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Metallurgy
Materials Engineering

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Materials Matter

E-news letter of IIM Kalpakkam Chapter

Indira Gandhi Centre for Atomic Research, Kalpakkam

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Chairman's Message

Dr. M. Vasudevan
Head, Materials Development and Technology Division
Metallurgy & Materials Group
Indira Gandhi Centre for Atomic Research, Kalpakkam

Warm greetings to all the members of IIM Kalpakkam chapter. It is my privilege to present the Materials Matter-2021, the *e-newsletter* of IIM Kalpakkam Chapter.

During this period, our Chapter organized several programs, courses and meetings along with annual flagship events. Due to the prevalence of Covid-19 pandemic, many of our programs were conducted online through the video conferencing mode on WebEx platform as well as live streaming through Youtube. Our flagship event Prof. Brahm Prakash Memorial Materials Quiz (BPMMQ) has been deferred. Instead of this, our chapter organized the Prof. Brahm Prakash Memorial Materials Event (BPMME) comprising only of Prof. Brahm Prakash Memorial Materials Lecture and Essay cum Elocution Contest. Dr. Placid Rodriguez Memorial Lecture (PRML) jointly organized by IIM Kalpakkam and Chennai Chapters was conducted through online mode. The lecture was delivered by Prof. Surya R. Kalidindi, Regents Professor, Georgia Institute of Technology, USA.

In addition to the annual events, our chapter also conducted different theme meetings, workshops and webinars on various topics of interest. Due to the Covid-19 pandemic, the technical lectures organized by IIM KC were only few this and I hope the number will be improved in coming year. Apart from these, I am happy to know that many of our members have won several national and international awards and recognitions. I congratulate all of them.

In this news letter, Dr. David Vijayanand V has presented an interesting article on "Creep damage in multi-pass welded austenitic stainless steel joint– A microstructural perspective". Finally, we all faced difficulties in discharging our duties effectively due to Covid Pandemic. Despite this, our chapter has successfully organized many programs. In this regard, I appreciate all the members who are behind in organizing these programs. All these activities/programmes could not have been achieved without the active support and encouragement of Dr. Shaju. K. Albert, Director, MMG & MSG, and Dr. A. K. Bhaduri, Director, Indira Gandhi Centre for Atomic Research, Kalpakkam. Finally, we rededicate ourselves to strive for the high standards in all our future endeavors.

Dr. M. Vasudevan.
Chairman, IIM Kalpakkam Chapter.

IIM Kalpakkam Chapter EC 2021-22

IIM Kalpakkam Chapter EC 2020-21

Chairman

Dr. Divakar R

Associate Director
Materials Engineering Group
MMG/IGCAR, Kalpakkam
Email: divakar@igcar.gov.in
Ph: 044-27480500-ext.22178

Honorary Treasurer

Dr. S. Ningshen

Head, ACPS, Corrosion Science and Technology Division, MMG/IGCAR, Kalpakkam
Email: ning@igcar.gov.in
Ph: 044-27480500-ext.22094

Dr. G. Sainath

Materials Development and Technology Division, MMG/IGCAR
Email: sg@igcar.gov.in

Dr. Diptimayee Samantaray

Materials Development & Technology Division, MMG/IGCAR
Email: deepsaroj@igcar.gov.in

Shri P. Vasantharaja

Materials Development & Technology Division, MMG/IGCAR

Email: vasanth@igcar.gov.in

Vice-chairman

Dr. M. Vasudevan

Head, Materials Development and Technology Division, MMG/IGCAR, Kalpakkam
Email: dev@igcar.gov.in
Ph: 044-27480500-ext.21216

Ex-officio Member

Dr. P. Parameswaran

Head, Physical Metallurgy Division, MCG/MMG, IGCAR , Kalpakkam
Email: param@igcar.gov.in
Ph: 044-27480500-ext.22473

Members

Dr. Ch. Jagadeeswara Rao

Corrosion Science and Technology Division, MMG, IGCAR
Email: cjrao@igcar.gov.in

Dr. Rani P. George

Head, SMCS, Corrosion Science and Technology Division, MMG/IGCAR
Email: rani@igcar.gov.in

Dr. R. Ramaseshan

Surface & Nanoscience Division, MSG, IGCAR, Kalpakkam

Email: seshan@igcar.gov.in

Shri S. AthimoolaKrishnan

Materials Development & Technology Division, MMG/IGCAR

Email: sakrish@igcar.gov.in

Honorary Secretary

Dr. V. Karthik

Head, SMCS, Post Irradiation Examination Division, MMG/IGCAR, Kalpakkam
Email: karthik@igcar.gov.in
Ph: 044-27480500-ext.26479

Joint Secretary

Dr. B. Anandkumar

SMCS, Corrosion Science and Technology Division, MMG/IGCAR, Kalpakkam
Email: anandb@igcar.gov.in
Ph: 044-27480500-ext.22072

Dr. Shyamala Rao Polaki

NCSS, Surface and Nanoscience Division (SND), MSG/IGCAR
Email: polaki@igcar.gov.in

Shri. V. Ganesan

CSS, Materials Development & Technology Division, MMG/IGCAR, Kalpakkam
Email: vgan@igcar.gov.in

Shri M. Shanmuga Sundaram

Rig Operations Division & SGTF, RDTG/IGCAR, Kalpakkam

Email: mss@igcar.gov.in

EDITORIAL

It's my privilege to bring you the latest issue of the IIM Kalpakkam chapter newsletter (Volume 10, Issue 1, 2021). It contains all the important activities/events organized by the Chapter during the year 2020-21.

