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IIM METAL NEWS

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IIM
Metallurgy
Materials Engineering

77th Annual Technical Meeting
The Indian Institute of Metals (IIM)

Incorporating International Symposium on

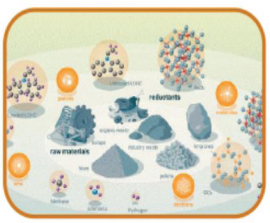
Sustainable Transformations in Metals Industry

ADITYA BIRLA
HINDALCO

22nd to 24th November 2023; Venue: KIIT, Bhubaneswar

Organising Chapters: IIM Sambalpur, IIM Angul, IIM Bhubaneswar in association with Hindalco Industries Ltd. and KIIT Deemed to be University

Broad Topics for IIM-ATM 2023



Fundamentals of Metal Science

Advanced Non-Ferrous Metallurgy

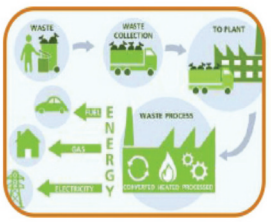
Advanced Ferrous Metallurgy

Battery

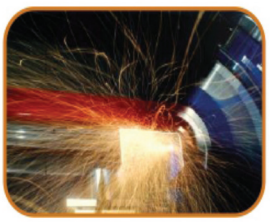
Decarbonization & Green Technologies

Industry 4.0

Raw Materials Preparation



Energy, Environment and Waste Utilization



Advanced Materials Processing and Manufacturing Techniques

Safety

Crude Steel production by region

	Mar 2023 (Mt)	% change Mar 23/22	Jan-Mar 2023 (Mt)	% change Jan-Mar 23/22
Africa	1.4	8.4	3.7	-2.6
Asia and Oceania	124.8	4.1	345.6	3.4
EU (27)	11.9	-5.6	33.1	-10.1
Europe, Other	3.5	-14.1	9.5	-18.3
Middle East	3.1	-17.5	8.9	-11.4
North America	9.3	-2.6	26.8	-4.1
Russia & other CIS + Ukraine	7.6	3.0	21.4	-11.8
South America	3.5	-7.6	10.3	-4.5
Total 63 countries	**165.1**	**1.7**	**459.3**	**-0.1**

The 63 countries included in this table accounted for approximately 97% of total world crude steel production in 2022. Regions and countries covered by the table:

- **Africa:** Egypt, Libya, South Africa, Tunisia
- **Asia and Oceania:** Australia, China, India, Japan, Mongolia, New Zealand, Pakistan, South Korea, Taiwan (China), Thailand, Viet Nam
- **European Union (27)**
- **Europe, Other:** Macedonia, Norway, Serbia, Türkiye, United Kingdom
- **Middle East:** Iran, Qatar, Saudi Arabia, United Arab Emirates
- **North America:** Canada, Cuba, El Salvador, Guatemala, Mexico, United States
- **Russia & other CIS + Ukraine:** Belarus, Kazakhstan, Russia, Ukraine
- **South America:** Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

Top 10 steel-producing countries

	Mar 2023 (Mt)	% change Mar 23/22	Jan-Mar 2023 (Mt)	% change Jan-Mar 23/22
China	95.7	6.9	261.6	6.1
India	11.4	2.7	33.2	3.0
Japan	7.5	-5.9	21.6	-6.0
United States	6.7	-2.1	19.4	-4.0
Russia	6.6 e	0.4	18.7	-1.3
South Korea	5.8	1.9	16.7	-1.5
Germany	3.3 e	-0.5	9.2	-5.8
Brazil	2.7	-8.7	8.0	-6.8
Türkiye	2.7	-18.6	7.4	-21.5
Italy	2.2	2.7	5.6	-6.0

e - estimated. Ranking of top 10 producing countries is based on year-to-date aggregate

Source : worldsteel.org

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Dr K Bhanu Sankara Rao

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E-mail: thesecretarygeneral.iim@gmail.com, iimmetalnews@yahoo.com
Phone: 033-2367 9768 / 2367 5004
Website: www.iim-india.net
Fax: (033) 2367 5335
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1968-76	Dr M N Parthasarathi					2018-23	*Mr Kushal Saha

Change of Guard — Secretary General of IIM

Farewell of Mr. Kushal Saha, outgoing SG of IIM

A function was arranged at IIM Head Office on Thursday, March 30, 2023, at 3.30 p.m. in hybrid mode, to bid farewell to Mr. Kushal Saha, who completed his term as Secretary General of IIM on Friday, March 31, 2023.

On the day of the farewell, the atmosphere was filled with mixed emotions as IIM bid farewell to Secretary General, who had dedicated five years of service to the organisation.

During his tenure, Mr. Kushal Saha had been an invaluable asset to IIM team, providing support, guidance, and expertise in a variety of areas. He has been the driving force behind many of the successful initiatives and projects that have been undertaken over the years.

The function started with his brief bio-data being read out, followed by speeches by Dr. S. V. Kamat, President of IIM and other members present, in which they shared their experiences of working with the outgoing Secretary General. The speakers expressed their satisfaction over the impact he has made in bringing the dynanism in various activitis of the organisation.

After the speeches, the outgoing Secretary General gave a farewell speech, thanking everyone for their support throughout his tenure. He reflected on his time in the organisation and highlighted some of the achievements he had made during his tenure. He expressed his gratitude to the organisation for giving him the opportunity to serve IIM and wished the institute to achive continued success in future.

After his speech, he was felicitated as tokens of appreciation from the organisation.

As the day came to a close, there was a feeling of nostalgia as IIM bid farewell to Mr. Kushal Saha. IIM wished him all the best in his future endeavours.

Brief Profile of Mr. Bhaskar Roy, Acting SG of IIM

Mr. Bhaskar Roy graduated in Metallurgical Engineering from the Indian Institute of Technology, Kanpur in 1969. After working in a Market Research firm for about a year, he joined M. N. Dastur & Company (P) Ltd. (DASTUR), Kolkata in 1970. He retired after 43 years' service in 2013. Between 2003 and 2013 he was a Member of the Board of Directors.

While in DASTUR, Mr. Bhaskar Roy was associated with various projects in India and abroad relating to development of the iron & steel sector; planning for establishment of new projects; assessment of new/emerging technologies & processes. He has widely travelled on professional assignment to a number of countries in Europe, South America, Africa, SE Asia and the Middle East, and has presented about 50 technical papers at various conferences in India & abroad. From 2013 to 2016 he was a member of the Research Council of NML, Jamshedpur.

Between 2013 and 2015, Mr. Bhaskar Roy was the Secretary General of IIM. In 2009 he was awarded the prestigious IIM-Tata Gold Medal and conferred the Honorary Membership in 2016. He is currently the Chairman of the Administrative cum Finance Review Committee of IIM and coming on board as the Acting Secretary General with effect from 3rd April 2023.

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Technical Article

Optimization of Heat Treatment Parameters for Superni 263 Superalloy for Fabricating Advanced Ultra Supercritical Power Plant Components

Jhansi Jadav[1], K V Rajulapati[2], K Bhanu Sankara Rao[3]

Abstract

Superni 263 Superalloy has been indigenously produced by MIDHANI, Hyderabad. It possessed similar chemical composition as C-263, Haynes 263 and Nimonic 263. It is a precipitation strengthened Nickel-Chromium-Cobalt alloy with an addition of Molybdenum for solid-solution strengthening. Though the alloy was developed for aeroengine applications, it is being considered for high temperature components like rotors and thick section heat exchanger components for Advanced Ultra Supercritical Power (AUSC) plants which are expected to operate at around 1033K with pressure of 350Kg/cm^2. The choice of this alloy is primarily due to its attractive mechanical properties, workability, weldability and oxidation resistance. The present work is aimed at establishing optimum heat treatments for the usage of this alloy in AUSC plants. Various heat treatments comprising of solution annealing and ageing at various temperatures for different durations were assessed for obtaining optimum combination of strength and ductility. The microstructure evolved under different heat treatment conditions was determined, and tensile properties, deformation and fracture behavior were evaluated for various combinations of heat treatments. The tensile deformation behavior was examined using several empirical equations. Based on microstructure, tensile deformation and fracture studies and deformation mechanisms, 1373K/1.5h + 1073K/8h is suggested as the optimised heat treatment condition.

Keyword : 263 alloy, Hardness, Tensile properties, Heat treatment parameters, SEM and TEM

1. Introduction

High temperatures and pressures are employed to improve the efficiency of power generation plants where development of high strength materials is one of the primary requirement, to meet the industry demands. In general, 9-12 Cr steels (Gr. 91, 92, 122) that are being used in ultra super critical power plants are designed to withstand a minimum creep strength of 100MPa at an average application temperature of 893K for 10^5 hours. These types of steels suits as components for ultra-super critical power plants while solid solution strengthened, advanced austenitic alloys (Super 304H, 347HFG, NF709), are considered for AUSC power plants where the temperatures are limited to 973K. On the other hand, the age-hardenable Alloy 263 holds promise for usage up to 1033K [1-4]. This wrought Ni-based superalloy is based upon Ni-Co-Cr austenitic matrix. It is strengthened by combined effects of solid solution hardening and by the precipitation hardening associated with intragranular γ' [Ni 3 (Ti, Al)] and intergranular $M_{23}C_6$ which precipitate on ageing at elevated temperatures. Solid solution elements such as Mo contribute to strengthening of the alloy at elevated temperatures through lattice distortion due to its atomic size difference from the matrix. The benefits arising from solid solution strengthening elements comprises of reduced diffusion and the lowering of stacking fault energy. Alloy 263 is being used very extensively in aeroengines for various stationary components that include combustion chamber, casing, liner, exhaust ducting and bearing housing. The usage of this alloy in aero-engine applications has been primarily attributed to its low sensitivity to segregation,

[1] Department of Materials and Metallurgical Engineering, Mahatma Gandhi Institute of Technology, Hyderabad
[2] School of Engineering Sciences and Technology, University of Hyderabad, Hyderabad 500046
[3]Department of Materials Science and Metallurgical Engineering, Indian Institute of Technology, Hyderabad, Kandi, Sangareddy, 502284, Telangana

remarkable combination of high workability during processing and weldability. Furthermore, the alloy displayed a good combination of monotonic yield and tensile strength, resistance to creep and oxidation on prolonged exposure to elevated temperatures up to 1033K. The comparative evaluation of creep rupture strength of various candidate materials has shown that Alloy 263 is superior than the standard Inconel Alloy 617 and very much close to that of Nimonic 740 alloy [4]. Alloy 263 possessed minimum desired creep rupture strength of 100 MPa at 10^5 hours in the range 1023-1033K, making it as a promising alloy for various components in A-USC plants which include the forged thick section rotor, superheater and reheater tubing of the steam generators, which are being designed to operate at ~993/1013K with an applied stress of 310 Kg/cm^2 . European projects have chosen 263 alloy for turbine rotors [5,6].

