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IIM
Metallurgy
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The Indian Institute of Metals


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The average life for steel products is approximately
40 years.
In applications with a long service life, such as buildings or infrastructure, we will need to wait up to 100 years or more to recycle. In the case of steel packaging the time between production and recycling can be just a few weeks; in the case of vehicles this may be up to 15-20 years.
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Industry 4.0 in Welding and Activities of Centre of Excellence in Advanced Manufacturing Technology

Surjya K Pal[1] and Debasish Mishra[2]

Abstract

This conceptual article introduces Industry 4.0 and its importance in welding. It also mentions about a unique research and development (R&D) centre established at the IIT Kharagpur titled, Centre of Excellence in Advanced Manufacturing Technology. The research activities of this Centre in implementing AI in welding are highlighted and a few of its success stories are outlined.

1. Introduction to Industry 4.0

Industry 4.0, the fourth industrial revolution is about convening the manufacturing diagnostics in a smarter and efficient manner than the traditional one. Diagnostics involve identifying the faults in a process/product and the root causes behind them. The fundamental primciple of manufacturing sector is to produce a defect-free high-quality product. At the same time, manufacturing industries strive for reducing the cost of manufacturing as well. The major cost cuttings involve reducing the lead time, efficient management of inventory, identifying the bottlenecks, reducing manual intervention, and the like. It is often found that these factors require attention as there is a lack of information sharing among the various departments. Therefore, there is a need to create a knowledge-base to equip all the departments with the acess to real-time information enabling better decision making on the shop floor.

Industry 4.0 is not a new concept; it is a successor of the extraordinary advancements through rigorous research and development, that have been occurring over centuries. The first industrial revolution, i.e., Industry 1.0, was about the use of machines replacing the human labor. It led people to realize the fact that a huge amout of work could be accomplished by running a machine for a short duration. The second industrial revolution (Industry 2.0) was about the introduction of electricity as a source for operating the machines. Industry 3.0 brought the use of robots and automation. To summarize, there was a thrust on reducing the manual intervention and performing jobs efficiently. In addition to these advancements, Industry 4.0 targets the use of intelligent, automated, and autonomous systems to perform jobs exchanging real-time information about the process and the machine.

2. Industry 4.0 in Welding

Manufacturing encompasses several operations involved in transforming a raw material to a desirable product. At times, the discrete components may constitute the final product. However, most products involve a collection of components, which are finally assembled. Welding is an assembling operation, where discrete metals are joined together into one. The undisputed importance of welding can be highlighted through two classic examples: first is an automobile, where the major individual components like chassis, body, engine, etc including sub-components are welded. The second example is the refineries or the power plants where steel pipelines are employed for transporting fluids from one unit of the plant to the other, where multiple pipes need to be welded. In both the examples, it is important

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to ensure the weld quality, thereby ensuring the life of the components and the service they are supposed to provide. Weld process monitoring thus becomes mandatory.

It refers to diagnosing the welding process, or, keeping a track of certain parameters or conditions. For instance, in shielded metal arc welding (SMAW), the parameters that require tracking are the current and voltage applied. Given the optimum conditions to achieve a good weld, there will be a certain range of current and voltage. Therefore, one needs to monitor these values during the welding process to ascertain the best weld quality. This is referred to as weld process monitoring. Every welding process involves multiple parameters, which require real-time monitoring, which necessitates the use of sensors. Though sensor-based technology to monitor welding is not new,the challenge lies in engaging multiple sensors, extracting real-time meaningful information, controlling the weld quality, driving predictive maintenance of the welding system, and managing those data. A few of the advanced technologies that are supporting these activities are fast communication system, edge device, cloud space, machine learning and deep learning algorithms, big data services, etc. Collectively, these supporting tools are referred to as *digital technologies,* and are becoming universal in advanced manufacturing.

Welding robots appeared in the automobile industry in the sixties (1960-), the third revolution era, with the aim of getting rid of repetitive and risky tasks . This helped ensure precise manufacturing to a certain extent, but the robots lacked intelligence. For instance, if improper parameters are fed to the welding robot, or there is inhomogeneity in the base materials, or if there is a deterioration in the health of the robot, weld quality is going to be affected adversely; this implies that there is a lack of flexibility. With the exchange of real-time data between the machines, continuous monitoring and control of the process can certainly be ensured. Thus, data is the foundation stone, fueled by artificial intelligence and machine learning acting as the enablers to the success.

3. Centre of Excellence in Advanced Manufacturing Technology

The *Centre of Excellence in Advanced Manufacturing Technology (CoE)* is an industry-focused research and development unit. The genesis of establishing this Centre is the fact that industry and academic institutions need to hold each other's hand. At present, they are yet to converge. The innovations of academic institutions are state-of-the-art, but are mostly developed in a laboratory environment. These are also referred to as lab-scale jobs or fundamental research. As industries engage in mass production, the equipment employed are industrial-scale. This creates a gap between the academia and industry. To fill this gap, catapult centres are established, which propel the laboratory research to industry scale. This Centre looks forward to playing the role of a catapult centre.

It was established in 2018 with the support from *Department of Heavy Industry (DHI),* a unit under the *Ministry of Heavy Industries and Public Enterprises (HI&PE),* Government of India. It also holds a consortium of industries comprising public, private, and startups, who provide the research problems to the Centre. At present, the Centre has partnered with two public sector companies, namely, Heavy Engineering Corporation Ranchi and Bharat Heavy Electricals Limited, and four private sector companies, i.e., TATA Steel, TATA Motors, TATA Consulatncy Services, and TATA Sons. Under TATA Consultancy Services, the Centre is also working with TATA Research Design and Development Centre, or TRDDC, Pune and under TATA Sons, the Centre has the presence of TATA Metaliks. A startup named Hemraj Infocom Private Limited is also working with the Centre.

3.1 Research verticals of the CoE

The Centre's research spans across four verticals, namely, *Specialty materials, Design and automation, Additive manufacturing, and Industry 4.0.* In *Specialty materials,* technology is being developed for identifying the non-metallic inclusions in the steel products, which are detrimental. Research is also being conducted in

the direction of developing new steel products for automobile applications. Knowledge is being developed for joining of hybrid structures such as aluminium to steel, magnesium to steel, and different steel alloys using friction stir welding and electron beam welding techniques. Research on materials is also being conducted for the manufacturing of large products to small artefacts using the 3D printing route. In *Design and automation,* robot-based systems with real-time automated inspection is being developed for handling hazardous components by using multiple sensors, deep learning, and artificial intelligence. The Centre is also engaged in replacing traditional manufacturing route by 3D-printing for gaining flexibility and profitability. The aim is to manufacture large industry-grade products such as turbine blades and impellers. These are being carried out under the *Additive manufacturing vertical.* Finally, under *Industry 4.0* vertical, the focus is on developing strategies for real-time monitoring and control of the manufacturing processes. It includes implementation of digital technologies.

3.2 Industrial infrastructure of the CoE

For strengthening the industry-focused research, the Centre has unique facilities, as shown in Fig. 1. The Centre also has an advanced sample preparation facility consisting of sample cutter, hot mounting press, semi-automated grinding and polishing, ultrasonic cleaning, and corrosion testing units. It also has advanced microscopy facilities such as stereo-zoom and metallurgical microscopes, field emission scanning electron microscopy, and X-ray diffraction units for sample characterization. It has created a common engineering platform called, *Innovation Lab,* which houses these unique facilities. This lab also has semi-production CNC machines, and pneumatic, hydraulic, and programmable logic controller (PLC) test kits.

Fig. 1 : Equipment & Facilities available in the CoE

3.3 Outreach Events of the CoE

The Centre has been training professionals in Industry 4.0 activities on advanced manufacturing. It is following a bottom-to-top approach, wherein, it has started imparting training on CNC. The event has attracted both academics and industry personnel because of the rigorous and insightful training with hands-on experience to operate CNC machines with different controllers. It also conducts a series of webinars every Saturday, titled *Saturday Manufacturing Talks,* where foreign and Indian professionals from academic institutions and industry share their research work on advanced manufacturing. It has helped the Centre ignite the fire of brainstorming, innovating, and developing collaborative research culture among the participants. Other events conducted were a short-term course on *Composites 4.0* and a one-day workshop on *Metallography.* A few more training events are in the pipeline, viz. *Industrial robotics, AI in manufacturing, AR/VR in manufacturing,* and *5G in manufacturing.*

3.4 Research at CoE – Implementing AI in Welding

Figure 2 shows the work plan of the Centre in implementing AI in welding. While some of the research goals have been successfully demonstrated, others are in progress, and a few are futuristic.

The following describe the process and machine twins developed by the Centre for an advanced welding technique named friction stir welding. It has been developed in collaboration with TATA Consultancy Services for real-time monitoring and control of the welding process and predictive maintenance of the welding machine.

The solution is built upon multiple sensors, which communicate to a cloud-based system in real-time during welding. The numeric-controlled friction stir welding machine is engaged with force, torque, and power sensors. These signals are typical to this welding process. The acquired data is processed in the cloud in real-time, using signal processing to extract features, which are fed to the machine learning model to predict the weld quality. The model determines the weld quality by comparing the predicted one with a standard value. It sends modified parameters as feedback to the machine if it finds the quality to be poor, thus improving the quality in real-time. Figure 3 shows the result of a sample welded with the developed system, where a defect-free weld is obtained from defective condition in real-time. As highlighted in Fig. 2, the welding defect is monitored, quality is predicted using sensors' features, and the process is controlled, all in real time.