This year, despite the challenges faced due to Covid-19 pandemic, our chapter has successfully organized many events, theme meetings, workshops and webinars, which catered the technical needs of our members and also sensitized the surrounding academic institutes about the importance of knowledge in materials science and engineering.

This year due to Covid-19, our flagship event, BPMMQ has been deferred. Instead of this, our chapter organized the Prof. Brahm Prakash Memorial Materials Event (BPMME) through webex platform. This event consisted of only Prof. Brahm Prakash Memorial Materials Lecture and Essay cum Elocution Contest. A brief report of this event has been presented in this newsletter.

The PRML was held online by video conferencing through Webex platform as well as YouTube streaming and it has been delivered by Prof. Surya R. Kalidindi from Georgia Institute of Technology, USA. The excerpt of this event has been presented in this newsletter.

This newsletter also contains a brief reports about various theme meetings, workshops and webinars conducted by chapter. This issue of IIM KC newsletter also has an interesting technical article by Dr. David Vijayanand V on "Creep damage in multi-pass welded austenitic stainless steel joint– A microstructural perspective". Also, I am happy to share with you the awards, honours and distinctions earned by our IIM members during the period.

Hope you enjoy reading this newsletter. Your comments and suggestions for further improvements are most welcome.

Dr. G. Sainath
Scientific Officer-E
Materials Development & Technology Division
Metallurgy & Materials Group
Indira Gandhi Centre for Atomic Research, Kalpakkam
Email: sg@igcar.gov.in

CONTENTS

EC meetings and Interactions with Head Office

The executive committee (EC) C had 5 meetings during this period. Our members are on the National Council of IIM and have consistently ensured representation at the Council meetings held online over the past year. Dr Divakar R., as Vice Chairman of Chapter Relations Committee (CRC), has played a lead role in enhancing the coordination among Chapters and monitoring the status of various Chapters. Our chapter has been regularly submitting the GST related transaction details to Head office to enable filing of GST returns in time. Our chapter has interacted with the head office for conducting the Platinum Jubilee Webinar series and was offered a slot in April 2021 for the lecture series.

Membership Details

- IGCAR has been a sustaining member of the Indian Institute of Metals (IIM) for many years now. During the period of this report, 4 new members have joined our Chapter. We welcome on board the new members and look forward for their active role in the chapter activities.
- The current membership of the Chapter stands at 221 with 162 life members (LM), 10 Fellow of IIM, 46 Associate members (AM), 2 Ordinary members (OM) and 1 student member (ST). The new membership took a hit this year because of the disruptions caused by Covid.
- In this period, 4 of our senior members namely **Dr. U. Kamachi Mudali**, **Dr. P. Parameswaran**, **Dr. S. Latha**, and **Sri N. Raghu** superannuated from their service in DAE. IIM Kalpakkam chapter records its appreciation of the services rendered by these eminent members to the materials and metallurgy community and in particular to our chapter activities. We wish them a healthy and prosperous life.

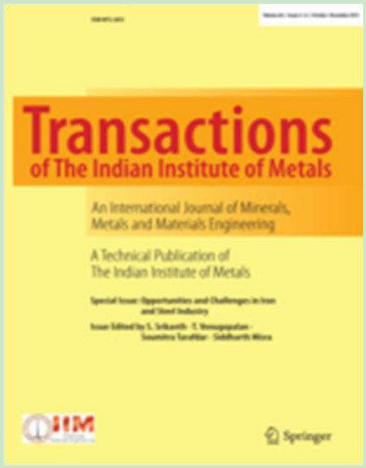
A glimpses of felicitation to retired members

Materials Endowment Fund (MEF)

Materials Endowment Fund (MEF) formed in 2009, has been supporting members of IIM KC to participate in international conferences, by providing partial travel grant. The MEF committee is headed by Dr. Shaju K.Albert, Director MMG & MSG as Chairman, Dr. V. Karthik as Secretary, Dr.Rani. P. George as Treasurer, and Dr. Divakar R and Dr. S. Ningshen as members. During this period, two of our chapter members were provided with partial support to attend international conferences held online.

Our Members in IIM Publications

- Transactions of the Indian Institute of Metals, a flagship international journal of the IIM is headed by Prof. B. S. Murty, Chief Editor and and Dr. Arup Dasgupta as Managing Editor. For the year 2019, the Impact Factor of the Trans. IIM is 1.205. It has clocked 1,04,002 downloads in 2020. The journal continues to maintain a high standard with more than 70% rejection rate.
- We are happy to note that many of our members are actively contributing to the success of the journal.
- During this period, one of our senior member, Dr. M. Vasudevan has been included as an Editor of the Journal.
- Our members, Dr. Chanchal Ghosh and Dr. Chittaranjan Das were awarded the best reviewers of Trans. IIM during the NMD-ATM 2020 and Dr Rani P George has been selected as a top reviewer.
- Our past members, Dr. T. Jayakumar and Dr. U. Kamachi Mudali were serving as members of Editorial Advisory Board.



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Dr. Chanchal Ghosh, Dr. Chittaranjan Das & Dr. Rani P George, All from MMG, IGCAR

IIM-Kalpakkam Chapter conducted the 28th Prof. Brahm Prakash Memorial Materials Event (BPMME) at Indira Gandhi Centre for Atomic Research, Kalpakkam on 28 November 2020 in a webinar mode using Webex platform. This time the event comprised only of Prof. Brahm Prakash Memorial Materials Lecture and Essay cum Elocution Contest with the deferment of Quiz grand finale.

The essay cum elocution contest was based on three topics (i) "Isotope based power sources for space applications" (ii) "Recovery of rare earths for self-sufficiency" and (iii) "Green Initiatives for Metals Industries". A total of thirty three essays (13 in Isotope based power sources; 11 in Rare earth recovery; and 9 in Green initiatives) were received from class XI and XII students across India through the fourteen chapters. All the 33 essays were evaluated by a three member jury of eminent experts from IIM Kalpakkam and eight best essays were selected for elocution contest.

