IGC Newsletter

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From the Director's Desk

NEW YEAR MESSAGE

It gives me great pleasure to wish you and your family the very best in the year 2010.

We have experienced a successful year 2009 with all-round developments in the Centre. We have met the essential commitments towards the construction of Prototype Fast Breeder Reactor (PFBR). The successful erection of safety vessel and main vessel at PFBR site, well within the stipulated specifications is an engineering marvel and, a tribute to the synergistic efforts of BHAVINI, IGCAR and manufacturing industries. Also the successful loading of about 1000 tonnes of molten sodium is a result of decades of focused research and development at the Centre towards mastering the sodium technology. The remaining major core components of PFBR such as cladding tubes, hex cans, roof slab, rotatable plugs, primary and secondary sodium pumps, etc. are in the final stages of fabrication. The specifications of all the components have been achieved and enhanced. We hold the pride and unique distinction for having reprocessed the highest burn-up mixed carbide, (Pu-U)C fuel. The necessary and important aspect of the closing the fuel cycle for the FBR is taking shape with synergistic efforts from all concerned in the Centre. It is also heartening to note that based on collaborative efforts with various agencies, we have already mastered the synthesis route to produce first oxide dispersion strengthned (ODS) steel clad tube and have taken steps to produce reduced activation ferritic martenistic (RAFM) steels. These two important developments have clear applications in future FBRs and fusion reactors. Indigenous electronics and sensor development programmes are providing valuable inputs to the mission goals of the Centre. Some of these developments have societal applications such as magnetoencephalography (MEG) for brain and heart mapping and electromagnetic techniques for medical diagnosis with high specificity and cost effectiveness. We have developed specialized chemistry based techniques for explosive detection and other ultra high sensitivity applications with synergy at national level. The availability of high-performance supercomputing capability is facilitating innovations in computer modeling and simulations in physical, chemical and engineering disciplines. We have pursued the basic sciences with passion and sustained support to enable harnessing of the breakthroughs for the mission mode programmes of our Centre.

We have successfully completed three years of BARC Training School programme at the Centre; which has provided valuable and capable manpower not only to our Centre but also to other units of the DAE. The academic programmes of Homi Bhabha National

Institute (HBNI) are well established and are being conducted smoothly and effectively for the last three years. With regard to benchmarking our R&D programmes, we have already conducted the second round of peer review of our physical and chemical sciences programmes by an external panel of eminent persons. They have provided valuable inputs and guidance and indicated clear pathways to move forward in taking the Centre to next stage of eminence and excellence.

Allround development of our townships in terms of more efficient functioning, greenery and aesthetic contents is well appreciated by the citizens of the DAE family residing at Kalpakkam and Anupuram. Our colleagues in GSO deserve credit for this allround achievement. The Schools are imparting quality education, thanks to dedicated efforts of the principals, teachers and parents. We are also taking steps to improve and enhance the school premises with better infrastructure and amenities. One of the unique features of our township has been the availability of quality and sensitive medical care; thanks to committed medical doctors, supporting staff and excellent management. We work with neighbourhood based on mutual trust, transparency and friendship principles.

We have always been proactive in connecting with the individuals and organizations capable of contributing to national challenges in strategic, industrial and academic endeavors. Our approaches and contributions have become exemplary and are well appreciated by peers and beneficiaries. Examples of our contributions are in health care, archeology, specific sensors and detectors, structural materials for fusion programme and super-critical coal technology. Similarly, we are also proactive in harnessing the best expertise of academic, research and industrial organizations for our research and mission programmes. We must continue on this path so well mastered and practiced by us in the Centre.

We are emerging as leader in our endeavours related to fast breeder reactors and associated closed fuel cycle programmes. Many of our achievements are unique international benchmarks. We have already made many breakthroughs and achieved many milestones in our journey; Yes, there are always challenges on our path of excellence with relevance. However, we have confidence in meeting the challenges and achieving the milestones in future too, with dedication, commitment, buoyancy and dexterity, true hallmarks of leaders of technology. Indeed our Mantra is to work with pleasure, converting the difficulties into challenges, meeting them with enjoyable efforts and exceeding the objectives of milestones. Our faith in science based technologies has proven right; thus, we must continue to pursue our path with even better results. In this regard, I would like to mention that *"Limitations live only in our mind. But, if we use our imaginations, our possibilities become limitless" – Jamie Paolinetti.* I am confident and positive that with all our collective dedicated efforts, synergy and hard work, we can certainly scale much bigger heights and contribute to realizing the national dream in energy security with climate mitigation by 2050.

I wish the New Year 2010 to be a new beginning for new dreams, immense possibilities, admirable achievements and immeasurable bliss for you, your family, loved ones and colleagues.

With my best wishes and personal regards,

Baldev Raj

(Baldev Raj)
Distinguished Scientist
Director, IGCAR & GSO

May the New Year bring in

New Dreams to fulfill
New Heights to scale
New Goals to attain

Wish you bliss, health and successes during the year 2010

Baldev Raj
Distinguished Scientist & Director
IGCAR & GSO

Limitations live only in our mind. But, if we use our imaginations, our possibilities become limitless

– Jamie Paolinetti

Ti-5Ta-1.8Nb Alloy– an Alternate Structural Material for Highly Oxidising Medium in Reprocessing Plant Applications

Fast Reactor Fuel Reprocessing based on aqueous processes, requires dissolution of spent fuel in hot, concentrated nitric acid containing ions such as Cr^{6+}, Ag^{2+}, Ce^{4+}, $Cr_2O_7^{2-}$ and Fe^{3+}. Corrosion resistance is the deciding factor for the selection of an alloy as a structural material in such hostile environments. Austenitic stainless steels show corrosion rates as high as 15-140 mpy, while Ti/ Zr based alloys exhibit low corrosion rate of <5mpy and are viable alternative materials for such media. A titanium based alloy of type Ti-5Ta-1.8Nb has been extensively studied for this purpose which is described in this article.

Since the alloy has been studied for the first time in our laboratory, it was necessary to obtain an in depth understanding with respect to the response of this alloy to different thermal cycles, oxidizing environments and mechanical deformation. This provided the inputs for optimizing the process flow chart and the heat treatments for the best performance under severely oxidizing conditions. The study of microstructures that evolved during thermo-mechanical treatments also provided an insight into the phase transformations and deformation mechanisms at an atomistic level in this system. The evaluation of three-phase corrosion behaviour of this alloy in hot concentrated nitric acid demonstrated the low corrosion rates and also aided in understanding the reasons for the enhanced corrosion resistance.

Physical Metallurgy

The literature available on this ternary alloy is very scarce, especially with respect to physical metallurgy. Figure1 shows the microstructure of the alloy in ‘as cast’ condition. Analysis of this structure showed that it consists of alternate lamellae of Ta and Nb lean 'α' and solute enriched 'β' phases, which classifies this alloy under the 'α+β' category of titanium alloys. This two phase nature of the alloy is responsible for a variety of phase transformations of the high temperature 'β' phase, which enables the design of heat treatments to achieve good mechanical properties and corrosion resistance through microstructural control.

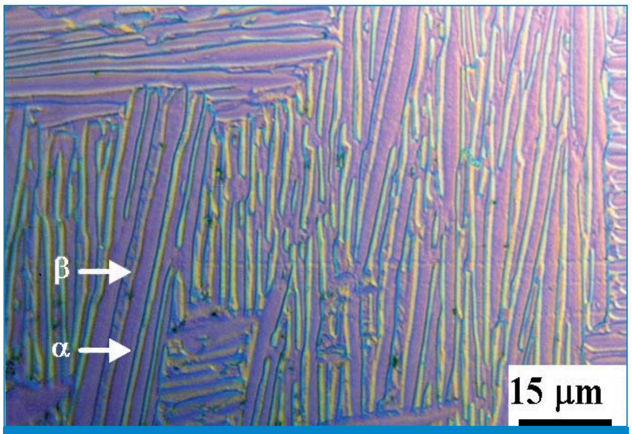


Figure 1: Optical micrograph of the ‘as cast’ alloy with alternate lamellae of α and β phases

Processing the alloy in the 'α+β' phase field was a crucial step to control grain growth. Hence, determination of the transformation temperature namely the β transus was essential. The 'β' transus temperature for Ti-5%Ta-1.8%Nb alloy was determined by several methods such as metallography, calorimetric and computational methods as ~1140K. It is understandable that the addition of β stabilisers like tantalum and Niobium to Ti has brought about a reduction in β transus temperature to ~1140K as compared to 1155K for pure titanium. Determination of the 'β' transus temperature enabled the selection of safe temperature for hot extrusion as ~1103K in the 'α+β' phase field.

Determination of martensite start temperature and the critical cooling rate for martensite formation is important for any alloy from an industrial point of view. The martensite start temperature of the alloy was calculated based on the suppression of martensite start temperature of pure titanium for each wt% addition of tantalum, Niobium and Iron and estimated as 1087K. It was determined that a critical cooling rate >99 K/min from the β phase field is essential for the formation of martensite.

