ASM INTERNATIONAL

Bangalore Chapter – News Letter

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Chairman's Message

Yet another term of the EC concludes soon with the AGM for our chapter scheduled for 2nd December 2021. It would therefore be appropriate to revisit the activities of our chapter during the last two years, and acknowledge the Contributors, this being my last opportunity to author the Chair's Message. Even though the Pandemic imposed restrictions on 'in person' meetings, the activities of our chapter resumed with renewed vigour, after a brief lull. Thanks to the tech savvy of our Chapter Secretary and the Ring Central Resource provided by HQ, we could continue the monthly council meetings consistently and also conduct technical talks on Ring Central. To our pleasant surprise the attendance at both improved dramatically due to the ease in attending. As part of the continued evolution of our chapter the out-going council established the following practices firmly: (1) Regular Council meetings on a monthly basis and a mid-monthly OB meeting to review MOM tasks. (2) Technical talks every fortnight, where we covered a variety of subjects. There were limited online workshops and a couple of Multi speaker series technical talks too, also in virtual mode. (3) Regular Engagement with Academia resulting in the establishment of 2 student chapters and more in the pipeline. (4) In house programme for corporates tailored to suit their needs. (5) Monthly monitoring of the membership status which allowed us to increase the membership substantially during our tenure. (6) Alignment to KPIs of HQ which qualified our Chapter for Awards from HQ in both the years.

I have no doubts that three things made this progress possible: (A) The pure spirit of contribution, personified by my immediate predecessors, on whom we depended for Ideas, resources and guidance. (B) The recognition and inclusion of those volunteering their time for the progress of the chapter, demonstrated by their consistent participation. (C) The extremely Gifted and Resourceful OB members who, along with our only Staff Mr. Satish, did all the due diligence and never spared any effort in working to fulfil the aspirations of the Chapter.

While congratulating the new leadership, we wish it all the success to take the chapter to greater heights in the service of the material science community, especially by venturing into new frontiers of activity which were hitherto untouched.

Rahul Masurekar

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About ASM International

ASM International formerly known as the American Society for Metals was established in 1913 as a professional body of heat treaters. It has since evolved as an international professional body of material scientists, engineers, R&D professionals and academicians with the motto of collecting &disseminating knowledge on Materials and Processes. The worldwide network of more than 38,000 individuals is led by members, guided by members' needs and fueled by members' participation.

About ASM Bangalore Chapter

ASM Bangalore chapter is actively involved in dissemination of materials centric knowledge among working professionals, researches and academicians. ASM Bangalore chapter began its activities in the year 2006. Since then it has dedicated itself in spreading information based on materials among various stakeholders. Bangalore is a strategic center for several major automotive, aerospace, defense & R&D institutes and thousands of engineering professionals and it is imperative to educate & connecting the community in the field of Metals & Material science Technology. Under the able leadership of present chairman Mr. Rahul Masurekar – a well-known Industrialist and capable office bearers, ASM Bangalore chapter is gaining wide popularity by activity involving and supporting the technological up-gradation of Engineering community.

The Prime Objectives of ASM Bangalore Chapter:

1. To disseminate materials centric information among professionals by organizing seminars, lectures, One/two days' workshops
2. To bring together Scientists, Intellectuals and Professionals working in the field of materials science to exchange ideas/knowledge/information.
3. To encourage and support student chapters among various Engineering colleges in the state of Karnataka and enlighten them, the importance of materials properties, selection and its application.
4. To Promote consultancy services by ASM members to solve industry problems in the area of materials.
5. To recognize and award ASM members for their contributions to field of materials science.

ASM Bangalore chapter has members with rich expertise and professional experience with deep insight to practical applications in the field of materials science & engineering. ASM Bangalore chapter offers consultancy in the broad areas of Material selection &Characterization, foundry practices, mechanical testing, forging, heat-treatment, failure analysis, Corrosion control, Nondestructive Evaluation (NDE), process simulation to name a few.

ASM Membership

A membership in ASM gives you every imaginable edge you seek in your career.

VISIT - **http://www.asmblrchapter.com/membership.php** - for Benefits and Forms

Or Call Membership Chair – Mr. Krishnadas Nair – 8879233440

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Featured Articles:

" Heat Treatment of Stainless Steel "

Mr. V. Babu Sathian

I chose this topic as I notice that there is an interest generated regarding heat treatment of various types of Stainless Steel in the ASM Online Connect.

Stainless Steel as the name denotes represents a range of steel which is used for its corrosion resistant properties. In this article, we primarily focus on the family of Austenitic Stainless Steel.