On the BPMME event day (28 November 2020), Divakar. R., Chairman, IIM Kalpakkam welcomed the gathering. Dr. Shaju K. Albert, Director MMG & MSG and Chairman – BPMME 2020 presided the event and in his presidential address, emphasized on the importance of materials science and metallurgy with some interesting examples from the periodic table elements. Dr. B. Anandkumar, Convener BPMME-2020 briefed about the genesis of BPMMQ since inception and its growth into an annual flagship event of IIM Kalpakkam Chapter.

Dr. U. Kamachi Mudali delivering the BPMML 2020 Lecture

Dr. U. Kamachi Mudali, Former Distinguished Scientist & Chairman and Chief Executive, Heavy Water Board, DAE and Immediate Past President, IIM delivered 28th Prof. Brahm Prakash Memorial Lecture 2020 on the topic "Urban Mining of E-waste: Challenges and Technologies to Reduce, Reuse, and Recycle of Materials". The speaker gave a broad and detailed view on the accumulation and environmental impact of e-waste. He briefed about the rare earth elements, the recoverable e-waste and its volume being accumulated globally. Dr. Kamachi Mudali presented the initiatives taken by Indian government and counterparts of overseas countries and also emphasized on different methods of e-waste recycling being adopted in India.

Dr. Shaju K. Albert, Director, MMG & MSG, IGCAR, Kalpakkam presenting the memento to Dr. U. Kamachi Mudali, Immediate Past President, IIM

This Memorial lecture was followed by the elocution contest on the selected eight essays over video conferencing by the students from their respective locations. The selected contestants rendered a sound and faultless elocution conducted before a three member jury from IGCAR, Kalpakkam. Mr. Aaryaman Choudhury, Birla High School, Kolkata Chapter was the winner of Essay/Elocution contest for the topic "Isotope based power sources for space applications. Ms. Suman Sanjana Mall, D.A.V. Public School, Kalinga, Angul Chapter, and S. Rajarajeswari, Mahatma Global Gateway, Tiruchirapalli Chapter, were the runners of this contest for the topics "Isotope based power sources for space applications" and "Recovery of rare earths for self-sufficiency", respectively.

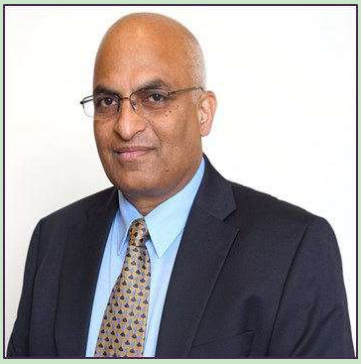
Elocution contest over video conferencing during the BPMME2020

The Winner and Runners of the elocution contest were awarded with prizes and certificates by Dr. Shaju K. Albert, Director MMG & MSG and Chairman – BPMME 2020, IGCAR, Kalpakkam. The event was successfully conducted thanks to the generous financial supports from JSW Centre, Mumbai and IGCAR, Kalpakkam. Shri. P. Vasantharaja, Co-convener BPMME 2020 proposed the vote of thanks. This online event was attended by over 300 participants including school students, school faculty, engineers and academicians from the various institutes across the country.

Dr. Placid Rodrigeuz Memorial Lecture (PRML)–2020

The 12th Placid Rodriguez Memorial Lecture (PRML) was organized on 29th October 2020 jointly by Kalpakkam and Chennai Chapters of Indian Institute of Metals. The programme was held online by video conferencing through Webex platform as well as YouTube streaming.

Dr. T. Sundararajan, Chairman IIM Chennai chapter welcomed the gathering and Dr. M. Kamaraj, Member, PRML Committee, briefly dwelt upon the genesis of PRML presenting the details of the series of lectures conducted since 2009. The chief guest, Dr. V. Jagadeesh Kumar, Dean (Academic), IIT Madras, in his address, recollected the humanistic side of Dr. Placid Rodriguez and expressed his delightment to be a part of this memorial programme. This was followed by address of Dr. Shaju. K. Albert, Chairman PRML committee, in which he recalled Dr. Placid Rodriguez's multifarious contributions as an institution builder, a mentor who nurtured multiple generations of materials scientists, and his humane approach which won many hearts. Dr. Divakar R., Chairman, IIM Kalpakkam introduced the PRML 2020 speaker Dr. Surya R. Kalidindi, Regents Professor, Novelis Innovation Hub, Georgia Institute of Technology, USA.



Dr. Surya R. Kalidindi

Dr.Surya Kalidindi first paid homage to Dr. Placid Rodriguez and shared his thoughts on the inspiration he drew from the seminal work of Dr. Rodriguez on the plastic deformation of metal alloys subjected to a broad range of loading conditions and extreme environments. In his lecture titled "Accelerated Materials Innovation using Knowledge Systems and High Throughput Experiments, he dwelt on the core knowledge needed to support accelerated materials innovation, in the form of PSP (process-structure-property) linkages formulated at various material length/structure scales. Towards accelerating materials exploration and discovery, the speaker highlighted the strategies involving synergistic use of data analytic tools in conjunction with the established toolsets such as physics-based multi-scale materials modeling tools, multi-resolution materials structure and response characterization protocols. As an example, the speaker presented novel data analyses protocols of spherical nanoindentation for stress-strain response of individual phases of dual phase steel as well as the bulk response. He concluded the lecture by stressing that advanced robotics, virtual and mixed reality, and human–machine interfaces is already a reality for optimization of process parameter and manufacture of advanced alloys.

