

Program

October 11th (Wednesday)

Room A

9:40 - 11:55 Plenary Lectures

Chair: Takaiku Yamamoto (Kyoto University)

9:40 - 10:25 [PL-1] Outline of COURSE 50 project

Toshihiro Bannai* (Director General, Environment Department of New Energy and Industrial Technology Development Organization)

Chair: Yukitaka Kato (Tokyo Institute of Technology Japan)

10:25 - 11:10 [PL-2] Paths to reduce CO₂ emissions in iron and steel making and by steel application in Germany and Europe

Hans Bodo Lüngen* (Steel Institute VDEh)

Chair: Fumitaka Tsukihashi (The University of Tokyo)

11:10 - 11:55 [PL-3] Review on Energy Saving and CO₂ Reduction of the Chinese Steel Industry since the 21st Century

Chunxia Zhang* (Central Iron & Steel Research Institute)

13:50 - 18:20 COURSE50

Chair: Koji Saito (Nippon Steel & Sumitomo Metal Corporation), Mutsumi Tanaka (Kobe Steel, LTD.)

13:50 - 14:20 [11A-KL1] CO₂ Ultimate Reduction in Steelmaking Process (COURSE50 Project)

Kyoichi Araki* (Nippon Steel & Sumitomo Metal Corporation)

14:20 - 14:40 [11A-1] Prediction of size degradation behavior of sinter at high hydrogen utilization of blast furnace

Yusuke Kashihara* (JFE Steel Corporation), Yuki Iwai, Takeshi Sato, Natsuo Ishiwata

14:40 - 15:00 [11A-2] Effect of surface characteristics of reduced iron on carbon deposition reaction by CO-H₂ gas mixture

Kazuto Nishihira* (Kyushu University), Ko-ichiro Ohno, Takayuki Maeda, Kazuya Kunitomo

15:20 - 15:40 [11A-3] Experimental Blast Furnace Operation

Yutaka Ujisawa* (Nippon Steel & Sumitomo Metal Corporation), Kazumoto Kakiuchi, Kohhei Sunahara, Yoshinori Matsukura, Kaoru Nakano, Hirokazu Yokoyama, Ryohta Sugitani

15:40 - 16:00 [11A-4] Development of mathematical model for COURSE50 blast furnace and brief analyses of the 1st trial operation

Koki Nishioka* (Nippon Steel & Sumitomo Metal Corporation), Hiroshi Sakai, Yukio Tomita, Yuki Yamashita

16:00 - 16:20 [11A-5] Opportunities for Reducing CO₂ emissions from Steel Industry

Jan van der Stel* (Tata Steel), Koen Meijer, Stanley Santos, Tim Peeters, Pieter Broersen

16:20 - 16:40 [11A-6] Development of cokemaking technology for hydrogen reduction iron making process

Takahiro Shishido* (Kobe Steel, Ltd.), Koji Sakai, Shohei Wada, Noriyuki Okuyama, Naoki Kikuchi

Chair: Yutaka Ujisawa (Nippon Steel & Sumitomo Metal Corporation), Yusuke Kashihara (JFE Steel Corporation)

17:00 - 17:20 [11A-7] Combined Coal Gasification and COG Reforming for Production of High Temperature Reductive Gas

Zhancheng Guo* (University of Science and Technology Beijing), Lei Guo

17:20 - 17:40 [11A-8] Hydrogen amplification technology development using coke oven gas (COG)

Kenji Nakao* (Nippon Steel & Sumitomo Metal Corporation), Mamoru Kasugai, Kimihito Suzuki, Nobuaki Ito, Hitoshi Donomae

17:40 - 18:00 [11A-9] Development of CO₂ capture and separation technology in COURSE50 project

Kazukuni Hase* (JFE Steel Corporation), Kyouichi Araki, Natsuo Ishiwata, Shigeaki Tonomura

18:00 - 18:20 [11A-10] Development of process for heat recovery from steelmaking slag

Yasutaka Ta* (JFE Steel Corporation), Nobuyuki Shigaki, Ikuhiro Sumi

Room B

13:50 - 18:00 Thermodynamics and Process Technology for Sustainable and Efficient Steel Refining and Recycling

Chair: Sun-Joong Kim (Chosun University), Shigeru Ueda (Tohoku University)

13:50 - 14:20 [11B-KL1] Perspectives of Global Optimization of EAF Steelmaking: from Process to Recycling

Joonho Lee* (Korea University), Sang Cheol Shim, Youn-Bae Kang, Dong-Joon Min, Chongku Yi, Seok Gyu Sohn

14:20 - 14:40 [11B-1] Interaction between tramp element and alloying elements in iron

Hideki Ono* (Osaka University), Hirokazu Konishi, Takaaki Maeda

14:40 - 15:00 [11B-2] Effect of SrO addition to the CaO-Al₂O₃-SiO₂ slag on desulfurization of plain carbon steel

Ahmadreza Amini* (Kyushu University), Takayuki Maeda, Ko-ichiro Ohno, Alireza Zakeri, Kazuya Kunitomo

Chair: Hideki Ono (Osaka University), Joonho Lee (Korea University)

15:20 - 15:40 [11B-3] Measurement of interaction parameters between Al and Cu, Al and Sn in molten high Al steel

Shigeru Ueda* (Tohoku University), Kengo Sugiyama, Xu Gao, Sun-Joong Kim, Shin-ya Kitamura