An attempt to determine the α/β solvus lines in a pseudo-binary diagram of titanium and Niobium combining the β stabilizing efficiency of both tantalum and Niobium has been made using microstructural methods. The microchemistry of the coexisting α and β/α' phases was experimentally determined at room temperature using electron microscopy methods after isothermally aging at various temperatures in the α+β phase field, which was converted into Niobium equivalent. The pseudo binary diagram of this ternary system arrived at is shown in Figure 2. Solubility of tantalum and Niobium in the β phase continuously increased with decrease in temperature while a different behaviour is observed in the α phase. The solubility of tantalum and Niobium increased with decrease in temperature from β transus (~1043 K) until 1023K, beyond which a decrease was observed. A limited solubility in α phase, also observed in the Ti-Ta and Ti-Nb binary systems,

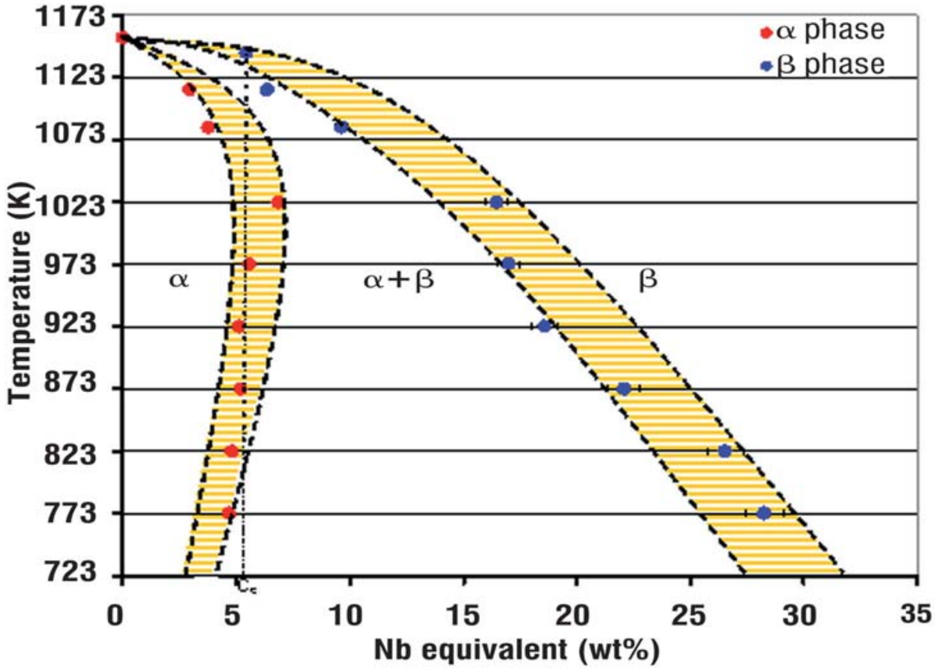


Figure 2: α|β solvus lines of a pseudo binary diagram of the Ti-Ta–Nb system based on the Nb equivalent estimation from the composition of α and β phases

could possibly be due to a miscibility gap in the β phase as predicted in these systems. The volume fraction of α and β phases estimated from the phase diagram showed a good agreement with the values obtained by quantitative image analysis methods. Further studies in this system with alloys of different composition and thermodynamic assessment are in progress to establish the phase diagram.

The body-centered-cubic β phase is unstable and undergoes a variety of trmations during cooling from high temperatures resulting in a myriad of microstructures, with the constituents possessing characteristic morphology, microchemistry and structure. An understanding of the microstructural evolution under different conditions is essential as the microstructural features control the corrosion behaviour and mechanical properties of the alloy. The transformation mode of high temperature β phase is strongly sensitive to its solute content and cooling rate, which has been systematically studied in the alloy subjected to isothermal treatments in β and α+β phase fields. It was observed that a martensite product (α') (Figure 3(a)) with predominantly lath morphology and hexagonal close packing structure formed on quenching from β phase field. The martensitic transformation is attributed to the instability of β phase due to low amount of β stabilizing elements at high temperatures. However, isothermal treatments high in the α+β phase field (>1023K), resulted in martensite product with plate morphology with internal twins together with the primary α phase. This change in morphology of martensite is attributed to the increase in the tantalum and Niobium content with decrease in temperature. Progressive increase in solute content of β phase with reduction in temperature (823-1023K) changed the transformation mode resulting in a mixture of orthorhombic martensite ϰα< <ς and hexagonal ω phase as shown in Figure 3(b), due to a competition between the two

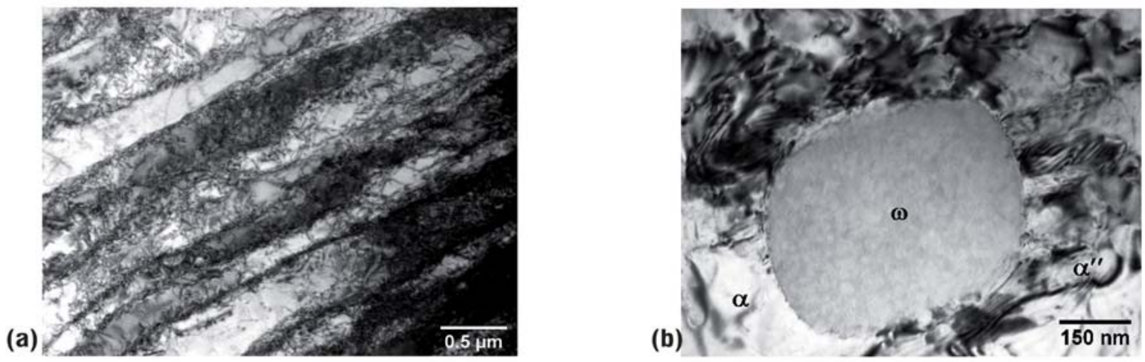


Figure 3: TEM micrographs showing (a) hcp lath martensite (α') formed on quenching from β' phase field and (b) coexistence of fine plates of α' and particulate v (region of mottled contrast) phases within a α β particle on quenching the alloy from 873K in α + β phase field

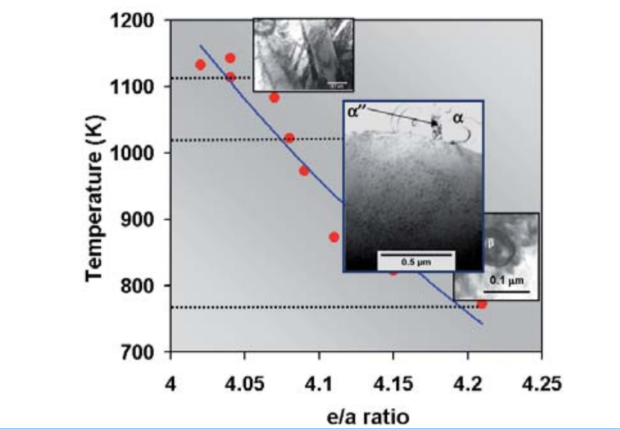


Figure 4: Change in transformation mode from α' to α'' to ω and β with increase in e/a ratio of β phase at different temperatures

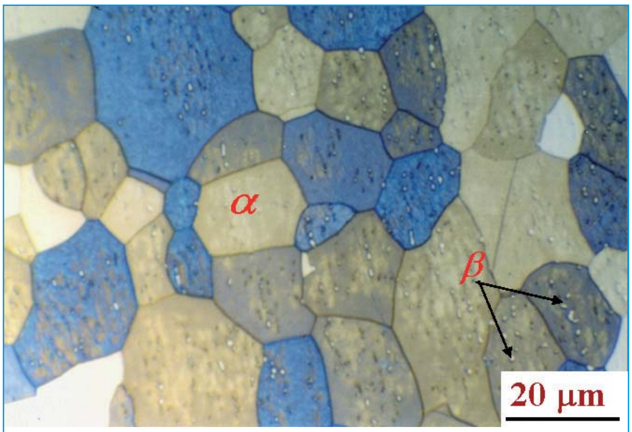


Figure 5: Microstructure of the TMP alloy with fine λ particles in an equiaxed α matrix

types of displacive transformations. These products possessed unique morphology, structure and orientation relationship with the parent phase which served as a fingerprint for identification of transformation mechanism. At temperatures lower than 773 K, β phase is retained due to its high solute enrichment which suppresses the start temperatures for the two types of displacive transformations.

Apart from temperature, cooling rate also had a strong influence on the decomposition mode of β phase. A diffusional Widmanstatten transformation product with alternate lamellae of α and β phases was always observed during low cooling rates. In the two phase field, ω phase formation was also observed at intermediate cooling rates as a result of the secondary transformation of solute enriched β phase. The stability of β phase is strongly dictated by its composition, which can be expressed in terms of electron/atom ratio to rationalize the different transformation modes. It is found that an e/a ratio below 4.1 favours a $\beta \rightarrow \alpha'$< transformation, between 4.1 and 4.2 favours the $\beta \rightarrow \alpha''/\omega$ transformation, above which β phase is retained as shown in Figure 4.