The lecture was very well received by over 70 participants in online platform with engaging discussions and interactions with the speaker. Dr. Shaju. K. Albert presented a e-memento to Dr. Surya Kalidindi and the programme concluded with a vote of thanks by Dr. Rani P. George, Convener, PRML2020.

Creep damage in multi-pass welded austenitic stainless steel joints- A microstructural perspective

Dr. David Vijayanand V

Creep Studies Section, Materials Development and Technology Division, MMG/IGCAR, Kalpakkam

Extreme operating conditions and envisaged design life for sodium cooled fast reactors (SFRs) have either narrowed down or shifted the compositional range of several materials which are used for fabricating its components. The composition of the 316LN stainless steel (SS) which is a prime structural material in SFRs was tailored along these lines by altering principally its nitrogen and carbon content to enhance its creep strength and corrosion resistance which are major requirements for components made from this material. The suitability of the evolved 316LN SS was backed up with comprehensive microstructural investigations which helped towards understanding the damage and failure evolution during creep deformation. However as many of the components in the SFRs are fabricated by welding, it becomes essential to study the properties of corresponding weldjoints in conjunction with the base metal. This is because it has been well documented that the strength of the base metal and its corresponding weld joints could vary significantly under the same testing conditions. The primary cause for the inferior performance of the joints can be attributed to the microstructural heterogeneity present in the weld metal. Apart from exhibiting inferior properties, substantial scatter is often observed in the mechanical properties of representative weldjoint specimens whose geometry incorporates both weld metal and base metal regions. As a consequence, more conservatism is adopted when framing the design codes for components with weld joints. It is the heterogeneity in the microstructure of weld metal which has also made interpretation of creep damage evolution more challenging. This report presents a systematic investigation on creep damage evolution of 316LN SS weldjoints and discusses how meticulous modifications in the microstructure can help enhance its creep strength.

It has been well established that creep cavitation in these weld metals predominately occurs along interfaces which form between the austenitic matrix and intermetallic phases like sigma and Laves [Fig. 1]. These intermetallic phases are quite brittle and evolve from delta ferrite which is an intentional phase prescribed for austenitic SS weld metals to prevent hot corrosion. Though the nucleation of cavities has been widely observed in crept weld metal specimens a careful examination

reveals that these evolve extensively in one side of the weld pass interface [Fig. 2]. In fact, the region which is more susceptible to cavitation is the one which has a vermicular delta ferrite morphology [1]. This is the morphology in austenitic SS weld metals in as deposited condition but subsequent weld passes transforms the delta ferrite morphology in a narrow layer of the prior weld pass to a globular morphology due to thermal cycling. The resultant microstructure in a multi-pass weld metal comprises of alternate layers of vermicular and narrow globular delta ferrite, with the weld pass interface serving as one of the boundaries between them.

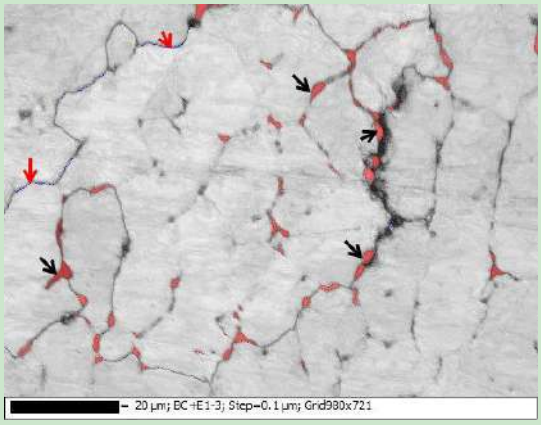


Fig. 1. Creep cavitation occurring at intermetallic/matrix interface

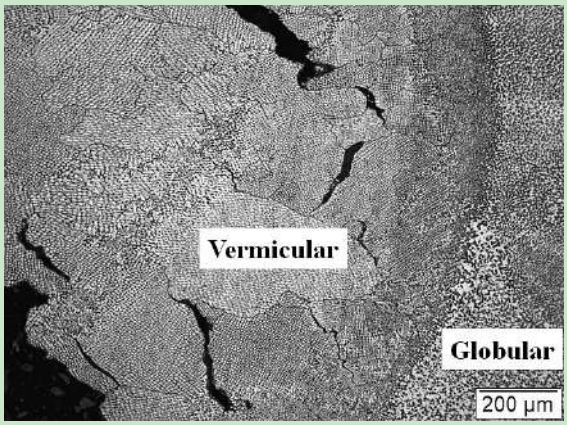


Fig. 2. Preferential cavitation occurring in the vermicular delta ferrite region

Transformation to intermetallic phases is enhanced for delta ferrite with a vermicular morphology as it has a higher surface interfacial energy. Subsequent weld metal deposition also creates a constraint associated with the solidification of the new weld metal apart from modifying morphology of delta ferrite. The strength gradient across the interface and the enhanced transformation rate to brittle intermetallic phases in the vermicular ferrite regions results in preferential cavitation in the vermicular delta ferrite region [2]. Relatively slower transformation rate and enhanced strength of the globular delta ferrite region renders it more resistant to creep cavitation [Fig. 3].