The Austenitic Stainless Steel are primarily classified into 5 groups as follows:

a) Conventional Austenitics such as 301, 302, 303, 304, 305, 308, 309, 310, 316 & 317

b) Stabilized Austenitics like 321, 347 & 348

c) Low Carbon Austenitics such as 304L, 316L & 317L

d) Nitrogenated Austenitics such as 304N, 316N

e) High Alloyed Special Austenitics such as 904L, CN7M, Sanicro 28 etc.,

Normal mechanical engineers use heat treatment procedures for hardening, tempering, stabilizing and annealing.

Conventional Austenitics: Conventional Austenitics cannot be hardened by heat treatment. These stainless steels are heat treated only to enhance its corrosion resistance. These steels are normally available in annealed or cold worked condition.

During the annealing the chromium carbide which are susceptible to corrosion dissolves in the matrix. Because of the carbide precipitation can reoccur between 900 to 425 °C, the solution annealed stainless steel should be rapidly quenched to prevent the chromium carbide precipitation. That's why all the Austenitics Stainless Steel are quenched after annealing at the elevated temperature so that its intergranular corrosion resistance is achieved. The typical annealing temperature for Conventional Austenitics is given in the following table:

Conventional Grades		
UNS No.	Designation	°C
S30100	301	1010-1120
S30200	302	1010-1120
S30215	302B	1010-1120
S30300	303	1010-1120
S30323	303Se	1010-1120
S30400	304	1010-1120
S30500	305	1010-1120
S30800	308	1010-1120
S30900	309	1040-1120
S30908	309S	1040-1120
30100	310	1040-1065
S31008	310S	1040-1065
S31600	316	1040-1120
S31700	317	1065-1120

The Stainless Steel should be held at the given temperature from 20 minutes to 3 hrs based on the thickness to ensure complete dissolution of chromium carbide and quenched in the water.

Stabilized Austenitics: Stabilized Austenitics such as 321, 347 & 348 contains controlled amount of titanium or niobium which prevents precipitation of the Chromium Carbide thus avoiding intergranular corrosion. But these alloys may require annealing to relive stresses thus increasing the softness & ductility. The typical annealing temperature is given in the following table:

Stabilized Grades		
S32100	321	955-1065
S34700	347	980-1065
S34800	348	980-1065
N08020	20Cb-3	925-955

Unlike Conventional Austenitics these steels do not require rapid quenching but air cooling is generally adequate.

Low Carbon Austenitics: Low Carbon Austenitics such as 304L, 316L & 317L. In these steels, the tendency for precipitation of chromium carbide lies in between Conventional Austenitics &Stabilized Austenitics. Typically, Low Carbon Stainless Steel will have carbon content of the maximum of 0.03%. This level of carbon content is low enough to reduce precipitation of intergranular carbides.Anyhow for a critical application to achieve high level of intergranular corrosion resistance it has to be quenched after holding in the annealing temperature. The typical heat treatment temperature is given below:

Low Carbon Grades		
S30403	304L	1010-1120
S30453	304LN	1010-1120
S31603	316L	1040-1110
S31653	316LN	1040-1110
S31703	317L	1040-1110

For the stainless steel like 316L & 317L containing molybdenum are susceptible to σ-phase formation if it is held between temperature 650 to 870 °C for a longer period. Therefore, for achieving higher

corrosion resistance, it should be cooled faster in the above mentioned region and stress relieved below 600 °C.

Low Carbon Stainless Steel are annealed frequently to achieve low magnetic permeability without going through quenching.

Nitrogenated Austenitics such as 304N & 316N: These stainless steels are heat treated in the similar manner of Conventional Austenitics Stainless Steel as these steels are subjected to the problems of carbide precipitation. They cannot be hardened by heat treatment but hardness can be enhanced by cold working. The Nitrogenated Austenitic Stainless Steel are annealed followed by rapid cooling to ensure maximum corrosion resistance.

High Nitrogen Grades	
304N	1010-1120
316N	1010-1120
Nitronic 32, 18Cr-2Ni-12Mn	1010-1065
Nitronic 33	1040-1095
Nitronic 40, 21Cr-6Ni-9Mn	980-1175
Nitronic 50, 22Cr-13Ni-5Mn	1065-1120
Nitronic 60	1040-1095
18-18 Plus	1040-1095

High Alloyed Special Austenitics: These stainless steels contain large amount of molybdenum to provide good corrosion resistance to chloride atmosphere. They are usually produced with a low carbon to avoid carbide precipitation. Further, they may contain copper for increased acid resistance. Annealing temperatures are confined to narrow range to avoid the formation of σ-phase at lower temperature or delta-ferrite at higher temperature. Rapid cooling following the annealing is usually recommended. The typical heat treatment temperature is given below:

Highly Alloyed Grades		
904L	1075-1125	1965-2055
CN7M	1075-1125	1965-2055
Sanicro 28	...	...