Knowledge of the above phase transformations and the resulting microstructures has been utilized to tailor the microstructure to exhibit good corrosion resistance in boiling 11.5 M nitric acid. The corrosion rate measured for the alloy with lamellar $\alpha+\beta$ microstructure was 1.25 mpy, while it was far lower (0.25 mpy $\pm$ 0.07 mpy) when the microstructure consisted of equiaxed α grains with a uniform distribution of β particles (Figure 5). A lamellar structure introduces a periodic micro-chemical variation and forms micro-galvanic cells leading to poor corrosion resistance, whereas the absence of periodic micro-galvanic cells in the equiaxed structure is responsible for its low corrosion rate. Equiaxed morphology of α phase also possesses higher ductility than in an acicular morphology. Hence, a uniform distribution of β particles in an equiaxed α matrix is a desirable microstructure which possesses better corrosion resistance. Such a microstructure was achieved by a series of thermo-mechanical processing in $\alpha+\beta$ phase field.

This alloy like titanium has excellent corrosion resistance in nitric acid, but under relatively weak oxidizing conditions, as in the vapour and condensate regions, exhibits a higher corrosion rate (~2.8 mpy). Hence, microstructural features that influence the corrosion behavior were identified by studying the corrosion rate in a variety of microstructures generated by design of heat treatments like mill annealing, solution treatment followed by aging and overaging that are normally adopted for commercial $\alpha+\beta$ alloys. The three phase corrosion rates are compared in Figure 6. It is observed that the corrosion rate is lowest in the liquid phase for all treatments. Low corrosion rate in the liquid phase is attributed to the high oxidising potential and self inhibiting effect of dissolved titanium ions, while low oxidation potential and absence of inhibiting titanium ions in vapour and condensate phases lead to high corrosion rates. It is also seen that the alloy in the solution treated and aged or overaged condition shows the lowest corrosion rate in all the three phases of nitric acid. Examination of the microstructure in this condition revealed a uniform distribution of fine β particles (<50 nm) distributed in an equiaxed α matrix. This

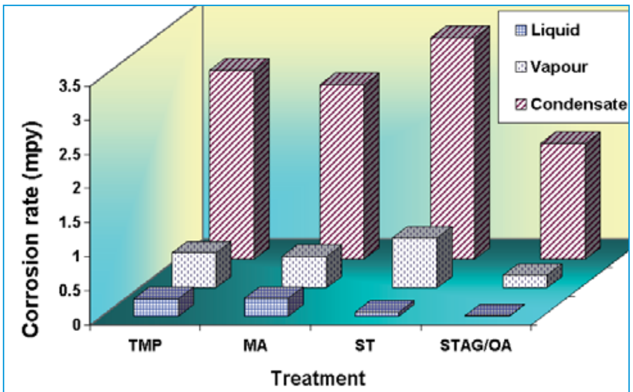


Figure 6: Comparison of three phase corrosion behaviour of the alloy after different treatments

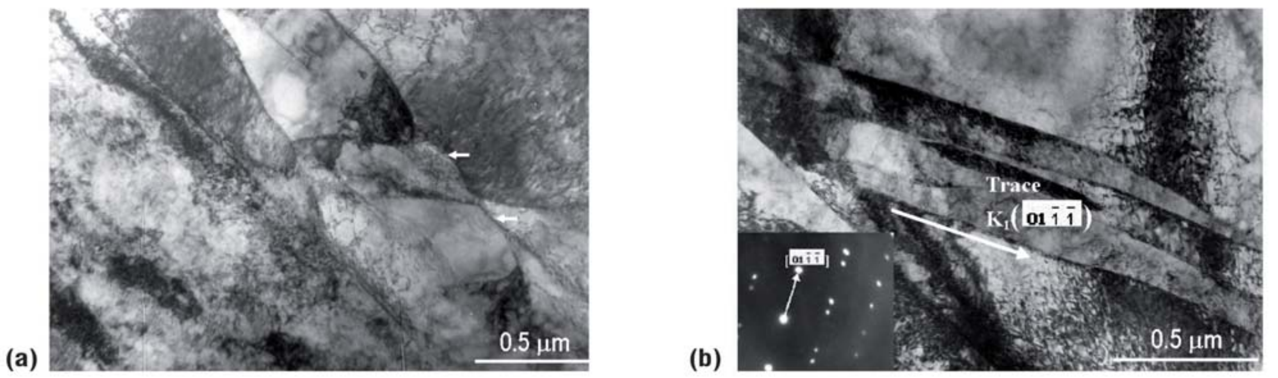


Figure 7: TEM micrographs of the tensile tested specimen showing the dual mode of deformation (a) dislocation cells(arrow marked) in an α grain and (b) twins originating from the boundary of another α grain. This is confirmed by the diffraction pattern which shows reflections from both matrix and twin along [1 1] and [11 3] zone axis respectively

suggested that the size and distribution of β phase dictates the stability of the passive oxide film, which in turn decides the corrosion rate. The enhanced stability of the passive oxide film produced by this treatment is responsible for the low corrosion rate despite flowing conditions. This study enabled the selection of heat treatment conditions to achieve the best corrosion properties for the Ti-5Ta-1.8Nb alloy.

The nature of oxide film was also studied to understand the mechanism of corrosion. The surface morphology of the alloy after liquid and vapour phase corrosion did not differ significantly from the unexposed alloy, while an accelerated attack was observed after exposure to weakly oxidising condensate phase. In addition to TiO_2 increased amounts of Ta_2O_5 and Nb_2O_5 were observed by X-ray Photoelectron Spectroscopy on the surface of the alloy exposed to condensate phase. This suggested increased dissolution of titanium due to the absence of inhibitor effect under flowing conditions of a weakly oxidising acid. Also the presence of nano-crystalline anatase along with other lower oxides of titanium in low amounts was elucidated by TEM studies. Based on these studies, it was concluded that higher corrosion rate in the condensate phase despite the formation of TiO_2, is due to increased dissolution of titanium and formation of lower valence oxides of titanium under flowing conditions.

The selection of an alloy for high performance applications also requires that the alloy possesses adequate strength and ductility to fulfill the design requirement of mechanical properties. The mechanical properties of this alloy were evaluated for different microstructural conditions. The yield strength is in the range of 302 - 338 MPa, ultimate tensile strength ranges from 404-443MPa, toughness from 110-130 MJ/m^3 and ductility is in the range 25 - 33%. These values are found to be higher than the expected values based on design requirements for titanium alloys namely yield strength in the range 275-400MPa, ultimate tensile strength ~ 345 MPa and ductility ~ 20%. Hence, the alloy exhibits good mechanical properties, though the variation in mechanical properties with microstructure was insignificant. This is due to the poor solid solution strengthening from tantalum and Niobium, which have the same atomic size as that of titanium.

Analysis of the stress-strain curves and correlation between primary α grain size and yield strength suggested that twinning could be a deformation mode of α phase. Detailed microstructural analysis on cross section was carried out to study the operative deformation mechanism. Void nucleation predominantly occurred at the α/β interface suggesting a difference in the degree of strain accommodation between α and β phases since the deformation rates of the two phases are different. The dislocation structures of α grains contained both cells and fine twins as shown in Figure 7(a and b), suggesting that α phase deforms both by slip and twinning. The deformation mode of β phase was identified as slip based on the observation of dislocations within β particles and absence of any dislocation pileup showed that they were not effective obstacles for dislocations.

The above studies provided an in depth understanding on the behavior of the Ti-5Ta-1.8Nb alloy when subjected to high temperature, stress and oxidizing environment. The alloy possesses good weldability characteristics and it was also demonstrated that the weld has lower corrosion rate (<2mpy) than commercial grades of titanium. The extensive R&D carried out at laboratory scale also served to fine tune the process parameters, leading to the industrial level scaling up of production of the alloy and fabrication into different product shapes and dimensions. The low corrosion rate of the weld of Grade-2 titanium with Ti-5Ta-1.8Nb as the filler wire has resulted in the selection of the Ti-5Ta-1.8Nb alloy as a filler material for the titanium dissolver of Demonstration Fuel Reprocessing Plant under fabrication.

(Reported by R. Mythili and colleagues, Physical Metallurgy Division, MMG)

Superhydrophobic Surface Modification for Enhancing Corrosion Performance of Materialst

Superhydrophobic surface has attracted considerable interest due to its great importance in fundamental research and potential industrial applications. Wettability is an important aspect of materials and is governed by both surface chemical composition and geometrical structure. A closely related phenomenon in nature is the "lotus-effect", referring to surfaces that are difficult to wet and called 'superhydrophobic' (the water droplet contact angles of superhydrophobic surfaces are greater than 150°). Figures 1 and 2 show the superhydrophobic surface, the Lotus leaf and the contact angle depicting hydrophobic and superhydrophobic conditions. The basic roughness and surface chemistry of the lotus leaf confer the superhydrophobic properties; that is, water drops adopt a contact angle greater than 150° and roll like marbles under the gentlest forces causing self-cleaning. The principle that both surface roughness and surface chemistry can be used to provide water repellency is the basis of superhydrophobicity. These surfaces usually have binary structures on the micrometer and nanometer scales, thus it is possible to trap a large amount of air and minimize the real contact area between the surfaces and water droplets. One of the attractive applications of superhydrophobic surfaces, in addition to the extraordinary water-repellency, is their speculated capability to reduce accumulation of snow and ice and to even completely prevent formation of ice on solid surfaces.