15:40 - 16:00 [11B-4] A study on the relationship between sulfide capacity and degree of polymerization in CaO-SiO₂-Al₂O₃-MgO slags

Sunghee Lee* (Yonsei university), Dong Joon Min

16:00 - 16:20 [11B-5] A Computational study to estimate the possibilities to improve utilisation of stainless steelmaking slags

Eetu-Pekka Heikkinen* (University of Oulu), Virpi Leinonen, Pekka Tanskanen, Timo Fabritius

Chair: Hiroyuki Matsuura (The University of Tokyo), Masanori Suzuki (Osaka University)

17:00 - 17:20 [11B-6] Enhanced combustion technology for BFG and COG recovery in steel reheating furnaces

Francesco Dentella* (Swiss Melting Technologies SA)

17:20 - 17:40 [11B-7] The prediction of ettringite formation from a blast furnace slag under wet alkaline environments

Aya Harashima* (Waseda University), Moeko Tennichi, Sara Arakawa, Kimihisa Ito

17:40 - 18:00 [11B-8] Comparison of Simulation models for efficient ladle refining process

Sun-Joong Kim* (Chosun University), Piotr R. Scheller, Shin-ya Kitamura

Room C

13:50 - 18:20 Thermal Energy Utilization

Chair: Takahiro Nomura (Hokkaido University)

13:50 - 14:20 [11C-KL1] Recent Advances in Thermochemical Energy Storage Technologies

Keiko Fujioka* (Functional Fluids Ltd.)

Chair: Yukitaka Kato (Tokyo Institute of Technology)

14:20 - 14:50 [11C-KL2] Heat transfer enhancement of thermal energy storage phase change material

Zhonghao Rao* (China University of Mining and Technology), Yutao Huo, Chenzhen Liu

Chair: Qi Zhang (Northeastern University), Koichi Nakaso (Okayama University)

15:20 - 15:40 [11C-1] Development of Latent Heat Storage System with High Heat Release Rate by Scraping Solidified Layer of PCM

Taichi Tsutsumi, Nobuhiro Maruoka, Akihisa Ito, Miho Hayasaka, Kensuke Yamamoto* (Tohoku University), Hiroshi Nogami

15:40 - 16:00 [11C-2] Combined Convection Heat Transfer of Microcapsule Slurry in a Horizontal Duct : Effects of Duct Height

Hyungsup Im* (Okayama University), Akihiko Horibe, Naoto Haruki, Yutaka Yamada, Shintaro Maeda

- 16:00 - 16:20 **[11C-3] Development of high thermal conductivity phase change materials to utilize exhaust heat from steelworks**
Takahiro Nomura* (Hokkaido University), Nan Sheng, Hiroki Sakai, Yuta Hasegawa, Tomohiro Akiyama
- 16:20 - 16:40 **[11C-4] Development of Iron-Based Heat Storage Materials Utilizing Solid Phase Transformation for Rapid Carbonization Process of Biomass**
Daisuke Maruoka* (Tohoku University), Hiroki Tsuneda, Taichi Murakami, Eiki Kasai
- Chair:* Armando Vazquez (Tenova Goodfellow Inc.), Hiroki Takasu (Tokyo Institute of Technology)
- 17:00 - 17:20 **[11C-5] Kinetic analysis of carbonation of lithium orthosilicate for thermochemical energy storage material**
Hiroki Takasu* (Tokyo Institute of Technology), Hitoshi Hoshino, Yoshiro Tamura, Yukitaka Kato
- 17:20 - 17:40 **[11C-6] Effect of the bridge formed between particles on heat transfer enhancement and gas permeability in the packed bed reactors**
Koichi Nakaso* (Okayama University), Kuniaki Gotoh
- 17:40 - 18:00 **[11C-7] Energy efficiency improvement and CO₂ emission reduction in China's iron and steel industry**
Qi Zhang* (Northeastern University), Jin Xu, Yujie Wang, Wei Zhang
- 18:00 - 18:20 **[11C-8] Improving Yield and Productivity While Reducing GHG Emissions and Operational Cost Using Off-gas Technology in EAF Steelmaking**
Armando Vazquez* (Tenova Goodfellow Inc.), Igor Todorovic