The processing route, as well as composition within the specified range for each of the elements in the alloy may vary depending on the manufacturing route adopted by each supplier. Furthermore, there would be large variation in grain size depending on the processing route, thickness of the end product and the heat treatments employed. In view of this there is a need to establish appropriate heat treatments for the selected alloy that would enable precipitation of carbides and γ' phases at appropriate locations. This work is aimed at establishing the suitable heat treatment parameters, for (rotor and reheater tubes) of AUSC plants. The effect of the heat treatment parameters on the tensile properties at 298K and 923K are evaluated.

2. Experimental Details

The chemical composition of Superni 263 alloy used in this investigation is listed in Table I.

Table I : Chemical composition of Superni 263 alloy [2].

Element	Wt.%	Element	Wt.%
C	0.074	N	0.005
Cr	20.00	Mn	0.400
Co	19.30	Si	0.030
Mo	05.90	Ag	0.0003
Ti	02.10	B	0.0050
Al	0.510	Bi	0.0005
P	0.005	Pb	0.0002
Fe	0.050	S	0.005
O	0.0012	Cu	0.020
Ni	Balance		

Superni 263 alloy of 70 mm diameter bar was supplied in solution treated condition by MIDHANI, Hyderabad, India. Samples of 10 mm ×10 mm × 5 mm size were cut from the 5 mm thick discs and were subjected two solutionising treatments at 1373K and 1423K for durations of 0.5h, 1h, 1.5h and 2hrs. The details of ageing treatments are given in the Table II.

Table II : Details of heat treatments investigated.

Treatment	Temperature (K)	Time (h)
Solution treatments	1373 and 1423	0.5, 1, 1.5 and 2
Aging treatments	1023 1073 and 1123	1, 4, 8, 16, 24, 48,100 and 150 1, 4, 8, 16, 24 and 48

Detailed microstructural analysis of heat-treated samples was carried out by optical, Scanning and Transmission electron microscopy. The samples, examined using Leica optical microscope (DFC 320), Line intercept method was used to examine the grain size. The fracture analysis of tensile samples was performed at an accelerating voltage of 15kV, using SEM (HITACHI S-3400N), to understand the mode of tensile failure and deformation mechanisms. TEM analysis of three aged samples were carried out at an operating voltage of 200KV, using FEI Tecnai G^2 - transmission electron microscopy (TEM) to identify the deformation mechanisms. The tensile testing of Superni 263 alloy was conducted on solutionised and the three peak aged conditions, at a $\dot{\varepsilon}$ of 8.3 × 10^{-3} s^{-1} to determine the optimum heat treatment that would establish a good combination of strength and ductility at 298K and 923K.

3. Results and Discussion

3.1. Optimization of heat treatment conditions, microstructure and hardness

Hardness and grain-size were evaluated, in all the solution treated conditions (Fig.1). Solutionising at 1373K resulted comparatively smaller grain size

than at 1423K. Longer durations of solutionising leads to very coarse grain size at 1423K. Hardness values displayed a rapid fall on increasing the duration of the solutionising with plateau in between 1 and 1.5hrs. Since the rotors and reheater tubes of AUSC plants will be subjected to low cycle fatigue (LCF) and creep fatigue interaction (CFI) conditions, alloy with finer grain size is generally preferred [7,8]. Based on fatigue and CFI resistance requirement, a solutionising treatment of 1373K/1.5h is appropriate for Superni 263 superalloy. An annealing time of 1.5h at 1373K was sufficient to dissolve prior existing γ' precipitates and $M_{23}C_6$ type of carbides, though some (Ti-Mo) C type of primary carbides that formed during solidification remained undissolved. It is observed that primary carbides (Ti-Mo)C type do not dissolve even after 2hrs duration at 1423K. The Superni 263 exhibited 0.2% YS of 426 MPa, UTS of 786 MPa, uniform elongation of 67% and reduction in area of 66% after solutionising at 1373K/1.5h with an average grain size, of ~160 μm.

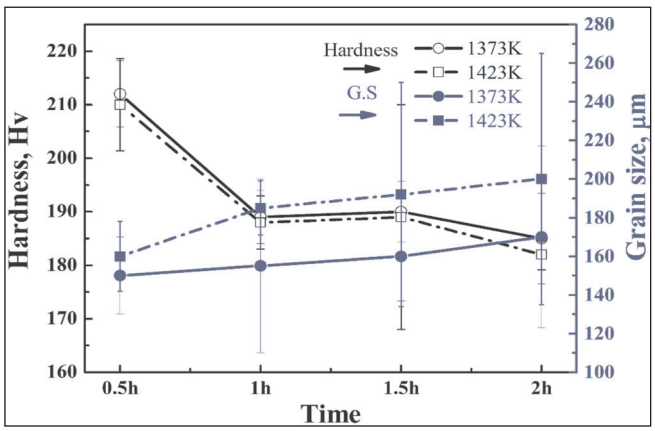


Fig. 1 : Variation in grain size and hardness of solutionised samples of Superni 263 alloy as a combined function of time and temperature

Ageing was carried out on solution annealed (1373K/1.5h) samples at three temperatures, 1023K, 1073K and 1123K; as shown in (Fig. 2) the hardness was found to be a complex function of ageing temperature and time. Depending on the temperature and time combinations, the peak in hardness, was obtained at 1023K/24h, 1073K/8h, and 1123K/4h. The peak in hardness was shifted to smaller durations on increasing the temperature of ageing. Detailed investigations conducted on precipitation kinetics of Superni 263, it has been found that the incubation period for the occurrence of γ' at 1073K and 1123K ageing was much smaller compared to that at 1023K [4]. Solution-annealed samples of Superni 263 alloy were subjected to aging at 1023K, 1073K and 1123K, leading to the precipitation of gamma prime (Ni_3(Al, Ti)) in the intragranular regions in addition to $M_{23}C_6$ type of carbides. The γ' size in all peak aged conditions was determined from images obtained by TEM. Ageing at 1023K/24h, 1073K/8h and 1123K/4h yielded an average γ' size of 14nm, 22nm and 58nm respectively. The shape of γ' remained spherical, though the volume fraction of γ' decreased with increasing temperature of ageing. More details pertaining to microstructure and mechanical properties were reported in Ref. [9].

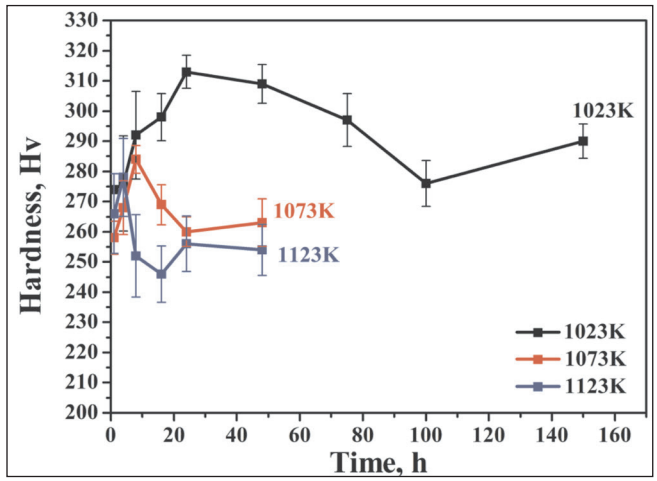


Fig. 2 : Variation of hardness of Superni 263 alloy as a function of aging duration at 1023K, 1073K and 1123K.

3. 2. Tensile Properties

Tensile Stress-Strain curves of Superni 263 alloy tested at 298K and 923K, in all peak aged conditions are presented in (Fig. 3). The alloy displayed maximum yield and tensile strength with minimum ductility on ageing at 1023K/24h. A combination of lower strength and maximum ductility was noted on ageing at 1123K/4h. The alloy displayed reasonable high strength and ductility at 298K and 923K on ageing at 1073K/8h. There is a decrease in flow stress of 263 alloy in 1123K/4h peak aged condition, at 923K, when compared to other ageing treatments.

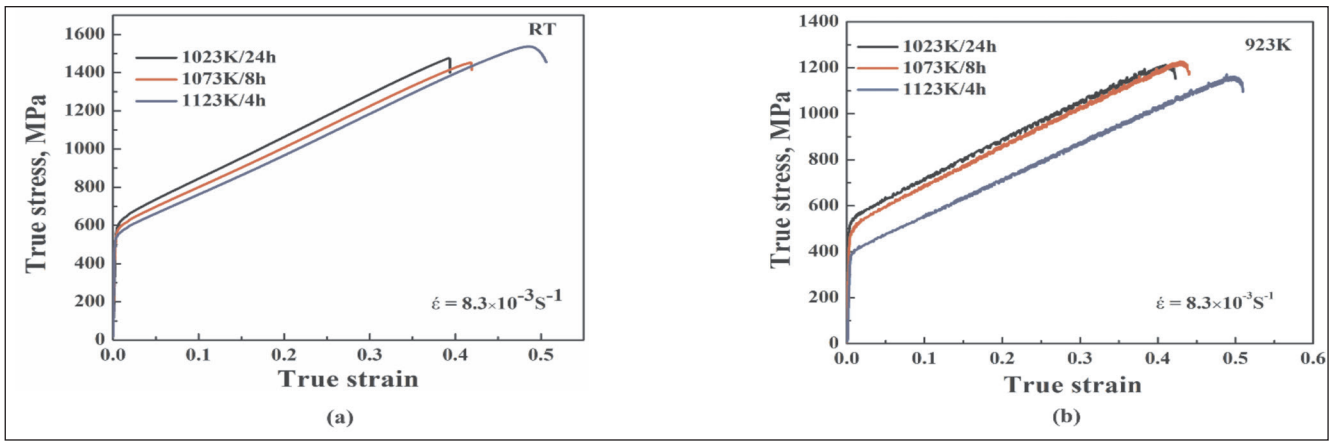


Fig. 3 : True stress-true strain plots of SU-263 alloy in different aging conditions that gave peak strength on aging at 1023K,1073K and 1123K (έ = 8.3 × 10-3 s-1 at 298K and 923K).