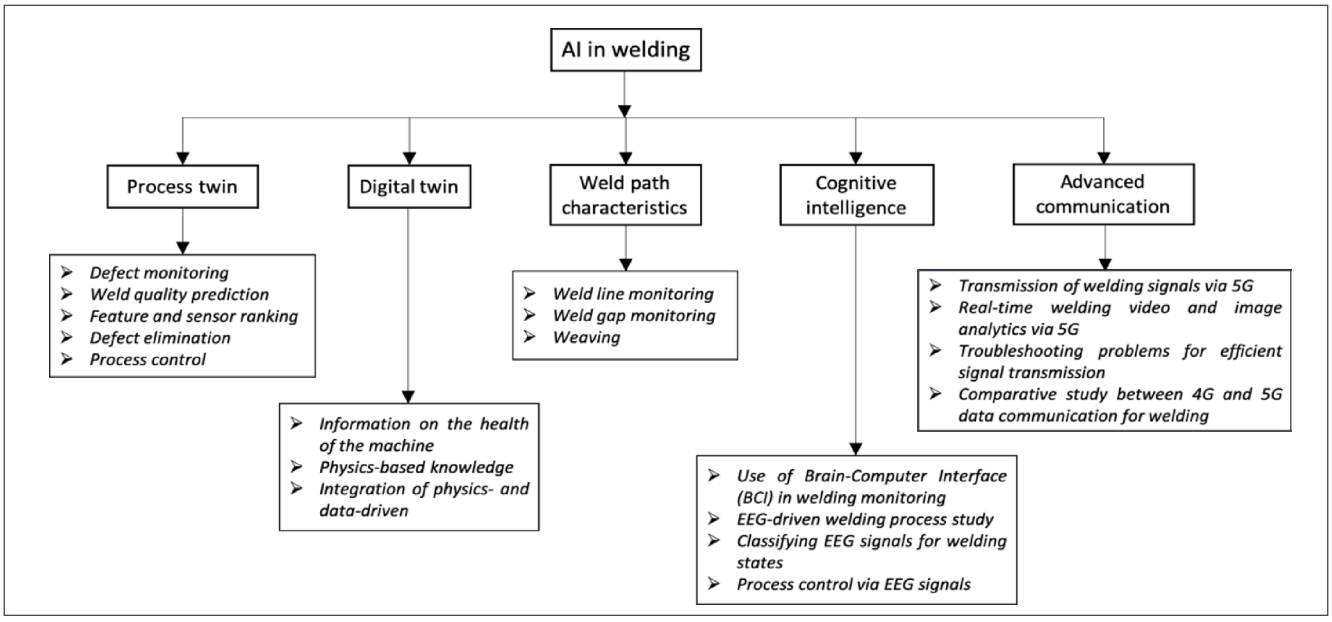

Fig. 2 : Activities of the CoE for implementing AI in welding

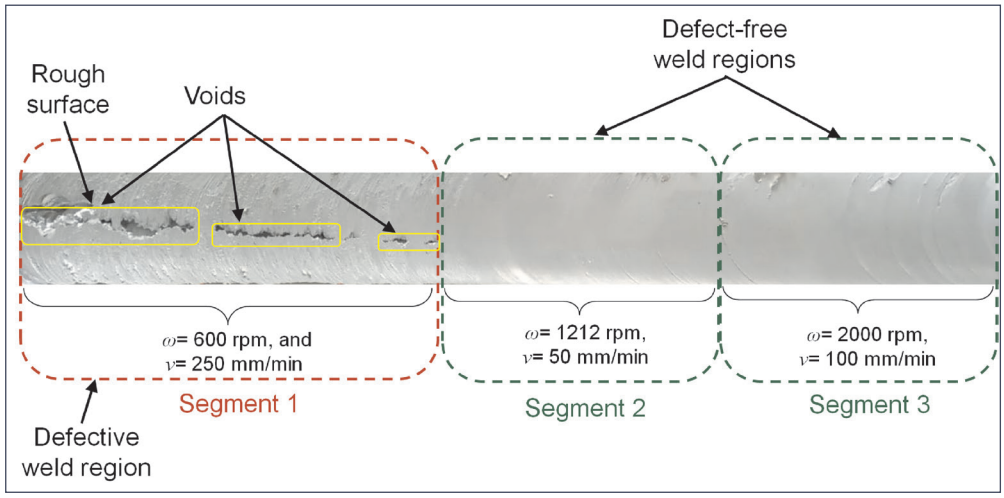

Fig. 3 : Real-time weld quality prediction and control

The Centre has also developed a preliminary digital twin that performs predictive maintenance of the friction stir welding machine. The system looks after the tool health, motors' health, and condition of the hydraulic system. Data acquired from force and power sensors are processed in a Support Vector Regressor that classifies the tool condition in real time. The twin also computes the degradation in the motors of the machine by comparing the real-time data collected from the speed sensors with the historical data. Hydraulic system diagnosis is performed using temperature, pressure, and turbidity sensors. With these inferences, the twin provides measures for prognosis.

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Nanomaterials-Based Manufacturing: Select DMSRDE Contributions

Debmalya Roy

Abstract

The recent years have witnessed a sustainable growth of nanotechnology and the nanomaterials-based products have been increasingly entering into the market covering a broad spectrum of applications. The transfer of nanoscience knowledge and understanding to industrial implementation is a step forward to boost the subsequent emergence of nanoproducts with improved performance and future benefits. The ability to control the material properties at length scale makes nanotechnolgy attractive for hostile defence applications, as it increases the life and performance of military systems. A range of speciality materials developed by DMSRDE have been highlighted with a special emphasis on products for Indian Armed Forces.

1. Introduction

Nanoscience can be best understood by the studies of materials at a scale of one billionth of a meter and considered as one of the key technologies of the 21st century. The recent years have witnessed the technology demonstration at that length scale which translates the promises of nanoscience into reality. The research and development in this field has attracted huge funding for the opportunities in economic growth and societal benefits. Almost all disciplines of science and many sectors in industries have explored the opportunities of nanotechnology. The defence and aerospace sectors particularly require high performance materials at extreme operational conditions and nanomaterials provide the unique opportunities to address these issues [1].

Government of India has established the Nanoscience and Technology Mission under the aegis of Department of Science and Technology in the 10th five-year plan in 2002 and was heavily funded in the subsequent five-year plans. The initiative of nano mission in India has been one of the highly successful programmes with the potential of possible technological paradigm in the direction of self-reliant India. While many other government agencies and industries are engaged in fundamental areas of research in nanoscience and technology, Defence Research and Development Organization (DRDO) has been actively pursuing research in the field of nanotechnology [2].

DRDO has already invested huge funds for nanotechnology research through "DRDO Nano Mission Programme" and plans to set up a nanotechnology foundry to develop new products based on nanomaterials. DRDO also intends to involve private industries and encourage investment in this sector to generate the socio-economic market for structural applications and in bio medical fields [3].

Several DRDO laboratories like Advanced Systems Laboratory (ASL), Defence Laboratory Jodhpur (DLJ), Defence Metallurgical Research Laboratory (DMRL), DMSRDE, Defence Research Laboratory (DRL), Naval Materials Research Laboratory (NMRL), Solid State Physics Laboratory (SSPL) etc. have been actively working in the field of nanotechnology to enhance the life and performance of systems for defence services. Defence Institute of Physiology & Allied Sciences (DIPAS) and Centre for Fire Explosive and Environment Safety (CFEES) have been exploring the toxicity effect of engineered nanomaterials.

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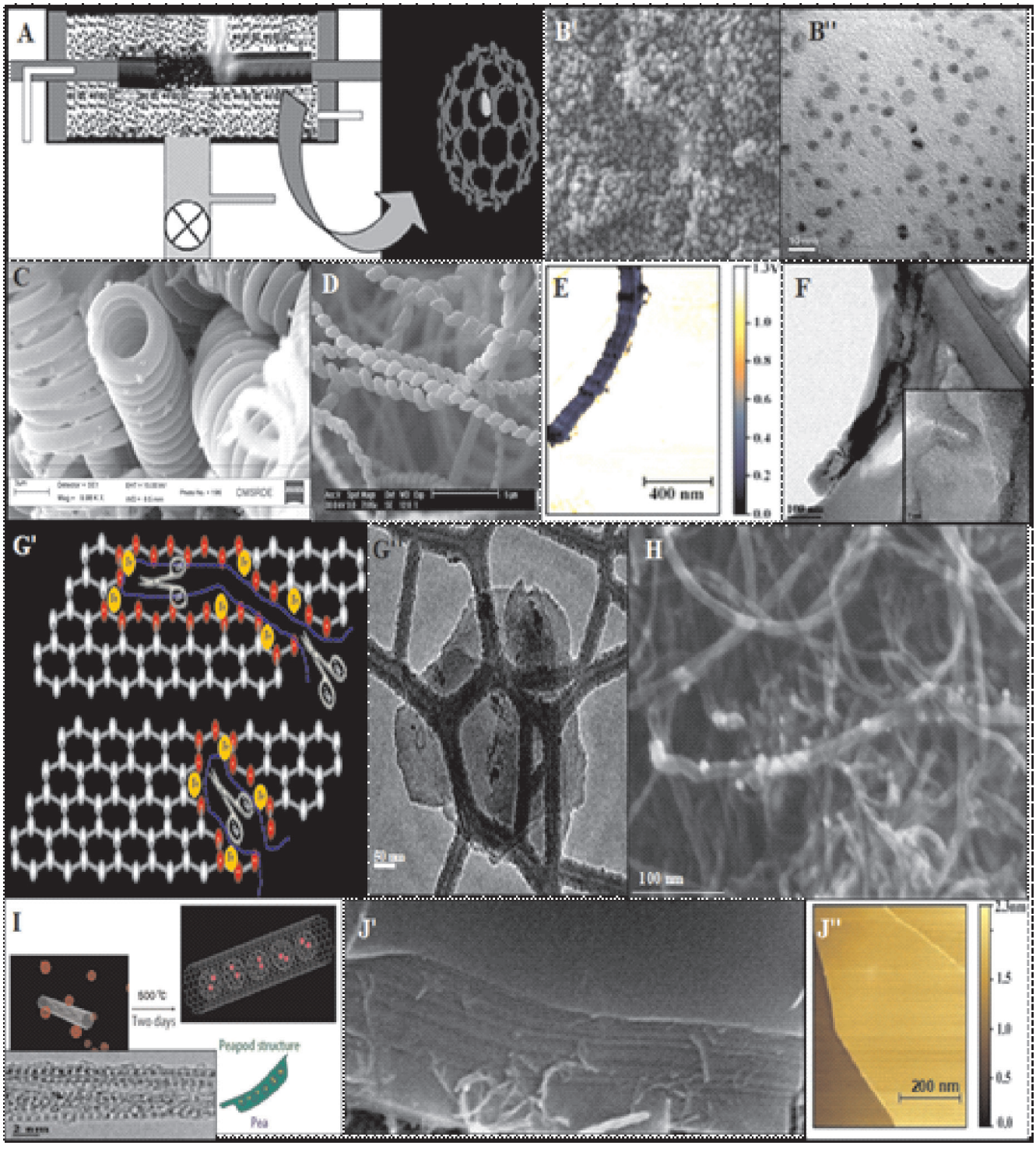

Fig. 1 : Schematic representation of synthesis strategy of (A) 0D metallofullerenes where (B') and (B'') are the SEM and TEM images of carbon nanoparticles respectively. (C) SEM images of synthesized 1D coiled carbon micro and (D) nanofibers are illustrated. (E) STM images of silicon carbide coated nanotubes and (F) TEM images of buckled nanotubes by ion impingements are represented. (G') and (G'') are denoted for the schematic representation of synthesis strategy and TEM image of 2D edge-selective functionalized few layers graphene using Fenton chemistry. (H) SEM image of the combination of 0D on 1D like silver nanoparticles coated nanotubes, (I) TEM image of fullerenes inserted into nanotubes and (J') SEM and (J'') AFM images of 1D with 2D combination like nanotubes immobilized into few layers graphene flakes are illustrated.

2. A Brief History of Nanomaterials Research in DMSRDE

DMSRDE was established in its present form in 1976 to be globally recognized centre of excellence to make the country self-reliant and a leader in the area of strategic non-metallic & specialty materials. In the last 45 years, DMSRDE has developed a core competence in the areas of development of materials of strategic importance, processing and analysis keeping in view of the present and future materials requirement of the services and the major programmes of DRDO. Carbon based nanomaterials have been in the forefront of research in DMSRDE and within a decade of discovery of fullerene and carbon nanotubes, various kinds of fullerenes, carbon nanotubes were synthesized by arc discharge and Catalytic Chemical Vapour Deposition methods in DMSRDE and their properties were evaluated. The topographically controlled carbon-based nanomaterials have been designed and synthesized by combining different dimensionalities to obtain the multiple performance objectives in a single material system [4]. Several organic-inorganic hybrid hierarchical nanomaterials have been synthesized where the new properties were generated by carefully optimizing the basic building blocks which is schematically shown in Fig 1.