Corrosion is one of the major mechanisms by which the industrial components in natural atmosphere deteriorate and fail during service. Most of the corrosion processes begin at surfaces where heterogeneities provide conditions to initiate and grow corrosion attack with time. If we can suitably modify the surfaces which can repel the presence of aqueous conditions (moisture, contamination, dissolved oxygen etc.) on the surface the corrosion initiation at the surfaces can be avoided and delayed as the modified surfaces do not provide conditions conducive for corrosion attack to initiate at the surface. Thus generating 'superhydrophobic' surface with water repellency is an attractive option to prevent and delay the onset of corrosion processes at surfaces of engineering components in natural atmosphere.

Figure 1: Lotus leaf - Natural surface of superhydrophobicity

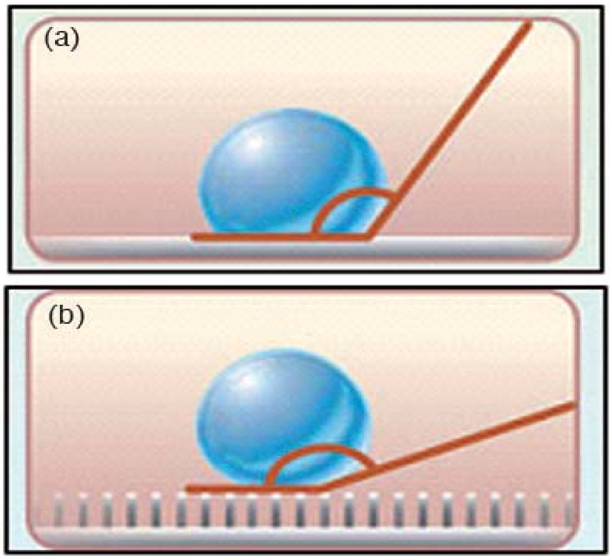


Figure 2: Contact angles depicting (a) hydrophobicity and (b) superhydrophobicity

Increasing the corrosion resistance of materials by superhydrophobic coatings appeared to be a promising application. Superhydrophobic coatings using myristic acid were prepared on pretreated titanium and 9Cr1Mo steel surfaces. The prerequisite of obtaining a nanorough surface prior to coating was achieved by anodization treatment in the case of titanium and by chemical etching treatment in the case of 9Cr1Mo steel. The coatings were prepared by using a simple dip coating method which is simple and effective for coating industrial components of complex shapes and dimensions. The coatings were characterized by using Atomic Force Microscope (AFM), Confocal Laser Scanning Microscope (CLSM) and Kruss Das contact angle measurement microscope. The surface wettability of myristic acid coated surfaces of titanium as well as 9Cr1Mo Steel was investigated by measuring the spread of 25 μL drops of a series of solutions of HPLC grade water and methanol. Figure 3 shows the AFM images and the corresponding contact angle measurement of such superhydrophobic surfaces on titanium and 9Cr1Mo steel.

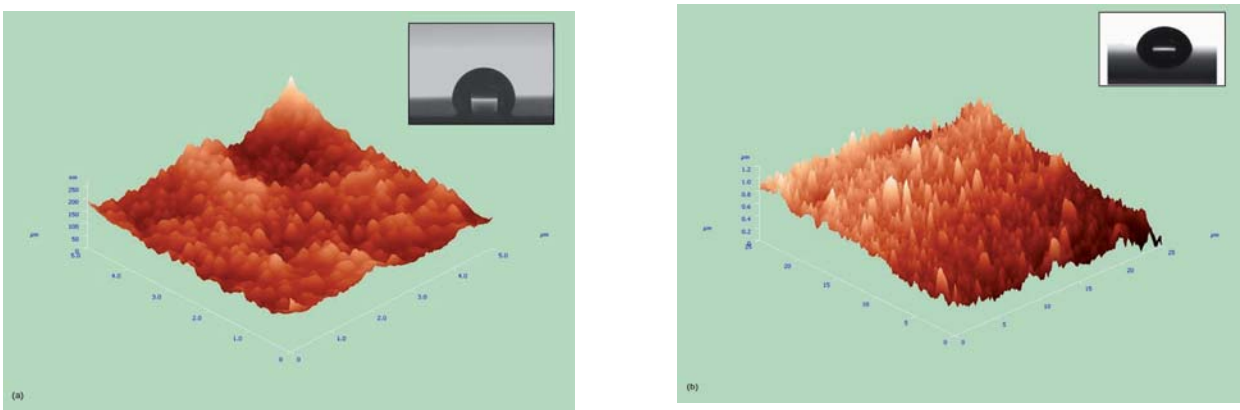


Figure 3: AFM images of a) Anodized-superhydrophobic coated titanium surfaces and b) Etched and superhydrophobic coated 9Cr1Mo steel surface (inset showing image of their corresponding water contact angle measurement)

The corrosion resistance of coated titanium and 9Cr1Mo steel was studied using Electrochemical Impedance Spectroscopy (EIS) in seawater (Figure 4). The superhydrophobic coatings for both materials showed increased semicircle arc radius of the Nyquist plot compared to polished control specimen. Thus higher polarization resistance of the coated specimens indicated good corrosion resistance of the coated specimens in seawater.

The surface appearance of coated and control 9Cr1Mo samples in seawater for about 24 hours was examined. The uncoated control sample corroded extensively with visible accumulation of rust (Figure 5) while the coated 9Cr1Mo sample did not show any signs of corrosion on the surface.

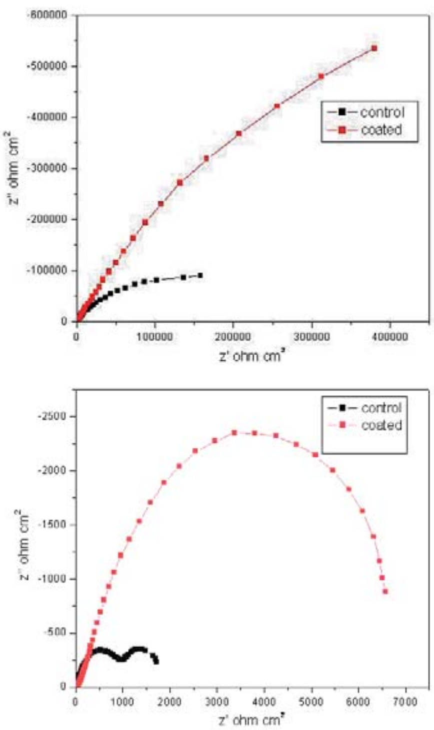


Figure 4: EIS graph showing increase in semicircle arc area depicting the increased corrosion resistance of the superhydrophobic coated titanium and 9Cr1Mo.

Thus, bioinspired superhydrophobic coatings on titanium and 9Cr1Mo steel surfaces resulted in increased corrosion resistance. The current knowledge developed provides insight for applying this superhydrophobic surface modification on materials surfaces for controlling corrosion in variety of environment. The creation of tailor made surfaces for specific environment will be a challenging task with appropriate selection of procedures for designing nano roughened surfaces and their chemical modification technologies.

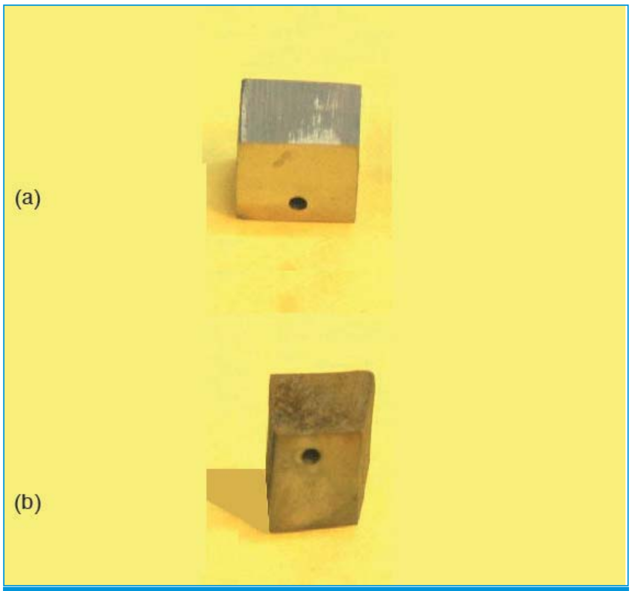


Figure 5: Photograph showing a) absence of corrosion on coated sample and b) corroded uncoated sample

(Reported by Judy Gopal and colleagues, Corrosion Science and Technology Division, MMG)

Young Officer's FORUM

Shri Narendra Kumar Kushwaha obtained his Bachelor of Engineering degree in Computer Science and Engineering (CSE) discipline from Kumaon Engineering College, (Kumaon University), Dwarahat, Uttarakhand in 1998. He joined Planning Division, IGCAR as Scientific Officer (SO/C) in 2001. His present assignments include automation and integration of software systems, monitoring of capital projects in IGCAR and coordination between indenters, MRPU, Accounts and Stores. He is also the project coordinator of capital project "Comprehensive Projects, Materials, Finance and Human Resource Management through Automation and Integration of Software Systems".