3.3. Work hardening behavior

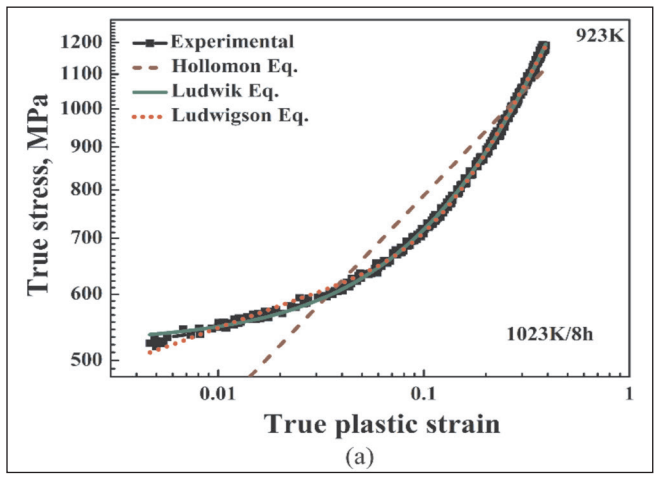
The strain hardening behavior of many structural materials is assessed from the true stress- true strain curves from tensile tests. The work hardening rate of the three aged conditions close to yield strength was calculated as $\Delta\sigma/\Delta\epsilon = (\sigma_{0.02} - \sigma_{0.002})/ 0.018$ (Table III). At 923K, the higher work hardening rate was observed in the 1073K/8h aged state. Strength values decreased on increasing the ageing temperature due to decreasing volume fraction of γ' in 1123K/4h peak aged condition at 298K and 923K. An interesting aspect observed from tensile deformation at 923K is the appearance of serrated flow in all the peak aged conditions. Serrated flow is considered as one of the manifestations of DSA [10]. Interactions among substitutional solute atoms and mobile dislocations promotes DSA.

Table III : Work hardening rate comparison in different heat treatment (aging) conditions at 298K and 923K.

298K		923K	
Sample condition	**θ, MPa**	**Sample condition**	**θ, MPa**
1023K-24h	4277	1023K-24h	2944
1073K-8h	4222	1073K-8h	3389
1123K-4h	3833	1123K-4h	2556

3.4. Empirical relationships and Empirical constants

In this investigation, the true stress- true strain data obtained for three peak aging conditions and the flow curves were derived from the Hollomon[11], Ludwik[12] and Ludwigson [13] empirical relationships. The important observations are: (i) The Hollomon relationship failed to predict the flow behavior in all the peak aged conditions at both the temperatures. (ii) Ludwik and Ludwigson equations represented the flow behavior more accurately at both the peak aged conditions (1023K/24h and 1123K/4h) at 298K. (iii) Ludwik relationship was found to give better fit to the empirical data in the peak aged conditions of 1023K/24h and 1123K/4h at 923K. (iv) In the peak aged condition of 1073K/8h, Ludwigson equation described experimental data very accurately at 298K and 923K at both low and high strains (Fig.4).



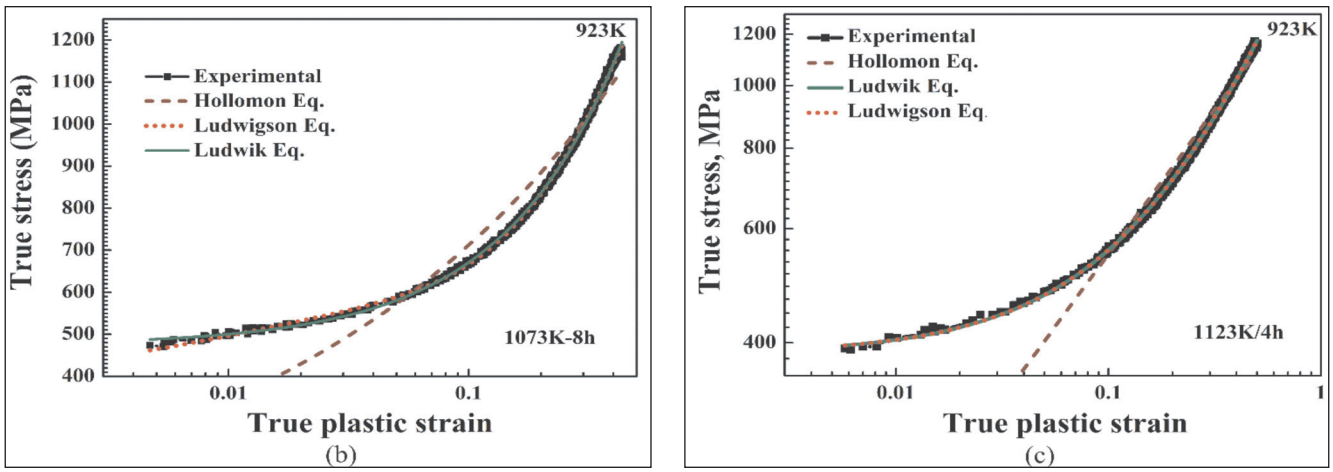


Fig. 4 : True stress-true plastic strain data of Superni 263 alloy fitted with various flow relationships in three aged conditions at 923K.

3.5. Fracture behavior

Fractographic investigations were conducted on samples tested at 298K and 923K in three peak aged conditions. At 298K, tensile deformation on samples aged at 1023K/24h caused intergranular cracking while ageing at 1073K/8h and 1123K/4h led to the occurrence of mixed mode fracture. Fig. 5(a-c)), illustrates the important features of the mode of fracture observed at 923K. The intergranular cracking in 1023K/24h - aged condition was found to have correlation with the decohesion of continuous carbide film developed at the end of ageing treatment. In the samples given heat treatments of 1073K/8h and 1123K/4h developed isolated cavities from the discrete carbides and linking of the cavities have not occurred.

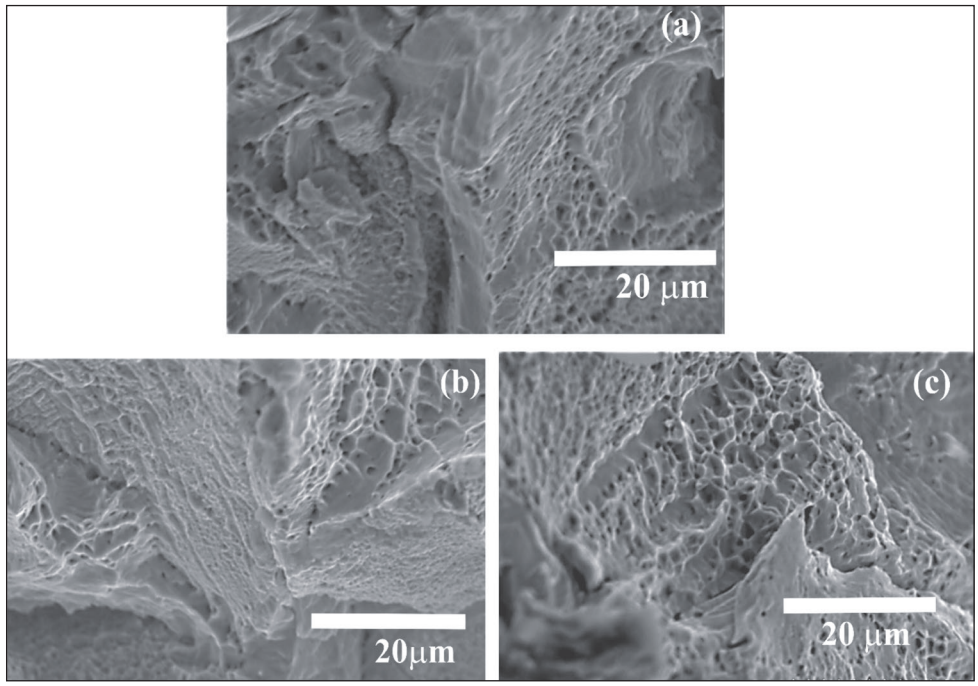


Fig. 5 : Tensile fractographs of Superni 263 alloy tested at 923K, in all peak aged conditions, illustrating (a) long intergranular cracks with mixed mode fracture at (1023K/24h) (b&c) Shows ductile fracture with isolated cavities from the discrete carbides and no linking of the cavities.

3.6. Microstructure evolved during tensile deformation

In this study, detailed TEM investigations were performed on samples tensile tested at 923K in the three peak aged conditions in order to obtain the information pertaining to the features contributing to high work hardening rates in the high strain regime [9]. At 923K, it has been noticed the occurrence of multiple slip bands, with high dislocation density in between the slip bands in the samples subjected to 1023K/24h. The deformed microstructure in the samples aged at 1073K/8h was composed of very high dislocation density between the slip bands comprising of dislocation tangles, dislocation loops, dislocation dipoles and dislocation pairs (Fig. 6). In case of 1123K/4h ageing, which contained initially low volume fraction of γ', the deformation was localized in planar slip bands with reduced propensity for multiple slip.

Additionally, the alloy has undergone micro twinning and developed a few stacking faults (Fig.7). The coarse γ' particles were by passed by Orowon looping process. The above observations clearly indicated several types of dislocation activity that promoted very high strain hardening rates in all the aged conditions. The above observations suggest that the description of flow behavior is dependent on the initial microstructure as well as tensile deformation temperature. It must be mentioned that irrespective of the aged condition, serrated flow was observed in the flow curves at 923K. The very high dislocation density, the occurrence of planar slip, generation of stacking faults can be considered as the micro-mechanistic features that support the macroscopic aspects of DSA that manifest itself in the form of serrated flow [9]. In many alloy systems, DSA caused an increased rate of dislocation multiplication with decreased tendency for cell formation reflecting the delay in in the onset of recovery process.