The range of nanometre-sized isotropic and anisotropic barium titanium oxalate and iron/cobalt/nickel magnetic particles were prepared with high saturation magnetization and super paramagnetic behaviour for magneto and electro-rheological fluids. The nanoparticles were suspended in non-electric/non-magnetic media such as oil/water for fast change in its viscosity and yield stress with excellent reversibility. The magneto sensitive, giant electro-rheological and shear thickening fluids have been used for nano finish of optical surfaces, smart damper and liquid body armour applications. The process parameters were optimized to synthesize MoS_2 nanoparticles and metal nanoparticles decorated on graphite oxide by chemical methods for thermally conducting fluids and lubricants. The high-density fuels were prepared via single step process using synthesized mesoporous supported nickel-based nano-catalyst where boron nanoparticles were suspended to enhance the heat of combustion. Polyaniline nanoparticles as well as nanotubes and iron oxide nanotubes have been introduced into the polymer matrix to enhance the radar absorption for stealth materials. Electromagnetic wave has both electrical and magnetic components and hence the ideal radar-absorbing material should be both conducting as well as magnetic. Carbon nanomaterials are inherently non-magnetic and hence the magnetic character was infused in carbon nanomaterials by decorating metal/metal oxide nano particles on the surface of nanotubes and graphenes. Carbon nanotubes and silver nanoparticles were reinforced into the polypropylene and polyacrylonitrile for increasing their mechanical strength and antibacterial properties. The different coating densities of chitosan nanofibers on polypropylene non-woven fabric caused significant improvement in biological and chemical protection while maintaining the clothing comfort. Metal oxide nanoparticles were introduced into textile materials to generate functional surfaces for superhydrophobic and oleophobic characteristics with self-cleaning dye-degradation capabilities.

C_{60} Buckminsterfullerene has a truncated icosahedron symmetry with twenty hexagons and twelve pentagons. C_{60} tends to avoid having double bonds in the pentagonal rings, which makes electron delocalization poor and leads to an interesting branch of fullerene chemistry which has been extensively studied in DMSRDE. The self-assembled polymer (Fig 2A)-fullerene derivatives-based donor-acceptor heterojunctions have been fabricated for photodiodes (Fig 2B) and photovoltaics devices with high efficiency and stability. The nanohybrid morphology has been synthesized for supercapacitors where fullerene moieties served as the 'pillars' in separating graphene layers to create an easy diffusion pathway for the electrolyte ions and allowing their faster migration on to coated electrode during rapid charge/discharge processes (Fig 2C).

The conventional precursors for preparation

of cadmium telluride thin films are toxic, pyrophoric, unstable and difficult to handle. DMSRDE therefore developed a process for making stable nano-sized CdTe thin film on silicon surface from single source precursor method using custom-built organometallic vapour phase epitaxy instrument. DMSRDE has designed a process to synthesize urea coordinated sphere around aluminium to form a complex, hexa urea aluminate (III) chloride, which is more stable compared to the contemporary air-sensitive halide and hydride precursors for preparing aluminium nitride thin film for high temperature electronics applications. Ternary semiconductor, Cu_2SnSe_3 (CTSe) nanocrystals were prepared by solvothermal route using copper, tin and selenium metals where CTSe nano-ink was prepared in ethanol. CTSe nano ink was employed as an additional photoactive layer to fabricate heterojunction hybrid solar cell based on P3HT: PCBM blend polymer as shown in Fig 3A. Carbon provides better stability but has low specific capacitance; hence organic-inorganic hybrid material systems with different morphologies (metal oxides nanostructures on carbon cloth, graphene or Ni foam) (Fig 3B) were synthesized for high capacitance and better stability in order to meet the demand of high capacity energy storage for applications like soldiers' battery-packs [4]. The silver nanostructures (Fig 3C) were synthesized and Surface Enhanced Raman Spectroscopy (SERS)-based sensors were fabricated using the nanomaterials on Si substrate. These sensors were subsequently tested against different analytes for detecting any trace amount of contaminants.

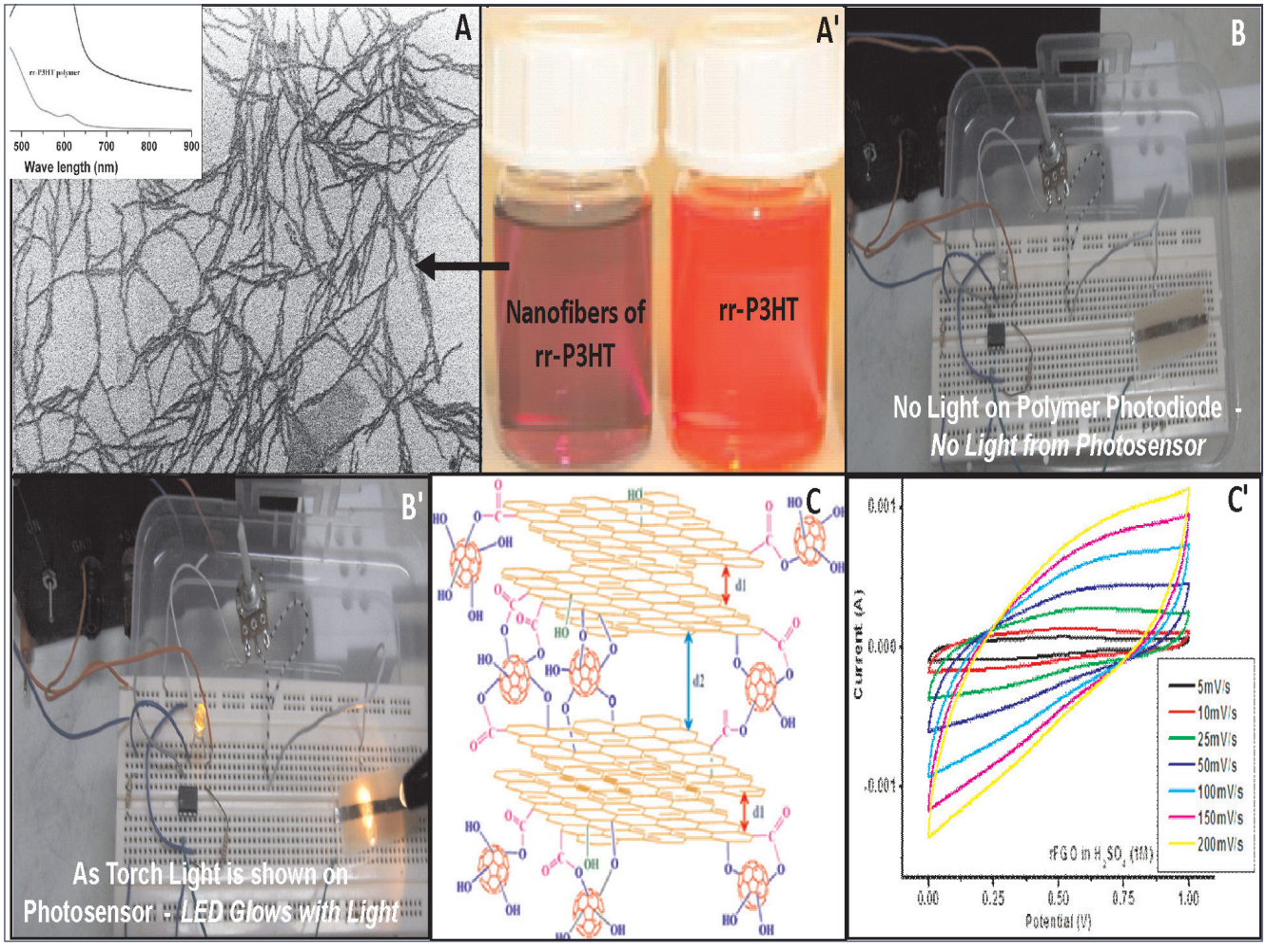

Fig. 2 : (A) Regio regular P3HT nanofibers for higher absorption of photons, (B) Photodiodes fabricated using fullerene derivatives, (C) Fullerene-graphene hybrid nanomaterials for supercapacitors.

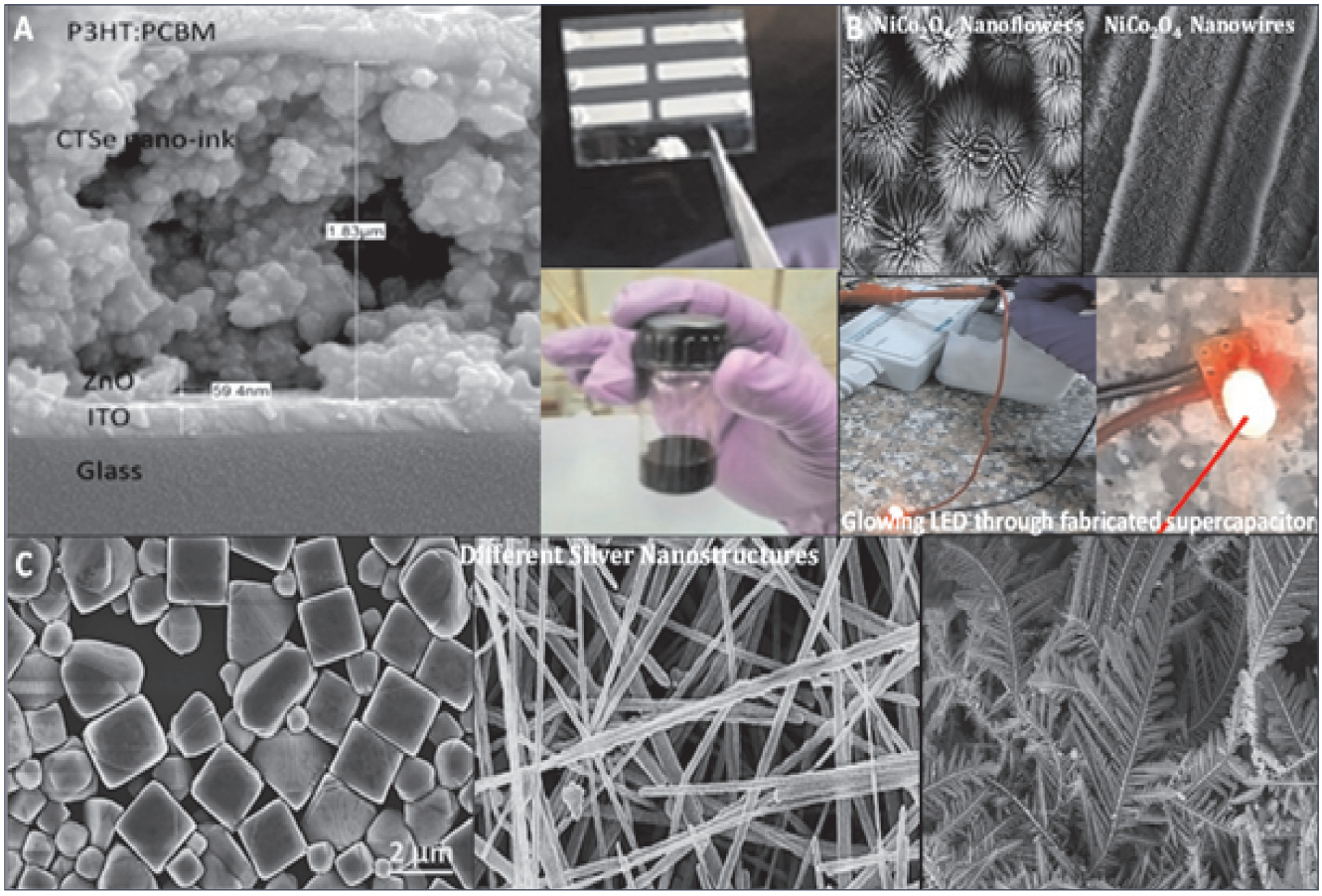

Fig. 3 : (A) Organic photovoltaic using nanoink, (B) Metal oxide nanostructures for high performance supercapacitors, (C) Morphologies of various silver nanostructures for SERS sensor applications.

