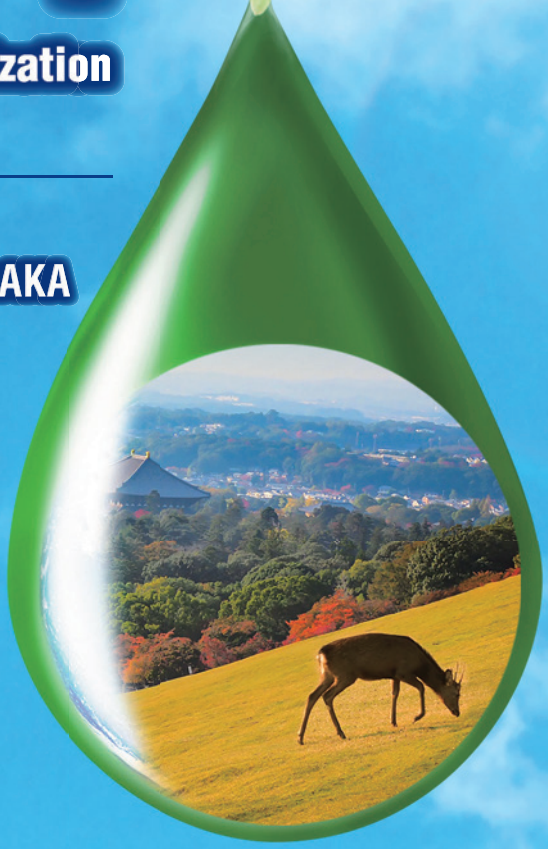
CUUTE-1

The First Symposium on Carbon Ultimate Utilization Technologies for the Global Environment

Date Tue 14 - Fri 17 December, 2021

Venue Nara Kasugano International Forum 甍 IRAKA

URL http://web.apollon.nta.co.jp/CUUTE-1/



Program & Extended Abstracts

Organized by :
The Iron and Steel Institute of Japan,ISIJ

Co Organized by :
The Society of Chemical Engineers, Japan

Sponserd by :
The Japan World Exposition 1970 Commemorative Fund

Contents

Welcome to CUUTE-1

On behalf of the symposium, I thank deeply all presenters and participants on the First Symposium on Carbon Ultimate Utilization Technologies for the Global Environment (CUUTE-1), Nara, Japan, on 14th -17th December, 2021.

The event has been postponed for one-year by the COVID matter, however, we can hold it finally by all contributors who kept their presentations for the postponed event and supported its preparation and organization, and the co-organizer and the sponsors.

The major themes of this new conference will be ultimate carbon utilization, and the establishment of carbon-neutral industry and society. Although the event was prolonged one-year, however, the importance of the CUUTE concept becomes larger more. Artificial carbon dioxide (CO_2) emissions become visibly a factor in global warming with frequent historical natural disasters in the last few years. Modern steel industry and other manufacturing sectors have achieved high energy savings and reduced CO_2 emissions. However, further activities are required to further reduce carbon emission according to the demands of the times.

The organizers hope that this conference will showcase innovation and technology, provide details of the latest industry solutions to carbon neutrality, and will establish a brilliant cute research community for CUUTE.

加藤之貴

Yukitaka Kato, Chair of CUUTE-1

Organizing Committee

Organizers

Organized by The Iron and Steel Institute of Japan, ISIJ
Co-Organized by The Society of Chemical Engineers, Japan
Sponserd by
- The Japan World Exposition 1970 Commemorative Fund
- Nara Visitors Bureau
- ISIJ Kansai Regional Office

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The Chemical Society of Japan
The Chinese Society for Metals (CSM), China
Czech Metallurgical Society, Czech Republic
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The Japan Research and development Center for Metals
Japan Society of Civil Engineers
The Japan Society of Mechanical Engineers (JSME)
Japanese Society of Steel Construction
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The Swedish Steel Producers Association (Jernkontoret), Sweden

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YAMAJI, Kenji (Research Institute of Innovative Technology for the Earth (RITE))
YI, Sang-Ho (POSCO)

Plenary Speakers

The role of CCUS for the pathways toward carbon neutrality

Dr. Keigo Akimoto

Research Institute of Innovative Technology for the Earth (RITE)

[Purpose of invitation] He serves as a member of the Strategic policy committee of Advisory committee for natural resources and energy, the Government of Japan. He has great contributions in research fields on the evaluations on global CO2 emission reduction, and energy systems. He is also involved in Japan's energy and climate policy making. He is also a Lead Author for the assessment report of Intergovernmental Panel on Climate Change (IPCC).