Room D

- 13:50 - 16:20 **Phosphorus Concentration and Recovery from Steel-making Slag**
Chair: Kazuyo Matsubae (Tohoku University), Takahiro Miki (Tohoku University)
- 13:50 - 14:20 **[11D-KL1] P innovation - Sustainable phosphorus value chain based on recycling -**
Hisao Ohtake* (Waseda University), Satoshi Tsuneda, Hirotsugu Fujitani
- 14:20 - 14:40 **[11D-1] Extraction of Phosphorus from Dephosphorization Slag**
Takaiku Yamamoto* (Kyoto University), Masashi Nakamoto
- 14:40 - 15:00 **[11D-2] A New Steelmaking Slag Recycling System for Iron and Phosphorus Separation (Fundamental Research)**
Yuji Miki* (JFE Steel Corporation), Kenji Nakase, Akitoshi Matsui, Naoki Kikuchi, Yu-Ichi Uchida
- 15:20 - 15:40 **[11D-3] Reduction of Steelmaking Slag using Closed type DC Arc Furnace**
Toshiya Harada* (Nippon Steel & Sumitomo Metal Corporation), Hiroshi Hirata, Takashi Arai, Tsuyoshi Yamazaki
- 15:40 - 16:00 **[11D-4] Hidden phosphorus flow caused by steelmaking activity**
Kazuyo Matsubae* (Tohoku University), Elizabeth Webeck, Eiji Yamasue, Takahiro Miki, Tetsuya Nagasaka
- 16:00 - 16:20 **[11D-5] Separation of phosphorus from synthetic steelmaking slag by selective leaching**
Xu Gao* (Tohoku University), Chuan-ming Du, Masanori Numata, Takayuki Iwama, Sun-joong Kim, Shigeru Ueda, Shin-ya Kitamura
- 17:00 - 18:00 **Behavior of Accompanied Element in Steel Cycle**
Chair: Eiji Yamasue (Ritsumeikan University), Alicia Sakurako Gauffin (KTH Royal Institute of Technology)
- 17:00 - 17:20 **[11D-6] Identification of end-of-life products causing tramp element contamination in carbon steel**
Satoshi Ohta* (The University of Tokyo), Ichiro Daigo, Yoshikazu Goto
- 17:20 - 17:40 **[11D-7] Estimation of possibility of steel scrap as secondary resource of Ni and Cr**
Kentaro Takeyama* (Tohoku University), Hajime Ohno, Kazuyo Matsubae, Kenichi Nakajima, Yasushi Kondo, Tetsuya Nagasaka
- 17:40 - 18:00 **[11D-8] Optimization of steel scrap use by focusing on alloying elements with IO-MFA based linear programming towards the development of sustainable steel cycle in our society**
Hajime Ohno* (Tohoku University), Kazuyo Matsubae, Kenichi Nakajima, Yasushi Kondo, Shinichiro Nakamura, Tetsuya Nagasaka

Reception Hall

11:55 - 13:50 **Poster Presentation**

Ironmaking Resources and Preparation Process

- [P-1] Effective Utilization of Dust and Sludge Formed in Ironmaking to Iron Ore Sintering Process**
Tsubasa Shima* (Tohoku University), Sanghan Son, Daisuke Maruoka, Taichi Murakami, Eiki Kasai
- [P-2] Effect of MgO Content on Metallurgical Properties and Microstructure of V-Ti Bearing Sinter**
Yao-zu Wang* (University of Science and Technology Beijing), Jian-liang Zhang, Zheng-jian Liu, Ya-peng Zhang, Dong-hui Liu, Cheng-bo Du
- [P-3] Effects of MgO on combustion reactivity of demineralized anthracite and its kinetic analysis**
Peng Wang* (University of Science and Technology Beijing), Jianliang Zhang, Guangwei Wang, Runsheng Xu, Zhengjian Liu
- [P-4] Preparation of high-strength carbon/carbon composites from tarry materials and low-grade cokes or pyrolyzed chars**
Jun Ma* (Hokkaido University), Yuuki Mochizuki, Naoto Tsubouchi, Kazuya Uebo
- [P-5] Reduction Mechanism of Carbon Cored Iron Ore Pellet with CO-CO₂ Gas**
Tsuyoshi Saito* (Tohoku University), Daisuke Maruoka, Taichi Murakami, Eiki Kasai

Blast Furnace Route for Future Ironmaking

- [P-6] Role of Carbon Dissolution Reaction in the Initial Contact Period of Carbon-unsaturated Fe-C Sample Wetting on Graphite Substrate**
Ko-Ichiro Ohno, Cao Son Nguyen, Takayuki Maeda* (Kyushu University), Kazuya Kunitomo
- [P-7] In situ observation of the Fe₂O₃ reduction by the materials which do not include C**
Nobuhiro Ishikawa* (National Institute for Materials Science), Tadashi Mitsui, Masaki Takeguchi, Kazutaka Mitsuishi
- [P-8] Experimental and Numerical Study on Gas-solid Flow Characteristics in Oxygen Blast Furnace**
Guang Wang, Jingsong Wang* (University of Science and Technology Beijing)
- [P-9] Recent Research Progress of Blast Furnace Cohesive Zone**
Hiroshi Nogami* (Tohoku University), Takahiro Miki, Shigeru Ueda
- [P-10] In situ X-ray diffraction evaluation of reducibilities of wustite and calcio-wustite in iron ore sinter**
Boyuan Cai* (Tokyo Institute of Technology), Takashi Watanabe, Masahiro Susa, Miyuki Hayashi

Thermodynamics and Process Technology for Sustainable and Efficient Steel Refining and Recycling

- [P-11] Determination of Zr activity coefficient in molten iron using gas / Fe-Zr alloy / ZrO₂-containing slag / ZrO₂ solid multi-phase equilibrium**
Masanori Suzuki* (Osaka University)
- [P-12] Dissolution of dicalcium silicate into molten CaO-FeO-SiO₂ slag**
Yoshinao Kobayashi* (Tokyo Institute of Technology), Takahide Sadamoto
- [P-13] Interaction between tramp element and alloying elements in iron**
Hideki Ono* (Osaka University), Hirokazu Konishi, Takaaki Maeda
- [P-14] Measurement of Interaction Parameters between Al and Cu, Al and Sn in Molten High Al Steel**
Shigeru Ueda* (Tohoku University), Kengo Sugiyama, Xu Gao, Sun-Joong Kim, Shin-ya Kitamura

