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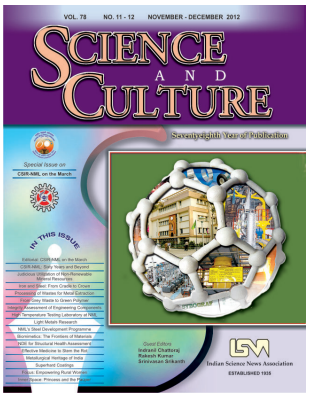
EDITORIAL

CSIR-NML ON THE MARCH



CSIR-National Metallurgical Laboratory (NML) has a glorious heritage of scientific industrial research and has significantly contributed to the growth of the metallurgical and mineral processing industries in India for over six decades. It has been a delight to team up with Prof. Suprakash C. Roy (Editor-in-Chief) and Shri Samarjit Kar (Editorial Advisor) and bring out this special issue of *Science and Culture* dedicated to CSIR-NML. This has provided us an opportunity to not only showcases our accomplishments of the past but also to provide a flavour of our current research programs and a glimpse of our vision and future direction.

The issue starts with a narration of the journey of CSIR-NML chronologically since its foundation in November, 1946. The evolution of the various research programs at NML through these times is a commentary on the, socio-economic and socio-political situation of the country and reflects the nations resource availability and development needs. This paper also provides a brief perspective of the research plans for the immediate future. NML was the cradle of mineral processing research in India and has nurtured this area since its inception. Today, there are several commercial plants that operate based on the flow-sheets developed at NML and these have been outlined in the paper on mineral processing. The emphasis on the processing of ore fines and overburden, beneficiation of lean grade ores and the processing of secondary resources is very relevant in today's context. Iron and steel making is one of the pillars of India's industrial economy. The paper on iron and steel making research at NML brings out NML's contributions in this area, especially the development of smelting technologies with low grade iron ores and coal, the direct reduction technology, energy efficient foundry technologies, steelmaking, ferroalloys and the development of a real time process simulator for the blast furnace. The emphasis on the use of low grade and fine iron ores and coal for iron making even during the 1950s when the availability of rich lumpy ore and coking coal was not a serious issue reflects a farsighted vision.

The coming up of Asia's largest creep laboratory in 1972 at NML with financial support from UNIDO was a landmark achievement and Tom Gibbons was one of the technical experts from UNIDO who was associated with the designing and commissioning of this creep lab.

Another visionary and pioneering initiative of NML since the early 1960s and that has sustained the vicissitudes of time has been the substitute steels development program. One of the papers chronicles this journey starting from the Ni-free stainless steel (Thackeron Steel), heat resistant steels, tool and die-steels, HSLA steels and more recently the silt erosion resistant steel in the context of achieving self reliance. The mammoth effort of compiling the corrosion map of India, the unravelling of the corrosion resistance of ancient Indian archeological masterpieces and the successes in the development of corrosion inhibitors for steels and their commercial exploitation have been elegantly projected.

Research on non-ferrous metals extraction especially the base metals and light metals and alloy development received importance in equal measure. Light metals research at NML initially concentrated on the development of technology for the extraction of Mg from a strategic viewpoint, development of Al-alloy conductors to replace copper and development of Al-Mg coinage alloys and their commercial translation. These as well as the more recent activities on light metals and alloys have been succinctly compiled.

This issue also contains some exciting original research results on rare-earth free permanent magnets, ratchetting fatigue in nuclear grade steels, the unusual mechanical behaviour of some bulk metallic glasses, introducing shape memory effect through magnetization in some materials and the design and development of a new molecule for lacquer by some of our young scientists.

The future of metal extraction lies in the processing of secondary resources and wastes. NML's activities on recycling and processing of secondary resources and wastes for the extraction of base, precious, energy critical elements, rare metals and rare earth metals have been outlined. There is no doubt that for the energy intensive and the less abundant elements such as the light metals, rare and precious metals and rare earth metals, the processing of secondary resources would be the main resource especially for countries that are deprived of natural resources. The paper on conversion of mineral and metallurgical wastes to value added products through the process of geo-polymerization describes a success story all the way from evolving a scientific concept to lab scale process development to establishment of pilot plant and ultimately the commercialization of the technology.