3. Nanomaterials-based Manufacture of Spinoff Products

The conventional gel-based disk electrodes for measuring bio-potentials (ECG/EEG) faces a problem of itching due to drying of the gel and are not suitable for long term monitoring. The gold-coated biocompatible polymeric pillars of nano- to micron-geometries were made [Fig 4A] using maskless lithography to penetrate the outermost layer of skin and protrude as much as possible without harming the dermis. The human trials are under progress at the International Institute of Sleep Sciences, Mumbai and the clearance from Ethical Committee has already been obtained.

Major challenges for materials under water are the stability and, multi-functionalities as well as elimination of acoustic and vibrational signatures. Our studies established that nanofillers plugged the gap in polymer-matrix composite and promote interfacial bonding which provide much higher stability in marine environments. The interfacial bonding between matrix and fibers is further enhanced by the addition of functional nanofillers which works as a bridge between matrix and fabrics [Fig 4B]. The conducting nanofillers have been used to slow down the ageing of nanocomposite under saline water. Nanocomposites materials, developed by DMSRDE, were certified to be viscoelastic and dimensionally stable. Electrically insulating vis-à-vis thermally conducting nanocomposite-based rotors, stator and end covers have been fabricated for torpedo-propulsion motor according to the design provided by Naval Science & Technological Laboratory (NSTL), Visakhapatnam with lower weight, higher viscoelasticity and dimensional stability compared to contemporary metal alloys [Fig 4B]. The end covers were successfully completed the field trial at NSTL, while the other

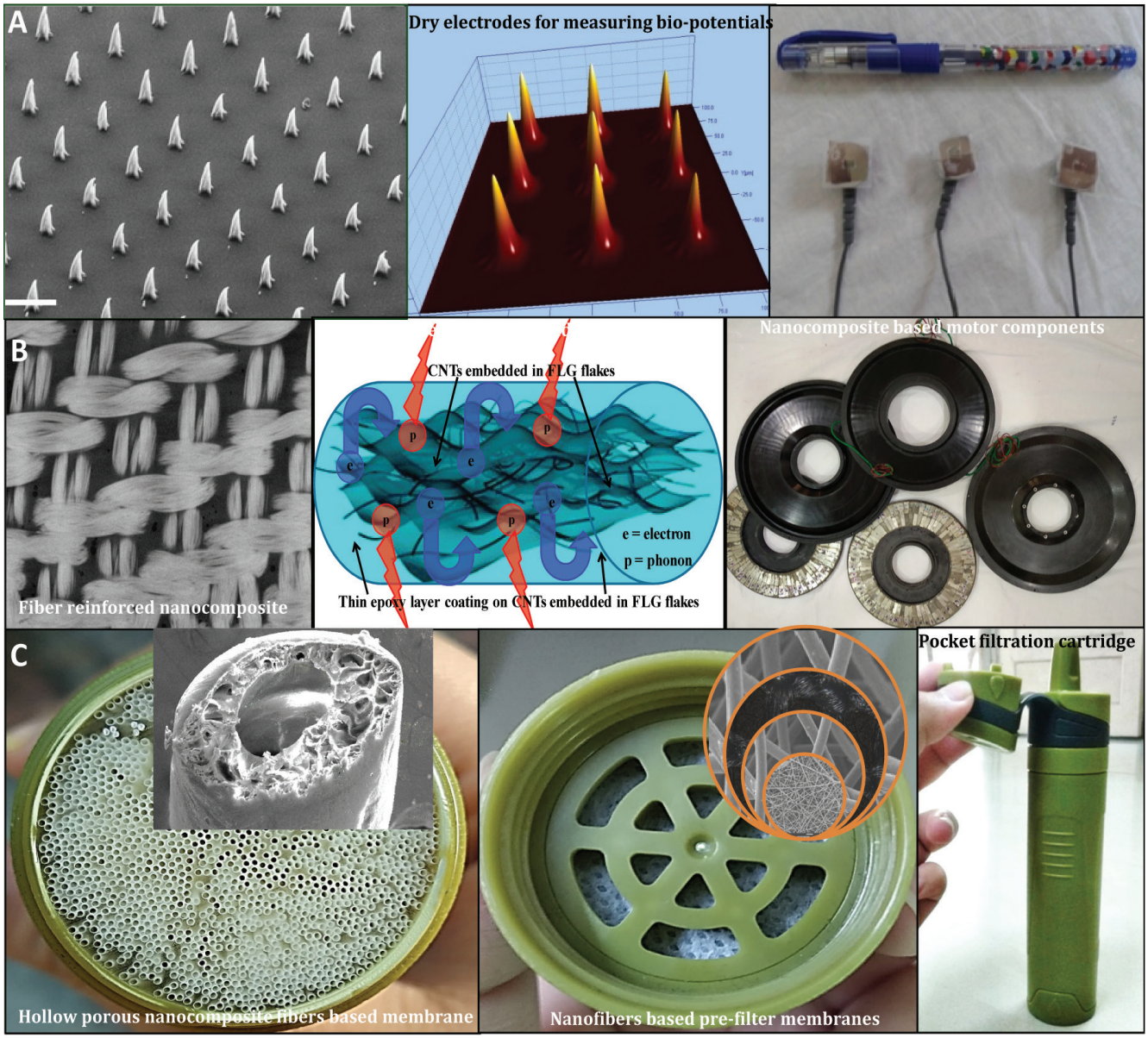

Fig. 4 : (A) Gold coated polymeric dry electrodes, (B) Nanocomposite for under water applications (B) and (C) Pocket filtration cartridge for mobile supply of potable water.

components are still under trial for making propulsion motor with advantages of stealth, power density and superior torque-quality. The technology to fabricate nanocomposite-based motor components has already been transferred to two Indian industries.

One of the major challenges in the process of portable water filtration is the rate of filtration due to insufficient gravitational pressure. DMSRDE developed a compact technology to mitigate this problem using porous nanofibers which don't use any chemical or electrical power for purification. Pocket water filtration cartridge which could fit into plastic water/cold drinks bottle of standard nozzle size has been developed using nanofiber-based membrane and changeable prefilters for prolonged uninterrupted supply of potable water [Fig 4C]. DMSRDE cartridges enable to achieve higher flow rate with little pressure on water bottles by hand or sucking from the tip of cartridges. The provision of easily changeable prefilters increases the life and efficiency of filtration where the contamination is high [5]. It has a unique feature of air droppable

characteristics which enables mass scale supply of drinkable water during natural calamities. We have transferred our technology to fabricate hollow porous fibre-based water filtration cartridges to Indian firms. These 'make-in-India' polymer nanofiber-based products have already successfully completed field trials at two major government organizations, CRPF and NDRF. The current development cost of each cartridge with prefilter is ₹2500 where flow rate and filtration capability are 400-500 ml/min and 700-1000L depending upon the severity of contamination level in input water. The current cost of our purified water is ₹2.5 per litre where 1 litre of commercially available packaged drinking water costs ₹20 per bottle.

4. Future directions

The research on nanomaterials has gained a firm foothold in DMSRDE to provide a long term service to the society and particularly to the defence sectors. The future of nanotechnology programs in DMSRDE bears the promise to address bigger material challenge in the realm of warefare and military applications. The directorate of nanomaterials in DMSRDE developed the expertise and infrastructure in the area of large scale development of nanomaterials by the active collaborations with industry and academia for innovative future material solutions. The future trends largely focus on the design and fabrication of nanocomposites and nanofiber based materials for structural, armour and device applications. The innovative processing technologies like 3D-printing and speciality precursor materials are the area of research for lighter and stronger military systems. While there is the growing appreciation of nanotechnology, the impact on health and environmental risks are still unclear; strict safety measures are also being followed in DMSRDE during handling and processing of nanomaterials.

Acknowledgements

The author gratefully acknowledges the support and guidance received from Dr. N Eswara Prasad, Director, DMSRDE and also for helping in preparation of the manuscript and for the nanomaterials-based research initiatives at DMSRDE. He also expresses his heartfelt thanks to Dr. S. V. Kamat, DG NS&M, DRDO and Dr. G. Satheesh Reddy, Chairman, DRDO for their constant supports and exemplary encouragements of nanomaterial research at DMSRDE and guidance for future R&Ds in nanotechnology. The author also feels indebted to his colleagues, especially to Dr. Kingsuk Mukhopadhyay, Dr. Tandra Nandi, Dr. T. H. Goswami and Shri Alok Kumar Dixit of DMSRDE for updates on their nano-based researches in their directorates, which have become integral part of this special article. The author would like to thank the divisional heads of directorate of nanomaterials of DMSRDE: Dr. Santosh Tripathi, Dr. Alok Srivastava and Dr. Kavita Agarwal, for fruitful discussions and suggestions. Author acknowledges the help of scientists, research scholars and staff members of Directorate of Nanomaterials, DMSRDE for the experimentations, characterizations and analysis. Author thanks all his academic and collaborators from other DRDO laboratories for active research support for manufacturing of nanomaterials-based products and prototypes.

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Indian aluminium producer NALCO faces coal scarcity due to train shortage

Indian state-run aluminium producer National Aluminium Co Ltd (NALCO) is facing a coal supply shortfall, due to supplies being diverted to priority electricity generation and a shortage of trains to deliver fuel to NALCO's power plants. Daily supplies to NALCO were falling short of requirement by at least 5,000 tonnes due to the train shortage, a senior company official told Reuters.

India has diverted coal supplies from the non-power sector, and put on hold plans for some fuel auctions, in a bid to ensure coal availability for utilities and tackle widespread power outages across the country.

There is also a general shortage of trains to move coal around the country. State-run Indian Railways has fallen short of utilities' requirements by 16% in the first half of April, a government official familiar with the matter said.

NALCO data seen by Reuters show that supplies by state-run Coal India under a long-term supply deal fell short of the contracted quantity by 17% in 2021/22, while shortfalls were more than 75% under another related deal.

Mahanadi Coalfields (MCL), the Coal India unit which supplies NALCO, said it has sufficient coal and has asked NALCO to prioritize moving coal via conveyor belts and trucks instead of using trains. It said it was prioritising the sending of coal via rail to power stations.