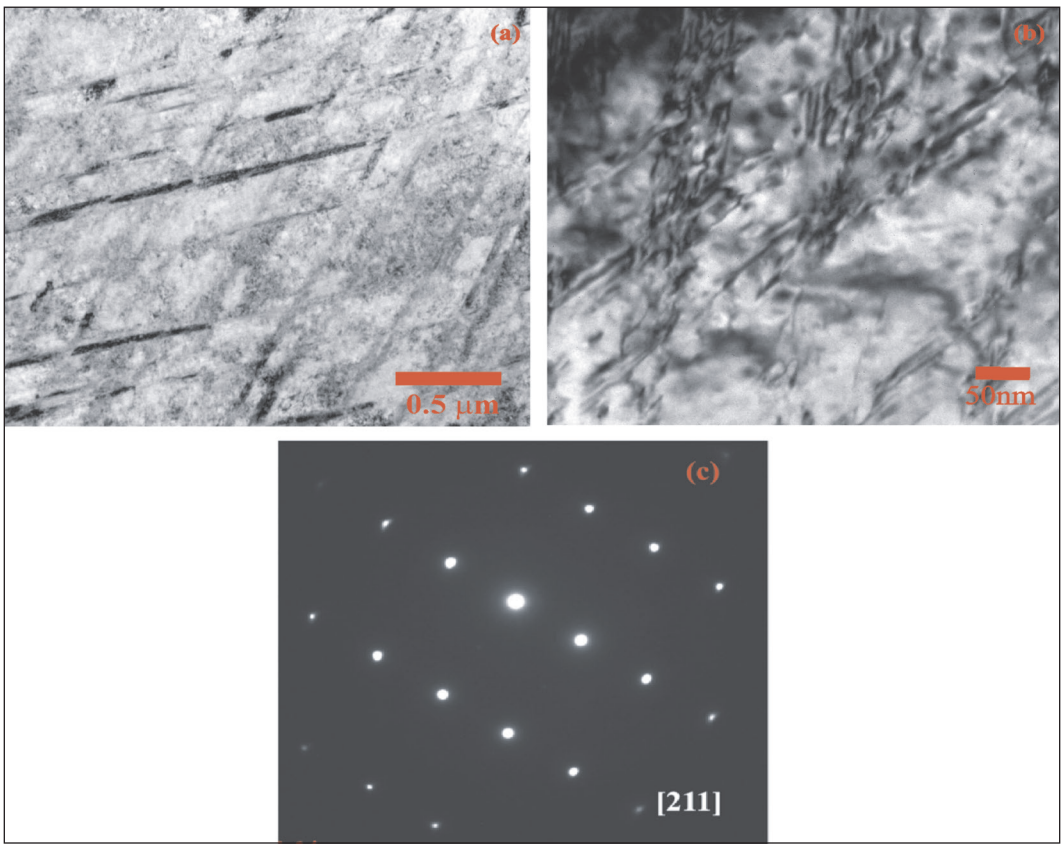


Fig. 6 : Bright field micrographs of samples deformed at 923K in 1073K/8h aged condition at a strain rate of 8.3 $10^{-3}s^{-1}$ (a) multiple slip with high dislocation density in the matrix (b) heavy deformation of matrix in between the slip bands indicating the presence of dislocation tangles, dislocation loops, dislocation pairs and dislocation dipoles(c) bright field image shown in (b) was obtained using [110] zone axis.[9].

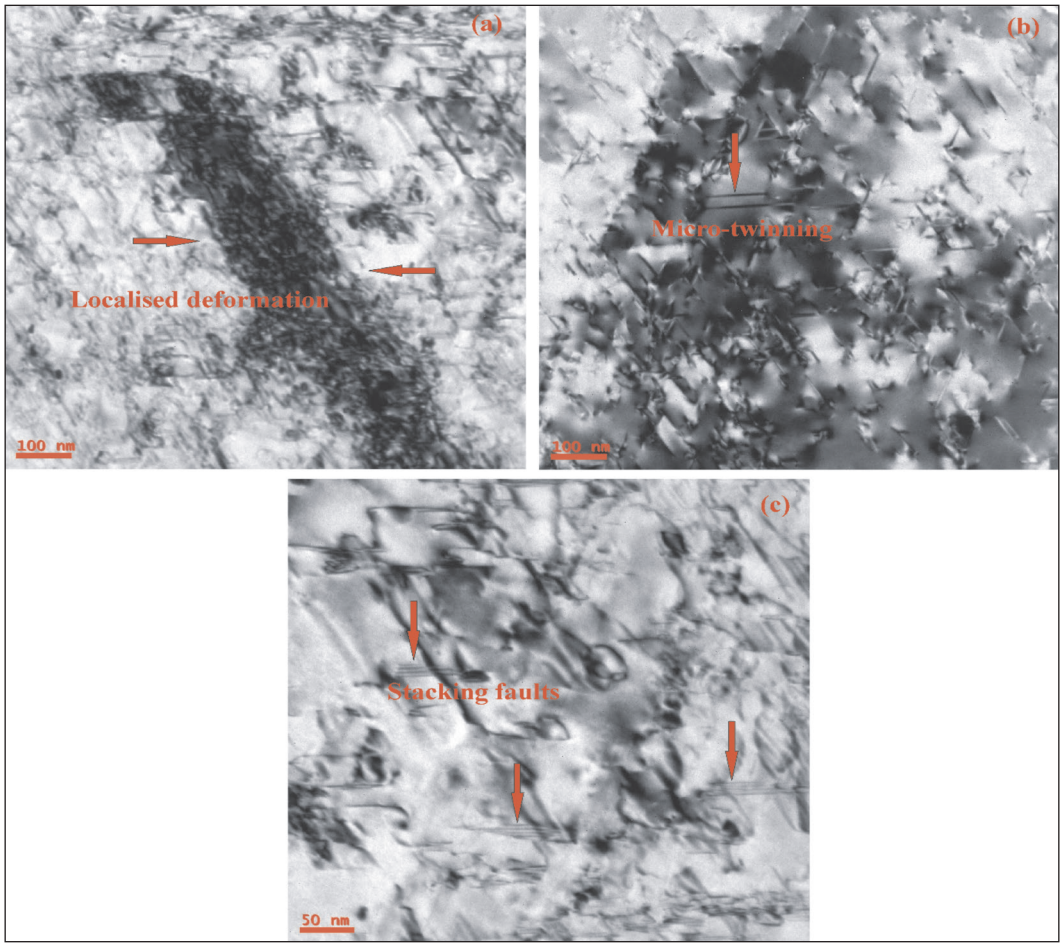


Fig. 7 : TEM bright field micrographs of deformed samples at 923K (1123K/4h) aged (a) localization of deformation in planar slip band (b) micro twinning and (c) stacking faults [9]

3.7. Relevance of empirical equations for heat treatment effects and optimization

The applicability of above empirical equations is dependent upon various flow parameters and their number in a given relationship. Each of the above equations represented the flow behavior of a certain shape in the range of their applicability. Ludwigson [13] equation described experimental data very accurately at 298K and 923K at both low and high strains. The transition strain separating the low and high strain regimes for all the three peak aged conditions is approximately same at 298K. The transition strain obtained at 923K for the deformed sample in 1073K/8h condition is high, when compared to other ageing conditions. Based on the investigations conducted on grain size, hardness and tensile properties, it is recommended that a solutionising treatment at 1373K/1.5h followed by ageing at 1073K/8h can be employed for Superni 263 superalloy [9].

4. Conclusions

(i) The heat treatment condition established for optimum microstructure and strength for Superni 263 superalloy consists of solutionising at 1373K/1.5h/WQ followed by ageing at 1073K/8h.

(ii) The microscopic deformation of Superni 263 alloy given the above treatment is composed of very high dislocation density between the slip bands comprising of dislocation tangles, dislocation loops, dislocation dipoles and dislocation pairs.

(iii) In case of 1123K/4h ageing, which was characterized by low volume fraction of γ', the deformation was localized in planar slip bands with reduced propensity for multiple slip.

(iv) Serrated flow behaviour was shown by the alloy at 923K test temperature, in both solutionised and aged conditions.

(v) Ludwigson equation described the tensile flow behaviour at 298K and 923K at both low and high strains very accurately in the peak aged condition of 1073K/8h.

(vi) Deformation substructure evolved during tensile testing at 923K was dependent on initial microstructure.

5. Acknowledgements

Authors would like to acknowledge Dr. N. Eswar Prasad, Formerly Outstanding Scientist DRDO for many useful discussions.

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A 3D printable GRX-810alloy designed for extreme environments by NASA

Multiprincipal-element alloys are an enabling class of materials owing to their impressive mechanical and oxidation-resistant properties, especially in extreme environments. National Aeronautics and Space Agency (NASA), USA, has demonstrated a breakthrough in 3D printable high-temperature materials that could lead to stronger, more durable parts for airplanes and spacecraft. A team of innovators from NASA and The Ohio State University described thedevelopment and characteristics of the new alloy, GRX-810, in a paper published very recently in the journal Nature [1].

The new oxide-dispersion-strengthened NiCoCr -based alloy was developed by employing a model-driven alloy design approach and laser-based additive manufacturing. In the development of oxide-dispersion-strengthened alloy, GRX-810, the scientists have adopted laser powder bed fusion to disperse nanoscale Y_2O_3 particles throughout the microstructure without the use of resource-intensive processing steps such as mechanical or in situ alloying. Smith et al. produced ODS NiCoCr through L-PBF in which nanoscale Y_2O_3 nanoparticles were coated onto NiCoCr metal powder through a high-energy mixing process that does not require any binders, fluids or chemical reactions [2] . This process did not deform or alter / impact powder spherical morphology, which is important in ensuring the production of high-quality Additive Manufacturing(AM) components. Building on the work and using the same coating process performed by Smith et al. [2] a model-driven alloy design approach was employed to optimize the NiCoCr alloy system for high-temperature applications using AM for complex components. This effort resulted in a new composition that was built using L-PBF to include nanoscale Y_2O_3 dispersoids for achieving high-temperature strength/stability above 810 °C. High resolution microscopy revealed the successful incorporation and dispersion of nanoscale oxides throughout the GRX-810 build volume. The mechanical properties of GRX-810 displayed a twofold improvement in tensile strength, over 1000-fold better creep performance and twofold improvement in oxidation resistance at 1,093 °C, compared with the traditional polycrystalline wrought Ni-based superalloys used extensively in additive manufacturing. It has been shown that the addition of nanoscale oxide dispersoids lead to sufficient strength in the matrix by avoiding dislocation motion.

The success of this alloy highlights how model-driven alloy designs can provide superior compositions using far fewer resources compared with the 'trial-and-error' methods of the past. These results showcase how future alloy development that leverages dispersion strengthening combined with additive manufacturing processing can accelerate the discovery of revolutionary materials. Dispersion strengthened alloys like GRX-810 are considered excellent candidates to build aerospace parts for high-temperature applications, like those inside aircraft and rocket engines, because they can withstand harsher conditions before reaching their breaking points. This study confirms the maturity of both model-driven alloy design and AM processes to produce next-generation materials with properties not feasible through previous, conventional manufacturing technologies.

A team of contributors from NASA's Glenn Research Center, Cleveland, NASA's Ames Research Center in California's Silicon Valley, NASA's Marshall Space Flight Center in Huntsville, Alabama, and The Ohio State University co-authored the Nature paper [1].

GRX-810 was developed under NASA's Transformational Tools and Technologies project, with support from the Optimized and Repeatable Components in Additive Manufacturing (ORCA) project under the agency's STMD Game Changing Development Program.

References:

[1] **A 3D printable alloy designed for extreme environments,** Timothy M. Smith, Christopher A. Kantzos, Nikolai A. Zarkevich, Bryan J. Harder, Milan Heczko, Paul R. Gradl, Aaron C. Thompson, Michael J. Mills, Timothy P. Gabb & John W. Lawson, ***Nature*, Volume 617,** PP.513–518 (2023), Published online, 19th April 2023.