Workflow Automation System for IGCAR and MRPU

Under the project "Comprehensive Projects, Materials, Finance and Human Resource Management through Automation and Integration of Software Systems", Planning Division has taken an initiative of automation and integration of processes in Administration, Accounts, Stores, Planning Division at IGCAR Kalpakkam and Madras Regional Purchase Unit, Madras Regional Accounts Unit at Chennai and also integration of the systems between Kalpakkam and Chennai.

In order to automate and integrate the processes in above mentioned areas, automation of Workflow has been chosen instead of conventional method of automation in individual areas and integration afterwards. The choice of automation of workflows instead of automation of individual activities is because workflow automation ensures data flow across organisation thus avoiding the need of integration of standalone systems at a later stage.

Workflow Automation – An Introduction

The term "Workflow" can be defined as a series of actions performed by various people in order to complete a process. It can be understood by taking an example of purchase process. The purchase request can be started by raising an indent by indenter. After obtaining required approvals, the indent is processed at purchase section for release of purchase order. Item is delivered at IGCAR Stores, based on the specifications and quantity mentioned in purchase order. Upon receipt of the material and inspection / acceptance report, payment is made by Accounts department. Though the whole scenario explained above involves the Indenter, Purchase, Stores and Accounts, the process remains only one (i.e. purchase process), which is initiated by the indenter and closed at Accounts Department upon successful completion. In an automated workflow, all the roles and action to be taken are pre-defined and the system executes the workflow based on these defined rules.

In the above mentioned purchase process, an automated workflow system provides online facilities viz., raising of indents by the indenters, approvals, tender evaluation, purchase recommendation, release of Purchase order, Inspection report, issue of item from stock and payment advice, across various agencies involved in the process.

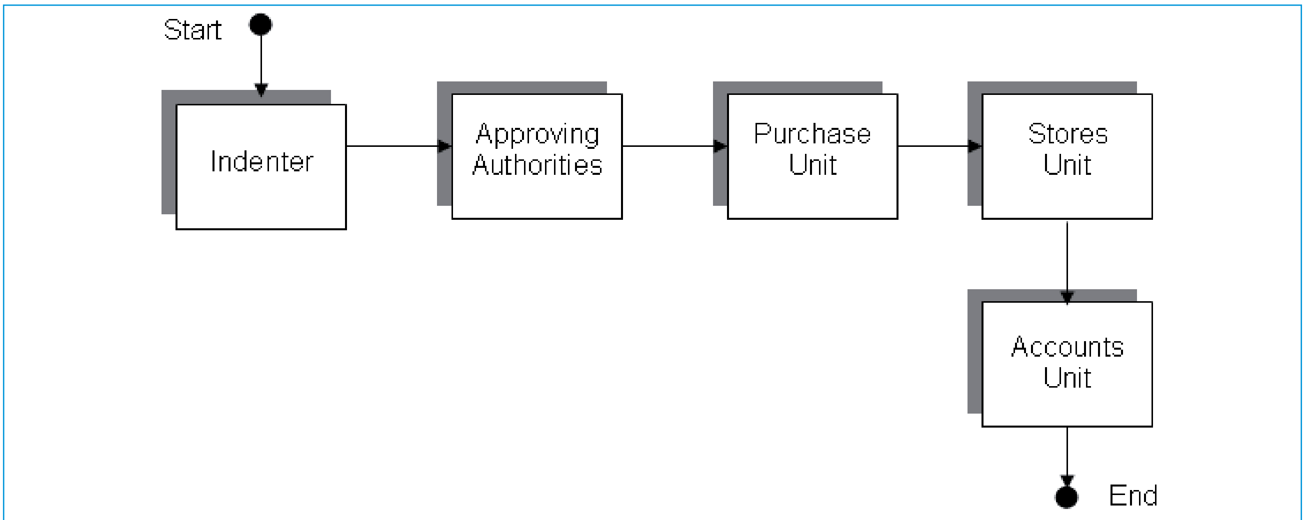


Figure 1 : Agencies involved in purchase process

According to Workflow Management Coalition, a non-profit organization, Workflow automation is automation of business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to predetermined set of procedural rules. The various types of workflows can be categorized as below:

- Ad hoc Workflow
- Production Workflow
- Administrative Workflow
- Horizontal versus Vertical Workflow

A business process contains a set of activities. An activity can be described as a piece of work that forms a logical step within the process. A process in a workflow automation system can have one of the states, i.e., Initiated, Running, Active, Suspended, Completed, Terminated.

The Workflow Automation System completely defines, manages and executes workflows through the execution of softwares where the order of execution is driven by a computer representation of the workflow logic.

Workflow Automation Project at IGCAR and MRPU

In order to implement Workflow Automation System in IGCAR and MRPU, after technical and financial evaluation of two-part tender for workflow automation system, M/s Wipro is selected to execute the project.

The technologies to be used in this project are as below:

Operating System:	Red Hat Linux
Webserver:	Apache Tomcat
Middleware:	JBOSS Application Server
Database:	MySQL
Other technologies:	Java, Ajax, XML

The proposed system provides functionalities like Workflow management System, File Management System, Document Management, Knowledge Management, Management Information System and Dashboard to provide holistic view of performance process-wise, department-wise etc.

Agile methodology has been adopted for the execution of this project. The agile methodology provides the benefit of multiple opportunities to assess the work being carried out throughout the project lifecycle. In this process the development team presents shippable increment of work (known as sprints) to end user for testing and feedback on a regular interval of two to three weeks. This results in rapid development and bug fixing during the development phase itself in contrast to Waterfall / traditional sequential software development where the end-user tests the developed work only at the end of development phase. The requirement study phase of the project also includes GAP analysis in order to improve the efficiency of the processes. During the requirement study phase, process owners are also identified who ensure the complete knowledge transfer to development team and also test the software modules for its correctness and completeness during every iteration.

In order to ensure security and privacy of data in the system, multi-factor authentication schemes and digital signatures are planned to be implemented at various levels. Since IGCAR and MRPU are geographically located at a distance of about 80 km, it is proposed to have redundant high speed leased line connectivity between servers at both the ends. The geographical distance between IGCAR and MRPU proves advantageous for disaster recovery plans. MRPU will also act as disaster recovery location for all data and application backup of IGCAR. Apart from disaster recovery plan, redundancy has been provided at each level, viz. application server, database server and backup server to ensure the availability and reliability.

The progress of the project is being monitored by a taskforce. The taskforce comprises specialists from administration, accounts, planning, stores, purchase and information technology. To assist this main taskforce, various sub-committees are also formed to provide specific inputs related to the core areas to the development team.

Benefits of Workflow Automation

Implementation of workflow automation system will provide following benefits to employees of IGCAR and MRPU:

- Improved services to employees due to lesser manual intervention in the processes
- Greater employee satisfaction due to improved services
- Better security and privacy of data because of process role-wise access control of application to users
- Increased productivity of employees due to electronic data flow across the organization
- Greater transparency and control of processes because the system generates audit logs reflecting the delays, (if any), occurred at each step in the process. It also results in process re-engineering and thus eliminating the steps, from the processes, with no value addition
- Reduces carbon footprint by reducing the paper consumption in all possible processes and leading towards less-paper office

(Reported by Narendra Kumar Kushwaha, Planning Division)

Young Researchers's FORUM

Single Fiber Grid with Improved Spatial Resolution in Distributed Optical Fiber Sensor System

Shri Pandian Chelliah obtained his Masters in Physics discipline from Madras Christian College, Chennai in 2004. He joined Non Destructive Evaluation Division, IGCAR as Junior Research Fellow in 2005. He and his colleagues have demonstrated High Temperature Measurement & Leak detection in Sodium Test Loop using Raman Distributed Temperature Sensor. He is pursuing his Ph.D under the guidance of Dr.C.Babu Rao.

Optical fiber based Raman distributed temperature sensors (RDTS), allow measurement over long lengths, typically of the order of tens of kilometers. Coupled with the inherent advantages of fiber optic sensor, such as immunity to electromagnetic interference, small size and geometrical flexibility, high resistance to radioactivity, RDTS provides a compelling solution to long term distributed and continuous and distributed temperature monitoring of coolants of reactors. RDTS has also been used in temperature monitoring of power lines, oil and gas pipelines, geothermal monitoring of river basins.

In RDTS, laser pulse is launched into the optical fiber. The intensity of the back scattered stokes and anti stokes lines gives measure of the temperature. The time of flight of the pulse gives the location of the temperature zone. The temperature measured is an integral average over the pulse width of the laser. For a laser with pulse width 5ns, the laser pulse width in fiber translates to 1m. Thus, the measurements are made every one meter. This is also known as the spatial resolution of RDTS. If a temperature zone is smaller than this measurement zone, such as the case with localized hot spots, the temperature measured is not accurate. This is especially an issue when we are monitoring leak in reactor coolant loops, oil pipelines, pressure vessels and refractory loss in furnace linings and boilers.

Many groups have worked towards increasing the spatial resolution of the RDTS using ultrashort pulse, frequency domain, correlation techniques, single photon counting and multi-photon counting technique. These methods require that either the source (the pulse width of the laser/ frequency modulation of probe and pump) and/or the detector have to be changed. To overcome this, a methodology was developed for improving spatial resolution, without having to install new hardware components.

