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Editorial

Ironmaking and Steelmaking

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1. Introduction and Scope

Steel is a critical material in our society and will remain an important one for a long time into the future. In the last two decades, the world steel industry has gone through drastic changes and this is predicted to continue in the future. The Asian countries (e.g., China) have been dominant in the production of steel, creating global over-capacity, while the steel industry in the developed countries have made tremendous efforts to reinforce its global leadership in process technology and product development, and remain sustainable and competitive. The global steel industry is also facing various grand challenges in strict environmental regulation, new energy and materials sources, and ever-increasing customer requirements for high quality steel products, which has been addressed accordingly by the global iron and steel community.

This Special Issue, Ironmaking and Steelmaking, released by the Journal Metals is solely dedicated to articles from the international iron and steel community to cover the state-of-the-art in ironmaking and steelmaking processes. The Guest Editors will not go into each individual paper in detail, however they will briefly overview some interesting points in the special issue.

2. Contributions

This Special Issue published 33 high quality articles from 10 countries (according to the country of the corresponding author) with the number of contributions in brackets: China (22) [1–22], Japan (1) [23], Korea (1) [24], Canada (1) [25], Sweden (2) [26,27], Italy (1) [28], UK (1) [29], France (1) [30], Austria (1) [31], and Slovakia (2) [32,33]. This clearly reflects the enormous investment in R&D in China and the resultant outstanding outcomes to support its steel industry with ~50% of global steel production. On the other hand, it also demonstrates that the western countries are continuing to invest in R&D for sustainable steel manufacturing.

International collaboration is another feature reflected by the authorship of the published papers. A UK–Netherland–USA contribution (Slater et al. [29]) studied the solidification phenomena of a molten steel surface by using infrared thermography and a Sweden–Russia contribution (Sidorova et al. [27]) reported the modification of non-metallic inclusions in oil-pipeline steels by Ca-treatment. A paper co-authored by scientists from Sweden and Egypt (El-Tawil et al. [26]) investigated the thermal devolatilisation of different bio-coals for the purpose of reducing fossil CO_2 emission in the steel industry. Other international collaborations include France–Canada–Albania (Kanari et al. [30]), Slovakia–Czech Republic (Neslušan et al. [33]), China–Ukraine (Cao et al. [1]), and China–UK (Ge et al. [2]).

The international iron and steel community is conducting intensive research and development to reduce CO_2 emissions from steel manufacturing, which is clearly highlighted by the papers in this special issue. One paper from China (Song et al. [3]) compared the energy consumption and CO_2 emissions between integrated steel plant (ISP) with conventional blast furnace (ISP + BF), ISP with top gas recycling oxygen blast furnace (ISP + TGR–OBF), and ISP with COREX (ISP + COREX). They found that the ISP + TGR–OBF has the lowest net CO_2 emissions compared with the other two process routes.

Another excellent contribution from China (Dong and Wang [4]) analysed the utilisation of CO_2 gas in various steel manufacturing steps from sintering, through blast furnace, steelmaking, ladle furnace, continuous casting to the smelting process of stainless steel. The paper concluded that the quantity of CO_2 utilization is expected to be more than 100 kg per ton of steel. Further, 10 papers covered various aspects of gas-based or carbothermal reduction of various iron ores, in particular the iron ores that are difficult to be treated in conventional processes. The production of iron using hydrogen as a reducing agent is an alternative to the conventional ironmaking process with potential benefit of substantial decrease in CO_2 emissions. Naseri Seftejani and Schenk [31] analysed the thermodynamics of the hydrogen plasma smelting reduction of iron ore in the process of using hydrogen in a plasma state to reduce iron oxides. The other nine papers covered experimental studies (El-Tawil et al. [26], Fukushima, and Takizawa [23], Wu et al. [5], Zhou et al. [6], Zhang et al. [7]), modelling predictions (Gao et al. [8], Tang et al. [9]), and kinetic analysis (Wang et al. [10], Chen et al. [11]).

An outstanding paper from Canada (Kadrolkar and Dogan [25]) developed a model for refining rates in oxygen steelmaking, with a focus on the impact and slag-metal bulk zones. This is of particular interest to the control of oxygen steelmaking, which is producing over 70% of global crude steel.

Five papers investigated continuous casting process-related topics, covering aspects from solidification mechanism (Slater et al. [29]), low fluorine mould flux (Li et al. [12], Zeng et al. [13]), transient fluid flow in the mould (Zhang et al. [14]) and high Al steels (Cui et al. [15]).

An interesting contribution from Italy (Marcias et al. [28]) thoroughly analysed the occupational exposure to fine particles and ultrafine particles in a steelmaking foundry. This is a critical aspect of steel industry considering the environment of the steel manufacturing lines.

3. Conclusions and Outlook

The objective of this Special Issue is to provide a scientific platform for the recent progress in ironmaking and steelmaking and these 33 articles excellently highlight the diversity of the recent research and development in the field. The steel industry is facing significant challenges and opportunities as well, from strict environmental legislations to new energy and raw material sources and rapid development of data science, and it becomes obvious that there are still plenty of exciting topics and research outcomes to publish. It is hoped that the creation of this special issue as a scientific platform will help drive the iron and steel community to build a sustainable steel industry.

Conflicts of Interest: The authors declare no conflict of interest.

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