and Kinetics of Oxidation of Multiphase Multi-component Alloys". During the occasion CD and books containing the manuscript and presentation of the PRML lecture were distributed to the members present. The participants, around 150 in number, constituted a wide spectrum of age group, from young trainees and research scholars in the area of materials science to experienced scientists in the area of physical metallurgy and thermo-dynamics.

## Workshop

### Structure and Thermodynamics of Emerging Materials (STEM 2011)

BRNS sponsored 'STEM-2011' focusing on "Diffusion, Mass Transfer and its Consequences in Materials was organized jointly by Indra Gandhi Centre for Atomic Research and The Indian Institute of Metals – Kalpakkam Chapter during November 24-26, 2011 at Convention Centre, Anupuram. On the first day, invited lectures were delivered by eminent experts from leading national R&D institutions and academia covering aspects related to mass transport in materials of importance to the power generation industry, diffusion bonding of dissimilar materials, diffusion studies with respect to materials used in the back end of the fuel cycle and the Kirkendall effect in solid state interdiffusion. On the second day, tutorial type lectures and practical demonstrations were held on the application of Monte Carlo and molecular dynamic simulation techniques to study the diffusion of atoms. On the third day the participants were taken for field visit to MAPS and also to Laboratories in the Physical Metallurgy Group. About 120 specialists, delegates and students from various institutes such as Indian Institute of Science, IITs, NIT, Sandvik, IPR, Anna University, Bengal Engineering College, and other engineering/science colleges, and from DAE units of BARC, NFC and IGCAR participated in the two-day deliberations. The technical program was appreciated by the participants, and valuable inputs for future theme meetings were provided during the feedback session at the end of the theme meeting.

### Clinic for Failure Analysis (CFA-2011)

BRNS sponsored two day workshop CFA-2011 was jointly organized by the Society for Failure Analysis, Hyderabad and IIM Kalpakkam Chapter during 22-24<sup>th</sup> December 2011 in IGCAR, Kalpakkam. The event was inaugurated by Dr. K. Tamilmani, chief executive, CEMILAC, Bangalore. Several lectures were organized covering different aspects of failure analysis like 'General methodology to be adopted emphasizing design against failures', 'Energetics involved in crack initiation and propagation', 'Service and fabrication related issues and case studies', 'Importance of fine micro-cracks and deformation mechanism and role of environment on failure initiation', 'NDT techniques to monitor propagation of micro-cracks', 'Issues in chemical industries and corrosion', 'Tribological failures in engineering systems' and 'Advanced techniques in failure analysis'. The clinic received very good response with 55 outside participants and 14 invited speakers from various national labs, academic institutions and other DAE units. In addition to the lectures there were practical demonstration sessions and also a poster session giving opportunity for the participants to interact and share their work with others.

### 6<sup>th</sup> International Conference on Creep, Fatigue and Creep-Fatigue Interaction (CF-6)

This conference was organized jointly by IGCAR, IIM Kalpakkam Chapter and the Metal Sciences Division of The Indian Institute of Metals during 22-25<sup>th</sup> January, 2012 in Radison Temple Bay Resort, Mamallapuram. The conference was sponsored by BRNS and Co-Sponsored by The Japan Society of Mechanical Engineers, The Society of Materials Science, Japan, The Korean Society of Mechanical Engineers and The Korean Institute of Metals and Materials. Eminent experts in the areas of creep, fatigue, creep-fatigue interaction, materials development and high temperature design were invited to share their knowledge and perspective on these topics during the conference.

## IIM-Kalpakkam Chapter EC Members

Dr. B.P.C. Rao	- Chairman	Shri. V. Karthik	- Member
Dr. P. Parameswaran	- Vice-Chairman	Shri. A. Ravishankar	- Member
Smt. C. Sudha	- Secretary		
Shri. A. Viswanath	- Joint Secretary	Shri. S. Nagaraju	- Co-opted Member
Smt. N. Sivai Bharasi	- Treasurer	Shri. Sunil Goyal	- Co-opted Member
Dr. Rani P. George	- Member	Dr. R. Krishnan	- Co-opted Member
Dr. Arup Dasgupta	- Member	Shri. M. Shanmugavel	- Co-opted Member
Smt. B. Sasi	- Member	Dr. U. Kamachi Mudali	- Ex-Officio Member
Dr. R. Ramaseshan	- Member		

## Theme Meetings

### *All about Electron Microscopy*

A theme meeting on 'All about Electron Microscopy' was organized in IGCAR, Kalpakkam on February 2, 2012 by IIM Kalpakkam Chapter. The theme meeting started with an opening remark by Dr. B.P.C. Rao, Chairman, IIM Kalpakkam Chapter on the genesis of the Chapter's Theme Meetings and reframing them as "All about..." series that aims covering both basics and recent advances in one popular area, for the benefit of young colleagues and newly joined members. He highlighted the importance of electron microscopy during material design, material selection, manufacturing, quality control, damage assessment etc. He lauded the efforts of Dr. Arup Dasgupta, Convener of this first theme meeting.