The NALCO official said it was not possible to increase transport by road due to "logistical challenges".

The NALCO Officers' Association, a welfare association for executives of the company, is taking legal action over the coal supply shortfalls, alleging poor planning by the Indian government and the various state bodies involved.

"The lopsided prioritization of the union government and the lackadaisical attitude of the railways has triggered the present crisis," said Subir Palit, a lawyer representing the NALCO Officers' Association, which has taken the coal ministry, MCL and a unit of the Indian Railways to court over the supply shortfalls.

The Economic Times

JSW Group to develop 900 MW hydel, rolling mill projects in Bengal

The JSW Group has expressed interest to develop a 900 MW pumped storage hydel power project and a state of the art rolling shop for steel in West Bengal, company chairman Sajjan Jindal said. He announced the projects while addressing the inaugural session of the Bengal Global Business Summit, organised by the state government.

"We are keenly pursuing a 900 MW hydro pumped storage project. This will bring clean energy to the state and we hope to receive this prestigious project through a nomination from the state government," Jindal said.

The Economic Times

India exports 13.5 Mt finished steel worth Rs 1 lakh cr in FY22

India exported 13.5 million tonne (Mt) of finished steel valuing Rs 1 lakh crore in the last financial year, Minister of Steel Faggan Singh Kulaste has said. According to official data, India’s finished steel exports were at 10.78 million tonne in 2020-21.

“India exported 13.5 Mt finished steel amounting to Rs 1 lakh crore and imported steel of around Rs 46,000 crore during FY22,” Kulaste said at Steel and Engineering Exports organised by Metalogic PMS.

The value of merchandise exports from India was at USD 420 billion, he said. In FY22, India's steel consumption was at an all-time high of around 106 Mt, while the country produced a record 120 Mt crude steel, Kulaste said.

The sector is growing at a compound annual growth rate (CAGR) of around 5 to 6 per cent on a year-on-year basis.

"Notwithstanding the challenges arising out of COVID-19, the steel sector in terms of external trade, production and consumption registered a record performance. We have the potential to do better in the steel sector across all areas. The engineering sector -- is closely linked to the manufacturing and infrastructure sectors -- is of strategic importance to India's economy, and the steel sector is closely linked to this sector," the minister said.

The Economic Times

Nithia Capital acquires Crest Steel & Power for Rs 600 crore

Global advisory and investment firm Nithia Capital said that it acquired Crest Steel & Power out of bankruptcy for a total consideration of Rs 600 crore (around $80 million).

It acquired Crest in partnership with Amalgam Steel Pvt Ltd. Nithia has a majority control in the partnership.

"With our newly forged partnership with Amalgam Steel, we believe Crest will soon achieve a successful turnaround and is well set on its planned growth programme," said Jai Saraf, founder of Nithia Capital.

Vedanta's Sesa Resources, Real Ispat & Power, Sunil Kumar LLP and Orissa Metaliks were also in the fray to acquire Crest Steel.

The Economic Times

Jindal Stainless-Jindal Stainless (Hisar) merger gets shareholder, creditor approval

Jindal Stainless Limited (JSL) and Jindal Stainless (Hisar) Limited (JSHL) said that their proposed merger has been approved by their shareholders and creditors as required by the National Company Law Tribunal (NCLT).

The companies now plan to file a second motion application with the Chandigarh bench of NCLT. They had filed the first motion petition in March 2021.

"We are happy that our shareholders and creditors have approved the scheme of arrangement for JSL-JSHL merger by an overwhelming majority," Abhyuday Jindal, the managing director of Jindal Stainless said in a press statement. The companies hope to complete the merger during the course of this financial year, he said.

The two companies had been demerged in 2015 as part of a financial and operational restructuring exercise to bring down the cost of borrowing. Jindal Stainless had been laden with debt of over Rs 8,500 crore, which had prompted the restructuring.

The Economic Times

Kamdhenu eyes Rs 22,000 crore brand sales turnover by FY24: CMD Satish Agarwal

The Kamdhenu Group is eyeing for a brand sales turnover of Rs 22,000 crore from its steel business by financial year 2023-24, its Chairman and Managing Director (CMD) Satish Agarwal said. The Gurugram-based TMT rebars maker operates on a franchisee model in the steel segment.

"Looking at the demand for our products, we expect a total brand sales turnover of Rs 22,000 crore in the steel segment," he said and explained "brand sales turnover includes the total business by the company (Kamdhenu Group) and its franchise partners."

When asked about the timeline for the target, Agarwal said in the financial year 2020-2021, the company's overall brand sales turnover was Rs 12,000 crore and the Group aims to achieve the said target by 2023-24 fiscal.

The Economic Times

India's Tata Steel to stop doing business with Russia

Tata Steel will stop doing business with Russia, the Indian steel major said, making it the latest global company to cut ties with the country for invading Ukraine.

"Tata Steel does not have any operations or employees in Russia. We have taken a conscious decision to stop doing business with Russia," Tata Steel said in a statement.

All of the company's steel manufacturing sites in India, the UK and the Netherlands have sourced alternative supplies of raw materials to end its dependence on Russia, Tata Steel said.

The Economic Times

JSPL's steel production rises in March quarter

Jindal Steel and Power Limited (JSPL) posted a 2 per cent rise in steel production at 2.11 million tonnes in the quarter ended March 2022.

Its sales also registered a growth of 8 per cent at 2.07 million tonnes (Mt) in the January-March period, according to a statement.

In financial year 2021-22, the company produced a record 8.1 Mt of steel while sales were at a record 7.63 Mt.

Despite several challenges throughout FY22, JSPL managed to meet its production guidance breaching the 8 Mt mark for the first time. For the fifth consecutive year, JSPL has also posted spectacular growth in annual steel sales on a year-on-year basis, the statement said.

JSPL Managing Director V R Sharma said, "we aim to produce more than 9 Mt in FY23. Our Angul plant expansion is on track and we expect to reach more than 15 Mt capacity by FY25. The company has significantly enhanced its raw material supply after winning four new coal blocks recently".

As part of its expansion, the company has plans to set up a coal gasification plant to manufacture steel through gasification technology.

The Economic Times

Steel ministry seeks duty-free import of ferronickel

Union steel ministry has asked the finance ministry to remove the basic customs duty on ferronickel, a key raw material for stainless steel makers, a senior government official said.

The move will help stainless steel makers to reduce their input cost. At present, a 2.5 per cent duty is imposed on the imports of ferronickel. The domestic stainless steel manufacturing industry meets the bulk of its nickel requirements through ferronickel and stainless steel scrap.

Earlier, the government had removed the 2.5 per cent import duty on scrap for a limited period till March 2023.

The government is aware of the challenges the Indian stainless sector is facing. Raw material availability is one of the major challenges in front of the industry. Additional Steel Secretary Rasika Chaube told PTI on the sidelines of the Global Stainless Steel Expo (GSSE) 2022.

"We got (zero duty on scrap) extended up to March 23. Second is nickel and chromium. Chromium is in good supply but nickel is not available. We have taken up the matter (to remove duty ferronickel) with the finance ministry because this is a very important raw material for the stainless steel industry," Chaube said.

Such decisions are taken after a lot of considerations by the finance ministry, and the steel ministry can recommend for the same, the official said.

Ferronickel is required for the manufacturing of corrosion-free steel which is used in various sectors like auto, defence, railways and infrastructure.

The Economic Times

NMDC posts higher output, sales in April

India's largest iron ore producer NMDC reported 3.15 million tonnes of production and 3.12 Mt sales in April, both an increase of under 1% compared to the year earlier period's performance.

Iron ore production in April 2022 was 0.6% more that the output in the year earlier, while sales were 0.9% higher.

This was the highest production in April in the company's history. It came in the backdrop of the company producing over 42 Mt in 2021-22.

"FY23 has started on the right note for us and is a reflection of the team's hard work aligned with the company's strategic posture. Our adoption of new technology and digital initiatives is strengthening our supply chain and making NMDC future ready," CMD Sumit Deb said. After achieving the target of 42 Mt iron ore production, "We are confident that NMDC will grow to become a 50 Mt mining company in the near future," he said.

The Hindu

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The Ministry of Steel (MoS) sponsored National Metallurgists Day (NMD) Awards scheme has been rationalised as National Metallurgist Awards (NMA) Scheme to enhance the stature of the award in line with the vision of Hon'ble Prime Minister, as per the directions received from MHA.

The Ministry of Steel (MoS) presented the National Metallurgist Award in association with The Indian Institute of Metals to recognise Metallurgists in Iron & Steel Sector on 20th April, 2022. The Honourable Union Steel Minister, Shri Ram Chandra Prasad Singhji chaired the program. Dr S V Kamat, Distinguished Scientist & Director General - Naval Systems & Materials (NS & M) and Vice President of The Indian Institute of Metals was also present in that event.

In his address Shri Singh elaborated that due to versatility and longevity of steel,"he foresees that steel application across segments will see a quantum jump." He also said that newer areas of usage such as increasing deployment of drone technology will provide ample opportunities to the steel players. The Minister opined that the Indigenous Research and Development in Iron and Steel Sector would rise to the next level and would be central to the growth of the sector in times to come.

The Steel Secretary, Shri Sanjay Singh said that Indian Steel Industry is on the cusp of transition. This phase of transition can only be driven by strong Research and Development, which would address the need for green steel, reduce carbon emission and efficiency in steel production.

Awardees of National Metallurgist Award have been shortlisted by Ministry of Steel through a very well-conceived and transparent process by two stage mechanism of screening committee and selection committee. The applications for participation in award process were invited by the Ministry through a notification. The following awardees were presented the award for 2021 by Hon'ble Union Minister of Steel –

S. No.	Name	Award Category
1	Sri Hemant Madhusudan Nerurkar	Lifetime Achievement Award
2	Prof. B S Murty	National Metallurgist Award
3	Dr. Gnanaprakasam Balachandran	Award for R&D in Iron & Steel Sector
4	Dr. Pratik Swarup Dash	Certificate of Excellence (R&D in Iron & Steel Sector)
5	Dr. Ashok Kamraj	Young Metallurgist (Metal Science) Award
6	Ms Minal Shah	Young Metallurgist (Metal Science) Award

These Awards have been instituted to recognize outstanding contribution of Metallurgist who are working across value chain of Iron and Steel Industry covering areas of Manufacturing, R & D, Design, Waste Management, Education, Energy Conservation and finally those working towards making the steel sector 'Atmanirbhar'.

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Source : https://pib.gov.in/

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IIM CHAPTER ACTIVITIES

Jamshedpur Chapter

In the IIM Jamshedpur Chapter Lecture series on 25th of March 2022, Professor A.K. Singh, Department of Materials Science and Engineering from IIT Kanpur, delivered a lecture on the online platform. In his deliberation, Prof. Singh said it can take a decade or more to engineer materials. The stages of generating and deploying new materials include lab-scale research and development, pilot-scale testing, process scale-up, plant-level production and certification. Integrated Computational Materials Engineering (ICME) is emerging as a key technology enabler for accelerating the realization of materials into products by leveraging the advances in digital technologies involving the integration of models, experiments, and knowledge bases, advances in modelling and simulations of materials and

processes, and advances in the applications of emerging technologies such as machine learning and artificial intelligence to accelerate the realization of materials into products. His talk focuses on the importance of digital twins of manufacturing processes in horizontal integration of workflows and the role of vertical integration of models and data and knowledge in obtaining the digital twins with sufficient accuracy. The talk was attended by a large gathering of more than 40 participants.