COURSE50

- [P-15] Characteristics of lithium silicate prepared by rice husk ash and thermogravimetric analysis**
Haiyang Wang* (University of Science and Technology Beijing), Jianliang Zhang, Guangwei Wang
- [P-16] Utilizing Technique of Unused Exhaust Heat Generated from Steel Works (Overall Optimization)**
Ryota Murai* (JFE Steel Corporation), Naotaka Ogawa, Ikuhiro Sumi
- [P-17] Heat recovery from low-temperature off-gas using micro-channel heat exchanger**
Kazuaki Kobayashi* (Nippon Steel & Sumitomo Metal Corporation), Yuki Kuwauchi, Yuji Ogawa
- [P-18] Optimum Design of the Complex Injection Lance for COURSE50 Experimental Blast Furnace**
Akito Kasai* (Kobe Steel,Ltd), Kazuya Miyagawa, Kentaro Nozawa

Life Cycle Social Value and Environmental Impacts

[P-19] Data Envelopment Analysis for Steel Productions with The Use of Total Material Requirement for Mining Activities

Akira Oyaizu* (Ritsumeikan University), Ichiro Daigo, Cravioto Jordi, Eiji Yamasue

Behavior of Accompanied Element in Steel Cycle

[P-20] Identifying the factors of the difference of impurity element contents in steel between Japan and Netherlands

Shota Koketsu* (The University of Tokyo), Leo Fujimura, Benjamin Sprecher, Ichiro Daigo, Yoshikazu Goto

Creating Social Value Beyond Steel Industry

[P-21] Analysis of Total Material Requirement for automotive technological change

Kenyu Matsui* (Tohoku university), Akira Oyaizu, Eiji Yamasue, Kazuyo Matsubae, Tetsuya Nagasaka

[P-22] Framework for Expressing Social Value of Materials: Social Value of "TETSU"

Kenichi Nakajima* (National Institute for Environmental Studies, The University of Tokyo), Ichiro Daigo, Hiroki Hatayama, Eiji Yamasue, Kazuyo Matsubae, Yoshinao Kobayashi, Wataru Takayanagi

Thermal Energy Utilization

[P-23] Reactivity evaluation of Li-based mixed oxide with CO₂

Yuki Hanaoka* (Chiba University), Junichi Ryu

[P-24] Hydrogen Generation via Some Catalytic Reactions over Limonite Ore

Keisuke Abe* (Hokkaido University), Ade Kurniawan, Takahiro Nomura, Tomohiro Akiyama

Carbon and Material Recycling

[P-25] Development of Solid Oxide Electrolysis Cells for CO₂ reduction in an Active Carbon Recycling Energy System as applied to iron-making process

Yuichi Numata* (Tokyo Institute of Technology), Maria Caprisse Azucena Nepomuceno, Yukitaka Kato

[P-26] Intelligent Energy Saving Technology for Rolling Mill Lines

Tatsuya Tsukamoto* (Toshiba Mitsubishi-Electric Industrial systems Corporation), Hiroyuki Imanari

[P-27] New Technology for the Production of Ultra-Pure Calcium Carbonate and Sequestration of Recycled Carbon Dioxide from Steel Slag

Mike Wyrsta, Mark Tilley, Takashi Murayama* (Lixivia Inc.)

Gas Separation by PCPs/MOFs for the Steel Industry

[P-28] CO₂ gas separation using PCPs/MOFs with fluorinated anions

Shin-ichiro Noro* (Hokkaido University), Xin Zheng, Takayoshi Nakamura

[P-29] JST ACCEL Project for Gas Separation by PCPs/MOFs

Takaiku Yamamoto, Mari Inoue* (Japan Science and Technology Agency)

[P-30] A new synthesis process of Ethylene Glycol from Carbon mono-Oxide

Jianyu Chai* (Highchem Company Ltd.), Sun Li, Yoshio Taguchi

Phosphorus Concentration and Recovery from Steel-making Slag

[P-31] Separation of iron oxide and phosphorus oxide from steelmaking slag by capillary action

Takahiro Miki* (Tohoku University)

[P-32] Separation of phosphorus oxide from steelmaking slag by porous CaO absorber

Aoi Oashi* (Tohoku University), Takahiro Miki, Tetsuya Nagasaka

October 12th (Thursday)

Room A

9:00 - 9:45 Plenary Lectures

Chair: Eiki Kasai (Tohoku University)

9:00 - 9:45 [PL-4] Steel industry in Brazil – development, challenges and opportunities

Paulo Santos Assis* (Federal University of Ouro Preto/Materials, Metallurgy and Mining Brazilian Association)

9:55 - 12:35 Blast Furnace Route for Future Ironmaking

Chair: Hiroshi Nogami (Tohoku University)

9:55 - 10:25 [12A-KL1] Energy and mass balance evaluation of actions for efficiency improvement of blast furnace ironmaking process

Kazuya Kunitomo* (Kyushu University)

10:25 - 10:55 [12A-KL2] A New Direct Reduction Technology with Low Carbon Rate

Fengman Shen* (Northeastern University), Li Zhang, He Guo, Qiulin Wen, Haiyan Zheng, Qiangjian Gao, Xin Jiang

Chair: Kazuya Kunitomo (Kyushu University), Fengman Shen (Northeastern University)

11:15 - 11:35 [12A-1] Technical Development of Low Carbon and Greenization Blast Furnace Ironmaking

Zhang Fuming* (Shougang Group Co., Ltd.), Meng Xianglong, Hu Zurui

11:35 - 11:55 [12A-2] Recent Research & Development topics of Iron-making Technologies in NSSMC