More GHG • Minimizing Carbon Emission and Some CCUS in China

Prof. Daqiang Cang

University of Science and Technology Beijing

[Purpose of invitation] As a professor having outstanding research in material researches and furnace designs, and hot-slag thermal energy recovery at iron and steel making processes in China. The current status of CO_2 emission reduction by CCUS in the Chinese steel industry will be reported.

Japan's Green Growth Strategy to Support 2050 Carbon Neutral Goal

Prof. Takeo Hoshino

The University of Tokyo

[Purpose of invitation] "Fomer Deputy director-General for enegy and natural resource policy of Minister of Economy, Trade and Industry (METI), Japan". From the perspective of sustainability, he has developed a method for quantitative analysis of resource efficiency and environmental load over the entire life cycle, including steel, from production to use, recycling and disposal after use, using objective evaluation indexes, and also researches the optimal solution for material utilization. Japan's green growth strategy will be reported.

Net Zero by 2050: A Roadmap for the Global Energy Sector

Dr. Peter Levi

International Energy Agency

[Purpose of invitation] Peter leads the analysis of the Industry sector with the Energy Technology Policy Division of the International Energy Agency. He was one of the authors of the IEA's Net Zero by 2050 Roadmap for the Global Energy Sector, and his presentation will provide an overview of the key findings, with a focus on the transition for the Industry sector.

Towards fossil-free steelmaking in Sweden and Finland

Dr. Martin Pei

SSAB AB

[Purpose of invitation] He is the CTO of SSAB AB, and the initiator of the HYBRIT research program in co-operation with LKAB and Vattenfall in Sweden. The HYBRIT pilot plant operated successfully at 1 ton/hr of HDRI since June 2021. He will give a lecture on the progress of HYBRIT and the planned transformation of iron ore based steelmaking in Sweden and Finland.

Carbon Neutral Goals and Strategies in Korea's Coal Based Steel Industry

Dr. Sang-Ho Yi

POSCO

[Purpose of invitation] Representative researcher of the POSCO, Republic of Korea. He has great achievements in energy saving, high efficiency and low carbonization of blast furnace processes. The prospects for carbon neutralization of the blast furnace process in Korea will be presented.

General Information

Conference Date
Tue 14 – Fri 17 December 2021

Conference Venue
Nara Kasugano International Forum 甍 IRAKA
101 Kasugano-cho, Nara 630-8212 JAPAN　+81-742-27-2630

Conference Program

Day	Morning	Afternoon
Tue 14 December, 2021		On-line Pre-test
Wed 15 December, 2021	Technical session (on-line)	Technical session (on-line)
Thur 16 December, 2021	Technical session (on-line)	Technical session (on-line)
Fri 17 December, 2021	Technical session (Hybrid) at Nara Kasugano International Forum	Technical session (Hybrid) at Nara Kasugano International Forum

On-line information

- Web meetings will be held via Cisco Webex Meetings System.
- Please log in the URL for on-line participation, which will be emailed to you in advance from the Secretariat, and then please click on the Session button you want to attend.
- Please prepare to use the latest version of Cisco Webex Meetings System.
- We kindly request all online attendees to change/set your display name to "Your name (Affiliation)".
- We also kindly request all online attendees to mute yourself, except when you ask questions or speak.
- When you want to ask questions or speak, you can use in-meeting chat or reactions in Webex.

Official Receipt
The official receipt for the registration fee will be issued by the organizing committee.
And we will send it to On-line participants together with the conference kit after the symposium, while we will hand it over to Actual participants at the registration desk on-site on 17 December.

Onsite information (Fri 17 December 2021)
Registration Desk 10:00－16:00
Registration desk will be set up at the lobby in front of the Noh Theatre in the Nara Kasugano International Forum.

Lunch 12:00－13:30
Lunch will be served in the Conference Room 1&2 on the first-floor.

Refreshment

Drinks and cookies will be available in the Conference Room 1&2 .