Dr. Arup Dasgupta delivered the first lecture on basics of electron microscopy, contrast mechanisms and imaging techniques. The second and third lectures were focused on analytical electron microscopy and delivered by Dr. R. Mythili and Ms. C. Sudha, respectively. Dr. Mythili gave a detailed account of the EDS and EELS techniques using an electron microscope. Later, Ms. Sudha explained the WDS technique in detail covering various aspects of the analyzing crystal, X-ray detectors and the method adopted for accurate quantitative assessment of chemical composition in a material. The final lecture was delivered by Dr. Joysurya Basu on high resolution electron microscopy bringing out the importance of the knowledge on lens errors and how to correct them in order to achieve well resolved phase contrast imaging of atomic columns in a material. The theme meeting was attended by about 50 scientists, engineers and research scholars of the center, with very good interaction between faculty members and attendees.

*For more details, please contact Dr. Arup Dasgupta (arup@igcar.gov.in)*

### *All about laser Materials Processing*

One day theme meeting on "All about Laser Materials Processing" at CMPL Seminar Hall, IGCAR, Kalpakkam on February 14, 2012. The theme meeting started with an opening remark by Dr. B.P.C. Rao, Chairman, IIM Kalpakkam Chapter and he emphasized the importance of lasers as a powerful materials processing tool and outlined the emerging industrial scenario evolved around the development of high power lasers and beam steering optics. Dr. B.P.C. Rao appreciated the best efforts put by Dr. R. Krishnan of MSG, who is also the convener of this theme meeting.

The theme meeting started with an overview talk by Dr. R Krishnan who covered the fundamentals and applications of lasers in materials processing and described CO<sub>2</sub>, Nd:YAG and diode lasers. He explained the important surface engineering processes viz., laser surface modification, duplex surface engineering and laser shock peening and concluded with possible directions for future. Prof. M.S. Ramachandra Rao of IITM, Chennai presented a pedagogical talk on synthesis of novel materials, thin films and nanostructures using pulsed laser deposition technique describing in depth various thin film growth modes and effect of various process parameters on the final product. Dr. C.K. Srinivasa, Head, Ultra Precision Engineering Unit, Central Manufacturing Technology Institute, Bangalore spoke on Direct Metal Deposition (DMD) and Direct Metal Laser Sintering (DMLS) of both metallic and composite components. Dr. S. Murugan, MMG delivered the lecture on laser welding of precision engineering components relevant to nuclear applications including Eddy Current based Position Sensor (ECPS) and Sodium Leak Detectors (SLD) in Diverse Safety Rod Drive Mechanism (DSRDM) of PFBR, components for High Dose Rate (HDR) source for Board of Radio Isotope Technology (BRIT) and development of experimental instrumented capsule for irradiation of structural materials in FBTR. The talk was well received by student members and research scholars. The theme meeting was attended by more than 30 scientists, engineers and research scholars and project students from the centre and a very good interaction between faculty members and attendees was observed.

*For more details, please contact Dr. R. Krishnan (krish@igcar.gov.in)*

## Events to look out for

Events	Convener	Date
BPM MQ 2012 (www.iim-kalpakkam.in)	Dr. Aniruddha Moitra	15 <sup>th</sup> September 2012
<b><i>IIM Co-organized Events</i></b>		
11 <sup>th</sup> International Conference on High Nitrogen Steels and Interstitial Alloys (HNS 2012)		27-29 <sup>th</sup> September 2012, Chennai
Structure and Thermodynamics of Emerging Materials (STEM 2012) on "Challenges and issues in surface modification, thin films and coatings "		5-6 <sup>th</sup> November 2012 , Chennai

## Technical Lectures

S. No.	Title of the talk	Name of the speaker	Affiliation	Date
1	Morphological variation in metal oxide systems Produced through SILAR method	Dr. R.Chandramohan	Sree Sevugan Annamalai College,Devakottai	27.04.12
2.	Continuum damage mechanics based methodology for Structural safety and residual life against creep damage	Dr. Sayan Gupta	IIT, Madras	30.03.12
3.	Sintering Behavior / Kinetics of Nanocrystalline Titanium Powders	Dr. Vikram Dabhade	IIT, Roorkee	27.03.12
4.	Solar energy engineering	Prof. V.S. Raghunathan	Meenakshi Sundarajan Engg.College, Chennai	02.03.12
5.	Nanostructures via Thermal Spray:Processing, Properties and Modelling	Prof.Christopher Berndt	Swinburne University of Tech., Melbourne, Australia & President, ASM International, USA	15.02.12
6.	Photothermal microscopy & Related Techniques for Materials	Prof. Oscar. E. Martinez	Universidad de Buenos Aires. Argentina	13.02.12
7.	Effect of variable loading amplitude on initiation of fatigue micro-	Dr. Christian Robertson	CEA, France	31.01.12
8.	Probing internal selective oxidation under conditions relevant to cooling of hot-rolled steel coils	Dr.Srinivasan Swaminathan	Christian Doppler Laboratory for Diffusion & Segregation, Max-Planck-Institut für Eisenforschung	03.01.12
9.	Non-Destructive Evaluation of Concrete Structures using Microwaves	Dr. Thomas Kind	Federal Institute for Materials Research and Testing, Berlin, Germany	13.12.11
10.	Cross over of the nanosecond technology & Nano-technology for eco-technology	Prof. T. Nakayama	Nagaoka University of Technology, Japan	01.12.11
11.	Plasticity in Metallic Glass	Dr. K. Mondal	Dept. of Mater. Sci. and Engg., IIT, Kanpur	22.11.11
12.	Radiation Damage in RPV Materials	Prof. Milan Brumovsky	Nuclear Research Institute Rez., Div. Integrity & Tech. Engg., Czech Re-	17.11.11
13.	Small Punch Testing for Tensile and Fracture Behaviour - Experiences and Way Forward	Prof. Karel Matocha	Material & Metallurgical Research Ltd.,Czech Rep.	08.11.11