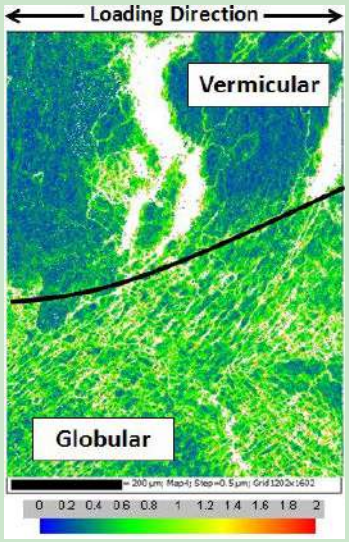


Fig. 3. Creep cavities blocked at the weld pass interface due to the presence of hardened globular delta ferrite region

Above findings suggest that, introducing weld passes which generate more damage resistant globular delta ferrite region could in fact be beneficial towards reducing the susceptibility of austenitic SS weld metal to cavitation thereby enhancing the creep strength. To further elucidate this finding, creep rupture properties were evaluated for ATIG (activated tungsten inert gas) weld joints fabricated by single and dual pass. The presence of just one additional pass in the dual pass made microstructural investigation more conducive. Creep testing at 923 K under a stress level of 140 MPa showed that the rupture life of the dual pass joint (7316 hours) was more than twice of the single pass joint (3214 hours) [3]. Microstructural investigations revealed that cavities which nucleated in the second pass were arrested at the weld pass interface and did not propagate into the first pass [Fig. 4]. To establish the degree of variation in strength between the two passes, impression creep tests were carried out on the dual pass weld joint. As impression creep uses a small indenter for probing creep response of the material, it could be used to obtain distinct properties of each of the two passes. The impression creep rate of the first pass was lower than that of the second pass [Fig. 5]. Though the delta ferrite content in weld metal region of ATIG weld joints are relatively lower, the deposition of additional pass generated a constraint effect which enhanced the creep deformation resistance of the first pass.

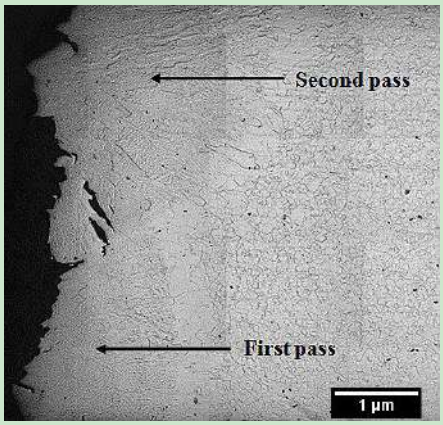


Fig. 4. Cavities nucleated in the second pass being blocked at the weld pass interface in creep tested ATIG weldjoints

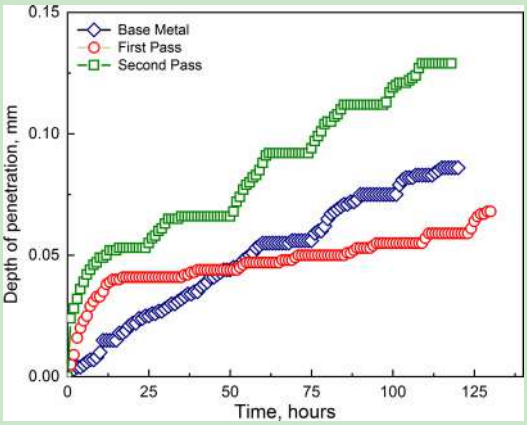


Fig. 5. Comparison of the impression creep curves of various regions of a dual-pass welded ATIG

Results from the ATIG welded joints show that introducing weld pass interface is beneficial for creep strength enhancement of the joints. It can therefore be is intuitionally stated that increase in number of weldpasses would invariably result in increased rupture life of austenitic SS weld joints. To further verify the influence of the number of weld passes on the preferential damage, creep performance of shielded metal arc welded joints fabricated with two different

electrode sizes viz., 2.5 mm and 4 mm was evaluated. The number of weld passes for the weldjoint fabricated with smaller and larger electrodes was around 90 and 45 respectively. Interestingly, creep testing at 923 K under a stress level of 140 MPa showed that the rupture life of the weldjoint made with the smaller electrode size (5624 hours) was lower when compared to the weldjoint fabricated with the larger electrode size (8060 hours) albeit having higher number of weld pass interfaces when compared to the latter [4]. Microstructural examination on the failed weld joint specimens showed extensive interlinking of creep cavities for the weld joints made with a smaller electrode size as the more susceptible vermicular delta ferrite regions in this case were at closer proximity [Fig. 6]. Though cavitation was evident for the weld joint made with larger electrode size, their interlinking was less favored as vermicular regions in this case were farther apart [Fig. 7].

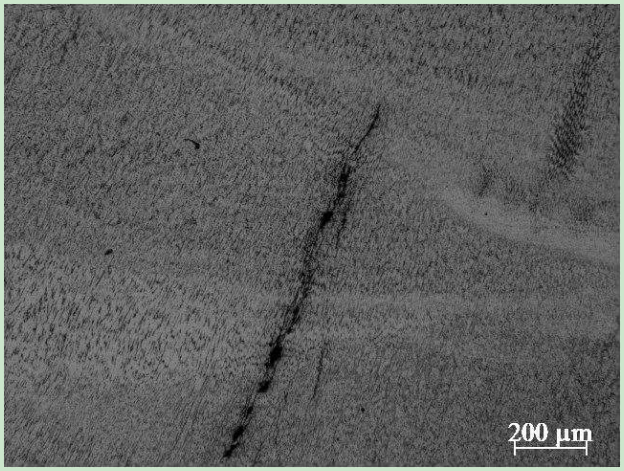


Fig. 6 Interlinked cavities in creep tested weldjoints fabricated with 2.5 mm electrode