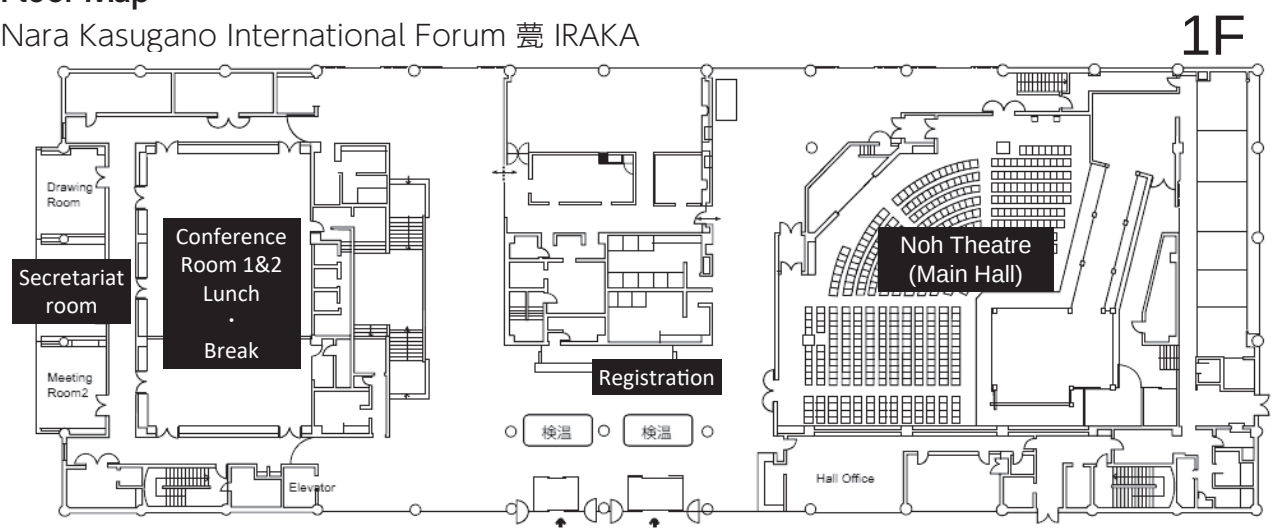
※No eating and drinking in the Noh Theatre (Main Hall)

Internet

We are pleased to offer you free wireless internet throughout the venue.

Floor Map

Nara Kasugano International Forum 甍 IRAKA



Guidelines for COVID-19 Prevention

We kindly request all onsite participants to follow the guidelines below:

- Please measure your body temperature before leaving your lodging. If your temperature is higher than 37.5 degree Celsius or if you do not feel well especially with cough and runny nose, you must refrain from coming to the venue.
  In this case, please participate via online. We also request all onsite attendees to measure your body temperature at the entrance of the venue.
- You are not allowed to enter the venue without wearing a mask. Inside the venue, please wear a mask at all times.
  Masks made of non-woven material are highly recommended.
- Please keep a distance about 2m from your person next to you. Even when seated, please keep enough space from others.
- Please wash your hands often and always keep your hands and fingers clean with sanitizers.
  Many sanitizers are prepared at the venue for your use.
- When taking your mask off during lunch, please keep quiet.
  Please wear a mask, when you enjoy a conversation with others.

Guideline for Plenary Lecturers

Rehearsal on Dec. 14

Please join the presentation rehearsal on the first day (Dec. 14) between 2 p.m. and 6 p.m. (Japan Time/GMT+9) as much as possible to test your camera, microphone, and screen sharing. Please use the system environment (PC and internet), which will be used in your presentation. The URL for entering the rehearsal room will be announced separately. If the rehearsal schedule is inconvenient for you, please let us know by email (cuute-1@nta.co.jp).

Presentation time

Plenary lecture: 40 minutes (30 minutes for presentation and 10 min for Q&A)

Preparation for presentation

- Any file format (for example, PowerPoint, Keynote, and PDF) is acceptable for your presentation. Horizontally long slides with aspect ratio of 16:9 are recommended.
- Please submit a pre-recorded presentation file in MP4 format to the organizing committee according to the procedure as previously advised. This file will be used by the session chair only when the presenter cannot have the presentation due to troubles in the communication system. Lecturers, who will have presentations at the venue in-person, do not need this submission.