## Article

### Evaluation of microstructural, mechanical properties and corrosion behaviour of structural material exposed in a dynamic bi-metallic sodium loop

In the prototype fast breeder reactor (PFBR) at Kalpakkam, liquid Sodium is used as coolant. AISI type 316LN stainless steel has been selected as structural material in the primary circuit in order to circumvent the problem of sensitization and related aqueous corrosion issues during fabrication and storage. Modified 9Cr-1Mo steel has been selected as the construction material for steam generators mainly due to its resistance to waterside corrosion, such as chloride and caustic stress corrosion cracking and adequate high temperature mechanical properties. The compatibility of these materials with liquid sodium is of utmost importance for the safe operation of the reactor. Though localized electrochemical corrosion of structural materials is absent in sodium, liquid sodium can slightly dissolve some of the constituents of stainless steel at high temperatures, which then get deposited at different regions. This mass transfer is influenced by impurities such as oxygen because of formation of ternary oxides of sodium

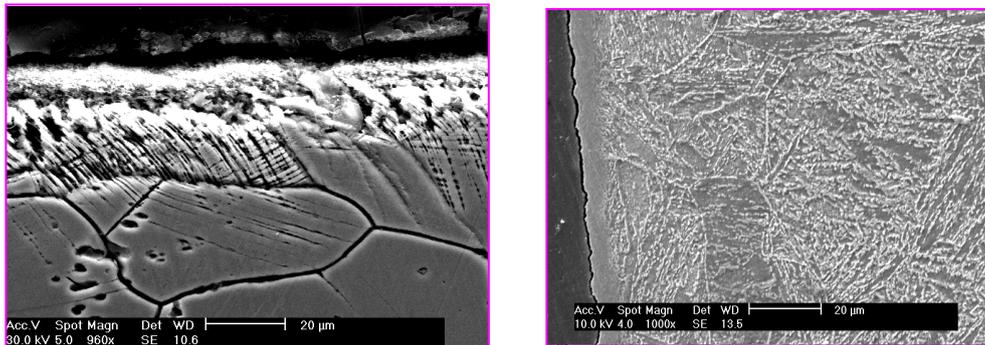
Complete loss of material due to leaching, leading to reduction in wall thickness, preferential leaching of elements forming modified surface layer, formation of a carburized or decarburized layer beneath the modified surface layer depending on the carbon activity difference between sodium and steel, temperature, and duration of exposure and precipitation of carbides in the matrix brought about by thermal effects coupled with carbon transfer are the different processes involved in the corrosion by liquid sodium at high temperatures. Several countries in the world have carried out experiments in flowing sodium with very low carbon concentrations, of less than 5 ppm, in order to assess the extent of carburization and its consequent changes in mechanical properties.

The observations and predictions made in the literature cannot be extended to the present study since Indian sodium contains relatively high concentration of carbon of the order of 25 ppm. To get insight into the long term carburization/decarburization behavior, the changes in the microstructure and mechanical properties of type 316LN stainless steel and modified 9Cr-1Mo steel in the simulated environment of the secondary circuit of PFBR (comprising of the IHX and steam generator), samples of these steels were exposed in a bi-metallic (BIM) sodium loop for 16000 hours at 708K. Microstructure was examined by SEM, elemental depth profiling was carried out by using EDAX. Tensile, Impact and microhardness tests were carried out and evaluated.