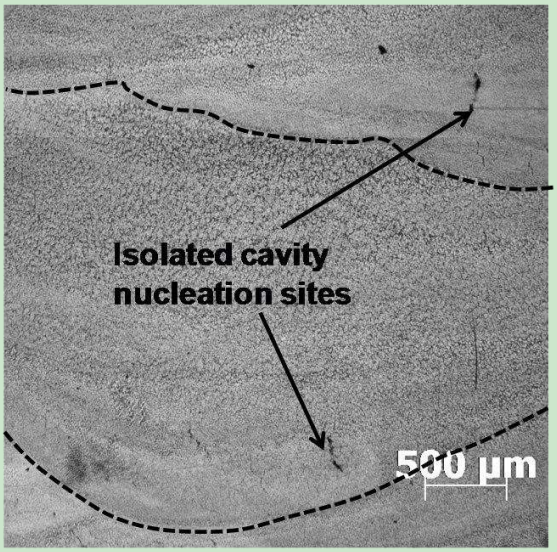


Fig. 6 Insolated cavities in creep tested weldjoints fabricated with 4 mm electrode

Deposition of weld metal through multi-pass welding processes produces microstructural heterogeneity which manifests as changes in morphology of delta ferrite and generation of a hardened region along a thin layer in the prior deposited pass for austenitic SS based weld joints. Though the presence of this layer prevented propagation of cavities, increasing the number of these layers by enhancing the number of weld passes could have a deleterious effect on the creep strength. Higher number of weld passes would place the more susceptible regions which have vermicular morphology in closer proximity which could result in inferior creep rupture life. Hence depending on the welding process, a judicious choice of the number of passes has to be made for enhancing their

creep strength. A comprehensive investigation about the influence of weld passes on the microstructure of the weld metal could help understand the underlying causes for scatter in the mechanical data generated from the corresponding weld joints.

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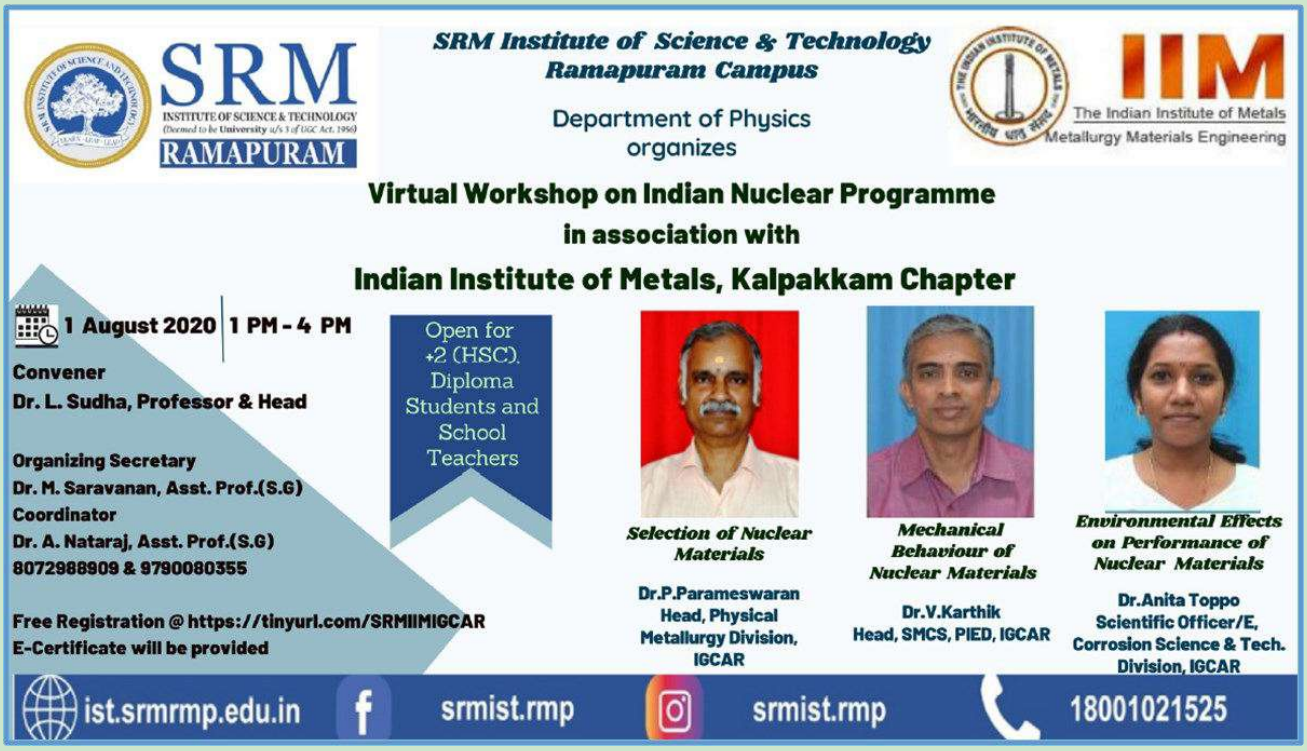
Workshop on Materials for Indian Nuclear programme

IIM Kalpakkam chapter was associated with SRM institute of Science and Technology in conducting an online workshop titled Materials for Indian Nuclear programme. This programme held on 1 Aug 2020 comprised of three lectures namely (i) Selection of Nuclear Materials by Dr. P. Parameswaran, (ii) Mechanical behaviour of nuclear materials by Dr. V. Karthik and (iii) Environmental effects on performance of nuclear materials presented by Dr. Anita Toppo. Over 350 students and faculty participated in this online programme and interacted with the speakers.