Koji Saito* (Nippon Steel & Sumitomo Metal Corporation)

11:55 - 12:15 [12A-3] An approach to hydrogen reduction using the off-gas of iron-making process

Jonghwun Jung* (POSCO), Seungmoon Lee

12:15 - 12:35 [12A-4] Modelling of blast furnace process modification for lowering CO₂ emissions from integrated steel plant

Joel Orre* (Swerea MEFOS), Lena Sundqvist, Mats Bramming, Bo Sundelin, Per Lagerwall, Bo Bjorkman

13:35 - 14:20 Plenary Lectures

Chair: Hiroshi Nogami (Tohoku University)

13:35 - 14:20 [PL-5] FINEX® as a Solution to Steel Industry's Challenge

Sang-Ho Yi* (POSCO)

14:25 - 17:55 Ironmaking Resources and Preparation Process

Chair: Masaru Matsumura (Nippon Steel & Sumitomo Metal Corporation), Takayuki Maeda (Kyushu University)

14:25 - 14:55 [12A-KL3] Recent Studies on Preparation Process of Raw Materials for Iron Ore Sinter

Eiki Kasai* (Tohoku University)

14:55 - 15:15 [12A-5] Recent advances in utilisation of biomass materials in steel production

Liming Lu* (CSIRO Mineral Resources)

15:15 - 15:35 [12A-6] Effect on coke when using biomass as part of the blend

Maria Lundgren* (Swerea MEFOS AB), Lena Sundqvist Ökvist, Alexandra Hirsch, Janaina Brum, Ahmet Y. Gunbati, Katarina Pein, Anna Dahlstedt, Johanna Alatalo, Astrid Mata, Caisa Samuelsson, Bo Björkman

15:35 - 15:55 [12A-7] Optimization of Coal Briquettes for Lower Reactivity and Higher Strength under Melter-gasifier Conditions

Anrin Bhattacharyya* (Montanuniversitaet Leoben), Hado Heckmann, Johannes Schenk, Johann Wurm

Chair: Takahide Higuchi (JFE Steel Corporation), Liming Lu (CSIRO)

16:35 - 16:55 [12A-8] Glycerin-Ethanol Blending on Temperature Programmed Decomposition over Low-Grade Iron Ores

Ade Kurniawan* (Hokkaido University), Keisuke Abe, Koichi Ohashi, Takahiro Nomura, Tomohiro Akiyama

16:55 - 17:15 [12A-9] Development of gas analysis method for solid fuel combustion reaction

Yasuhiro Tobu* (Nippon Steel & Sumitomo Metal Corporation)

- 17:15 - 17:35 **[12A-10] Sustainable and environmentally friendly production of high grade iron ore pellet, for improved blast furnace operation**
Mikael Pettersson* (LKAB), Peter Sikström
- 17:35 - 17:55 **[12A-11] Efficient Bonding Agents Application with Intensified Granulation Technique**
Osamu Ishiyama* (Nippon Steel & Sumitomo Metal Corporation), Kenichi Higuchi, Tsutomu Okada, Seiji Nomura

Room B

10:05 - 18:15 Carbon and Material Recycling

Chair: Yukitaka Kato (Tokyo Institute of Technology)