From the microstructural analysis, a modified ferrite layer of about 5  $\mu\text{m}$  width was detected on the surface of type 316LN stainless steel after sodium exposure. No such microstructural changes were observed on the surface of modified 9Cr-1Mo steel. SIMS investigations confirmed surface carburization of both the materials. The maximum surface carbon concentration in 316LN stainless steel was 0.37 wt% and the carburization depth was around 100  $\mu\text{m}$ . In the case of modified 9Cr-1Mo steel, the carbon concentration at the surface was 3.50 wt%. The depth of carburization was nearly 75  $\mu\text{m}$ . EDAX analysis showed decreased values of nickel and chromium contents on the surface of 316LN stainless steel. Nickel content was 4 wt% at a distance of 2  $\mu\text{m}$  from the surface and then gradually increased and attained its original concentration of 11.33 wt% at around 30  $\mu\text{m}$ . Chromium content was also 4 wt% up to a depth of 10  $\mu\text{m}$ , thereafter increased and obtained its original concentration of 16.58 wt% at around 26  $\mu\text{m}$ , shown in Fig.1. No such compositional changes were observed in modified 9Cr-1Mo steel. Preferential leaching of nickel promoted the formation of ferrite layer to about 5  $\mu\text{m}$  in the case of type 316LN stainless steel. Type 316LN stainless steel and modified 9Cr-1Mo steel showed a surface hardness increase up to about 70  $\mu\text{m}$  on sodium exposure. Tensile properties of sodium exposed type 316LN stainless steel indicated a slight increase in YS and UTS and a large reduction in ductility vis-a-vis annealed material. Significant changes in strength and ductility were not observed on sodium exposure of modified 9Cr-1Mo steel. No changes in impact energy values were observed on exposure of type 316LN stainless steel to high temperature sodium. Decrease in impact energy was noticed in modified 9Cr-1Mo steel on exposure to high temperature sodium.

#### Reference:

Evaluation of Microstructural, Mechanical Properties And Corrosion Behaviour Of AISI Type 316LN Stainless Steel And Modified 9Cr-1Mo Steel Exposed In A Dynamic Bi-Metallic Sodium Loop At 798 K For 16000 Hours, N. Sivai Bharasi, K. Thyagarajan, H. Shaikh, A. K. Balamurugan, S. Venugopal, A. Moitra, M.Radhika, S. Kalavathy, S. Chandramouli, G. Sasikala, A. K.Tyagi, R. K.Dayal, and K. K. Rajan, **Metallurgical and Materials Transactions A**, Vol 43A Feb (2012) 561-571



Scanning electron micrographs of (a) 316LN stainless steel and (b) Mod.9Cr-1Mo steel

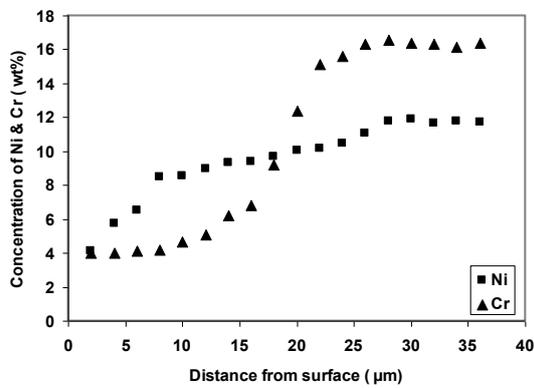


Fig.1. Elemental concentration profiles for Cr and Ni of 316LN stainless steel exposed to sodium for 16000 hours at 525<sup>o</sup>c

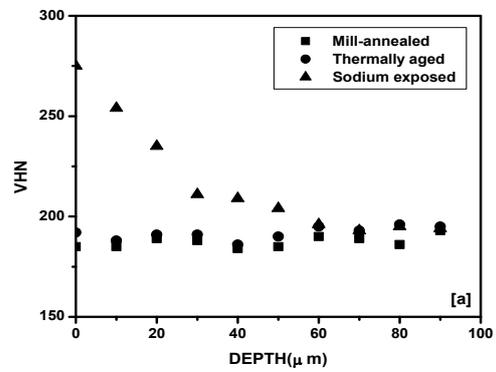


Fig.2. Microhardness profile of stainless steel

Table 1. Tensile and impact data of 316LN stainless steel and (b) modified 9Cr-

Material condition	YS(MPa)	UTS(MPa)	TE(%)	Impact energy
316LN SS:mill-annealed	324	627	66	144
316LN SS: aged	324	632	66	169.5
316LN SS Na- exposed	356	657	43	136
Mod.9Mr-1Mo N&T	510	629	20	99
Mod.9cr-1Mo aged	533	700	19	47.5
Mod.9Cr-1MoNa-exposed	514	711	17	56.5

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## Article

### Relevance of Molecular Biology Techniques in Microbiologically Influenced Corrosion (MIC) and Biofouling Studies

Materials exposed to natural waters in cooling water system of several industries are prone to biofilm formation by the microbial consortia present in these waters. These microbes in the aquatic systems adhere on to material surface, secrete slime, trap nutrients, and reproduce resulting in a complex biofilm, which hampers the properties of the materials. They can cause heat transfer and fluid flow resistance in condenser materials and may also accelerate microbiologically influenced corrosion (MIC) beneath these deposits. Several methods are used for the control of industrial biofouling and MIC, important among which are chlorination (continuous/intermittent), heat treatment, on-line mechanical tube cleaning, oxygen scavenging etc. However, many of these techniques singly nor in-group is unable to deliver a clean cooling water system. Hence, these days more importance is given to develop early biofilm monitoring and surface modification techniques that can effectively supplement the present treatment programmes.