Durgapur Chapter

1. IIM Durgapur Chapter celebrated "Women in Metallurgy" program to recognise and reward the women metallurgists on the occasion of International Women's Day on 27th March 2022 at NIT Durgapur. Chapter has instituted this award for the best female student in Metallurgy every year on the basis of merit and this award is handed over every year on International Women's Day. On this occasion a technical talk "Metal Additive Manufacturing" was delivered by the Chief Guest Prof (Mrs) NC Shanti Srinivas, Dept. of Met. Engg., IIT BHU, Varanasi. Large nos. of participants including students, faculty, industry participants like SAIL, PIONEER IMPEX and members of IIM attended the programme. Director I/c, NIT Durgapur in his address praised IIM Durgapur chapter and secretary for this great initiative and assured all support from his side and the institute. Dean of student welfare spoke

at length about the involvement of girl students in all spheres of activities. Shri L Badu, Secretary, IIM Durgapur Chapter congratulated the student awardees namely Ms Dayeeta Pal and Ms Khansa Sahnawaz for getting the coveted awards and wished them all success in their career. Secretary in his address highlighted the importance of the women and their contribution for the society and the nation. HoD of Metallurgical Engg. Dept., NIT Durgapur also addressed the gathering and encouraged the girl students to come forward and take the leadership roles. The programme ended with a vote of thanks delivered by Shri Subhadip Paul, student member & co-ordinator from student chapter. Dr Arup Mondal, Faculty & co-ordinator student chapter, NIT Durgapur steered the programme. The programme was followed by lunch.

2. The Executive Committee meeting of Durgapur Chapter was held on 27.3.22 at NIT Durgapur. It was attended by all concerned including student members and faculty co-ordinators. The main agenda of the meeting was "Membership drive for students, organizing more programmes jointly and further strengthening synergy between industry, academia and chapters etc."

Kolkata Chapter

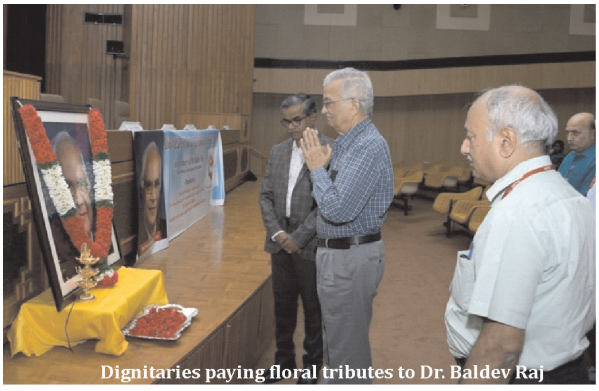
The IIM Kolkata Chapter along-with IIChE Calcutta Regional Centre and the Jadavpur University organised the fifth lecture of the Webinar Series 2022 on 6th April, 2022. The lecture was delivered by Sri Kundana Kumar Lal, Head of Vitti Research Foundation, a global Artificial Intelligence (AI) thought leader on "Innovation Deficit". The sixth lecture was delivered by Sri Anirban Bhattcharya, Chairman and Board Member at Amplo Global Inc, Industry 4.0 leader on "Industry 4.0 and Sustainability" which was held on 20th April, 2022.

Fourth Dr. Baldev Raj Memorial Lecture (BRML-2022)

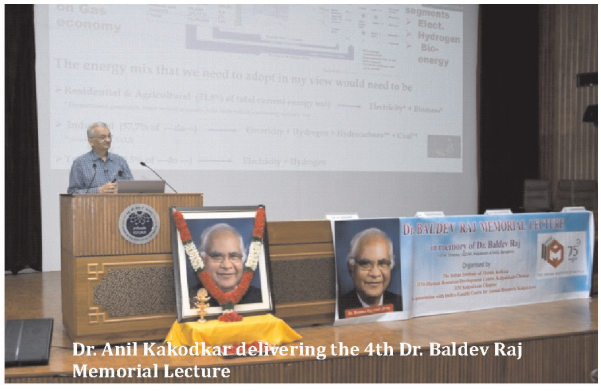
The 4th Dr. Baldev Raj Memorial Lecture (BRML) was organised by The Indian Institute of Metals, Kolkata, IIM Human Resources Development Centre, Kalpakkam-Chennai & IIM Kalpakkam Chapter in association with Indira Gandhi Centre for Atomic Research (IGCAR) on 9th April 2022. This program was conducted in hybrid mode from Vikram Sarabhai Auditorium at IGCAR, Kalpakkam with video conferencing through Webex platform. Before starting the program a floral tribute was paid by the dignitaries to late Dr. Baldev Raj.

The program started with a welcome address by Dr. B. Venkatraman, Director, IGCAR, during which he recalled his long association with Dr. Baldev Raj. Dr. U. Kamachi Mudali, Vice Chancellor, VIT Bhopal & Chairman, IIM HRDC-KC presented the profile of Dr. Baldev Raj and briefed about the genesis of "Dr. Baldev Raj Memorial Lecture". Dr. Baldev Raj has mentored hundreds of scientists, technologists, and students inspiring them to pursue high levels of professionalism in the pursuit of science and technology with impeccable ethical practices.

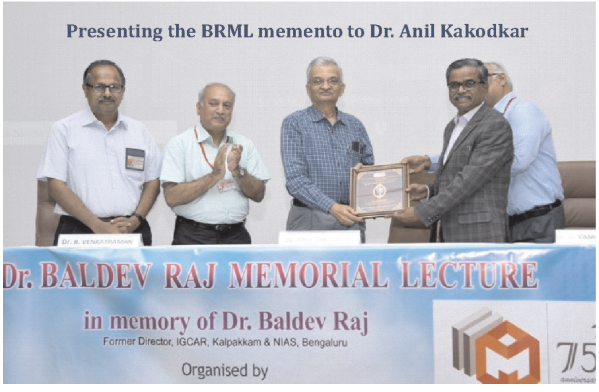
In the presidential address, Sri T.V. Narendran, President IIM, recalled the monumental contributions of Dr. Baldev Raj in existing and emerging fields of science as well as in shaping the activities of IIM at the national level as former IIM President. He highlighted the various initiatives



Dignitaries paying floral tributes to Dr. Baldev Raj



Dr. Anil Kakodkar delivering the 4th Dr. Baldev Raj Memorial Lecture



Presenting the BRML memento to Dr. Anil Kakodkar

Snapshot of the audience for the lecture programme

of IIM such as collaborations with CII and private institutions of excellence to establish programs in materials for students and to encourage material related startups.

Dr. R. Divakar, Member of Baldev Raj Endowment, introduced the speaker, Dr. Anil Kakodkar, Chancellor, Homi Bhabha National Institute, Mumbai; Chairman, Rajiv Gandhi Science & Technology Commission; Former Chairman, AEC & Secretary, DAE.

Dr. Anil Kakodkar recalled his very long association with Dr. Baldev Raj and admired his multidimensional personality with contributions in science, technology, innovation, administration and policy making. He delivered the fourth Dr. Baldev Raj Memorial Lecture on the topic "Clean Energy Transition in India- A Macro View". Dr. Kakodkar presented the energy supply-demand scenario and dwelt on the key elements of sustainable clean energy policy highlighting the role of electricity, hydrogen and bio-energy for meeting the energy demand. Besides developing critical technologies such as steam electrolysis, production of hydro-carbon substitutes using hydrogen and bio-mass, Dr. Kakdokar stressed on augmenting electricity generation based on energy mix option involving renewables, hydro and nuclear. To meet the net zero carbon emission in India by 2070, Dr. Kakodkar urged nuclear industry in India for speedier implementation of capacity addition especially of the standardized 700 MWe PHWR's. The lecture was very well attended by the 200+ scientists, research scholars and school students with lively question-answer session.

Dr. U. Kamachi Mudali presented the memento for BRML-2022 to Dr. Anil Kakodkar on behalf of President, IIM, and Dr. B. Venkatraman presented a Certificate from M/s Springer Publishers to avail books and publications worth of 1000 Euro, and a memento. The program ended with a vote of thanks by Dr. M. Vasudevan, Chairman, IIM Kalpakkam Chapter.

Hyderabad Chapter : XXVII Tamhankar Memorial Lecture

The Tamhankar Memorial Lecture is organised every year by the IIM Hyderabad Chapter to pay tribute to the unique contributions made by Dr R V Tamhankar in establishing and nurturing two important institutions in the country viz. Defence

Metallurgical Research Laboratory (DMRL) and Mishra Dhatu Nigam Limited (MIDHANI). The 27th Tamhankar Memorial Lecture was organised at DMRL on April 11, 2022. Dr. U Kamachi Mudali, Vice Chancellor, VIT Bhopal University; Former Chairman & Chief Executive, Heavy Water Board and Former President, The Indian Institute of Metals has delivered the lecture on "Materials Security and Strategy for a Sustainable Future". He has emphasised on different ideas to secure materials and a variety of strategies to sustain them, various initiatives introduced by the government and the importance of three R's i.e., Reduce, Reuse, and Recycle.

ANNUAL ACTIVITY REPORT of IIM CHAPTERS for the FY 2021-22

Dolvi Chapter :

- Life membership of 9 new members
- IIM talk on "Steel slag- conversion from ticking bombs to valuable resources" by Prof Seetharaman, Professor emeritus, Royal Institute of Technology, Sweden
- IIM talk on "Influence of inorganic additives in hematite ore pelletizing" by Dr J Pal, Sr Principal scientist, NML Jamshedpur
- IIM talk on "A brief insight into the mechanisms of Palletization and its benefits as feed in Iron Making Process" by Dr T K Sandeep Kumar, Research engineer, LKAB, Sweden
- IIM talk on "Application of computational thermodynamics in process modeling" by Prof Manas Paliwal, Asst Professor, IITKGP.

Delhi Chapter :

1. The 69th Annual General Meeting for the year 2020-21 was held on 14th August 2021 at Google meet platform, wherein the Annual Report and Accounts of the Chapter were presented and approved.
2. During the year 2021-22, nine EC meetings were held. Among other issues, important decisions relating to MMMM 2022 activities and functioning of the Chapter etc. were taken. The following programmes were held on virtual platform.

* Technical Talk on Product, Process & Application – Cold Rolling Mill, Tata Steel BSL, Sahibabad on 3.5.2021

* Technical Talk on Pelletization : Industry Overview and MECON's Role on 26.6.2021

* Technical Talk on Innovative Roll Profile Design for Thin Strip Cold Rolling Mills on 14.8.2021

* Green Steel : A Disruptive Innovation on 2.10.2021

3. On the eve of IIM Platinum Jubilee Celebrations Delhi Chapter brought out a booklet. The Booklet inter-alia, contains the following:

❖ 75 years journey of IIM

❖ Evolution and growth of IIM Delhi Chapter

❖ Office Bearers name of Delhi Chapter since inception of the Chapter

❖ Themes of the MMMM events held by the Chapter since 1996

❖ Contact details and professional profile of IIM DC members.