Reference : ASTM Speciality Handbook ; Corrosion Engineering Handbook

About the Author :

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Founder, Managing Director, Process Pumps (I) Pvt. Ltd. (https://www.process-pumps.com) Company manufacturing wide range of corrosion resistant pumps in various material like stainless steel, super alloy, titanium & fluoro carbon PVDF, PFA, FEP
Founder & Promoter, Cathodic Control Pvt. Ltd.(https://cathodiccontrol.com) committed to the cause of corrosion control by cathodic protection system for both, onshore and offshore.

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" Materials 4.0 and Machine Learning In Material Science "

Material discoveries has always defined the milestones in the progress of human civilization. We have come a long way from using natural materials such as rocks or wood in the Stone Age to creating nanostructures by manipulating atomic arrangement today. Research efforts over the centuries has led to collection of abundant information on processing, characterization, properties on a wide range of materials which can only be quantified in magnitudes of petabytes and above. The disruptive growth of computer technology and cyberspace technologies has created an unprecedented data processing capability far surpassing the human abilities for the same.

Parallels can be drawn between the industrial revolution and the revolution in the development of materials. Development of steam engine marked the first industrial revolution (Industry 1.0) in the beginning of the 18th century, similarly Materials 1.0 began when bronze, iron and steel were developed. Mass production lines along with the use of electricity marked the second industrial revolution (industrial 2.0). Analogously, Material 2.0 is when the materials research was systematized through conceptualization, qualification experiments, prototyping in laboratories, characterization and testing. Industry 3.0 was marked by the development of electronics, information technology, computer technology etc. which further modernized and automated the production line. Similarly, in Materials 3.0 computational methods such as combinatorial and computational material science were employed to develop materials that meet target functionalities. Manufacturing in the Industry 4.0 system is enabled by the synergetic integration of physical space and the cyberspace to monitor, control, communicate and coordinate manufacturing operations. A similar paradigm shift can be observed in the materials domain which is the Material 4.0 [1].

The conventional methods of material synthesis involved long lead times with low probability of success. This generally dissuaded the investors and stake holders who were more concerned from the business feasibility perspective, since development of a new material took decades, sometimes exceeding the service life of the individuals involved. Material 4.0 takes advantage of the advent of computers and advances in software technology, accelerating the development pace of novel materials by orders of magnitude, aligning with timeline of investors, providing good success rate and promising return on investment [2]. Material 4.0 has six tentacles namely:

- **Big data on material properties and processing**
- **Machine learning algorithms**
- **Multistate modelling**
- **Virtual synthesis and characterization**
- **Prototype testing and validation**
- **Life cycle assessment**