The methods used to assess the effectiveness of these methods involve enumeration and isolation in nutrient media by culturing in nutrient agar to get the total viable density of cells, followed by testing for physiological and biochemical traits. Thus success of all the experiments depends upon the ability to culture all the microorganisms in the sample. However, a microbial ecologist faces several constraints like 1) many microbes resist culturing, 2) several microbes do not have distinct morphological characteristics, and 3) physiological traits of many microbes are ambiguous.

Literature [1] clearly shows that cultivability determined as a percentage of culturable bacteria in comparison with total cell counts is often in the range of 0.1 to 0.3 %. Thus biologists have come up with a new method to access and enumerate microbial diversity by analysis of r RNA molecule. The desirable properties of r RNA is that it is the key element of protein synthesizing machinery, it is a very ancient molecule and extremely conserved, identifiable by size and has sufficient sequence information that permits statistical analysis. 16S r RNA molecule of each species can be amplified by polymerase chain reaction (PCR) technique using a thermal cycler. Then the sequence characterization of this molecule helps to get the phylogenetic information that can be used to identify the microbes, and oligodeoxynucleotides complementary to these conserved sequence domains can be synthesized and used as hybridization probes [2]. Thus nucleic acid hybridization probes labeled with fluorescent dyes (FISH) permit uncultivable organism to be characterized phylogenetically and can also quantitate microorganisms in mixed microbial populations especially biofilms [3].

Fig. 1 shows epifluorescence micrographs of Multi Color FISH sample of three closely related species of a bacterium *Acinetobacter*. Three color simultaneous detection of three different species were done by hybridizing with polynucleotide transcript probes carrying dyes. FISH also gives additional information on changes in cell size and morphology. Fluorescence intensity can be used to infer the activity of cells also.

The application of Denaturing Gradient Gel electrophoresis (DGGE) system range from species identification to delineation of population structure to monitoring genetic diversity. This is a powerful culture-independent approach for assessing microbial genetic diversity in the natural environment like biofilms on materials. From a biofilm where there is a mixture of microbes with only few base differences in the key 16S rRNA molecule, DGGE can separate and amplify variable regions and the resulting diversity patterns analyzed and compared. In this electrophoresis system a constant heat of 60°C and an increasing concentration of denaturing chemicals are used to force DNA molecules to unwind and migrate. They migrate to different positions of the gel depending on the sequence of DNA. Fig. 2 shows a DGGE gel showing band compositions of various population samples, representative of complex microbial systems.

Each band in each lane represents a 16S amplified product migrating to a unique position in the gel, which melts in a sequence dependent manner. The major advantage of this technique is the direct and speedy determination of bacterial genetic diversity in biofilms. This information will give us a true picture of effectiveness of various surface modification techniques in making the surface antibacterial and non-conventional biofouling control techniques. Additional highlight of this technique is the identification of particular group of microbes that are affected by various surface modification techniques.

Thus molecular technology tools like PCR, DGGE and FISH probes can be used effectively in MIC and biofouling studies

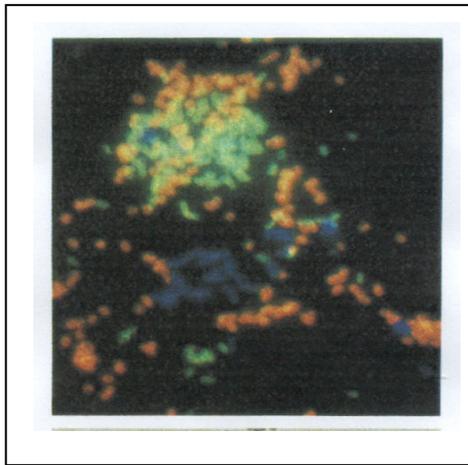


Fig.1. Multi Color FISH sample of three closely related species of a bacterium *Acinetobacter*

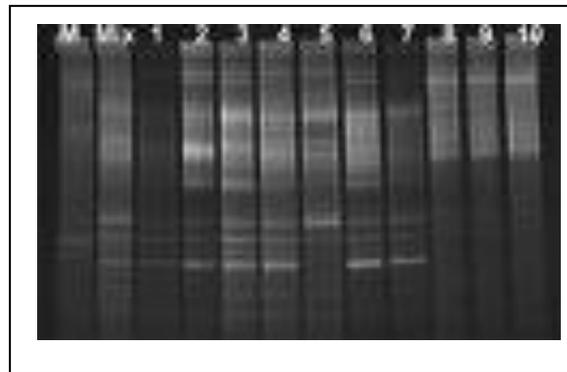


Fig.2. DGGE gel showing band compositions of various population samples

#### References:

- (1). Staley, J.T. and Konopka, A., Annual Review of Microbiology, 1985, 39: 321-346.
- (2). Annette Moler, Ulf. B. Gobe, "FISH for direct visualization of microorganisms", J. of Microbiological Methods, 2000, 41: 85 – 112.
- (3). Amman, R.I., Ludwig, W. and Schleifer, K.H., "Phylogenetic Identification and In situ detection of individual Microbial cells Without Cultivation", Microbiological Reviews, 1995, 59: 143-169.

