

Foreword

Stainless steels play a crucial role in every aspect of life. From its use in plant components in various industries to its use as surgical instruments, in kitchen as cutlery items to architecture to art, every one comes across stainless steels. The first stainless steel discovered was a ferritic stainless steel but today we use five categories of stainless steels – austenitic stainless steels, ferritic stainless steels, martensitic stainless steels, duplex stainless steels, and precipitation hardenable stainless steels. Austenitic stainless steel remains a workhorse of industry and the most popular and widely used category. However, specific applications require a combination of properties and many other grades of stainless steels are used for specific applications.

I am glad to note that the proceeding of **Stainless Steel Centenary Symposium (SSCS 2013)** is being published after a thorough peer review of all the submitted manuscripts. India has been producing stainless steel in the last five decades. Today we have a number of major producers of stainless steels and many medium and small producers. It is important for industry to put their contributions and efforts on record and this experience and strength of industry has found a sufficient space in this proceeding. The fabrication technology has also risen to challenges and requirements from the growing industry in India. As is evident from the papers in this proceeding, a number of companies in India today can fabricate components from stainless steel for any demanding industry. The advancement in melting and refining technology, welding technology and fabrication technology has kept pace with the demand for increased cleanliness and strict control over composition and properties of stainless steels, reduced residual stresses, defects and distortion of weldments, cleanliness required for fabrication of stainless steel components. At the same time, the researchers have advanced the frontiers of understanding in fields related to microstructure-property correlations, physical metallurgy, mechanical metallurgy and corrosion and its control. The experience with use of stainless steels is very important and provides a feedback to researchers, manufacturers and fabricators to address the problems being faced in the field. I am happy to see a number of papers in the proceeding covering the latest in all these topics. I would urge our colleagues from industry to keep sharing their experience from time to time by publishing in journals and highlighting their strength and capability to international readers.

I am sure this proceeding of **Stainless Steel Centenary Symposium (SSCS 2013)** would become a key referral point for various aspects of stainless steels.

Srikumar Banerjee, Chairman, Advisory Committee, SSCS 2013

From the editors

Stainless steels are around for last one century and have remarkably changed our lives. The discovery of stainless steel can be traced to the first two decades of twentieth century. Stainless steel or “rustless steel” as a corrosion resistant steel came into vogue in the second decade of twentieth century. The Germans, P. Monnartz and W. Borchers, established the correlation between chromium content and corrosion resistance in 1911. They showed that a minimum of 10.5 wt% chromium was required for significant improvement in resistance to corrosion. On August 13, 1913, Harry Brearley made a steel with 12.8% chromium and 0.24% carbon, possibly the first “stainless” steel as the correlation of corrosion and chromium content was already established in 1912. He demonstrated the corrosion resistance of the stainless steel by testing it with nitric acid, lemon juice and vinegar. For the record, there have been many metallurgists/scientists who claimed to have produced a steel that today can be called stainless steel. These include the hull of the Germania yacht in Germany in 1908 by the Krupp Iron Works, Elwood Haynes in America in 1911 and the ferritic stainless steels by Becket and Dantsizen during 1911-1914. Max Mauermann of Poland also claimed to have created the first stainless steel in 1912 that he presented to public in 1913 in Vienna.

As Harry Brearley’s discovery was followed by industrialization of stainless steels and came after establishment of the correlation between chromium content and corrosion resistance, August 13, 1913 is widely taken to be the date when stainless steels were discovered. The 100 years of discovery of stainless steels have been celebrated in many countries. At the completion of one century of discovery of stainless steels, it is appropriate to take stock of the latest trends in wide ranging fields that relate to stainless steels. This **Stainless Steel Centenary Symposium (SSCS 2013)** covers advances in all the major aspects related to stainless steels namely melting and refining, fabrication & forming, welding & joining, physical metallurgy, corrosion and its control and experience from use of stainless steels in various industries including newer varieties of stainless steels.

Selected papers from the **SSCS 2013** have been peer reviewed and included in the proceeding being published in Advanced Materials Research. It is hoped that this proceeding would become a good source of information about various aspects of stainless steels. The editors thank all the reviewers who reviewed manuscripts in a short period and thoroughly checked the revised versions also. The editors would like to thank all the authors who readily revised their manuscripts according to the suggestions from the reviewers and editors.

Vivekanand Kain
L. K. Singhal
K. P. Dwivedi
R. Easwaran
G. K. Dey
V. S. Raja
M. Kiran Kumar

SSCS 2013 Committees

Patrons: R. K. Sinha Baldev Raj P. Rama Rao T. Ramasami

National Advisory Committee

S. Banerjee	Chairman
Sekhar Basu	BARC
L. K. Singhal	JSL
A. K. Suri	BARC
S. B. Roy	BARC
V. S. Raja	IITB
H.M. Nerurkar	Tata Steel
R. N. Patra	IREL
Amit Ganguly	Consultant
G. Balachandran	Kalyani
G. K. Dey	BARC
N. C. Mathur	ISSDA
Sanjay Basu	Sandvik
K. C. Purohit	NPCIL
N. Saibaba	NFC
Prabhat Kumar	Bhavini
M. Narayana Rao	Midhani
P. V. Vasudeva Rao	IGCAR
A. M. Kulkarni	Mukand
M. V. Kotwal	L&T
Kaustubh Shukla	Godrej
R. Easwaran	WRI
Yatinder Suri	Outokumpu(I)
Vivekanand Kain	Convener

National Organizing Committee

G. K. Dey	BARC Chairman
K.P. Dwivedi	NPCIL
S. K. Verma	NPCIL
Rohit Kumar	ISSDA
A. B. Mukherjee	BARC
R. S. Soni	BARC
U. Kamachi Mudali	IGCAR
Sourav Sen	Sandvik
S. Bhattacharya	Viraj Steel
P. K. Singh	SAIL, Durgapur
A. Bandyopadhyay	SAIL, Salem
A. V. Parab	L&T
A. K. Tewari	ASM Intl India Section
Tushar Jhaveri	NACE Intl GIS
Suresh Chavan	Ind. Foundrymen Assoc.
Kamlesh Chandra	BARC, Treasurer
Vivekanand Kain	BARC, Convener

Reviewers

Anil Bhardwaj, ONGC	Abhishek Mukherjee, BARC	Kamlesh Chandra, BARC
P. Ahmedabadi, Univ. of Michigan	P. Saravanan, SAIL	P. Sengupta, BARC
P. Sivaprasad, Sandvik	Somnath Basu, IITB	Swati G. Acharya, BARC
S. M. Parida, IITB	Supratik Roychowdhury, PSI	

Symposium Sponsors:

Platinum sponsor:

BRNS, Department of Atomic Energy
Jindal Stainless Steel Limited

Gold sponsor:

Ratnamani Metals & Tubes Ltd.

Silver sponsors:

MIDHANI
SANDVIK
L & T
Vividh Hi-Fab Pvt. Ltd.
Godrej Precision Engineering

Other sponsors:

BHAVINI
AERB
Symec Engineers