A Single fiber grid (SFG) with novel fiber laying methodology was developed to improve spatial resolution by ten times. Here, fiber is laid along two orthogonal projections, forming a grid (Figure 1). The geometrical concept of RDTS is similar to 'kolam'. Single fiber grid is an open curve, whereas 'kolam' is a closed curve. Once the fiber is laid as a Single fiber grid, the arms of the grid, act as measurement lines. The principle of data gathering is similar to that of tomography, where data is collected in different projections. The advantage of this orthogonal configuration is that for a given hot spot, the temperature spread in the apparent measurement will always be along the direction of these two projections, which are mutually exclusive except at the intersection point corresponding to the location of the hot spot.

Consider a temperature profile consisting of three localized hot

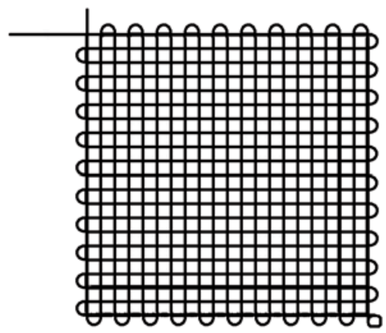


Figure 1: Single fiber grid laid along x and y axes

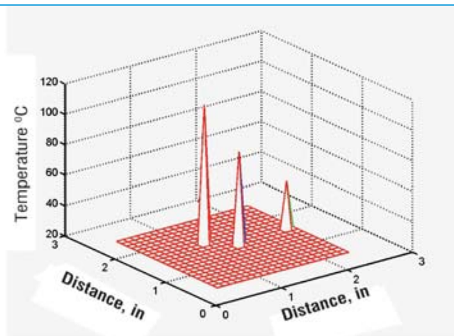


Figure 2: Actual temperature profile along Single Fiber Grid. The peaks represent hot spots

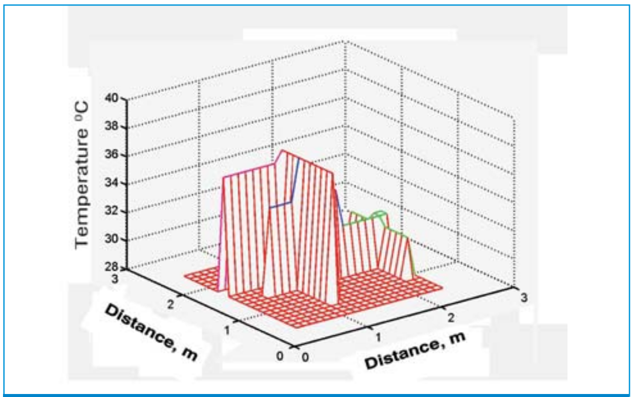


Figure 3: Temperature seen by RDTS along the 2D projection. Compare with Figure 2. There are spurious measurement points along with true measurement points

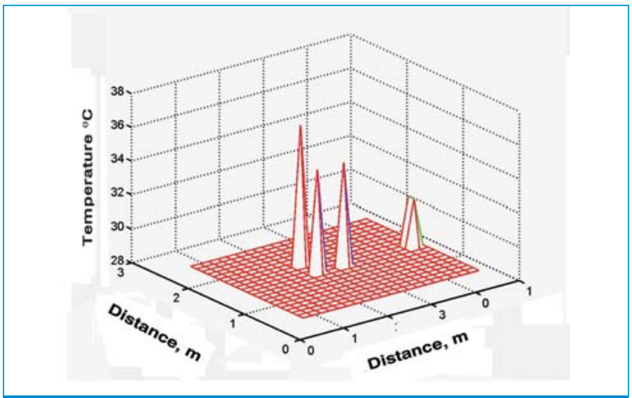


Figure 4: Temperature seen by RDTS along the 2D projection. Comparing with Figure 2. There are spurious measurement points along with true measurement points.

spots as shown in Figure 2. The apparent temperature profile measured by RDTS is shown in Figure 3. This temperature profile consists of true and spurious points. That is, apart from the actual hot spots, called true measurement points henceforth, there are spurious measurement points. Also, it is to be noted that the temperature is grossly underestimated. The true measurement points are identified in two steps.

Due to the mutually exclusive characteristics of the orthogonal projections of the single fiber grid, the apparent elevated temperature, of a point in one projection will not be corroborated by the measurement in other projection, except at the true measurement point. Based upon this hypothesis, true measurement points can be identified by accepting the minimum of the two measures in each projection. When there, is an isolated hot spot, the minimization rule, identifies the true hot spot uniquely. However if more than one hot spot is present within the same measurement zone, there will be still some spurious points left at the intersection of these two projections. Table 1 lists the number of true and spurious points after minimization. Figure 4, represents the temperature profile after the minimization. It can be seen, that the number of true and spurious points is brought to just five. Thus the minimization process brings down the number of true and spurious points to a manageable level.

Table 1: Number of true and spurious points, before and after taking minimum along the two orthogonal projections.

Number of hot spots	1	2
Number of true points	1	2
Number of spurious points/number of projections*(number of subsections in a section) – number of subsections that overlap	19 =(2*10 -1)	when the hot spots are independent 38=(2*[2*10 -1]) when the sections of the hot spots overlap at one subsection 37=(2*[2*10 -1]-1) when the sections of the hot spots intersect at two subsection 36=(2*[2*10 -1]-2)
Number of spurious points after taking minimum along the projections	0	0 1 2

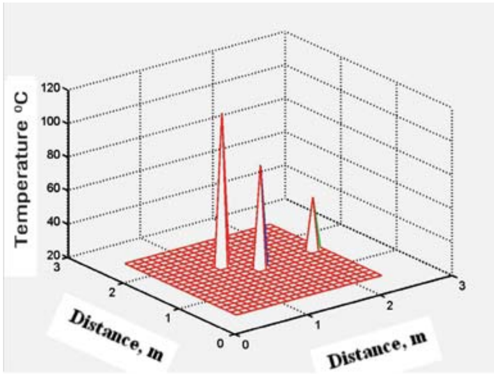


Figure 5: Temperature profile reconstructed along Single Fiber Grid

Now, the problem of temperature reconstruction is reduced to a search algorithm. In step two, a genetic algorithm is used to identify the true measurement points. If the pulse shape of the laser and the integral average function for temperature measurement is known, it is possible to reconstruct temperature, provided that the true measurement points are known. The optimization function is the error between the actual temperature profile as sensed by RDTS, and temperature reconstructed locally with the assumed true measurement points. Once, the true measurement points are identified, temperature can be reconstructed easily (Figure 5). It can be seen that temperature reconstructed is closer to actual temperature.

In this work, a spatial resolution improvement of ten times, and temperature measurement with greater accuracy was achieved using single fiber grid. A patent has been applied for the same. (Application no. 696/MUM/2009 dt of publication 17th July 2009)

(Reported by Pandian Chelliah, Non Destructive Evaluation Division, MMG, IGCAR)

Conference/Meeting Highlights

Workshop on Nuclear Power Plant Life Management (WoN-PLiM 2009)

October 6-9, 2009

Commemorating the birth centenary of Dr. Homi Jehangir Bhabha, a workshop on Nuclear Power Plant Life Management (WoN-PLiM) was organized jointly by IGCAR, BRNS and AERB during October 6-9, 2009 at IGCAR under

Dr. Philip Tipping, Nuclear Energy and Materials Consultant, Swiss Federal Nuclear Safety Inspectorate (HSK), Switzerland giving the address during the inaugural function of WoN-PLiM 2009

the Chairmanship of Dr. Baldev Raj, Director, IGCAR. During the inaugural function held on October 6, 2009, Dr. T. Jayakumar, Director, Metallurgy and Materials Group, gave the welcome address and Shri S.C. Chetal, Distinguished Scientist and Director, Reactor Engineering Group, IGCAR presided over and Dr. Philip Tipping, Nuclear Energy and Materials Consultant, Swiss Federal Nuclear Safety Inspectorate (HSK), Switzerland gave the inaugural address during which he lauded the pioneering and visionary contributions of Dr. Homi Bhabha and lead role being played by India in the area of sodium cooled fast reactors.

The workshop was attended by about one hundred and eighty five scientists and engineers from various DAE units, IIT Madras, SERC, DMRL, NTPC, L&T and Walchand Nagar Industries. In the workshop, sixteen eminent experts from various units of DAE and Dr. Philip Tipping, delivered invited lectures covering various PLiM aspects of FBRs, PHWRs and BWRs including ageing management, life extension, risk analysis, safety upgradation, mitigation strategies, in-service inspection, regulatory guidelines and public acceptance. Technical visits to FBTR, MAPS and BHAVINI were organized to the delegates and a panel discussion was conducted on October 9, 2009. During the feedback session held on October 9, 2009, delegates appreciated the technical program and requested holding of dedicated workshops for life extension of electronic instruments and concrete structures.