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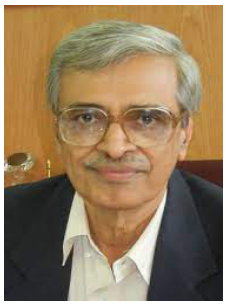
Achievements of Members and National Appointments

Prof K Chattopadhyay



Prof. Chattopadhyay has recently been awarded the prestigious National Science Chair by the Science and Engineering Board of India, in recognition of his outstanding research and academic achievements. He is a highly esteemed scientist and academician, and an honorary fellow and past President of The Indian Institute of Metals.

As the National Science Chair, Prof. Chattopadhyay will lead research and development activities in Materials Science and Engineering, his area of expertise, and promote scientific excellence in the country. He will be associated with the Indian Institute of Science, one of the most prestigious research institutions in India.

Prof. Chattopadhyay's prolific research output includes over 350 research papers in peer-reviewed journals and numerous patents. His work has been widely cited and has received international acclaim. He has also been recognized with several other awards and honors, including the Shanti Swarup Bhatnagar Prize, which is considered one of the highest scientific honors in India, and fellowships of all the three science academies in India and Indian National academy of Engineering.

Prof. Chattopadhyay is a co-discoverer of Decagonal quasicrystals and high-temperature cobalt base superalloys. His research interests include the study of advanced materials, nanotechnology, and surface engineering. His work has significant implications in the fields of manufacturing, energy, and healthcare, and he has made important contributions to the development of new materials and processes that have the potential to transform various industries.

Overall, the National Science Chair award is a well-deserved recognition of Prof. Chattopadhyay's outstanding achievements in the field of materials science and engineering, and his contributions to the advancement of scientific knowledge and innovation.

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Non-Ferrous Metals Statistics Domestic Scenario

Prices in India (as on 28th April, 2023)

(Mumbai Local Price in Rs. / kg)

Product	Rs. / kg	Product	Rs. / kg
Copper Armature	**723**	Aluminium Ingot	**210**
Copper Cathod	**749.4**	Aluminium utensil	**157**
CC Rod	**761**	Zinc Ingot	**238**
Copper Cable scrap	**738**	Lead ingot	**185**
Brass Sheet Scrap	**523**	Tin Ingot	**2280**
Brass Honey Scrap	**460**	Nickel Cathod	**2043**

Source : http://www.mtlexs.com/

IIM Metallurgy Materials Engineering

IIM – ATM 2023

77th Annual Technical Meeting of the Indian Institute of Metals (IIM-ATM) and International Conference on Metals.

Date 22nd November – 24th November, 2023

Venue KIIT, Bhubaneswar

Organising Chapters IIM Sambalpur, IIM Angul in association with Hindalco Industries Ltd

The flagship annual event, IIM ATM, is a unique platform wherein the relevant people representing all significant sectors of industry, academia and R & D institutes from all parts of India join together to deliberate the future advancements and development initiatives. The participating Metallurgists and Material Scientists / Engineers will do lot of knowledge-sharing and speak about their rich experiences and do exchange of ideas.

The International Conference will throw light on contemporary topics of relevance such as green manufacturing, strategic and rare metals, additive manufacturing and accelerated development of materials. There will be various themes which covers all the crucial and emerging topics of interest that benefit of the industrial community at large. The valuable deliberations and presentations during the conference would also immensely benefit the research community in the field of metals and materials.

A Technical exhibition & Metallography contest on the theme topic and presentation of IIM Awards will be added attractions of the IIM-ATM 2023.

President of The Indian Institute of Metals : 2022-23

Dr. Samir V. Kamat, Chairman
Defence Research and Development Organisation (DRDO)

Incoming President of The Indian Institute of Metals : 2023-24

Mr. Satish Pai, Vice-President IIM
Managing Director
Hindalco Industries Ltd

TENTATIVE PROGRAMME SCHEDULE

22nd November
- Inaugural function
- International Conference
- Opening of Technical exhibition & Metallography contest

23rd November
- IIM Award ceremony
- IIM Memorial Lectures
- 77th Annual Technical Meet (ATM)

24th November
- 77th Annual Technical Meet (ATM)
- Valedictory function

Chairman : **Mr S S Mohanty**

Convener : **Mr Bibhu Prasad Mishra**

The IIM-ATM 2023 organising committee cordially invites you to join this magnificent platform of learning, sharing and networking. We also sincerely thank all our esteemed co-organizers for their active participation and involvement during this phase of programme conceptualization and planning.

Contact: bibhu.mishra@adityabirla.com

Second Announcement

IIM Metallurgy Materials Engineering

IIM-ATM 2023

77th Annual Technical Meeting of the Indian Institute of Metals

22nd – 24th November 2023

Venue: KIIT, Bhubaneswar

Organisers: IIM Sambalpur Chapter, IIM Angul Chapter, IIM Bhubaneswar Chapter and Hindalco Industries Ltd.

77th ATM 2023, an annual flagship event of IIM will be attended by many prominent industry captains, technical experts, senior academicians and students from various technical institutions from all parts of India and abroad. The ATM's multiple sessions are a centralised hub for sharing knowledge, exchange of ideas and deliberating new initiatives.

- Online Abstract submission till 30th June 2023
- Be a Sponsor to the Mega Event of Industry and Academia
- Advertise in the 77th IIM-ATM Memorial Souvenir
- Book a stall at IIM-ATM Technical Exhibition
- For details log on to www.iimatm.org

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CONVENOR

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Advisor,
Hindalco Industries Ltd.

Unique event of joint deliberation on Future Development Initiatives by Industry-Academia-R&D Institutes.

Come, Be a Part of the Brainstorming on Metal Industry.

- **9** Plenary Talks at the International Conference
- **40** Keynote Addresses
- **360** Technical Paper Presentations
- **300** Poster Presentations

22nd November
- Inauguration of IIM-ATM 2023
- Inauguration of Technical Exhibition
- International Symposium

23rd November
- Inauguration of 77th ATM Technical Meeting
- IIM Award Ceremony
- IIM Plenary Lectures

24th November
- 8 Parallel Technical Sessions
- Valedictory Session

The IIM-ATM 2023 Organizing Committee, cordially invites you to join for a wonderful learning, sharing and networking experience, in Bhubaneswar - The City of Temples and the emerging Educational and Health Services hub of Eastern India. We look forward to your valuable participation and overwhelming support.

SAIL produces record 18.28 Mt crude steel; 19.40 Mt hot metal in FY23

State-owned SAIL has produced a record 18.28 Mt of crude steel during financial year 2022-23, registering a year-on-year rise of 5.3 per cent. The production of hot metal also rose by 3.6 per cent to 19.40 Mt during the financial year ended March 31.

In a statement, the Steel Authority of India (SAIL) said it has achieved the best-ever annual production during FY23.

"The company recorded 19.409 Mt hot metal and 18.289 Mt crude steel production with a growth of 3.6% and 5.3%, respectively over the previous best in FY22," the statement added.

The steel giant further said it is continuously ramping up its production over the years with a focus on more value-added and special-steel production.

SAIL, under the Ministry of Steel, is the country's largest steel producer with an annual installed capacity of around 20 Mt. It has five integrated and three special steel plants across various locations in the country.

The Economic Times (3.4.23)

DRDO CoE inaugurated at IIT-H

DIA-CoE being inaugurated at IIT-H in Sangareddy

Defence Research and Development Organisation (DRDO)'s collaboration with the Indian Institute of Technology-Hyderabad (IIT-H) started in 2020 with the former's research cell transformed into a Centre of Excellence as DIA-CoE.

This centre was inaugurated on 16th April, 2023 by Chairman of DRDO Dr. Samir V. Kamat in the presence of IIT-H director Prof. B.S. Murty and Director of DIA-CoE Dr. G. Ramaguru at Technology Research Park, IITH.

There are seven verticals of technology projects that will be undertaken at DIA-CoE, including ultra-high temperature materials, additive manufacturing, space technologies, AI for defence, image processing, seekers and homing technologies and nano-ornithocopter technologies.

Prof. Murty said, "This centre is a major step towards Atmanirbhar Bharat in the defence sector. I am happy that this CoE will take shape under the leadership of Dr. Ramaguru, who has experience in managing strategic projects. I am looking forward to the faculty of IIT-H working together with DRDO to make India a global leader in each of the verticals assigned to the CoE".

Praising IIT-H for cutting-edge research, Dr. Kamat said, "DRDO and IIT-H will work together and identify target projects in each domain and execute them in 3-5 years. DIA CoE at IIT-H is the country's largest centre among all 15 DIA-CoEs and has many verticals".

The Hindu (17.4.23)

Govt. not keen on imposing higher import duty on steel

The Centre is unlikely to relent to the domestic steel industry's demand for increasing basic customs duty (BCD) on the import of steel, or levy any additional safeguard duty on the alloy, in the near term, said two officials in the know.

The government believes that such an intervention could result in the crucial alloy getting more expensive in the domestic market, one of the officials said.

While the steel ministry has engaged with the commerce ministry and the finance ministry on the subject, the prevailing view is that imports have not gone up at an alarming level for the government to intervene, said the second official.

In fact, Jyotiraditya Scindia, the union minister of steel, recently dismissed concerns around rising imports.

"If you look at the numbers, the rise (in imports) is very, very minimal. Our market is growing tremendously, and our domestic producers are supplying well," Scindia had said in February.

An emailed request for comments to the steel ministry remained unanswered.

The Indian Steel Association (ISA), a group representing the interests of manufacturers such as Tata Steel and JSW Steel, has made multiple representations to the government seeking intervention against alleged predatory pricing of overseas steelmakers. It has sought measures like increasing the BCD on steel to 12.5% from 7.5% currently for flat steel products, and 10% for long products from 7.5% at present.

The industry body has also sought 25% safeguard duty on steel imports from countries that have a free-trade agreement with India, thus bypassing the BCD. Such countries account for more than 60% of steel imports into India.

Steelmakers have said that overseas manufacturers are dumping excess output in India at prices lower than those in their domestic markets at a time when demand for the alloy has slumped in most major consumer countries.

"We should not be vulnerable to unfair trade at predatory prices," a top executive at one of the country's largest steel companies said.

India's total steel imports went up by 45% in FY23 to 7 Mt, preliminary data from Joint Plant Committee show. Countries such as South Korea, Japan, Russia, China and Vietnam are the top exporters of steel to India.

During this period, exports dipped 55% to 8.3 Mt. The decline in exports can be attributed to the levy of a 15% export duty on steel from May to November last year by New Delhi to rein in local prices of the alloy.

The Economic Times (28.4.23)

NFC-Kota Project

NFC-Hyderabad has progressively undergone modernization, capacity augmentations to meet the increasing demand during past four decades. There is going to be substantial increase in fuel demand owing to the new PHWRs planned by NPCIL.