- 10:05 - 10:35 **[12B-KL1] Development of Cogeneration High Temperature Gas-cooled Reactor for Decarbonization**
Kazuhiko Kunitomi* (Japan Atomic Energy Agency), Tetsuo Nishihara, Yukio Tachibana, Xing Yan, Taiju Shibata, Hirofumi Ohashi, Shinji Kubo, Hiroyuki Sato
- Chair:* Ichiro Yamanaka (Tokyo Institute of Technology), Ryosuke O. Suzuki (Hokkaido University)
- 10:35 - 10:55 **[12B-1] Development of low carbon emission and material saving ironmaking system, SMART**
Yukitaka Kato* (Tokyo Institute of Technology), Hiroshi Nogami
- 11:15 - 11:35 **[12B-2] Quantitative evaluation of SMART steelmaking system by sensitivity analysis of operating conditions on CO₂ emissions and exergy**
Shinnosuke Hisashige* (Waseda University), Junpei Katayama, Takao Nakagaki
- 11:35 - 11:55 **[12B-3] A mechanism model for accurately estimating carbon emissions on a micro scale of the steel industrial system**
Gang Zhao* (Wuhan University of Science and Technology/Hubei Key Laboratory of Mechanical Transmission and Manufacturing Engineering), Dan Ruan, Xing Gao
- 11:55 - 12:15 **[12B-4] Conversion of CO₂ to CO gas using molten CaCl₂ and ZrO₂ anode**
Ryosuke O. Suzuki* (Hokkaido University), Fumiya Matsuura, Shungo Natsui, Tatsuya Kikuchi
- Chair:* Dongfeng He (University of Science and Technology Beijing), Takao Nagasaki (Waseda University)
- 14:35 - 14:55 **[12B-5] Conversion of carbon dioxide and water to carbon monoxide and oxygen by electrolysis using Co-N-C electrocatalysts**
Ichiro Yamanaka* (Tokyo Institute of Technology), Tomomi Maezuru, Yuji Ogishima, Hitoshi Ogihara
- 14:55 - 15:15 **[12B-6] Melting behaviour observation of iron contacted with different kinds of carbonaceous materials under loading condition**
Ko-ichiro Ohno* (Kyushu university), Shinya Miura, Takayuki Maeda, Kazuya Kunitomo
- 15:15 - 15:35 **[12B-7] Leaching of copper in an ammonia solution containing ammonium chloride or sulfate**
Hirokazu Konishi* (Osaka University), Hideki Ono, Takashi Bitoh
- 15:35 - 15:55 **[12B-8] Leaching behavior of waste electric arc furnace (EAF) stainless steel slag by ammonium salts under microwave radiation**
Xiang Zhang* (Wuhan University of Science and Technology), Guojun Ma, Qinan Li, Zhi Li
- 15:55 - 16:15 **[12B-9] Preparation of Ti alloy from Ti-bearing blast furnace slag using carbon, Al₂O₃ and MgO saturated aluminothermic-reduction technology**
Yun Lei* (Kunming University of Science and Technology), Luen Sun, Kuixian Wei, Wenhui Ma
- Chair:* Guojun Ma (Wuhan University of Science and Technology), Yukitake Kato (Tokyo Institute of Technology)
- 16:35 - 16:55 **[12B-10] Molten slag property estimation using deep neural networks for advanced material recycling**
Corey Adam Myers* (Waseda University), Takao Nakagaki
- 16:55 - 17:15 **[12B-11] Effect of carbonaceous reductants on the energy consumption of the silicon furnace**
Wenhui Ma* (Kunming University of Science and Technology), Zhengjie Chen, Kuixian Wei
- 17:15 - 17:35 **[12B-12] Enrichment of CO from blast furnace gas by VPSA using adsorbent PU-1**
Tang Wei* (Peking University/Pioneer Technology Company), Geng Yunfeng, Lü Changzhong, Li Tengjiao, Zhang Jiaping, Xie Youchang
- 17:35 - 17:55 **[12B-13] Introduction of biomass lignin to blast furnace process as cement substitute in cold-bonded briquettes**
Antti Kemppainen* (University of Oulu), Elsayed Mousa, Chuan Wang, Hannu Suopajarvi, Mikko Iljana, Eetu-Pekka Heikkinen, Timo Fabritius
- 17:55 - 18:15 **[12B-14] Decomposition of Glycerol to High Calorific Gas Catalyzed by Iron Ore**
Hirokazu Eguchi* (Kyushu University), Tatsuya Kon, Hitoshi Saima, Ikuhiro Sumi, Yasuhiro Mogi

Room C

9:55 - 15:15 Life Cycle Social Value and Environmental Impacts

Chair: Ichiro Daigo (The University of Tokyo), Jean-Pierre Birat (IF Steelman)

- 9:55 - 10:25 **[12C-KL1] Thinking Life Cycle in a Circular Economy**
Louis George Brimacombe* (IOM3)
- 10:25 - 10:55 **[12C-KL2] Conditions of Material Recycling, and Material LCA reflecting Recycling**
Toru Ono* (Nippon Steel and Sumitomo Metal Corporation), Toshio Isohara
- 11:15 - 11:45 **[12C-KL3] The steel eco cycle - A Swedish initiative for closing the loop**
Alicia Sakurako Gauffin* (KTH Royal Institute of Technology)
- 11:45 - 12:15 **[12C-KL4] Musica Universalis, the Music of the spheres**
Jean-Pierre Birat* (If Steelman)
- 14:35 - 14:55 **[12C-1] Development of a new LCA framework for materials**
Ichiro Daigo* (The University of Tokyo), Kenichi Nakajima, Eiji Yamasue, Kazuyo Matsubae, Hiroki Hatayama, Yoshinao Kobayashi
- 14:55 - 15:15 **[12C-2] Assessment and Study on the Impact on Environment by Multi-crystalline Silicon Preparation by Metallurgical Route**
Kuixian Wei* (Kunming University of Science and Technology), Zhiqiang Yu, Wenhui Ma
- 15:25 - 17:55 **Creating Social Value Beyond Steel Industry**
- Chair:* Kenichi Nakajima (National Institute for Environmental Studies), Nicole Kinsman (International Molybdenum Association)
- 15:25 - 15:55 **[12C-KL5] Reducing water loss with corrugated stainless steel service pipe**
Nicole Kinsman* (International Molybdenum Association), Richard Matheson, Gary Coates, Shinji Esaki
- 15:55 - 16:15 **[12C-3] The total anticorrosive function performed by steel stock in use**
Ichiro Daigo, Yumi Aduma, Yoshikazu Goto* (The University of Tokyo)
- 16:35 - 16:55 **[12C-4] Industrial symbiosis of steel and cement production in Vietnam**
Jordi Cravioto* (Ritsumeikan University), Duc-Quang Nguyen, Tran-Duc Huy, Eiji Yamasue, Akira Oyaizu, Ichiro Daigo
- 16:55 - 17:15 **[12C-5] Nitrogen flow analysis focused on by-product ammonia from steel industry**
Kiwamu Katagiri* (Tohoku university), Kazuyo Matsubae, Tetsuya Nagasaka
- 17:15 - 17:35 **[12C-6] A new model to explore time-series changes in demand for material based on services**
Yosuke Kawamura* (The University of Tokyo), Ichiro Daigo, Yoshikazu Goto
- 17:35 - 17:55 **[12C-7] Development of a criticality assessment method for materials**
Masato Nakada* (The University of Tokyo), Ichiro Daigo, Yoshikazu Goto, Hiroki Hatayama