Mumbai Chapter :

1. Evening Lecture by Prof Milos B. Djukic, University of Belgrade, Serbia (in association with, NACE International Gateway of India Section, ASM International, India Section, Society for Failure Analysis, NACE International India Student Chapter) on 08/07/2021
2. IIM Evening Lecture by Prof. Parag Bhargava, Department of Metallurgical Engineering and Materials Science, IIT Bombay, India, on Additive Manufacturing on 09/07/2021
3. IIM 'Sundaram Memorial Lecture' by Prof. K. A. Padmanabhan, Professor of Eminence, Anna University, India, on ICME on 04/09/2021
4. Evening Lecture by Prof Milos B. Djukic, University of Belgrade, Serbia (in association with, NACE International Gateway of India Section, ASM International, India Section, Society for Failure Analysis, NACE International India Student Chapter) on 08/07/2021
5. AGBM 2021 on 04/09/2021
6. Afternoon Lecture by Prof. Neeraj Sharma, The University of New South Wales, Australia on Battery Materials on 18/09/2021
7. Evening Lecture by Prof. Günter Schmitt, Institute for Maintenance and Corrosion Protection Technology Iserlohn, Germany, on Corrosion (in association with, Dept. of

Metallurgical Engineering and Materials Science, IIT Bombay, NACE International Gateway of India Section (AMPP), Electrochemical Society of India, ASM International India Section, International Tube Association, India Section Society for Failure Analysis, NIGIS Student Chapter) on 08/10/2021

8. Evening Lecture by Prof. V. S. Raja, Department of Metallurgical Engineering and Materials Science, IIT Bombay, India on Corrosion Resistant Coatings on 10/11/2021
9. Evening Lecture by Dr. S. M. Yusuf, Bhabha Atomic Research Centre (BARC), Mumbai, India on Magnetic Materials on 14/01/2022
10. Evening Lecture by Dr. Daniel Abraham, Argonne National Laboratory, USA, on Battery Materials on 23/03/2022.

IIM Student Affiliate Chapter under IIM Mumbai Chapter

1. Introductory Meeting with Student Chapter Members on 12.06.2021
2. Strain Engineering across phase change materials and interaction with students on PhD in Germany by Dr Nico Peter, former PhD student, MPIE Duesseldorf, Germany on 17.08.2021
3. An Excursion on Implementation of Scientific Inquiry in Research by Ms Shalaka Shinde, PhD student at Stony Brook University, USA on 25.08.2021
4. Panel Discussion on Literature Survey for Early Career Researchers on 22.09.2021
5. An introduction to APT-theory and practicals, by Dr Baptiste Gault, Faculty at Imperial College London and Group Leader, MPIE Duesseldorf on 29.09.2021
6. Seminar talk by Prof Sam Daly, Vice Chair of Mechanical Engg at UCSB, USA on 16.11.2021
7. Seminar talk by Dr Megan Cordill, Deputy Director, Erich Schmid Institute of Materials Sciences, Austria on 23.11.2021
8. Seminar talk and interaction with students on PhD at MPIE, by Ms Heena Khanchandani, PhD student, MPIE Duesseldorf, Germany on 04.01.2022.

Kolkata Chapter

1. The 55th Annual General Meeting, 2021-22 held on 28th May, 2021 on web platform.
2. Prof. Brahm Prakash Memorial Materials Event (BPMME), 2021, Essay Competition in the month august, 2021.
3. Technical talk on "Mechanobiology; How mechanical forces at the Cell -material interface influence Biology", by Prof. Kinjal Dasbiswas, Assistant Professor, University of California on 7th August 2021.
4. Technical talk on "Global Chrome Business - an overview", by Mr. Debraj Mukherjee, Asst. Genl. Manager (International Sales), Tata Steel Mining Limited on 18th September, 2021.
5. DEMYSTIFYING INDUSTRY 4.0: Curtain Raiser programme, jointly organized by the "IIM, Kolkata Chapter", "Indian Institute of Chemical Engineers, Calcutta Regional Centre" and "Jadavpur University" on 27th November, 2021 in hybrid mode.

- The First lecture of the webinar series held on 9th February, 2022 by Sri Narayan Chandra Chakrabarti, Vice President and Head - Smart Manufacturing, Reliance Industries Ltd., on "Evaluation and Enabling Technologies for Enhanced Value Creation from Manufacturing".
- The Second lecture of the webinar series held on 23rd February 2022 by Sri Ambarish Dasgupta, Senior Partner, Intueri Consulting LLP, on "How to adjust Corporate Strategy to deal with the opportunities & challenges in Industry 4.0".
- The Third lecture of the webinar series held on 9th March 2022 by Sri Bireswar Roy, Head-Industry Services, Digital Industries, Siemens Ltd, on "Digital Transformation taking Industry Forward".
- The Fourth lecture of the webinar series held on 23rd March 2022 by Dr. Susmita Sur Kolay, Senior Professor, Indian Statistical Institute, on "Challenges in Design of Secure IoT based Industrial and Healthcare Systems".

6. Annual Get Together held on 6th March 2022.

Durgapur Chapter

1. Prof SC Dasgupta memorial lecture / talk on 27.6.21 was delivered by Shri L Badu, Secretary, Durgapur Chapter on the subject "Development of Wide Parallel Flange beams (WPB) at MSM, DSP."
2. AGM held on 27.06.2021 at Dhatu Bhawan, IIM Durgapur chapter. It was also displayed through MST Platform due to COVID situations.
3. Webinar on 17th July 2021. Dr Shantanu Ray, former General Manager RDCIS SAIL, former STEEL CHAIR professor, IIT Madras and currently consultant to JINDAL STAINLESS delivered the lecture on Quality Aspects of Steel.
4. Executive Committee meeting on 17.7.21, 28.11.21, 13.3.22 and 27.3.22.
5. Metallurgy and Materials Quiz on 10.10.21 at NIT Durgapur.
6. Celebrated "Women in Metallurgy" program to recognize and reward the women metallurgists on the occasion of International Women's Day on 27.3.22 at NIT Durgapur.

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OBITUARY

With deep anguish and sadness we would like to convey that the Senior nuclear scientist and former Director of the Indira Gandhi Centre for Atomic Research Dr. Arun Kumar Bhaduri breathed his last at Kalpakkam. He was the former Council Member, former Chairman of IIM, Kalpakkam Chapter and Life Fellow of The Indian Institute of Metals.

Dr. Bhaduri, who worked extensively on fast breeder reactors, served as the director of IGCAR, Kalpakkam, from July 2017 to August 2021. He was awarded the Raja Ramanna Fellowship post retirement. Born on August 28, 1959, Dr. Bhaduri joined IGCAR in 1984 and became the Director of Metallurgy and Materials Group and also a Senior Professor of Homi Bhabha National Institute. Consequent to his superannuation he assumed the position of the Homi Bhabha Chair at IGCAR. He received the Humboldt Research Fellowship from the Alexander von Humboldt Foundation, Germany in 1994 and carried out post-doctoral research in University of Stuttgart, Germany for two years.

He specialised in the field of materials welding, hard-facing and materials joining and has to his credit more than 220 journal publications, 410 conference presentations and two international patents. He steered the research and development on the development of materials and their fabrication technologies for Indian programmes on sodium-cooled fast reactors, fusion reactors and advanced ultra-supercritical thermal power plants.

May his soul rest in peace eternally.

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ADVERTISERS' INDEX

Name of the Organisations	*Page Nos.*
Pragati Defence Systems Pvt Ltd	**5**
Chennai Metco Pvt Ltd	**29**
PTC Industries Limited	**30**
JSW Steel Ltd	**4th Cover**

PTC INDUSTRIES LIMITED

Manufacturer of

1) Titanium Castings

2) Nickel Super Alloys Castings

3) Hot Isostatic Pressurised Parts

4) 5 Axis CNC Machining

Components of Aero Engines, Rocket, Missiles, Submarines and Land based Defence equipments.

Advanced Manufacturing and Technology Centre
NH-25A, Sarai Sahjadi, Lucknow – 227101
E-mail – marketing1@ptcil.com ; Ph no. 0522-7111017 ; Fax no. 011-66173715

Production (unit : Lakh Tonnes)

	Apr'22	Mar'22	Feb'22	2021 - 22	2020 - 21
ALUMINIUM					
National Aluminium Co Ltd	0.38	0.39	0.37	4.60	4.18
Hindalco Industries Ltd	1.08	1.12	1.02	12.94	12.28
Bharat Aluminium Co. Ltd	0.47	0.49	0.45	5.80	5.68
Vedanta Ltd	1.42	1.47	1.33	16.78	13.72
TOTAL	**3.35**	**3.47**	**3.17**	**40.12**	**35.86**
ZINC (One major producer)					
Hindustan Zinc Ltd	**0.70**	**0.78**	**0.65**	**7.76**	**7.15**
COPPER (Cathode)					
Hindustan Copper Ltd	Nil	Nil	Nil	0.62	Nil
Hindalco (Birla Copper)	0.31	0.34	0.29	3.95	2.89
Vedanta Ltd.	0.126	0.134	0.11	1.37	1.118
TOTAL	**0.436**	**0.474**	**0.40**	**5.94**	**4.008**
LEAD					
Hindustan Zinc Ltd	**0.16**	**0.19**	**0.14**	**1.91**	**2.14**

Source : https://mines.gov.in/

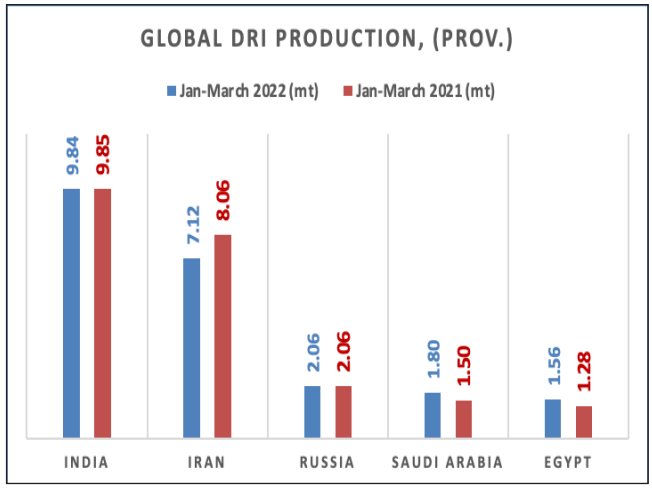
Prices in India (as on 16th April, 2022)
(Mumbai Local Price in Rs. / kg)

Product	Rs. / kg	Product	Rs. / kg
Copper Armature	776	Brass Shell 40mm	679
Copper cathod LME ++	836	Aluminium 6063 scrap	Not available
CC Rod LME ++	850	Aluminium scrap Taint/Tabor	do
Copper Cable scrap	804	Aluminium Cable scrap	do
Copper shell 40mm	826	Aluminium Ingot	271
Electrolytic Copper strip 25mm	826	Aluminium utensil scrap	195
ACR Copper Coil 3/8	886	Zinc Slab	382
Brass Sheet scrap	581	Lead Ingot	189
Brass Pales scrap	Not available	Tin Slab	3888
Brass Pallu scrap	do	Nickel Cathod	2603
Brass Honey scrap	520		

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

India leads global DRI production in 2022 so far

Provisional worldsteel report indicates that global DRI output stood at 25.95 Mt in January-March 2022, down 1.8% yoy. Such growth was driven by India (9.84 Mt, down 0.1%) at the number one spot and Iran, where production stood at 7.12 Mt, down 11.6%. The two countries together accounted for 65% of global DRI output during this period. Together, the top five countries accounted for 86% of the world DRI production during this period and saw their cumulative output go down by 1.6% yoy.