Presentation

- Please enter the session room 20 minutes before the start of session. The URL for entering the session room will be announced separately.
- When you start the presentation, unmute your microphone, turn on your camera, and share the presentation slide.
- Please keep to the presentation time. The symposium staffs and chairperson will support your presentation.

General

- All sessions will be held via Cisco Webex Meeting system.
- The official language of this symposium is English.
- Online symposium presentations are considered to be “public transmission” (retransmission by automatic public transmission) under copyright law. Public transmission rights include the right to broadcast copyrighted works and the right to download, browse, and view on the internet.
- The copyright of the presentation material (content) in the online symposium presentation belongs to the presenter. Therefore, if the presentation material causes a problem of infringement of the rights or interests of a third party, the presenter will bear all responsibility.

Emergency contact:

E-mail: cuute-1@nta.co.jp, Tel: +81 90 6486 7960
(Contactable only during the period of symposium: Dec. 14 – 17)

Guideline for Keynote Lecturers and Oral Presenters

Rehearsal on Dec. 14

Please join the presentation rehearsal on the first day (Dec. 14) between 2 p.m. and 6 p.m. (Japan Time/GMT+9) as much as possible to test your camera, microphone, and screen sharing. The URL for entering the rehearsal room will be announced separately. Please use the system environment (PC and internet), which will be used in your presentation. If you are a keynote lecturer and inconvenienced by this rehearsal schedule, please let us know by email (cuute-1@nta.co.jp).

Presentation time

Keynote lecture: 30 minutes (20 minutes for presentation and 10 min for Q&A)
Oral presentation 20 minutes (10 minutes for presentation and 10 min for Q&A)

Preparation for presentation

- Any file format (for example, PowerPoint, Keynote, and PDF) is acceptable for your presentation. Horizontally long slides with aspect ratio of 16:9 are recommended.

Presentation

- Please enter the session room 20 minutes before the start of session. The URL for entering the session room will be announced separately.
- When you start the presentation, unmute your microphone, turn on your camera, and share the presentation slide.
- Please keep to the presentation time. The symposium staffs and chairperson will support your presentation.

General

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(Contactable only during the period of symposium: Dec. 14 – 17)

Guideline for Poster Presenters

Rehearsal on Dec. 14

Please join the presentation rehearsal on the first day (Dec. 14) between 2 p.m. and 6 p.m. (Japan Time/GMT+9) as much as possible to test your camera, microphone, and screen sharing. The URL for entering the rehearsal room will be announced separately. Please use the system environment (PC and internet), which will be used in your presentation.

One-minute flash presentation material by Dec. 7

- All poster presenters are requested to submit one-minute flash presentation file. Please upload the presentation file by Dec. 7, 2021 according to the following procedure:

1. Click the link below.

https://archive.iii.kyushu-u.ac.jp/public/GgmAQA5IkM_Ai2ABTmd80E794UhH26cGEVAOPbytdOVH

- Please prepare one-page Microsoft PowerPoint slide in the default widescreen (16 : 9) size (33.867 x 19.05 cm), record your presentation including voice (+ laser pointer, ink, and camera as options), and save in the pptx format. The presentation will be automatically screened during the first 30 minutes of the session (from 12 : 10 p.m. to 12:40 p.m.).

Poster presentation on Dec. 15

- PowerPoint or PDF file is acceptable for the poster presentation. One-page horizontally long slide with aspect ratio of 16 : 9 is recommended. Please design the poster so that you give a brief explanation in a short time, for example 3 min.
- The poster presentation will be given in a breakout room prepared for each presenter.
- Please enter the session room at the noon and start poster presentation at 12 : 40 p.m. The URL for entering the session room will be announced separately.
- Please share the presentation file, and turn on your microphone and camera before the presentation starts. The presenters are requested to stay their room during the session.

- Please have discussion with the guest in the order of entrance to your room or together with multiple people. You are allowed to show other materials for supporting your explanation and deeper discussion as appropriate.
- Your poster presentations will be evaluated by referees, and the selected presenters will be awarded in the symposium closing session on Dec. 17.