Room D

11:15 - 12:15 COURSE50

Chair: Yutaka Ujisawa (Nippon Steel & Sumitomo Metal Corporation), Yusuke Kashihara (JFE Steel Corporation)

- 11:15 - 11:35 **[12D-1] Development of CO₂ chemical absorption technology**
Yoichi Matsuzaki* (Nippon Steel & Sumitomo Metal Corporation), Firoz Alam Chowdhury, Kazuya Goto, Hidetaka Yamada, Shin Yamamoto, Takayuki Higashii, Masami Onoda
- 11:35 - 11:55 **[12D-2] Development of CO₂ physical adsorption technology**
Nobuyuki Shigaki* (JFE Steel Corporation), Yasuhiro Mogi, Takashi Haraoka, Ikuhiro Sumi
- 11:55 - 12:15 **[12D-3] Consideration of the scale-up of the entire COURSE50 system**
Shigeaki Tonomura* (Nippon Steel & Sumitomo Metal Corporation), Ryota Murai, Mutsumi Tanaka, Yukio Tomita, Shin Tomisaki

15:15 - 16:15 Thermodynamics and Process Technology for Sustainable and Efficient Steel Refining and Recycling

Chair: Noritaka Saito (Kyushu University), Gao Xu (Tohoku University)

- 15:15 - 15:35 **[12D-4] Dissolution of dicalcium silicate into molten CaO-FeO-SiO₂ slag**
Yoshinao Kobayashi* (Tokyo Institute of Technology), Takahide Sadamoto
- 15:35 - 15:55 **[12D-5] Compositions of liquid phases and activities of components in the CaO-SiO₂-P₂O₅-FeO heterogeneous slags coexisted with Ca₂SiO₄-Ca₃P₂O₈ solid solutions**
Masakatsu Hasegawa* (Kyoto University), Kohei Miwa, Ryota Matsugi
- 15:55 - 16:15 **[12D-6] Deoxidation equilibrium of molten Fe-Mn-Al alloy at steelmaking and casting temperature**
Hiroyuki Matsuura* (The University of Tokyo), Sho Higuchi

16:35 - 18:15 Blast Furnace Route for Future Ironmaking

Chair: Ko-ichiro Ohno (Kyushu University), Jonghwun Jung (POSCO)

- 16:35 - 16:55 **[12D-7] Experimental Blast Furnace Operation with Ore-Coke Mixed Layer**
Takuya Natsui* (Nippon Steel & Sumitomo Metal Corporation), Kaoru Nakano, Yoshinori Matsukura, Kohei Sunahara, Yutaka Ujisawa
- 16:55 - 17:15 **[12D-8] Effect of CH₄ injection to blast furnace tuyere on pulverized coal ignition**
Koichi Takahashi* (JFE Steel Corporation), Akinori Murao, Yusuke Kashihara, Nobuyuki Oyama, Hidetoshi Matsuno, Michitaka Sato
- 17:15 - 17:35 **[12D-9] Alternative auxiliary bio-based reducing agents for pulverized coal injection**
Hesham Ahmed* (Lulea University of technology), Martin Ölund, Lena Sundqvist Ökvist, Bo Björkman

Chair: Hiroshi Nogami (Tohoku University), Hesham Ahmed (Lulea University of technology)

- 17:35 - 17:55 **[12D-10] Effect of Reactivity of Carbonaceous Material in Iron Ore/Carbon Composite on the Reduction Rate in the Temperature Range of 800-1000°C**
Soon-Mo Shin, Min-Woo Choi* (Graduate Institute of Ferrous Technology), Sung-Mo Jung
- 17:55 - 18:15 **[12D-11] A direct numerical simulation of trickle flow in cokes bed**
Sungo Natsui* (Hokkaido University), Akinori Sawada, Tatsuya Kikuchi, Ryosuke O. Suzuki

October 13th (Friday)

Room A

9:00 - 9:45 Plenary Lectures

Chair: Takaiku Yamamoto (Kyoto University)

- 9:00 - 9:45 **[PL-6] Chemistry and Application of Porous Coordination Polymers/Metal-Organic Frameworks**
Susumu Kitagawa* (Kyoto University)

9:55 - 11:55 Gas Separation by PCPs/MOFs for the Steel Industry

Chair: Masaya Matsuoka (Osaka Prefecture University), Ryotaro Matsuda (Nagoya University)

- 9:55 - 10:15 **[13A-1] Cu(II) porous coordination polymers as adsorbents for CO/N₂ separation**
Shinpei Kusaka* (Kyoto University)
- 10:15 - 10:35 **[13A-2] Selective gas recognition and separation by porous coordination polymers**
Ryotaro Matsuda* (Nagoya University), Akihiro Hori, Yunsheng Ma
- 10:35 - 10:55 **[13A-3] CO₂ Capture using a Gate Type PCP/MOF**
Hiroshi Kajiro* (Nippon Steel & Sumitomo Metal Corporation)
- 11:15 - 11:35 **[13A-4] Fundamental Study of Transportation Phenomenon on CO₂ PSA System**
Ryo Matsuura* (Kyushu University/JFE Steel), Tatsuya Kon, Hitoshi Saima
- 11:35 - 11:55 **[13A-5] Shaped Porous Coordination Polymer Composites with Macroporous Solid Materials: Synthetic Approach and Application**
Yu Horiuchi* (Osaka Prefecture University), Dang Do Van, Makoto Katagiri, Masaya Matsuoka