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### APPLICATION FORM FOR MEMBERSHIP

MEMBER  / ASSOCIATE MEMBER  / STUDENT MEMBER  / LIFE MEMBER  /  
 SUSTAINING MEMBER  / SUSTAINING MEMBER(SS)  / PATRON MEMBER  / DONOR MEM-  
 BER  / AFFILIATE MEMBER  / OVERSEAS MEMBER  / LIFE ASSOCIATE MEM-  
 BER  / STUDENT AFFILIATE MEMBER

(Please tick whichever is applicable)

Membership No.	Date of Enrolment	
Receipt No.	Date	Amount
Name of the applicant : (In Block Letters)		
Father's Name : (In Block Letters)		
Permanent Address : (Please indicate PIN Code)		
Address for Correspondence: (In Block Letters) (Please indicate PIN Code)		
Qualifications :		
Date of Birth :		
Experience (in years) :		
Name & Designation : Head of the Organisation (applicable for Sustaining / Patron / Donor Membership only)		
Tel./Fax/E-mail/Website :		
Present Occupation :		
( Please see overleaf)		

Endorsement (by 3 IIM Members (not Student) or the Employer who know the applicant well)	<u>Name</u>	<u>Membership No.</u>	<u>Signature</u>
	1. _____	_____	_____
	2. _____	_____	_____
	3. _____	_____	_____
Primary field of interest : (Please mark 1, 2, 3 in order of preference)	Ferrous Production ( )	Non-Ferrous Production ( )	
	Mining Beneficiation ( )	Designing & Engineering ( )	
	Govt./Education ( )	Research ( )	
Name of the Chapter you intend to be attached :			

I agree, if elected, to accept election, pay the prescribed fees, to abide by the Articles of Association of the Institute and to promote its aims and objects.

\_\_\_\_\_  
Signature of the Applicant

(For Student Members only)

I undertake to appear at the Associate Membership Examination of the Institute as per the existing rules after election and to appear at the AMIIM Examination within 18 (eighteen) months from the date of enrolment as Member subject to fulfilling all the eligibility rules. (To be signed only by applicant for Membership aspiring for appearing at the AMIIM Examination)

\_\_\_\_\_  
Signature of the Applicant

**Admission Fees & Subscriptions Payable by the Applicants**

<b>MEMBER</b>	Rs.300/- as Admission Fees & Rs.450/- as an annual subscription.
<b>ASSOCIATE MEMBER</b>	Rs. 250/- as Admission Fees & Rs. 350/- as an annual subscription.
<b>STUDENT MEMBER</b>	Rs.75/- as Admission Fees & Rs.600/- towards 3 (three) years subscriptions, and Rs. 150/- towards registration fees, viz. A total of Rs.825/-.
<b>STUDENT MEMBER</b> (College Students studying Metallurgy)	Rs.75/- as Admission Fees & Rs.200/- as an annual subscriptions
<b>LIFE MEMBER</b>	Rs. 300/- as Admission Fees & Rs. 6000/- as Membership Fees Or Rs. 300/- as Admission Fees & Rs.3200/- each in two installments as Membership Fees, within the same Financial Year
<b>LIFE ASSOCIATE MEMBER</b>	Rs. 3,000/- in a single installment or Rs. 3200/- in four installments of Rs. 800/- each, within the same Financial Year.
<b>SUSTAINING MEMBER</b>	Rs. 10,000/- per annum.
<b>SUSTAINING MEMBER (SS)</b>	Rs. 6000/- per annum.
<b>PATRON MEMBER</b>	Rs.2,50,000/- in one installment or 6 (six) annual installments of Rs.45,000/- each.
<b>DONOR MEMBER</b>	Rs.1,25,000/- in one installment or 6(six) annual installments of Rs.22,500/- each.
<b>AFFILIATE MEMBER</b>	Rs.400/- as Admission Fees & Rs.650/- as an annual subscription.
<b>STUDENT AFFILIATE MEMBER</b>	A Student Affiliate Member shall not pay any admission fees and subscription.