Dr. Baldev Raj, Director, IGCAR and Chairman, WoN-PLiM 2009 presenting a memento to Dr. Philip Tipping, as a token of appreciation for giving an invited lecture in WoN-PLiM 2009

(Reported by T. Jayakumar, Director, MMG)

Conference/Meeting Highlights

International Conference on Sol-gel Processes for Advanced Ceramics (SGPAC-2009)

October 11-14, 2009

Dr. Anil Kakodkar, Chairman, AEC, Dr. Baldev Raj,Director, IGCAR Dr. Srikumar Banerjee, Director, BARC, Dr. P. R. Vasudeva Rao, Director CG, with other dignitaries

An International Conference on Sol-gel Processes for Advanced Ceramics (SGPAC-2009) was jointly organized by the IGCAR and BARC during October 11-14, 2009 at the SRI Convention Centre, Anupuram. It was supported by the Board of Research in Nuclear Sciences, Materials Research Society of India (Kalpakkam Chapter) and the Indian Ceramic Society (Tamil Nadu Chapter). Dr. Baldev Raj, Director, IGCAR welcomed the delegates and made introductory remarks on the conference. The conference was inaugurated by Dr. Anil Kakodkar, Chairman, Atomic Energy commission and Secretary, Department of Atomic Energy, Government of India. In his inaugural address, he highlighted the versatility of the sol-gel processes tfor the fabrication of a variety of advanced ceramics including nuclear fuels. Dr. Srikumar Banerjee, Director, BARC compared and contrasted the sol-gel processes and the powder metallurgical processes in his special address. Dr. G. Sundararajan, Director, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad gave the key note address on the demonstration of the sol-gel coating technology for commercial applications. About one hundred and fifty delegates comprising plenary and invited speakers, scientists from abroad, students and research scholars participated in this conference. In all sixty eight contributed papers were presented in the oral as well as poster presentations. These papers covered the application of sol-gel processes for the fabrication of a variety of materials such as nuclear and industrial ceramics, thin films, coatings, glasses and glass fibres, bioceramics, aerogels and porous ceramics, ceramic fibres etc. A technical exhibition was also organized as part of this conference in which ARCI, Hyderabad and Central Glass and Ceramic Institute, Kolkatta had put up informative stalls on their products in the area of sol-gel. This conference facilitated good interaction among the young researchers and eminent scientists in the area of sol-gel science and technology. In order to motivate young research scholars prizes were awarded to the best poster and oral presentations made by student participants.

(Reported by K. Nagarajan, Convenor, SGPAC 2009)

Conference/Meeting Highlights

23rd International Conference on Surface Modification Technologies (SMT 23)

November 2-5, 2009

Inauguration of SMT 23

23rd International Conference on Surface Modification Technologies (SMT 23) was jointly organised by Kalpakkam Chapter of the Indian Institute of Metals, IGCAR, Kalpakkam, Confederation of Indian Industries – LM Thapar Centre for Competitiveness in SMEs with support from Board of Research in Nuclear Sciences, Department of Atomic Energy, Mumbai and NACE International Gateway India Section, Mumbai at Radisson Resort Temple Bay, Mamallapuram, India, during November 2-5, 2009. SMT 23 was cosponsored by Tata Steel, Jamshedpur, CETR, USA and ICON Analytical Equipments, Mumbai, MIDHANI, Hyderabad and SIMCO, New Delhi.

The conference was inaugurated on November 2, 2009 by Shri N. Sriram, President, Harita-NTI Ltd., TVS Group, Chennai and he recalled the various applications of surface modification technologies in manufacturing and automotive industries, and the importance of surface modification in corrosion control of the components. Dr. Baldev Raj, Director, IGCAR and Chairman, SMT 23 presided over the function and traced the historical and useful applications of surface science and engineering, and brought out how surface modification can enhance the performance of components in a variety of applications. Dr. Sarita Nagpal, Deputy Director General of CII presented the academia-industry-research interaction resulting in the formation of corrosion management committee under Dr. Baldev Raj providing valuable solution to industrial corrosion problems through surface modification technologies. Dr. T.S. Sudarshan narrated the formation and growth of series conference on surface modification technologies over the years. Dr. G. Sundararajan, Director, ARCI, Hyderabad and Shri Tushar Jhaveri, Secretary, NIGIS, Mumbai felicitated the conference and wished success in meeting the goals. Dr. U. Kamachi Mudali, Convener, welcomed the gathering and Dr. Rani P.George, Treasurer proposed the vote of thanks.

About one hundred thirty technical papers, twenty seven invited talks and six keynote lectures were presented by professionals from reputed academic and research institutions, coating suppliers, fabricators and user industries during the conference. About two hundred and ten delegates including leading experts from USA, UK, Japan, Germany, France, Korea, The Netherlands, Belarus, Malta, Brazil, Canada and India participated in this important event. The delegates were mostly from industries such as Steel, Power generation (Nuclear & Fossil fired), Chemical and Petro-chemical, Automobile, Oil and Gas, Boiler, Pressure Vessel, Tube, Pipe and Valve manufacturing, Material processing, Welding consumables, strategic sectors, Equipment Manufacturers, Educational Institutions, Research and Development organizations. Special workshops on “Advances in Lasers Surface Engineering”, “Advances in Plasma Processing” and “Coatings for Automobile Applications” were conducted with enthusiastic participation from the delegates. About fifty young delegates from academia and R&D put up posters displaying developments in surface modification technologies and had interesting interactions with peers and experts. Five best oral presentations and poster displays selected by eminent judges were presented with prizes.

A technical exhibition focusing on the theme of the conference was organized at the symposium venue on all the days. About twenty stalls displaying various products, services and equipments related to the theme of the conference from India and abroad participated in the exhibition.

SMT 23 provided a meeting place for all those involved in finding solutions to challenging problems connected with coating design, synthesis and processing, fabrication, properties, applications and global marketing. The conference definitely attracted wide participation from industry, research institutions, academia, end user companies and marketing personnel.

(Reported by U. Kamachi Mudali, Convenor, SMT 23)

Conference/Meeting Highlights

7th National Conference on Recent Advances in Information Science and Technology (READIT-2009)

December 29-30, 2009

Prof.D.K.Subramanian, consulting advisor to Tata Consultancy Services and former Dean & Professor Indian Institute of Science, with Dr. Baldev Raj, Director, IGCAR

The 7th biennial national conference on "Recent Advances in Information science and Technology (READIT 2009)" was organized jointly by Scientific Information Resource Division of IGCAR and Kalpakkam Chapter of Madras Library Association (MALA) on December 29-30, 2009 at Sarabhai Auditorium, Kalpakkam with the theme of 'Knowledge Representation through Semantic Library'. Dr.Baldev Raj, Director, IGCAR presided over the inaugural session and emphasized the importance of Semantics in Information retrieval & need of Knowledge Domains in the presidential address. Prof.D.K.Subramanian, Consulting Advisor to Tata Consultancy Services and former Dean & Professor Indian Institute of Science, delivered the inaugural address. In his keynote lecture, he highlighted the semantic technologies for knowledge representation. The conference had four major sessions on Semantic Technologies for Knowledge Representation, Digital Library Infrastructure and Information Retrieval, Open Source Solutions and Federated Search and Knowledge Management Practices in Library & Information Centers. About two hundred delegates including research scholars & students, Library & IT professionals and various DAE participated in the technical deliberations. The conference included invited talks from the eminent persons from academic institutions, industries and R&D organizations. The conference had one session especially for research scholars and students. There was also a separate poster session for the contributed papers.

An exhibition was also organized as part of the conference in which latest IT gadgets and Standards & Books were displayed. This conference facilitated good interaction among the young researchers, professionals and eminent speakers in the area of Semantic Library. On the valedictory function, Dr.M.Sai Baba, Head SIRD & Convenor READIT 2009 summed up the overall deliberations of the conference.

Dr.J.K.Suresh, Associate Vice President and Chief Knowledge Manager, Infosys gave the keynote address followed by valedictory address by Shri.SC.Chetal, Director, Reactor Engineering Group, IGCAR. A Pre-Conference tutorial on Digital Repositories Creation and Preservation Management was also arranged on December 28, 2009 as part of READIT 2009.