Room B

9:55 - 12:15 Blast Furnace Route for Future Ironmaking

Chair: Koichi Takahashi (JFE Steel Corporation), Fuming Zhang (Shougang Group)

- 9:55 - 10:15 **[13B-1] Hot blast superheating – A scalable technology to reduce carbon consumption**
Ian Cameron* (Hatch Ltd.), Mitren Sukhram, Barry Hyde, John Busser, Alex Gorodetsky
- 10:15 - 10:35 **[13B-2] A Critical Review of the Oxygen Blast Furnace Process**
Wei Zhang* (Wuhan University of Science and Technology), Jing Dai, Jindong Zhou, Wei Wang, Zhengliang Xue
- 10:35 - 10:55 **[13B-3] Towards High Productivity in Full Oxygen Blast Furnace Based on Synergy Enhancement of Energy-Mass Transfer and Chemical Reaction**
Piao Li, Junkai He,
Zeyi Jiang* (University of Science and Technology Beijing/Beijing Engineering Research Center of Energy Saving and Environmental Protection),
Jingsong Wang, Xinxin Zhang

Chair: Takuya Natsui (Nippon Steel & Sumitomo Metal Corporation), Hiroshi Nogami (Tohoku University)

- 11:15 - 11:35 **[13B-4] Increasing the proportion of lump ores in blast furnace by improving the characteristics of primary-slugs**
Binbin Du* (University of Science and Technology Beijing), Shengli Wu, Laixin Wang, Kai Gu, Yanan Lu
- 11:35 - 11:55 **[13B-5] Reduction of carbon footprint of 'i' blast furnace by theimproving the process efficiency and reliability of energy-saving equipment**
Subhachandhar S* (Tata Steel Ltd), Dhiren Patnaik, P Jaya Krishna, Santosh Kumar Lal, Basant Kumar Singh, Vineet Ranjan Tripathi, Amit Kumar Singh
- 11:55 - 12:15 **[13B-6] Reduction of Material and Utilities Consumption by Optimization of the usage at 'I' Blast Furnace**
Vineet Ranjan Tripathi, Basant Kumar Singh* (Tata Steel Ltd), Rajkumar Vishwakarma, Narayana Chandra Sinha, Anil Singh, Satish Kumar, Ujjal Ghosh, Subhachandhar S

Room C

9:55 - 11:55 Ironmaking Resources and Preparation Process

Chair: Taichi Murakami (Tohoku University), Osamu Ishiyama (Nippon Steel & Sumitomo Metal Corporation)

9:55 - 10:15 [13C-1] New Granulation Process Aiming at Uniform Size Distribution for Utilizing Fine Iron Ores

Takahide Higuchi* (JFE Steel Corporation), Naoyuki Takeuchi, Yusuke Ishigaki, Tetsuya Yamamoto, Hidetoshi Matsuno, Nobuyuki Oyama

10:15 - 10:35 [13C-2] Evaluation of Dynamic Cohesive Properties of Iron Ore Powders

Takeyuki Fujisaka* (Nippon Steel & Sumitomo Metal Corporation), Hiroshi Mio, Kenichi Higuchi, Seiji Nomura

10:35 - 10:55 [13C-3] A study on the gas reduction behaviour of calcined limonite by H₂-Ar and H₂-CO mixtures

Sang Gyun Shin* (Yonsei University), Dong Joon Min

11:15 - 11:35 [13C-4] Reduction behaviors of iron ore pellets containing coal under different heating rates

Hao Hsun Chang* (University Rd), In-Gann Chen, Chi-Hao Wang, Ke-Miao Lu, Shih-Hsien Liu

11:35 - 11:55 [13C-5] A possible method for the controlling of carburization content of pig iron nugget: a new finding

Guang Wang* (University of Science and Technology Beijing), Jingsong Wang, Qingguo Xue

Room D

9:55 - 12:15 Thermodynamics and Process Technology for Sustainable and Efficient Steel Refining and Recycling

Chair: Masakatsu Hasegawa (Kyoto University), Dr. Masashi Nakamoto (Osaka University)

9:55 - 10:15 [13D-1] Dissolution rate of CO₂ controlled spherical quicklime into molten slag

Nobuhiro Maruoka* (Tohoku University), Akihisa Ito, Miho Hayasaka, Hiroshi Nogami

10:15 - 10:35 [13D-2] Rheological Behavior of Foaming Slag

Yusuke Harada, Noritaka Saito* (Kyushu University), Kunihiro Nakashima

10:35 - 10:55 [13D-3] Slag foaming behaviors in EAF process using DRI addition

Won Yeong Son, Youngjo Kang* (Dong-A University)

Chair: Yoshinao Kobayashi (Tokyo Institute of Technology), Youngjo Kang (Dong-A University)

11:15 - 11:35 [13D-4] Converter slag recycling by tuyere injection in high PC rate operation at Kobe No.3 blast furnace

Nayuta Mitsuoka* (Kobe Steel Ltd), Kota Tanaka, Tomonori Maeda, Hitoshi Toyota, Atsushi Sato, Tadasu Matsuo

11:35 - 11:55 [13D-5] Numerical simulation of flow characteristics of partially solidified steelmaking slag for the recovery of its sensible heat

Yuichi Tsurukawa* (Waseda University), Masahiro Tsuboi, Ito Kimihisa

11:55 - 12:15 [13D-6] Estimation of thermodynamic parameters in liquid iron

Masashi Nakamoto* (Osaka University), Toshihiro Tanaka