To meet the additional demands of PHWR fuel, NFC proposed an additional facility at a new location. After evaluation of different locations, Site Selection Committee recommended to setup a PHWR fuel fabrication project and township in the vicinity of RAPS, Rawatbhata, Rajasthan which was approved by AEC.

NFC-Kota is a green field project being established adjacent to Heavy Water Plant, Rawatbhata (HWP-Kota), Rajasthan.

This project is established as an extension to NFC-Hyderabad and is based on the technological procedures adopted at NFC-Hyderabad.

NFC-Kota project is mandated to supply fuel to 4 x 700 MWe PHWRs. The scope of this project is to establish manufacturing facility for:

- 2 x 250 TPY of 37 element PHWR Fuel bundles from PFFF (PHWR Fuel Fabrication Facility)
- 1 x 65 TPY of Zircaloy products from ZFF (Zircaloy Fabrication Facility)
- Future expansion of ZFF from 65 TPY to 165 TPY.
- Required Supporting Services and Statutory Facilities

Subsequent to clearances from various agencies viz., MoEFCC, Cabinet, Siting consent by AERB, Rajasthan State PCB, NOC from Wild Life authorities (NBWL), site grading works for NFC- Kota commenced on 15th January, 2015. Construction works for Plant & Non-plant buildings started on grant of Consent for Construction from AERB.

As on date, most of the civil works for Plant & Non-plant buildings are completed and erection & commissioning of equipment is ongoing in full swing.

Recently, on 25.04.2023, satisfactory demonstration of fuel bundle assembly was carried out to check the performance of some of assembly shop machinery after obtaining regulatory permission.

Source : P. A. Pratap
Project Director & Deputy Chief Executive,
Nuclear Fuel Complex - Kota Project, Rawatbhata

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12.	**Dr. R. Lakshmi Narayan** **Editor**	B.E (Met.) VNIT Nagpur, Ph.D. (Met.) IISc Bangalore	Assistant Professor Department of Materials Science and Engineering, IIT Delhi	Multiscale processing-structure-property correlations in advanced materials such as additively manufactured metals and alloys (Steels, Al and Ti alloys), metallic glasses and their composites, Ni based superalloys, fracture, fatigue and indentation of materials.
13.	**Shri Subrat K Baral** **Editor** subrat.baral @tatasteel.com		Chief, Alliances and Ventures Technology and New Materials Business, Tata Steel Limited 2nd Floor, Jubilee Building, Museum Road, Bangalore	New Materials

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IIM Foundation Day — Celebration on 24th February 2023 @ IIM-HO

The 77th IIM Foundation Day was celebrated with gusto at 'Metal House' premises, connecting Chapters, Former Presidents, Office Bearers, IIM Members and other delegates through hybrid mode in the forenoon of February 24, 2023.

All members, delegates and employees present were welcomed by Mr. Kushal Saha, Secretary General, IIM with all warmth. This was followed by the lamp-lighting ceremony in the presence of all delegates, and theme based welcome songs in the voice of Ms. Nabatara Mitra, IIM-HO, accompanied by her musicians. The rich melodies depicting different facets of the Indian Culture and the countryside in particular were appreciated by all members present.

Lamp Lighting Ceremony

A video showcasing the artworks/murals being designed to enhance the aesthetics of the exteriors of Metal House was played by HO team.

As the ceremony unfolded, Prof. B. S. Murty, Vice President and Chairman, Metal Science Division shared his journey so far with the Institute and reckoned the transformation & success of the Institute in the years to come. His shared nostalgia on this day was relatable to many. A glimpse of a heart-warming song in his voice was enjoyed thoroughly and applauded by all present.

Mr. Bhaskar Roy, Chairman of AFRC, then shared that he has had a long association with the IIM since 1967. He was then a 4th-year student at IIT Kanpur when NMD-ATM was held there. The memories and journeys traversed had since then been unfading and significant in many ways. He wished the organisation goes from strength to strength in all possible endeavours and stand tall in the field of metallurgy and materials science.

The ceremony continued with sharing of reminisces of all IIM Members present. Dr. Asim Kumar Ray, Chairman, IIM Kolkata Chapter shared his objective of inducting younger demographic in various activities of the Institute; Dr. Rahul Mitra, Chairman, IIM Kharagpur Chapter shared that his association with the august body since his academic days.

The President of IIM, Dr. S. V. Kamat encapsulated the thoughts put forth by all the Members and reiterated the dynamicity of IIM in being able to offer services to Industry, Institutes & Research Organisations at the same time. He added here that the Hon'ble Prime Minister of India has given a target that by 2047 our country has to become a developed country, and to make it happen, we have to become self-reliant in producing all types of materials, including metals. IIM can play a critical role in fostering interactions, cooperations, and dialogues between various agencies and people working in different areas of materials and metals. He emphasised on the strengths of the Institute and envisaged that the next 25 years will be going to be the golden period for IIM.

Prof. B. S. Murty, Director, IIT-Hyderabad & Vice President-IIM addressing the assemblage

@the event of IIM Foundation day

The cake cutting ceremony was witnessed by all Members present through both the modes. The event was concluded with a vote of thanks delivered by Mr. Somnath Guha, Honorary Treasurer, IIM. Mr. Tamal Goswami, IIM HO was the emcee of the event.

Apart from IIM Head Office, Mumbai & Kanpur chapters connected through web, also graced the occasion with several mesmerizing vocal and instrumental performances.

A team consisting of Sayandeep, Sonal, Sreepooja, and Anik represented the Mumbai Chapter with their melodious performances. The team's performance was well-received by the audience.

The musical presentation of IIM Mumbai Chapter

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Chapter Activities Mumbai, Kanpur, Pune

Mumbai Chapter

IIM Mumbai Chapter organised an evening lecture as part of its monthly lecture series on 24th February, 2023. The event was held at the Training School Hostel's multipurpose hall in Anushaktinagar, Mumbai, and was attended by over 65 people in person and an additional 50 online. The evening started with the welcome address by Shri D. Singh, Chairman IIM Mumbai Chapter & CMD, IREL (India) Ltd. Subsequently, Dr. R Tewari, Vice Chairman IIM Mumbai Chapter, introduced Ms. Ruchika Jha, Founder of Arkya Consulting and invited the speaker of the evening. Ms. Jha has extensive expertise in the metals and mining industry, further highlighted by her previous role as Group Commercial leader and CEO - Silver at Vedanta Ltd.

Ms. Ruchika Jha is being felicitated on that occasion

In her talk, Ms. Jha shared her insights on the emerging applications of metals and the opportunities for collaboration between research organizations and the industry to indigenize the production of specialty alloys. Her presentation was informative and engaging, and the audience had several questions for her after the talk.

The Attendees @ the evening session

After the talk, Dr. D. K. Singh, Secretary of the IIM Mumbai Chapter, thanked Ms. Ruchika Jha for her informative presentation. The event concluded with networking opportunities for the attendees.

Kanpur Chapter

IIM Kanpur Chapter organised a talk on March 20, 2023 from 11:00 a.m. at FB421 (Conference room, Department of Materials Science and Engineering), IIT Kanpur. The talk was delivered by Dr. Soumya Sridar, Visiting Research Assistant Professor, University of Pittsburgh. The title of the talk was "Application of computational thermodynamics for design of materials and post-processing operations".

Pune Chapter

IIM Pune chapter conducted a 1-day workshop on "AI-ML in Materials and Manufacturing" on 1st of April 2023 at Kirloskar Auditorium, BHAU Institute, COEP Technological University, Pune. The intent of the workshop was to discuss on AI/ML in Materials Engineering and show some applications where this technology can be leveraged for materials design & performance, process quality control, microstructure design, materials selection and how industries can develop this competency. One presentation was also devoted to hands on python programming.

The workshop was attended by 50+ from academia, R&D Institutes, and Industries. The list includes ARAI, DIET, Alleima, JSPM, SCOE, NCL, Hexagon, ARDE, DataNnovite Sol, Tantrata Solution, John Deere, Industrial Metal Powder, Tata R&D (TRDDC) & COEP. The event was opened with welcome address by Mr. Pahwa, Chairman IIM PC, inviting all the attendees and presenters and emphasizing the importance of the workshop. Prof. Dhokey, Director (Research, Innovation, Incubation and Linkages) briefed on IIM Pune chapter activities and Mr. Mandar Joshi, CEO, Bhau Institute sharing his personal experiences and learning on startups with audience. There were six invited presentations given by eminent speakers from academia and Industries during this workshop. The list of presenters & presentation titles is shown in the table below.

The attendees had an engaging session with good discussions around how they can leverage this technology for their work. Dr Satyam Sahay from John Deere volunteered to support attendees on getting started on leveraging AI/ML for their research such as (1) defining and validating appropriateness of their problem for AI/ML vs traditional approach and (2) support on initial steps to leveraging AI/ML. This workshop initiative by IIM PC was well appreciated by audience and expected to conduct such workshops at regular intervals. The workshop was ended with Vote of Thanks by chapter vice chairman Dr. Pravin Kumar from ARDE.

S. No	Presenter and affiliation	Title of presentation
1.	Dr. Satyam Sahay, John Deere, Pune	Building Competency & Developing Talent in AI-ML
2.	Mr. Mahesh Gudipati, John Deere, Pune	AI-ML using Python programming
3.	Prof. Alankar Alankar, IIT Bombay	Machine Learning for Novel Material Design and Performance Analysis
4.	Mr. Avadhut Sardeshmukh, TCS Research, Pune	AI-ML for Microstructure Informatics
5.	Dr. Goutam Mohapatra, John Deere, Pune	AI-ML in Materials related decision making - Design, Manufacturing & SCM
6.	Dr. Ritwik Basu, KCTI, Bharat Forge Ltd, Pune	AI-ML in Process Quality Control in Steel Manufacturing

Glimpse of the event 'AI-ML in Materials and Manufacturing'

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BRML-2023 A Brief Report on the 5th Dr Baldev Raj Memorial Lecture

The fifth Dr. Baldev Raj Memorial Lecture (BRML) was organized on 10th April 2023, by the Indian Institute of Metals, Kolkata, IIM Human Resources Development Centre, Kalpakkam - Chennai & IIM Coimbatore Chapter in association with PSG College of Technology, Coimbatore. The program was conducted in hybrid mode in the Conference Hall at PSG Tech, Coimbatore with video conferencing through Webex platform.