(Reported by M. Sai Baba, Convenor, READIT - 2009)

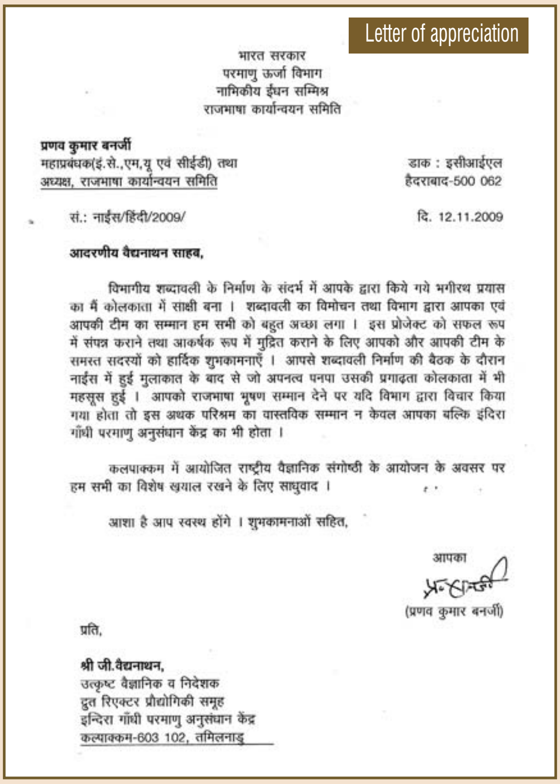
News and Events

Release of Hindi Glossary

Shri A. P. Joshi, Additional Secretary, Department of Atomic Energy releasing Hindi Glossary

The Department of Atomic Energy has made significant progress in various facets of Nuclear Science and Engineering and it is a matter of pride for the nation as a whole. Specially, the achievements in peaceful uses of atomic energy relate to the common man and it is imperative that these are communicated to the masses. This must be done in Hindi, the official language and undoubtedly the best available link language of our country. This would require translating the text from English to Hindi and of course, subsequently to other regional languages for facilitating the translation, a need was felt for a glossary that would provide Hindi equivalent of English scientific and technical terms used in nuclear industry. The glossary must have the approval of competent body and should be regarded as a source of reference for the whole of nuclear industry. With this in view, a committee was constituted by Dr. Baldev Raj, Director, IGCAR, with members from IGCAR and BARC Facilities at Kalpakkam, with the responsibility to prepare a suitable English-Hindi glossary, containing terms related to various aspects of nuclear industry. The committee under the chairmanship of Shri G. Vaidyanathan, Director, FRTG, started functioning in collaboration with experts from Commission of Scientific and Technical Terminology (CSTT), Ministry of Human Resource Development, Government of India. The committee decided to compile words from all DAE units and NPCIL and provide their appropriate Hindi equivalents for inclusion into the glossary. Meetings were held at Hyderabad, Kolkata and Mumbai, where words from different units were discussed at length in the presence of CSTT experts. Finally a glossary with 8500 words was compiled in March, 2009 and the printing was completed by October 2009. The glossary was released by Shri A. P. Joshi, Additional Secretary DAE, in the presence of Smt. Revathi Iyer, Joint Secretary (I&M), DAE during the 12th All India Atomic Energy Official Language conference held at VECC, Kolkata. The glossary was received well and there was lot of appreciation for the efforts taken to prepare it. The next attempt is to bring out a Tamil glossary of nuclear terms.

Letter of appreciation



भारत सरकार
परमाणु ऊर्जा विभाग
नाभिकीय ईंधन सम्मिश्र
राजभाषा कार्यान्वयन समिति

प्रणव कुमार बनर्जी
महाप्रबंधक(इं.से.,एम,यू एवं सीईडी) तथा
अध्यक्ष, राजभाषा कार्यान्वयन समिति

डाक : इसीआईएल
हैदराबाद-500 062

सं.: नाईस/हिंदी/2009/ दि. 12.11.2009

आदरणीय वैद्यनाथन साहब,

विभागीय शब्दावली के निर्माण के संदर्भ में आपके द्वारा किये गये भगीरथ प्रयास का मैं कोलकाता में साक्षी बना । शब्दावली का विमोचन तथा विभाग द्वारा आपका एवं आपकी टीम का सम्मान हम सभी को बहुत अच्छा लगा । इस प्रोजेक्ट को सफल रूप में संपन्न कराने तथा आकर्षक रूप में मुद्रित कराने के लिए आपको और आपकी टीम के समस्त सदस्यों को हार्दिक शुभकामनाएँ । आपसे शब्दावली निर्माण की बैठक के दौरान नाईस में हुई मुलाकात के बाद से जो अपनत्व पनपा उसकी प्रगाढ़ता कोलकाता में भी महसूस हुई । आपको राजभाषा भूषण सम्मान देने पर यदि विभाग द्वारा विचार किया गया होता तो इस अथक परिश्रम का वास्तविक सम्मान न केवल आपका बल्कि इंदिरा गाँधी परमाणु अनुसंधान केंद्र का भी होता ।

कलपाक्कम में आयोजित राष्ट्रीय वैज्ञानिक संगोष्ठी के आयोजन के अवसर पर हम सभी का विशेष खयाल रखने के लिए साधुवाद ।

आशा है आप स्वस्थ होंगे । शुभकामनाओं सहित,

आपका

(प्रणव कुमार बनर्जी)

प्रति,

श्री जी.वैद्यनाथन,
उत्कृष्ट वैज्ञानिक व निदेशक
द्रुत रिएक्टर प्रौद्योगिकी समूह
इन्दिरा गाँधी परमाणु अनुसंधान केंद्र
कल्पाक्कम-603 102, तमिलनाडु

(Reported by K. Zahir Hussain, IGCAR)

Visit of Dignitaries

Dr.Yury Sokolov, Deputy Director General, IAEA with Dr.Baldev Raj, Director, IGCAR

Dr.Yury Sokolov, Deputy Director General, IAEA visited the Centre on October 3, 2009. After a meeting with DAC members, Dr.Sokolov visited the Fast Breeder Test Reactor, Laboratories in Non-Destructive Evaluation Division and Hot Cells and the construction site of PFBR at BHAVINI. Dr.Sokolov addressed and interacted with the young scholars in the Centre.

Members from the Legislative Assembly of Meghalaya with Dr.P.Swaminathan, Director, EIG and other colleagues of the Centre

A team of sitting members from the Legislative Assembly of Meghalaya, Shillong visited the Centre during October 28-29,18 2009. The team visited Fast Breeder Test Reactor, Hot Cells and Laboratories in Non-Destructive Evaluation Division and Safety Group. They also visited construction site of PFBR at BHAVINI, Madras Atomic Power Station, Kalpakkam Reprocessing Plant and Nuclear Desalination Development Plant.

Dr.Baldev Raj, Director, IGCAR and senior colleagues of the Centre with the "People to People, Citizen Ambassador Programs" delegation

A delegation from "People to People, Citizen Ambassador Programs", USA led by Dr. Alan Edward Waltar visited the Centre during November 8-9, 2009. The delegation visited the Fast Breeder Test Reactor, Hot Cells and Laboratories in Non-Destructive Evaluation Division, Safety Group, Fast Reactor Technology Group and the construction site of PFBR at BHAVINI.

Visit of Dignitaries

Prof.Herbert Dieter Gleiter, Director, Institute of Nanotechnology, Research Centre Karlsruhe and Professor, German Academy of Sciences with Dr.Baldev Raj, Director, IGCAR and other senior colleagues of the Centre

Prof. Herbert Dieter Gleiter, Director, Institute of Nanotechnology, Research Center Karlsruhe and Professor, German Academy of Sciences visited the Centre on December 16, 2009. Prof.Gleiter visited the Fast Breeder Test Reactor, Laboratories in the Metallurgy and Materials Group, Materials Science Group and the construction site of PFBR at BHAVINI. Prof.Gleiter also delivered eminent lecture in the Homi Bhabha Eminent Lecture Series.

Forthcoming Meetings / Conferences

One Day Meet on Instrumentation & Control Systems for Radioactive Laboratories (ICRL 2010)

January 29, 2010

It is proposed to conduct a one day meet on instrumentation and control systems for radioactive laboratories on January 26, 2010, in Kalpakkam, under the auspices of Post Irradiation Examination Division (PIED), GRIP, Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam.

Instrumentation and control systems play a vital role in the successful operation of hot cell and glove box facilities where highly radioactive materials are handled either in the powder or liquid form. Highly reliable instrumentation and control systems are required to continuously monitor and control various process parameters such as temperature, pressure, moisture and percentage of oxygen etc. Over the years, vast experience has been gained in the various laboratories of IGCAR and other DAE units while solving and troubleshooting various problems. There is a need to consolidate the developments as well as the expertise and experience gained in the instrumentation and control systems in the radioactive laboratories in the past decades. This one day meet will help the Instrumentation experts working in these areas to share their experience and to help them to meet the challenges in developing robust Instrumentation and control systems for the future radioactive facilities and also to upgrade the control and instrumentation in the existing radioactive facilities.

The topics to be covered in the one day meet include:

- Monitoring and Control of hot cell/glove box parameters
- Instrumentation and control for inert gas/air ventilation systems
- Data logging & instrumentation for radioactive facilities
- Control systems for in-cell equipments
- Development of NDT equipments for radioactive facilities
- Calibration of in cell instruments/ sensors
- Physical protection systems for radioactive laboratories

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Awards & Honours : Congratulations

Dr. Baldev Raj, has been conferred "Pandit Jawaharlal Nehru National Award" in the field of Engineering & Technological Sciences, Department of Science & Technology, Government of Madhya Pradesh for the year 2007 (Awarded in 2010)

He has been invited to be a member, Dr. Yellapragada SubbaRow Award Committee (2010)

He has been appointed as a member, Nuclear Fuel Cycle Board, Department of Atomic Energy

Shri Sumantra Mandal, Materials Technology Division has been awarded "2009 Young Metallurgist of the Year." The award instituted by the Indian Institute of Metals, Ministry of Steel, Government of India

DAE AWARDS

The recipients of the awards from IGCAR for the year 2008 are:

Homi Bhabha Science and Technology Award:
Dr. N.Sivaraman, CG

Young Engineer Awards:
Shri T.Gokulakrishnan, EIG and Shri A.Ravishankar, MMG

Young Applied Science & Technology Award:
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Shri K. M. Natarajan, ESG, and Shri M. Ganapathy, CG

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