**THE INDIAN INSTITUTE OF METALS  
METAL HOUSE, PLOT-13/4, BLOCK-AQ  
SECTOR – V, SALT LAKE**

**KOLKATA – 700 091**

**Tel: 2367-5004 : Fax:033-2367 5335**

**E-mail: iiomcal@dataone.in**

**Website : www.iim-india.net**

**MEMBERSHIP RULES**

**MEMBERSHIP :**

There shall be the following classes of membership:

(a) Members, (b) Associate Members, (c) Student Members, (d) Life Members, (e) Honorary Members, (f) Sustaining Members, (g) Patron Members, (h) Donor Members, (i) Affiliate Members, (j) Fellows (omitted w.e.f 1.8.2000) , (k) Life Fellows and (l) Overseas Members. ( w.e.f 1.8.2000), (m) Life Associate Members, (n) Student Affiliate Members.

**QUALIFICATION:**

	(a)	<b>Members:</b> A candidate for admission to the class of Members or for transfer into the class shall not be less than 25 years of age;  AND
	(i)	Shall hold the Bachelor's Degree in Metallurgy or equivalent discipline from an Institute recognized by the Council or should have passed Parts I and II Examinations held by the IIM with at least 3 years experience;  OR
	(ii)	Shall hold a Master's Degree in Metallurgy or equivalent degree recognized by the Council and with one year experience;  OR
	(iii)	Shall hold a Bachelor's Degree in Engineering disciplines other than Metallurgy or equivalent or a Master's Degree or Doctorate in Physics or Chemistry or Geology with at least 5 years experience;  OR
	(iv)	Shall be a Diploma Holder in Metallurgy with at least 6 years experience;  OR
	(v)	Shall be a Diploma Holder in Engineering other than Metallurgy/B.Sc. with Physics, Chemistry, Mathematics/Geology and at least 7 years experience;  OR
	(vi)	Shall hold a Degree from a recognized University and shall be proposed / recommended by at least 3 Past Presidents of The Indian Institute of Metals.
	(b)	<b>Associate Members:</b> A Candidate for admission to the Class of Associate Members or transfer into the Class shall be not less than 20 years of age;  AND
	(i)	Shall hold a Bachelor's Degree in Metallurgy or an equivalent discipline from an Institute recognised by the Council or should have passed parts I & II Examination held by the IIM;OR
	(ii)	Shall hold a Bachelor's degree in Engineering discipline other than Metallurgy or equivalent or a Master's Degree or Doctorate in Physics or Chemistry or Geology with at least 2 years experience;  OR
	(iii)	Shall be a Diploma Holder in Metallurgy with at least 3 years experience;  OR

	(iv)	Shall be a Diploma Holder in Engineering other than Metallurgy/B.Sc. with Physics, Chemistry, Mathematics/Geology and at least 4 years experience.
<b>Note: EXPERIENCE</b>		
Experience in Research/Teaching/Industry after graduation shall be counted for eligibility to both the classes of Membership. Experience will be in the Metallurgical field and will not include the period of Registration for a Degree or Parts I & II of IIM Examinations.		
	(c)	<b>Student Members:</b> A candidate for admission into the class of student member category, shall be a person, who is being educated or being trained for and who intends to adopt the profession of a Metallurgist. Student members will automatically become Associate Members as soon as they acquire necessary qualifications.
	(d)	<b>Life Members:</b> A member shall be a life member on paying the prescribed fees.
	(e)	<b>Honorary Members:</b> Shall be a person of distinction in technology or public service.
	(f)	<b>Sustaining Members:</b> Shall be individual, companies, corporations, firms, industrial or trade associations or such other organisation as the Council may deem as properly coming under this classification.
	(g)	<b>Patron Members:</b> Any Company, Institution, Government Department, Corporation or individual, connected with the metallurgical industry, education research, will be eligible to be elected as Patron Members.
	(h)	<b>Donor Members:</b> Any Company which satisfies the qualification for a Patron Member, but whose annual turnover is less than Rupees five crores will be eligible for this class of membership.
	(i)	<b>Affiliate Members:</b> Shall be such other persons as are directly engaged in the promotion of science and art of making, shaping and treating of metals and alloys for a period of not less than 10 years who, in the opinion of the Council are qualified for membership; AND Any person who is not eligible for Membership of the Institute in any other way, but whose association with the Institute will in the view of the Committee be useful to the Institute may be elected as an Affiliate Member.
	(j)	<b>Fellows: (omitted w.e.f 1.8.2000)</b>
	(k)	<b>Life Fellows:</b> A candidate for admission to the class of Life Fellows shall have made contribution(s) in the field of Metallurgy of significance admitted by the Council of the Institute with reference to each individual case; AND Shall be not less than 40 years of age with 15 years standing as Member/Life Member and relaxable by the Council only in case of those with exceptional and outstanding contribution in the field of Metallurgy.
	(l)	<b>Overseas Members:</b> shall be individuals eligible to become members residing abroad.
	(m)	<b>Life Associate Members :</b> An Associate Member can become a Life Associate Member by paying the prescribed fees.
	(n)	<b>Student Affiliate Members :</b> Shall be a Member of a Student Affiliate Chapter of the Institute.

- Notes: 1. Please attach attested copies of Mark Sheets/Certificates wherever necessary.  
2. Payment should be made by DD favouring 'The Indian Institute of Metals, Kolkata.'  
For further details, please contact the IIM Head Office at Kolkata.