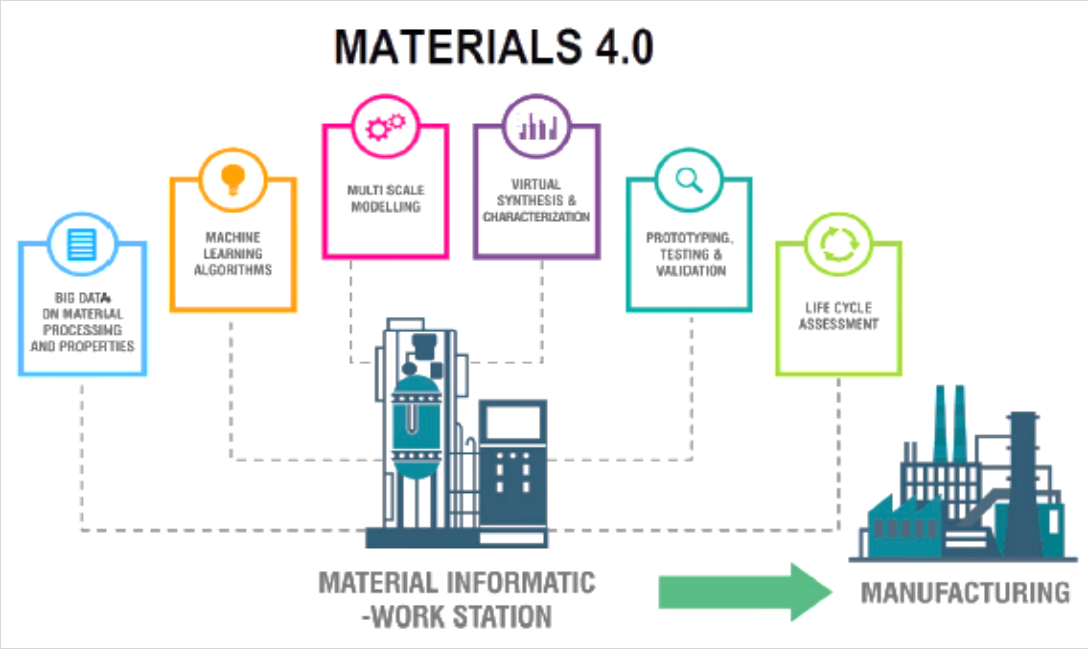

Fig 1. Concept of web based materials bid data platform or Materials 4.0 [1]

Recently, readily available comprehensive databases of material properties, processing, and characterization have emerged providing a prospective direction for material analytics. Coupled with the big data, the development of appropriate machine learning algorithms has led to informatics enabled materials research in several areas. As a result of which a myriad of algorithms have been built and trained on the existing database to make predictions on the properties of materials. This approach helps researchers to focus their studies on promising materials and neglecting the non-synthesizable materials without the desired properties. Thus reducing the amount of time and resources spent on experimental synthesis or iterative computations[5, 9].

Machine learning is often criticized for its assumed inability to extrapolate values beyond the training dataset. A study carried out by researchers at University of Utah, aimed at investigating just that. It was observed that the algorithm trained with a fraction of the bottom 99% of the dataset was capable of consistently predicting 3/4th of the top 1% materials having the desired properties with an acceptable accuracy [3]. Time temperature transformation diagram is instrumental in enhancing the properties of steel, thus a need for their accurate and rapid prediction for practical purpose is essential. A study was conducted on the same by using a combination of machine learning algorithms, back propagated artificial neural networks, bagging, random forest and random committee for predicting TTT using relevant descriptors. Results showed a high predictive accuracy implying an obvious advantage over the empirical approaches and commercially available predictive software tools [4]. Researches from Japan successfully created material databases using first principle calculations and was used to train machine learning algorithms. Prediction of material combinations and material properties was achieved, with a good agreement with the experimental results [6]. Machine learning has been employed in high throughput prediction, while its application has been somewhat limited in understanding the physical mechanisms in materials. A study conducted by Oak Ridge National laboratory, demonstrated the reliability and efficiency of the Gaussian Process classification in predicting the solutes for ductile magnesium alloys [8].

To keep up with the paradigm shift new software tools for material predictions being developed and evolved continuously. AFLOW ML is one such cloud based software which streamlines machine learning algorithms, removing the ML technical expertise barriers for users. The frame work is integrated with a RESTful API which provides access to updated algorithms, which can be implemented in the workflow to predict the electrical, thermal and mechanical properties of materials [9]. DScribe another off the shelf user friendly software propels the application of ML for atomistic property prediction. This package is capable of predicting formation energy in solids and ionic charge prediction in organic materials [10]. MATCALO is a prototype, intelligent, cognitive assistant system which is capable of developing novel materials. By employing a synergetic combination of machine learning with the abundant semantic knowledge, it is capable of modelling relationships between materials, process and properties [11]. Materials Genome Integration System Phase and Property Analysis (MIPHA) and rMIPHA (based on the R programming environment) have been independently developed to propel the process of materials discovery through a data-driven materials research approach [12].

Materials 4.0 is a technological revolution which is gaining momentum as the need for new high performance materials arises now more than ever. Machine learning being a branch of artificial intelligence has become the major driving force of the revolution owing to its analysis techniques, modelling, processing and prediction capabilities. Applications of machine learning span a multitude of hot research topics such as novel material discovery, material property prediction etc. The diverse nature of the studies demonstrates the capability of machine learning to develop efficient and accurate tools, theories, methods for material science [7]. The technology is still in its infancy, therefore strong initiatives across academic, industrial and bureaucratic levels are necessary to expand the proficiency on the related technologies in order fully exploit the its potential [1].

References:

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[3] Can machine learning find extraordinary materials?