A Course on Advanced Manufacturing

Our chapter conducted an online course on Advanced Manufacturing technology (CAM 2020) during 10-11 Dec 2020 with an objective to connect practicing engineers of manufacturing industries, R&D organizationswith domain experts from academia and research institutes. The inaugural address was delivered by Dr. Shaju K. Albert, Director MMG & MSG, IGCAR, in which he recapitulated the improvements and innovations in manufacturing technology over the years and highlighted the challenges and open ended questions. The course comprised of 8 lectures covering major areas of manufacturing technology such as bulk forming, sheet metal forming, heat treatment and additive manufacturing. Each topic was covered by two experienced faculties; one with academic expertize in premier institutes to dwell on the basic/theory and the other faculty with working experience in industry/national R&D laboratories to cover the technological advances and case studies. The course was attended by seventy participants from various institutes, industry and academia across the country. The convener of this online course was Dr. Diptimayee Samantharay, supported by Sri B. Aashranth and Sri Arvinth DaVinci of IIM Kalpakkam chapter.

Theme Meeting on Experiences in Engineering Failure Analysis

A theme meeting titled "Experiences in Engineering Failure Analysis" was organized jointly by IIM, Kalpakkam and Society for Failure Analysis (SFA), Chennai chapter, through video conferencing on 28th January, 2021 at IGCAR. The theme meeting comprised of 5 lectures on topics related to role of failure analysis in design, manufacturing processes, plant operation & life extension with few case studies and also dwelt on mechanics of materials in failure/fracture under various loading conditions. Dr. S. Raju, AD, MCG/MMG, IGCAR welcomed the gathering and shared his thoughts on the historical origins of metallurgical failure analysis highlighting the contributions of Prof Cottrell to fracture theories. Dr. B.P.C. Rao, PD, FRFCF, IGCAR, in his presidential address, highlighted the multidisciplinary nature of failure analysis and commended the efforts of IIM and SFA in disseminating the collective wisdom on this topic. Dr. Shaju K. Albert, Director, MMG & MSG, IGCAR, in his opening remarks, recalled the specialized expertise developed over the years in IGCAR for failure analysis of components in nuclear as well as in other strategic sectors.

The first lecture delivered by Dr. P.K. Parida dwelt on the role of failure analysis in optimizing the fabrication processes of ODS ferritic steel clad tubes. This lecture was followed by Dr. S. Athimoolakrishnan on a coupled experimental-numerical predictive methodology for fracture prediction in pipes. The following lecture by Mr. S. Surya Prakash, NACE International, Kuwait, carried interesting case studies on cracking in weld HAZ of gas pipelines and the role of proper selection of material and fabrication methods to prevent failure in large diameter pipes. Prof. Raghu V. Prakash from IIT-Madras shared his experiences on employing fractography as a tool to quantify fatigue crack growth kinetics. In the final lecture, Dr. P. Parameswaran, Head, PMD, IGCAR shared his long research experience in employing microstructural studies to understand material failure. The theme meeting was attended by over 40 participants interacting with the speakers through useful discussions. Dr. P. Parameswaran who had served in IIM and SFA in various capacities was felicitated. The programme concluded with vote of thanks by convener Dr. S. Athimoolakrishnan.

A few glimpses of the event

Webinar on Biofilms, Biofouling and Microbial Corrosion

IIM KC conducted a one-day webinar on Biofilms, Biofouling and Microbial Corrosion (BBMC) at IGCAR on 19th December 2020 in Webex platform. The programme commenced with welcome address by Dr. John Philip, Head, Corrosion Science and Technology Division, IGCAR & Convener, BBMC, followed with briefing by Dr. Rani P. George on the scope and objectives of the webinar. Dr. Shaju K. Albert, Director MMG & MSG in his inaugural address, emphasized on the consequences of corrosion in industries and country's economy and shared his views on microbiologically influenced corrosion and biofouling issues in the nuclear power plants.

Dr.V.P. Venugopalan, Raja Ramanna Fellow, BARC, delivered the first lecture on "Microbial adhesion to surfaces and its implications" covering the fundamentals of microbial adhesion to material surfaces, initiation and development of biofilms and its consequences in the different process industries. Dr. Subba Rao Toleti, BARCF in his lecture "Microbial Corrosion in Industrial Water Distribution Systems: Case Studies and Control" presented on various bacterial groups and metabolismsof microbial corrosion. Dr. M. Eashwar, Chief Scientist (Retired) CSIR - CECRI, Karaikudi in his talk "Passivity and its breakdown in stainless steels and alloys in natural waters: Environmental and bio-electrochemical perspective" explained the influence of biofilms in cathodic and anodic kinetics on stainless passivity with specific case studies. Dr. A. Rajasekar, of Thiruvalluvar University, Vellore, in his lecture "Microbial diversity in crude oil reservoir and Control" elaborated the bacterial groups involved in bioremediation of hydrocarbons polluted soil environment and the molecular biological tools in identification of microbial consortia of environmental samples.

Dr. B. Anandkumar, Coordinator, Webinar BBMC concluded the session with vote of thanks. This online event was attended by over 190 participants including research scholars, faculty members from academic institutes and from the various industries across the country.

Young Scientist Forum (YSF-2020) Webinar

IIM Kalpakkam chapter organized a half-day webinar titled Young Scientist Forum (YSF-2020) on 22nd September 2020. This programme was aimed to motivate young members of the chapter by providing them a platform to share their recent research findings in materials science, metallurgy and related aspects. The program consisted of three talks delivered by young members of chapter on diverse topics and the entire programme was live streamed from IGCAR.

In his opening remarks, Dr. Shaju K. Albert, Outstanding Scientist, Director, MMG & MSG, IGCAR, emphasized the importance of the topics chosen by young officers for the talks and its relevance to the nuclear energy programme of the country. The first talk delivered by Dr. Renjith Ramachandran on "Radiation effects in INRAFM steel –Investigation using Positron annihilation Spectroscopy" dwelt on He-ion irradiation effects on INRAFM steel for fusion reactor applications. The second talk delivered by Dr. M. Divya on "Weldability assessment of Borated Stainless Steel" focused on the assessment of different types of boron added steels and welding electrodes for nuclear applications. The final talk delivered by Mr. B. Aashranth on "Use of computer simulations to enhance experimental deformation studies" presented the use of numerical simulations to understand the microstructural changes of materials during deformation. All three talks are well received with over 35 participants through online media and about 15 participants at the auditorium. The programme concluded with vote of thanks by the convener Dr. Ch. Jagadeeswara Rao.