At the onset, a floral tribute was paid by the dignitaries to late Dr. Baldev Raj. The program started with a welcome address by Dr. K Prakasan, Principal, PSG Tech; in his address, he recalled association of Dr. Baldev Raj with PSG Tech. Dr. U. Kamachi Mudali, Vice Chancellor, VIT Bhopal & Chairman, IIM HRDC-KC presented the profile of Dr. Baldev Raj and briefed on the genesis of 'Dr. Baldev Raj Memorial Lecture'. The lecture was started in the memory of Dr. Baldev Raj, a renowned metallurgist and eminent scientist-cum-technologist to perpetuate his significant contributions towards energy policy, advanced materials, manufacturing processes, and characterization of materials. Dr. Baldev Raj had mentored hundreds of scientists, technologists and students, inspiring them to pursue high levels of professionalism with ethical practices in the domain of engineering, science & technology.

Dr. Samir Kamat, President IIM Kolkata, in his presidential address, recalled his long association with Dr. Baldev Raj, when working in several committees. He highlighted that Dr. Baldev Raj had bridged disciplines, societies and nations with effortless ease. He also mentioned that the special way by which Dr. Baldev Raj brought academia, industry and government together was unique. Dr. V. Ramaswamy, Professor, Dept. of Metallurgical Engg., PSG Tech introduced the speaker, Dr. Sanak Mishra, Former Managing Director, SAIL Rourkela Steel Plant; Former President of Indian Institute of Metals & Indian National Academy of Engineering.

Dr. Sanak Mishra recalled his very long association with Dr. Baldev Raj. He delivered the fifth Dr. Baldev Raj Memorial Lecture on the topic 'Evolution of Steel Technology and Current Indian Steel Scenario'. Dr. Mishra presented an overview of evolution of blast furnace technology, steel making & casting in the last fifty years. He highlighted how advancement of process - structure - property concepts are used for the production of steel with improved properties. He recounted the replacement of conventional steels used in automobile segment by advanced high strength steels through Ultra Light Steel Auto Body (ULSAB) initiatives. He presented a chart of different steels now available for the auto-segment matching the property requirements. He stressed that modern steel meets both the higher and complex performance requirements, as compared to earlier quality requirements of steels. The lecture was attended by more than 200 scientists, faculty, research scholars and UG / PG students, and more than 50 IIM professionals; the family of Dr. Baldev Raj was also present through Webex Online.

Dr. U. Kamachi Mudali, Former President, IIM presented to Dr. Sanak Mishra the memento for BRML-2023 on behalf of the President, IIM. The program ended with a vote of thanks by Dr. J. Krishnamoorthi, Chairman, IIM Coimbatore Chapter.

Glimpse of the event




Dignitaries paying floral tributes to Dr. Baldev Raj

Dr. K. Prakasan welcoming the dignitaries and gathering

Dignitaries on the dais

Dr. U. Kamachi Mudali speaking about Dr. Baldev Raj and the BRML Series

Dr. Samir Kamat's address

Dr. V. Ramaswamy introducing the speaker

Dr. Sanak Mishra delivering the 5th Dr. Baldev Raj Memorial Lecture

Snapshot of the audience for the lecture programme

The BRML memento being presented to Dr. Sanak Mishra

Vote of thanks proposed by Dr.J.Krishnamoorthi

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रक्षा अनुसंधान एवं विकास संगठन
रक्षा मंत्रालय, भारत सरकार
DEFENCE RESEARCH & DEVELOPMENT ORGANISATION
Ministry of Defence, Government of India

Aeronautics Research & Development Board

Vision

Make India technologically strong by establishing world class cutting edge aeronautical science and technology base to provide our Defence, Space and Civil Aviation sectors a decisive edge by equipping them with internationally competitive systems and solutions.

Mission

To encourage and fund basic and applied research in pertinent scientific disciplines directly relevant to our aeronautical systems needed for future by enabling and supporting emerging talents, particularly in academic and research institutions to create and evolve a potential knowledge-base system applicable to future aeronautics needs of the country.

Charter

- To formulate research, design and development programmes in aeronautics and allied sciences, keeping in view future needs of the country specifically with respect to aircraft, helicopter, missiles and all other airborne vehicles.
- To implement such programmes through appropriate institutions and individuals by sponsoring research, design and development projects, creating/ improving infrastructure facilities deemed necessary, while ensuring that they are suitably monitored.
- To promote in all possible ways such educational and training programmes as may be considered necessary for ensuring that adequate manpower of requisite quality becomes available to various aeronautical organizations in the country.
- To promote all relevant R&D activities in the country through appropriate scientific meetings, provisions of support for participation of Indian and foreign scientists in such meetings, conduct of relevant competitions as well as other training and visiting programmes within India and abroad as may fall within the scope of the programmes mentioned at sub para (a) above.
- Dissemination of appropriate technical information through journals and documents, encouragement of individual and collective efforts and nurturing of young talent by institutions with suitable awards, scholarships etc. Organization of necessary centralized services related documentation, software, data-link etc. and in all such other ways that the Board may determine from time to time.

Panels & Chairmen (2017-2022)	
Aerodynamics Panel **Dr S Pandian** Prof. Vikram Sarabhai Distinguished Professor & Ex- Director & DS, SHAR	**Propulsion Panel** **Dr V Ramanujachari** National Centre for Combustion Research & Development (NCCRD), IIT Madras, Chennai
Aerospace Resources Panel **Dr N Eswara Prasad** OS & Ex-Director, DMSRDE (DRDO), Knp.-13	**UNMANNED AERO SYSTEMS PANEL** **Shri PS Krishnan** DS & Ex-Director, ADE, Bangalore-560075
Materials & Manufacturing Panel **Dr DK Das, Scientist H** Group Head (DSG), DMRL (DRDO) Hyd. - 58	**Structures Panel** **Dr Makarand Joshi** Scientist G, R&DE (E), DRDO, Pune-411015
GTMAP **Prof. Amol A Gokhale, IITB, Chairman**	**Systems / Systems Engineering Panel** **Shri APVS Prasad** Scientist H, CE, CEMILAC, DRDO, Bangalore

Seminars & Conferences

National Seminar on Advanced Materials and Processes (AMP-2023)

The Department of Metallurgical and Materials Engineering, MGIT, Hyderabad organised a 2-Day National Seminar on Advanced Materials and Processes (AMP-2023) during April 17-18, 2023, in association with IIM, Hyderabad chapter with an aim of educating the students of Metallurgical and Mechanical Engineering on processing of various advanced materials. Dr. R Balamuralikrishna, Director, Defence Metallurgical Research Laboratory (DMRL), Hyderabad was the Chief Guest for the inaugural program.

Prof. G. Chandra Mohan Reddy, Principal, MGIT with the dignitaries @ lamp lighting ceremony

Prof. G. Chandra Mohan Reddy, Principal, MGIT welcomed all the Dignitaries in his welcome address and advised the department to collaborate with more core industries to understand and appreciate the latest technologies in material processing. Dr. K. Ramanjameyulu, Head of the Department, has appraised various research activities that are being pursued by the Department and elaborated the overall spectrum of the national seminar.

In the Keynote Address of the Chief Guest, Dr. Balamuralikrishnan emphasised the importance of Metals and Materials in Technological advancements. He expressed that the current advancements in many engineering fields would not have been possible without the development of materials. The advancement in the latest technology lies in the pace of advances in the processing of current materials, and, also, development and processing of new materials. Dr. Balamuralikrishnan suggested the students follow the principle of PDC – Passion, Determination, and Commitment. He also added that determination and commitment will rope in once students develop passion for every act of theirs. He has advised the students to be more focused on their academics and get ready to undertake the challenges that the industry sectors come across time and again. Sri D. Praveen Reddy, Chairman, Chaitanya Bharathi Educational Society has interacted with the students, and during his address, he suggested that the students shall become communicative and become multitaskers. Prof. K. Bhanu Sankara Rao, formerly Ministry of Steel Chair Professor at MGIT, and currently the Adjunct Professor at IIT Hyderabad and the Chief Editor of IIM Metal News, graced the occasion and interacted with faculty and students. The Inaugural program was concluded with a vote of thanks by Dr. M. Phaniraj, Convener, AMP-2023.

Invited Technical Talks:

The 2-day seminar on Advanced Materials & Processes contained presentations on a spectrum of topics, from welding of superalloys at one end to ceramic matrix composites and additive manufacturing at the other end. Dr. Manivel Raja, Scientist, DMRL, Hyderabad delivered lecture on functional materials. After briefly describing the various types of functional materials, Dr. Manivel explained the physics behind magnetic properties and the related applications. He elucidated on critical steps associated with the manufacturing process of the magnet.

Dr. Manish Patel, Scientist, DMRL, Hyderabad highlighted the need for materials that can operate

beyond superalloys and emphasized on the development and usage of the ceramics and ceramic matrix composites at very high temperatures. Dr. Manish addressed the challenges in developing components of the oxide- fiber- reinforced /oxide-matrix composites. The latest entry in CMCs, the Ultra High Temperature Ceramic Matrix Composites (UHTCMCs) are being developed in which UHTCs matrix are reinforced with continuous fibers.

Prof. Subhradeep Chatterjee, Associate Professor, IIT Hyderabad spoke on metallurgical issues related to the welding of Ni- and Co-based superalloys. Specifically, he highlighted the consequences of dissolution of strengthening phases during heating cycle of welding and phase transformations during the cooling cycle.

Prof. Rajesh Korla, Assistant Professor, IIT, Hyderabad talked of high entropy alloys their potential for high temperature applications. He chose the Al0.2CoCrFeNiMo0.5 high entropy alloy and discussed its manufacture, high temperature tensile and creep behavior as well as oxidation resistance. The probable operative deformation mechanisms based on microstructural analysis were also discussed.

Prof. J D. Janakiram, Professor, IIT Hyderabad dealt on ultrasonic additive manufacturing and its advantages vis-vis laser additive manufacturing. It's a solid-state process! Parts with complex geometries and internal passageways with fine dimensional accuracy and smooth surfaces can be built. He explained the process, its origin, and applications.

Dr. L. Ramakrishna, Scientist, ARCI, Hyderabad showcased a variety of heterogeneous microstructures and corresponding processing techniques including a variety of unique surface engineering technologies. Each of the microstructures was linked with the associated properties and performances. The resulting industrial applications developed and demonstrated were highlighted to portray the precise role of heterogeneous microstructures.

@ the event of AMP-2023

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Seminars & Conferences

National Conference on Recent Advancements in Iron and Steel industries and Emerging areas (RAISE-2023)

One day National conference on "Recent Advancements in Iron & Steel Industries and Emerging areas"-RAISE 2023 was organised jointly by CSIR-Institute of Minerals and Materials Technology (IMMT), Bhubaneswar and The Indian Institute of Metals (IIM) Bhubaneswar chapter on 24th February 2023, which was attended by more than 150 delegates including industry persons, scientists, students, R&D professionals. The core organising committee of the conference comprised Prof. G. Narahari Sastry, Patron, RAISE-2023 and Director, IMMT Bhubaneswar, Dr. D.S. Rao, Vice-Chairman, IIM Bhubaneswar chapter, Dr. Pravas Ranjan Behera, Convenor, RAISE-2023 and Principal Scientist, IMMT Bhubaneswar, Dr. Ajit Panigrahi, Co-convenor, RAISE-2023 and Sr. Scientist, IMMT, Bhubaneswar.