General

- All sessions will be held via Cisco Webex Meeting system. The official language of this symposium is English.
- Online symposium presentations are considered to be “public transmission” (retransmission by automatic public transmission) under copyright law. Public transmission rights include the right to broadcast copyrighted works and the right to download, browse, and view on the internet.
- The copyright of the presentation material (content) in the online symposium presentation belongs to the presenter. Therefore, if the presentation material causes a problem of infringement of the rights or interests of a third party, the presenter will bear all responsibility.

Emergency contact.

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(Contactable only during the period of symposium: Dec. 14 – 17)

Guideline for Chairpersons

In order to operate the session smoothly, chairpersons are requested to confirm the followings:

Presentation time

Plenary lecture: 40 minutes (30 minutes for presentation and 10 min for Q&A)
Keynote lecture: 30 minutes (20 minutes for presentation and 10 min for Q&A)
Oral presentation 20 minutes (10 minutes for presentation and 10 min for Q&A)

Before the session

- Please join the chairpersons' meeting on the first day (Dec. 14) between 1：30 p.m. and 2：00 p.m. as much as possible. The URL for entering the meeting room will be announced separately.
- Chairpersons are requested to enter the session room 15 minutes before the start of session.
- Please check the attendance of presenters of the session. They are requested to enter the session room 20 minutes before the start of session.

During the session

- In case a presenter does not appear by the time of his/her presentation, the chairperson shall announce its cancellation and that the next presentation will start on schedule.
- Please inform the audience of the following items when the session starts.
- Chairperson's name and affiliation.
- Either video or audio recording of the session, including taking photos, is prohibited.
- The time allotment for each presentation.
- People asking questions or making comments should introduce themselves before their questions or comments.
- Please introduce the name and organization of the speaker and the title of the paper before each presentation.
- The chairperson is expected to moderate discussions and manage time during the session.
- At the end of the session, the chairperson might be asked to make a few administrative announcements.

Please ask the symposium staffs if you have any questions.

Thank you for your cooperation.

Emergency contact:

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(Contactable only during the period of symposium: Dec. 14 – 17)

CUUTE-1 Programme at a Glance

Tue 14 December

Time	Rehearsal 【on-line】
13:30–14:00	Chairpersons' meeting
14:00–18:00	On-line pre-test

Wed 15 December — Technical session 【on-line】

Time	Room A	Room B	Room C
8:30–9:00	Opening Opening address Prof. Yukitaka Kato		
9:00–9:40	[P1] Plenary lecture Prof. Daqiang Cang		
9:40–10:00	[K1] Keynote lecture Mr. Toru Ono		
10:10–10:40	[K2] Keynote lecture Dr. Koichi Izumiya		
	Break		
10:50–12:10	[A1] Iron and steel making industry	[B1] CO_2 capture/ separation	[C1] Chemical industry
12:10–13:40	Lunch/Poster		
13:40–15:00	[A2] Iron and steel making industry	[B2] CO_2 capture/ separation	[C2] System modeling and analysis
	Break		
15:10–16:30	[A3] Iron and steel making industry	[B3] CO_2 capture/ separation	[C3] Megatrends in industrial sector, Generation and utilization of heat and power
	Break		
16:40–17:20	[P2] Plenary lecture Dr. Martin Pei		
17:20–17:50	[K3] Keynote lecture Prof. Henrik Saxen		

Thu 16 December — Technical session 【on-line】

Time	Room A	Room B	Room C
9:00–9:40	[P3] Plenary lecture Dr. Sang-Ho Yi		
9:40–10:10	[K4] Keynote lecture Mr. Todd Astoria		
	Break		
10:20–12:00	[A4] Iron and steel making industry	[B4] CO_2 capture/ separation	[C4] CO_2 conversion/ utilization/ sequestration
12:00–13:00	Lunch		
13:00–14:40	[A5] Iron and steel making industry	[B5] CO_2 conversion/ utilization/ sequestration	[C5] Hydrogen-based energy system

Fri 17 December — Technical session 【Hybrid】

Time	Nara Kasugano International Forum 甍 IRAKA
10:00–11:00	Registration at the IRAKA
11:00–11:20	Opening
11:20–12:00	[P4] Plenary lecture Prof. Takeo Hoshino
12:00–13:30	Lunch
13:30–14:10	[P5] Plenary lecture Dr. Keigo Akimoto
14:10–14:50	[P6] Plenary lecture Dr. Peter Levi
	Break
15:05–16:05	Panel discussion
16:05–16:40	Awards/Photo/ Closing