Failure analysis and structural integrity assessment have been NML's forte since the inception of the lab, and more so in the last three decades. The article on integrity assessment of engineering components captures the diversity of activities pursued by NML in this area reflected in the wide range of industries it caters to. The coming up of Asia's largest creep laboratory in 1972 at NML with financial support from UNIDO was a landmark achievement and Tom Gibbons was one of the technical experts from UNIDO who was associated with the designing and commissioning of this creep lab. He nostalgically recollects the careful and detailed planning that went into this exercise. The innovative feature of NML's structural integrity program has been the development of novel Non-Destructive Evaluation (NDE) techniques, sensors and devices based on magnetics and ultrasonics for quantification of damage of in-service components of power plants and petrochemical industries. A lucid account of these developments is summarized.

Sometime in the early 1990s, when advanced materials research overshadowed conventional metals and alloys research, NML also initiated several materials programs. Prominent amongst this was the birth of the biomaterials program at NML. The bio-materialists share their excitement and accomplishments in this area over the two decades.

Another area within the domain of materials science established at NML was the development of coatings. The concerned scientists share their fascinating experiences on the development of superhard coatings especially the carbides, carbonitrides and borides for various applications.

The canvas of contemporary research at NML covered utilization of contemporary techniques to unravel the secrets of the metallurgical heritage of India. A refreshing review on NML's contribution towards the preservation and rejuvenation of archeo-metallurgical structures provides insights into India's glorious past.

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Overall, this issue covers a spectrum of writings invoking the nostalgia of heritage, providing insights into the visionary choice of research areas, laying emphasis on the translation of science to technology and to commercialization, sharing the excitement of science and above all the thrust on keeping the nation's requirements uppermost in mind. ❐

Indranil Chattoraj
Rakesh Kumar
Srinivasan Srikanth
Guest Editors

Dr. Indranil Chattoraj graduated in Metallurgical Engineering and subsequently obtained a Ph.D in the area of hydrogen embitterment of steels. He has spent more than twenty years researching various niches of corrosion, surface engineering, component integrity and life prediction. He has participated in more than fifty projects in a variety of areas. He has numerous articles in peer-reviewed journals, a monograph on stress corrosion cracking and has authored a book chapter. He has received the Metallurgist of the Year Award in Metal Sciences from the Ministry of Steel and Mines in 2011. He is presently the Head of NML's Business Development and Monitoring Division.

Dr. Rakesh Kumar, Chief Scientist and Group Leader Nonferrous Process Engineering at CSIR-National Metallurgical Laboratory (NML), obtained his B.Sc (Eng) degree in Metallurgical Engineering from National Institute of Technology, Rourkela (India) and M.Tech and Ph.D degrees from Indian Institute of Technology (IIT), Kanpur (India). His research interests include hydrometallurgy, mechanochemistry, geopolymers and solid wastes minimisation and utilization. He has over thirty years of research experience. Dr. Kumar is recipient of Binani Gold Medal of Indian Institute of Metals and Metallurgist of the Year Award (2006) from Ministry of Steel and Mines.

Dr. Srinivasan Srikanth, Director, National Metallurgical Laboratory (NML), Jamshedpur (India), obtained his B.Sc (Eng) degree in Metallurgical Engineering from National Institute of Technology, Rourkela (India) and M.E. and Ph.D from Indian Institute of Sciences (IISc), Bangalore (India). His research interests include thermodynamics and kinetics of processes, extractive metallurgy, thermodynamics of non equilibrium phase transformations, mechanochemical activation of minerals, high temperature corrosion, failure analysis and solid oxide fuel cells. Dr. Srikanth is fellow of National Academy of Engineers (FNAE) and National Academy of Sciences in India (FNASc).

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