The main aim of the conference was to show a path towards adopting the new technologies to improve the efficiency, expand into new markets, and to embrace the principles of the circular economy. The inaugural session began with welcome address of convenor followed by the speech of Prof. Sastry and Dr. D.S. Rao. A souvenir and AMT Department Memoir-20yrs of R & D works was being brought out to mark the occasion. Chief guest Dr. Awanindra Kumar Singh, Sr. Vice President, JSL and guest of honor Dr. Narayan Ch. Pal, Engineer-in-Chief (Design), PWD, Govt. of Odisha welcomed all the participants and briefed about the importance and role of iron and steel industry in shaping the India's economy. Dr. Markus Reifferscheid, SMS group GmbH gave a keynote talk which stimulated active and intense discussion among delegates. The technical sessions consisted of eight lectures and poster session from various R&D professionals, industry persons, academicians where it was discussed about the challenges and opportunities and the sustainable growth in Iron and Steel industries. Co-convenor, RAISE-2023 thanked the delegates, participants, sponsors, advertisers for the successful conduction of the event.

Glimpse of RAISE-2023

Release of Souvenir of the Conference during inaugural function. Left to Right: Dr. Pravas Ranjan Behera, Dr. Narayan Ch. Pal, Prof. G. Narahari Sastry, Dr. Awanindra Kumar Singh, Dr. Bhagydhar Bhoi, Dr. D.S. Rao.

The dignitaries

The Attendees

Valedictory function

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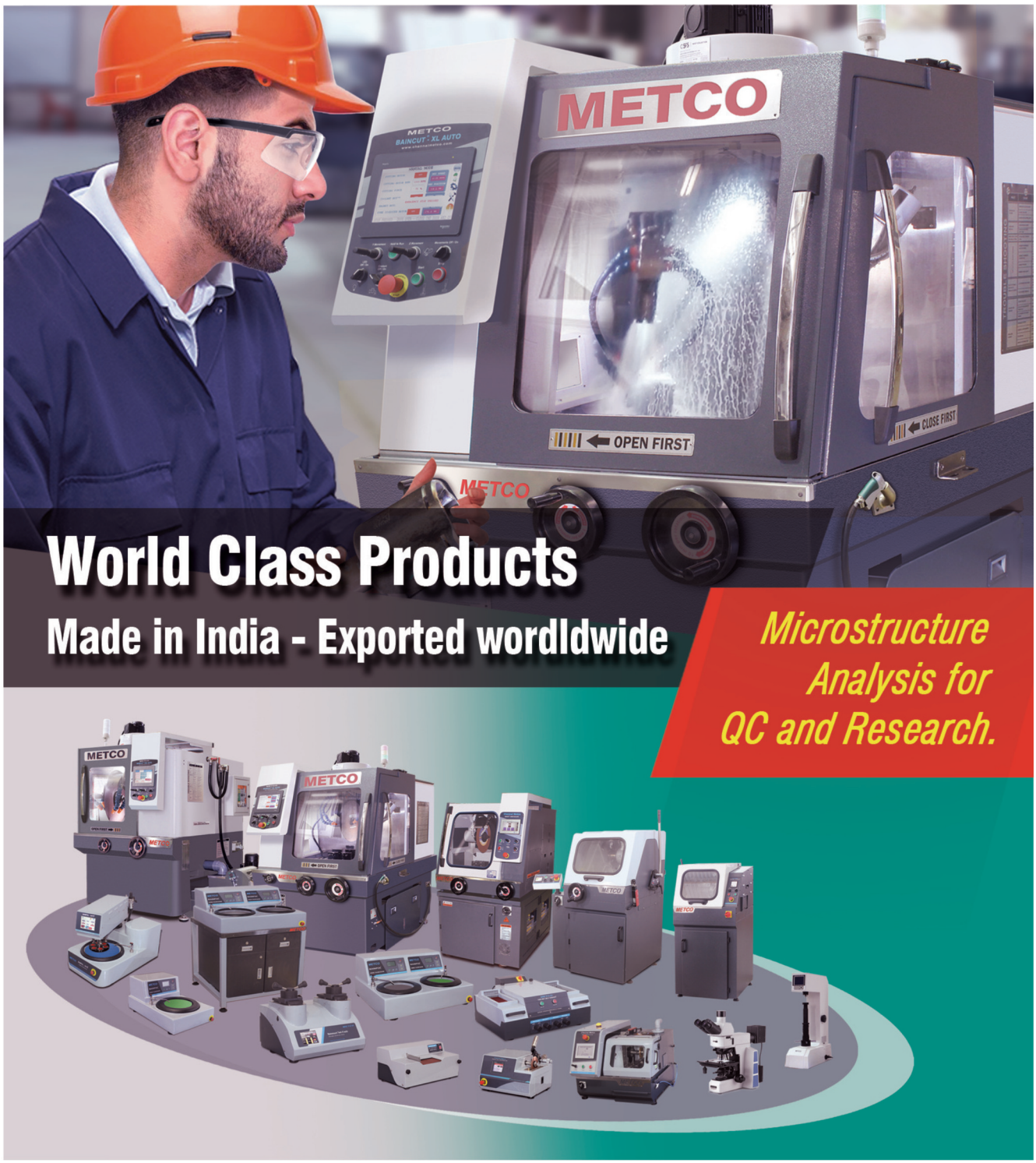

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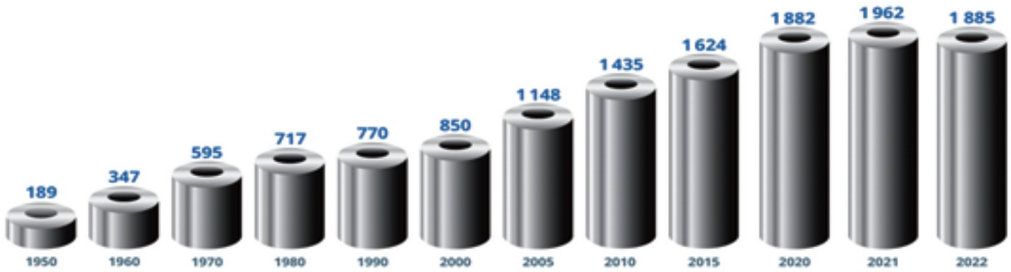
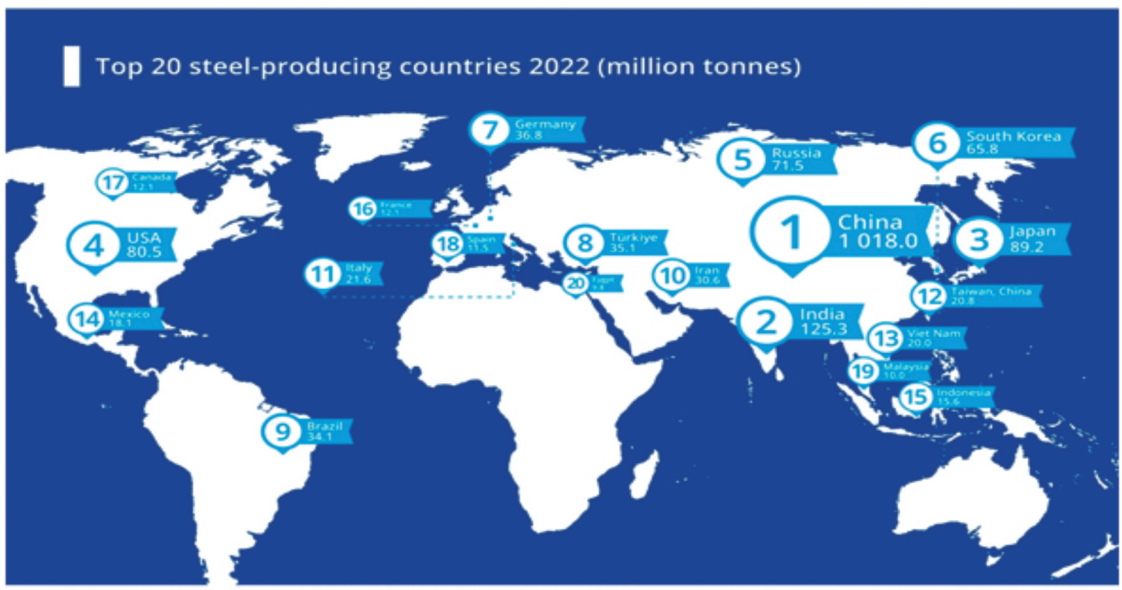
World crude steel production 1950 to 2022 (million tonnes)

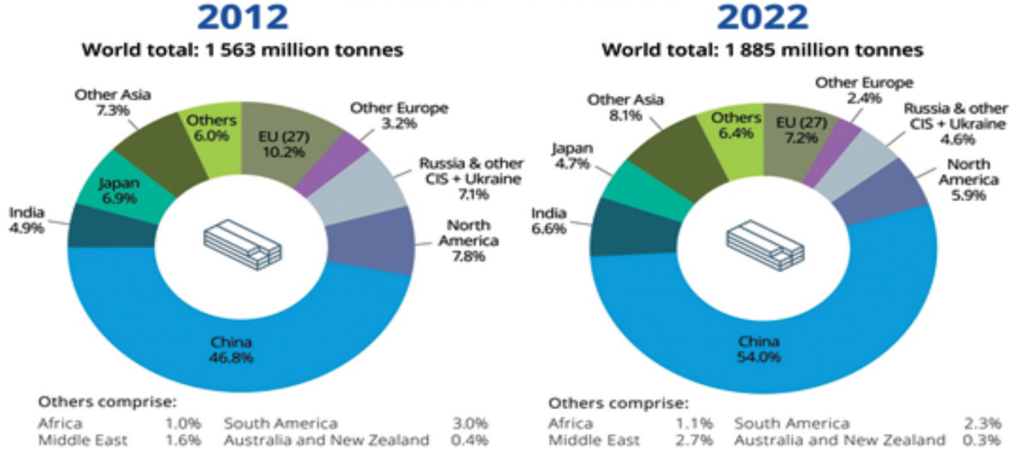


Top 20 steel-producing countries 2022 (million tonnes)



Steel production and use: geographical distribution in 2012 & 2022

CRUDE STEEL PRODUCTION



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