**ELECTION:**

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|-----|--|
| (a) | Application for membership shall be submitted on prescribed forms for the approval of the Council.   |
| (b) | Persons should be duly proposed for membership on prescribed forms by at least three members of the Institute of good standing. The Council shall have the right to reject any application for membership without assigning any reasons. Non-election shall not necessarily prejudice the candidate concerned, in any future application for election. |

**MEMBERSHIP DUES ( Accounting Year 1<sup>st</sup> April to 31<sup>st</sup> March) :**

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|-----|--|
| (a) | The annual subscription for Membership shall be Rs. 450/-.   |
| (b) | Members shall pay an admission fee of Rs. 300/-.   |
| (c) | Associate Members shall pay an annual subscription of Rs. 350/- and admission fee of Rs. 250/-.  |
| (d) | Student Members including College Students studying metallurgy shall each pay an annual subscription of Rs. 200/- and an admission fee of Rs. 75/-.  |
|     | <b>Note:</b> Student member other than College students studying metallurgy are required to pay registration fees Rs. 150/- and 3 (three) years subscription in advance at the time of enrolment, besides the admission fee of Rs 75/- viz total Rs 825/-. If any candidate does not appear at the AMIIM Examination within the specified period of 18 (eighteen) months, not only he/she will loose his / her candidature but also the advance subscription paid by him / her.  |
| (e) | Sustaining Members shall pay an annual subscription of Rs. 10,000/- provided that the Sustaining Members falling in the Small Scale Sector pay an annual subscription of Rs. 6000/-.   |
| (f) | A candidate is eligible to become Life Fellow on paying Rs 7000/- as subscription and an admission fee of Rs 400/- (subject to fulfillment of other criteria)  |
| (g) | (i) Subscription shall be payable along with the application on election and subsequently advance annually and shall be due in the month of April in each year.  |
|     | (ii) A member of thirty three years standing who has discharged all his dues to the Institute shall automatically become a life member.  |
| (h) | A member can become a life member on paying a subscription of Rs. 6000/- in a single installment or Rs 3200/- each in two installments, within the same financial year, while a member of 15 years standing can become a life member on paying a subscription of Rs. 4500/- in single installment or Rs 2400/- each in two installments, within the same financial year. A candidate eligible to become a member can also become Life Member on paying Rs 6000/- towards subscription and an admission fee of Rs 300/-. A Life Associate Member, if eligible, may transfer to the class of Life Membership by paying a subscription of Rs. 3000/- in a single installment or Rs. 3,200/- in two installments of Rs. 1,600/- each within the same financial year. |
| (i) | The minimum subscription for becoming a Patron Member will be Rs. 2,50,000/- payable in one installment (or six annual installments of Rs. 45,000/- each).   |
| (j) | The minimum subscription for Donor Members will be Rs. 1,25,000/- payable in one installment (or six annual installments of Rs. 22,500/- each).  |
| (k) | Affiliate Members shall pay an annual subscription of Rs. 650/- and an admission fee of Rs. 400/-.   |
| (l) | An Associate Member can become a Life Associate Member by paying subscription of Rs 3,000/- in a single installment or Rs 3,200/- in four installments of Rs 800/- each, within the same financial year.   |
| (m) | A Student Affiliate Member shall not pay any Admission Fees and Subscription.  |

“Provided that only half the amount of Annual Fee shall be payable for the first year by a person admitted on or after the first October of that year in the case of Members, Associate Members, Affiliate Members and Overseas Members.”

“Provided further that a Member/Associate Member/Affiliate Member/ Overseas Member who is of the age of 55 years or above and is not in any gainful employment or in practice, shall pay half the annual subscription relating to his/her class of Membership.” A member means Ordinary / Associate member.

**ABBREVIATION:**

The authorised abbreviation indicating the class of membership of the members of the Institute shall be as follows:

1. Member                    M.I.I.M.
2. Associate Member    A.M.I.I.M.
3. Life Member            M.I.I.M.(Life.)
4. Hon. Member          M.I.I.M(Hon)
5. Life Fellow             F.I.I.M (Life)

Contact us.....

## IIM KALPAKKAM CHAPTER

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*Please write to us with your valuable suggestions and enquiries about the activities of the IIM Kalpakkam Chapter. We would be most happy to reply.*

## Editorial

As we enter an era of rapid growth, our developmental index mainly relies on materials and processes. Subsequently, the increasing in production of primary metals and their effect on the environment are of greater concern. The bare necessity for a greener world and human survival with unabated progress calls for many such innovative technologies and inventions. As we increasingly recognise the efficient and innovative technologies of the future will require fundamental integration of all knowledge which should also include practitioners of sciences, economists, policy makers and social scientists. In this context, editors would like to utilise the e-newsletter “Materials Matter”, as a knowledge sharing open platform to increase our outreach to all segments of professionals.



Editor

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