INDIAN STEEL MARKET ROUND-UP

The following is a status report on the performance of Indian steel industry during April-March 2021-22, based on provisional data released by Joint Plant Committee (JPC) in its MIS Report for April-March 2021-22. It is to be noted that total finished steel includes both non-alloy and alloy (including stainless steel) and all comparisons are made with regard to same period of last year.

Performance of Indian steel industry			
Item	**April-March 2021-22*(Mt)**	**April-March 2020-21 (Mt)**	**% change***
Crude Steel Production	120.007	103.545	15.9
Hot Metal Production	78.123	69.266	12.8
Pig Iron Production	5.759	4.877	18.1
Sponge Iron Production	39.031	34.376	13.5
Total Finished Steel (alloy/stainless + non-alloy)			
Production	113.596	96.204	18.1
Import	4.669	4.752	-1.7
Export	13.494	10.784	25.1
Consumption	105.751	94.891	11.4
Source: JPC; *provisional; Mt=million tonnes			

Overall Production

- **Crude Steel:** Production at 120.007 million tonnes (Mt), up by 15.9%.
- **Hot Metal:** Production at 78.123 Mt, up by 12.8%.
- **Pig Iron:** Production at 5.759 Mt, up by 18.1%.
- **Sponge Iron:** Production at 39.031 Mt, up by 13.5%, led by coal-based route (77% share).
- **Total Finished Steel:** Production at 113.596 Mt, up by 18.1%.

Contribution of Other Producers

- **Crude Steel :** SAIL, RINL, TSL Group, AM/NS, JSWL & JSPL together produced 74.452 Mt (62% share) during this period, up by 14.4%. The rest (45.556 Mt) came from the Other Producers, up by 18.4%.
- **Hot Metal :** SAIL, RINL, TSL Group, AM/NS, JSWL & JSPL together produced 70.101 Mt (90% share) up by 11.9%. The rest (8.022 Mt) came from the Other Producers, up by 20.7%.
- **Pig Iron :** SAIL, RINL, TSL Group, AM/NS, JSWL & JSPL together produced 1.462 Mt (25% share) up by 3.5%. The rest (4.296 Mt) came from the Other Producers, up by 24.0%.
- **Total Finished Steel :** SAIL, RINL, TSL Group, AM/NS, JSWL & JSPL together produced 65.065 Mt (57% share) up by 17.6%. The rest (48.531 Mt) came from the Other Producers, up by 18.7%.

Contribution of Public Sector Units (PSU)

- **Crude Steel :** With 81% share, the Private Sector (97.372 Mt, up by 15.9%) led crude steel production compared to the 19% contribution of the PSUs.
- **Hot Metal :** With 69% share, the Private Sector (53.615 Mt, up by 11.7%) led hot metal production, compared to the 31% contribution of the PSUs.
- **Pig Iron :** With 89% share, the Private Sector (5.124 Mt, up by 21.8%) led pig iron production, compared to the 11% contribution of the PSUs.
- **Total Finished Steel :** With 85% share, the Private Sector (96.017 Mt, up by 16.5%) led production of total finished steel, compared to the 15% contribution of the PSUs.

Contribution of Flat /Non-Flat in Finished Steel

- **Production :** Non-flat products accounted for 52% share (up by 21.0%), the rest 48% was the share of flats (up by 15.0%).
- **Import :** Flat products accounted for 92% share (up by 3.3%), the rest 8% was the share of non-flats (down by 38.2%).
- **Export :** Flat products accounted for 78% share (up by 12.6%), the rest 22% was the share of non-flats (up by 108.6%).
- **Consumption :** Led by Non-flat steel (54% share; up by 11.3%) while the rest 46% was the share of flat steel (up by 11.6%).

Finished Steel Production Trends

- At 113.596 Mt, production of total finished steel was up by 18.1% in April-March 2021-22.
- Contribution of the non-alloy steel segment stood at 106.615 Mt (94% share, up by 17.7%), while the rest was the contribution of the alloy steel segment (including stainless steel).
- In the non-alloy, non-flat segment, in volume terms, major contributor to production of total finished steel was Bars & Rods (45.809 Mt, up by 23.2%) while growth in the non-alloy, flat segment was led by HRC (46.803 Mt, up by 13.6%) during this period.

Finished Steel Export Trends

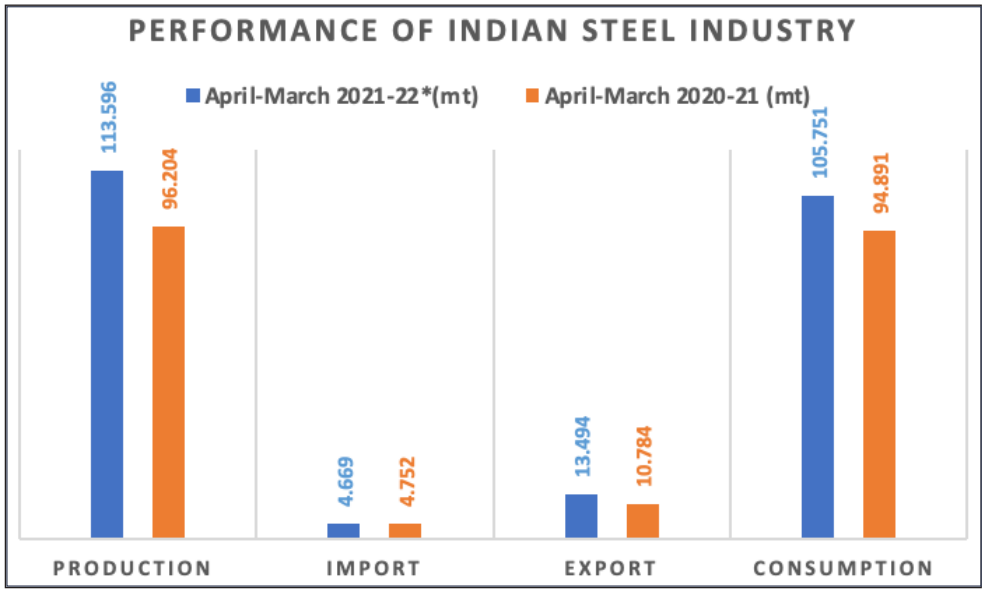
- Overall exports of total finished steel at 13.494 Mt, up by 25.1%.
- Volume wise, Non-alloy HR Coil/Strip (6.179 Mt, down by 7.0%) was the item most exported (50% share in total non-alloy).
- Vietnam (1.699 Mt) was the largest export market for India.

Finished Steel Import Trends

- Overall imports of total finished steel at 4.669 Mt, down by 1.7%.
- India was a net exporter of total finished steel in April-March 2021-22.
- Volume wise, Non-alloy HR Coil I Strip (0.811 Mt, down by 2.1 %) was the item most imported (28% share in total non-alloy).
- Korea (2.099 Mt) was the largest import market for India (43% share in total).

Finished Steel Consumption Trends

- At 105.751 Mt, consumption of total finished steel was up by 11.4% in April-March 2021-22.
- Contribution of the non-alloy steel segment stood at 98.176 Mt (93% share, up by 10.7%), while the rest was the contribution of the alloy steel segment (including stainless steel).
- In the non-alloy, non-flat segment, in volume terms, major contributor to consumption of total finished steel was Bars & Rods (44.595 Mt, up by 12.4%) while growth in the non-alloy, flat segment was led by HRC (40.445 Mt, up by 10.4%) during this period.



Source : http://jpcindiansteel.nic.in/

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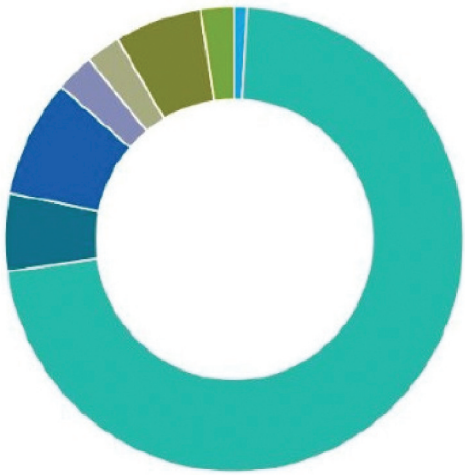
Crude Steel Production

Share in world total

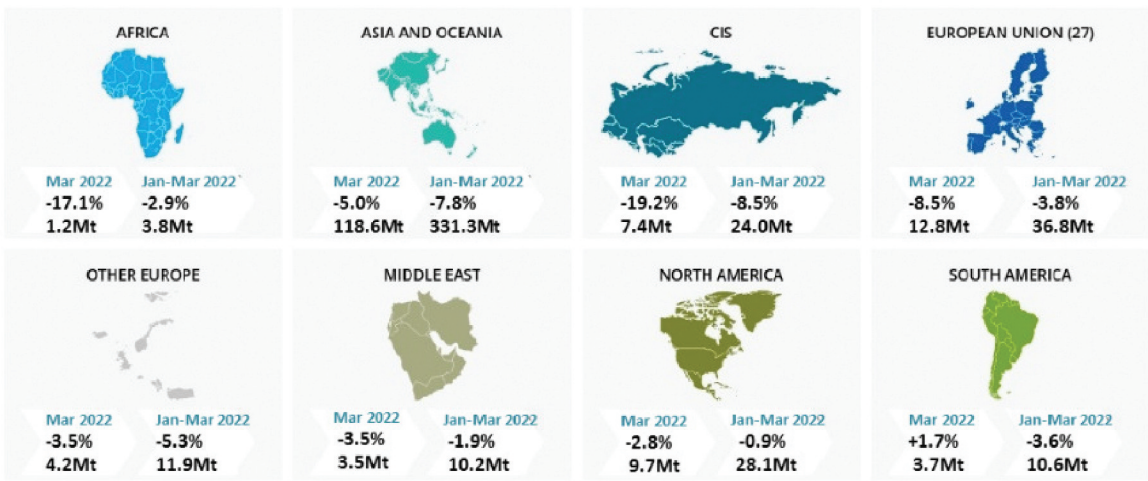


Mar 2022

- Africa, 1.2Mt (0.7%)
- Asia and Oceania, 118.6Mt (73.6%)
- CIS, 7.4Mt (4.6%)
- European Union (27), 12.8Mt (7.9%)
- Other Europe, 4.2Mt (2.6%)
- Middle East, 3.5Mt (2.2%)
- North America, 9.7Mt (6%)
- South America, 3.7Mt (2.3%)

WORLD

Mar 2022	Jan-Mar 2022
-5.8%	-6.8%
161.0Mt	456.6Mt



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

Source : World Steel Association