Current Advances in Materials and Processing- (CAMP 2021)

IIM Kalpakkam chapter organized a half day theme meeting titled "Current Advances in Materials and Processing- CAMP-2021" for research scholars on 16th February, 2021 held through video conferencing. A total of 4 talks were presented by the research scholars of our chapter. The programme commenced with opening remarks by Dr. Shaju K Albert, Director MMG & MSG, IGCAR, where he motivated the research scholars on updating the current trends in their research areas and also the presentation skills. The presentations were made by (i) Sri C. Praveen on Finite element implementation of internal-state-variable models (ii) Ms.Rasitha on Rapid Electro deposition Method for Super hydrophobic Coating with Corrosion Barrier Properties in Humid Coastal Environment (iii) Sri K.C. Sahooon multiaxial creep deformation and influence of different precipitate on creep cavitation behaviour of 304HCu SS through mechanistic approachand (iv) Sri Pavan A Ron "The influence of Shielding Gas on the Activated TIG welding Arc Characteristics. All the presentations were informative and participants interacted with the speakers through question-answer sessions. The speakers were felicitated with mementos and certificates by Dr.Shaju K Albert, Director MMG & MSG. Dr Divakar R. presented the concluding remarks and Sri P. Vasantharaja, Convener of this programme proposed the vote of thanks.

Dr. Shaju K. Albert, Director, MMG & MSG presenting the memento to the speakers of CAMP-2021

Best papers awards presented by IIM KC

Nominations were received from IIM members for the best technical paper published in Journals in the period of this report under (i) young researcher categories (< 35 years) and (ii) general category. A total of 30 papers (10 in young researcher category and 20 in general category) were received and judged by a panel of jury. The results of the two best papers selected in each category were announced during AGM for award of cash prizes.

Category	Place	Paper Title	Nominee (First Author)	Co authors
Young	Best	Isothermal and thermomechanical fatigue behaviour of type 316LN austenitic stainless steel base metal and weld joint, **Materials Science & Engineering A 772 (2020) 138627**.	**T. Suresh Kumar** MDTD/ MMG, AM56006	Surya D. Yadav, A. Nagesha, R. Kannan, G.V. Prasad Reddy
	Runner up	Visual detection of defects in carbon steel using magnetic nanoemulsions: Effect of stabilizing moieties on the defect detection sensitivity. **Sensors and Actuators A 314 (2020) 112220**	**Manali Nandy** CSTD, MMG AM58085	B.B. Lahiri and John Philip
General	Best	Fabrication of superhydrophobic titanium surfaces with superior antibacterial properties using graphene oxide and silanized silica nanoparticles. **Surface and Coatings Technology, 400 (2020) 126074**	**S.C. Vanithakumari** CSTD, MMG LM46258	G.Jena, S. Sofia, C.Thinaharan, R.P.George, John Philip
	Runner Up	In Anomalous enhancement of corrosion resistance and antibacterial property of commercially pure Titanium (CPTi) with nanoscale rutile titania film. **Corrosion Science 172 (2020) 108678.**	**Nanda Gopala Krishna** CSTD, MMG AM53311	R.P. George and John Philip

Awards and Honors

We are very happy to inform that many of our members have obtained significant recognitions from national/international organizations and various professional bodies. We congratulate all the following members who have received various awards and honours during the period of this report:

National/International Recognitions

- **Dr. A. K. Bhaduri**, **Dr. U. Kamachi Mudali** and **Dr. M. Vasudevan** have been named in the World's top 2% Scientists, Data Published by Stanford University, USA, 2020 in the Year 2019.
- **Dr. Sandip Dhara** has been awarded the DAE Homi Bhabha Science & Technology Award for the year 2019.
- **Dr. Harish Chandra Dey** was invited by The Indian Institute of Welding (IIW-India), for delivering the Prof. Placid Rodriguez Memorial Lecture 2020.
- **Dr. G. Sainath** was conferred with Young Scientist Award from DAE for the year 2019.

Best Presentation or Paper Awards

- **Anoop K. Unni** & **M. Vasudevan** bagged the ***best presentation award*** in the 2nd Inter. Conf. on Aspects of Materials Science and Engineering (ICAMSE-2021), Punjab National University, Chandigarh, for the paper "Determination of Heat source model for Simulating full penetration Laser Welding of 316 LN Stainless Steel by Computational Fluid Dynamics"
- **G.Shanthi**, **K. Sairam, M. Nani Babu**, **A. Moitra** bagged the ***best poster presentation award*** in NMD-ATM 2020 for the paper "Effect of Ageing on the fracture toughness of SS 304HCu.

Technical Lectures

During this period, 2 technical talks on topics of interest to the metallurgy and materials community were arranged and conducted by IIM Kalpakkam chapter. The details of the talks are given below

Sl. No	Date	Name	Organization	Topic
1	30/09/2020	Dr. Niyanth Sridharan	Lincoln Electric, India	A Road Map to Develop & Process Ferritic Martensitic Steel Components for Gen-IV Reactors using Additive Manufacturing
2	09/01/2021	Dr. K.G. Pradeep	IIT Madras, Chennai	Atom Probe Tomography – Indispensable Tool for Materials Characterization at near Atomic-scale

Materials Matter

E-news letter of IIM Kalpakkam Chapter





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