[4] Study on time-temperature-transformation diagrams of stainless steel using machine-learning approach

[5] Big Data Creates New Opportunities for Materials Research: A Review on Methods and Applications of Machine Learning for Materials Design

[6] Material synthesis and design from first principle calculations and machine learning

[7] Materials discovery and design using machine learning

[8] Machine learning as a contributor to physics: Understanding Mg alloys

[9] AFLOW-ML: A RESTful API for machine-learning predictions of materials properties

[10] DScribe: Library of descriptors for machine learning in materials science

[11] MATCALO: Knowledge-enabled machine learning in materials science

[12] Property prediction and properties-to-microstructure inverse analysis of steels by a machine-learning approach

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Calendar of Events

Special Events & Highlights

"Multifunctional Metallic Nanowire Foams and Networks "

- **Second Online Technical Talk organized by "RVCE Materials Advantage Student Chapter**

Date / Venue	September 24, 2021 Online
Speaker / Programme	Dr. Kai Liu, Department of Physics Georgetown University, Washington DC, USA

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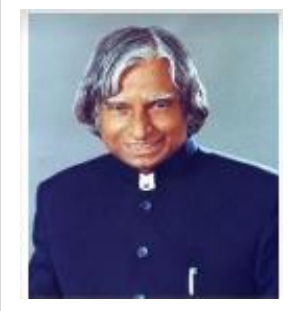
Technical Lecture / Talks

"Synthesis, Characterization, Phase Stability & Application of Nanomaterials"	
Date / Venue	August 28, 2021 @ Ring Central Online Meeting Platform
Speaker / Programme	Prof. Dr. Chandan Srivastava, Associate Professor, Department of Materials Engineering, Indian Institute of Science, Bangalore-560012, India

"METAL INJECTION MOLDING (MIM) PROCESS"	
Date / Venue	September 11, 2021 @ Ring Central Online Meeting Platform
Speaker / Programme	Mr. Debashish Mondal, Founding Director of NNF Tech Pvt Ltd. Kumbalgodu Industrial Area, Mysore Road, Kengeri, Bangalore 560074, India

“Tungsten Carbide and Its Application in Metal Forming”	
Date / Venue	October 9, 2021 @ Ring Central Online Meeting Platform
Speaker / Programme	Mr. Chandan Kumar, Senior Manager - Application Engineering, APAC. Infrastructure Business, Kennametal India Limited, Bangalore, India

“An introduction to Hard chrome Plating and its applications”	
Date / Venue	October 23, 2021 @ Ring Central Online Meeting Platform
Speaker / Programme	Mr. Jaikrishnan C., Director - Adpro Systems India P Ltd,318, 8th Cross, 4th Phase, Peenya Industrial Area, Bangalore -560058, India



DR. ABDUL KALAM MEMORIAL LECTURE

ASM International Bangalore Chapter and Department of Materials Engineering, IISc, organized Dr. Abdul Kalam Memorial Lecture on the topic -

"From Science to Engineering"

Date / Venue	October 27, 2021 @ MS TEAMS Online Meeting Platform
Speaker / Programme	Mr. Satish Pai Managing Director, Hindalco Industries. Vice President and Chairman –Non-Ferrous, Indian Institute of Metals, Vice President & Chairman –Government Affairs Committee of the Aluminium Association of India.

INTERACTION WITH OFFICE BEARERS OF RVCE MATERIAL ADVANTAGE STUDENT CHAPTER (OCTOBER 28, 2021)

Date / Venue	October 28, 2021 @ RV College of Engineering
Speaker / Programme	Mr. R. B. Dilip – Immediate Past Chairman and Student Chair of ASM Bangalore Chapter visited RV COLLEGE OF ENGINEERING, to meet the office bearers of Materials Advantage Student Chapter.

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CONGRATULATIONS TO THE NEWLY ELECTED OFFICE BEARERS OF ASM (I) BANGALORE CHAPTER FOR THE TENURE 2021-2023 :

			
Mrs. Jyothi Sriram **Chairperson**	**Dr. J. R. Nataraj** **Vice Chairman**	**Mr. Prakash Balasubramanian** **Secretary**	**Mr. P. T. Bindagi** **Treasurer**

Events Calendar 2020-21

1. Memberships	Drive by Headquarter / India Task Force
2. Monthly Technical Talks	To improve consistency and Participation
3. Student Outreach	a) Events for Students – Talks + Industrial Visits b) Membership & Student Chapter Formation c) Support in Projects / Training d) Material Camps
4. Major Events	a) One/Two Days Workshops / Seminars b) Annual Get-together c) Annual General Body Meeting d) Hosting of INC Meeting / Visiting ASM Leaders e) Support to other ASM Chapters / Local Associations in their events.
5. Technical Talk	Every 2nd & 4th Saturday 5.00 pm if Webinar or Every 3rd Saturday 5.00 pm
6. Executive Council Meetings	This Qtr. – September 6, 2021

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Visit www.asmblrchapter.com for more details about ASM Bangalore chapter and membership

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