Congress Programme

Wed 15 December

RoomA (On-line)

8:30～8:40

Opening

8:40～9:00

Opening Address

9:00～9:40

Plenary lecture 1

Chairperson：Hiroshi Nogami (Tohoku University)

P1 More GHG・Minimizing Carbon Emission and Some CCUS in China

○Daqiang Cang
University of Science and Technology Beijing

9:40～10:10

Keynote lecture 1

Chairperson：Hiroshi Nogami (Tohoku University)

K1 Challenges towards carbon-free ironmaking

○Toru Ono
Nippon Steel Research Institute

10:10～10:40

Keynote lecture 2

Chairperson：Hiroshi Nogami (Tohoku University)

K2 Methane Producing Technology from CO_2 for Carbon Recycling

○Koichi Izumiya, Izumo Shimada
Hitachi Zosen Corporation

10:50～12:10

Session A1 **Iron and steel making industry**

Chairperson：Hiroshi Nogami (Tohoku University)

A1-1 Development of ferro-coke process through national projects

○Michitaka Sato[1], Takashi Anyashiki[1], Kaoru Nakano[2], Takahiro Shishido[3]
[1)] JFE Steel Corporation, [2)] Nippon Steel Corporation, [3)] Kobe Steel, LTD

A1-2 Development of CO_2 Reduction Technology from Blast Furnace

Kaoru Nakano[1], ○Hiroshi Sakai[1], Koki Nishioka[1], Yutaka Ujisawa[1], Kazumoto Kakiuchi[1], Kohei Sunahara[1], Yoshinori Matsukura[1], Hirokazu Yokoyama[1], Shin Tomisaki[2]

[1)]NIPPON STEEL CORPORATION, [2)]NIPPON STEEL ENGINEERING CORPORATION

A1-3 Development of Mathematical Blast Furnace Model for CO_2 Reduction Technology (COURSE50)

○Hiroshi Sakai[1], Kaoru Nakano[1], Yutaka Ujisawa[1], Koki Nishioka[1], Kazumoto Kakiuchi[2], Kohei Sunahara[1], Yoshinori Matsukura[1], Hirokazu Yokoyama[1], Shin Tomisaki[2]

[1)]NIPPON STEEL CORPORATION, [2)]NIPPON STEEL ENGINEERING CORPORATION

13:40～15:00

Session A2 Iron and steel making industry

Chairperson : Michitaka Sato (JFE Steel Corporation)

A2-1 Separate Granulating Efficiency for Sinter Strength and Reducibility Based on Promotion of Magnetite Ore Oxidation

○Masaru Matsumura, Toru Takayma, Kyosuke Hara, Yasuhide Yamaguchi, Osamu Ishiyama, Kenichi Higuchi, Seiji Nomura

NIppon Steel Corporation

A2-2 Effect of CaO Component on the Property of Sintered Pellets Prepared by the Composite Sintering Process

○Zhe Ma[1], Shuya Nakamura[1], Daisuke Maruoka[1], Taichi Murakami[1], Eiki Kasai[1], Takahide Higuchi[2]

[1)]Graduate School of Environment Studies, Tohoku University, [2)]JFE Steel Corporation

A2-3 How to select the property of reducing agent for low carbon operation of the blast furnace

○Shigeru Ueda[1], Xu Gao[1,2], Hui Kong[3], Takayuki Iwama[1]

[1)]Tohoku University, [2)]Central South University, [3)]Anhui University of Technology

A2-4 Effect of Mineral Component on Carburization and Melting Behavior of Carbon-Iron Ore Composite

○Ryota Higashi, Daisuke Maruoka, Taichi Murakami, Eiki Kasai

Graduate School of Environmental Studies, Tohoku University

Wed 15 December

15:10～16:30

Session A3 Iron and steel making industry

Chairperson : Shigeru Ueda (Tohoku University)

A3-1 Thermodynamic Analysis of the Slag-metal Reactions in Blast Furnace and Packed Bed Type Partial Smelting Reduction Process for Utilization of Steel Scraps

○Kengo Kato[1], Hideki Ono[2]

[1)]Graduate School of Engineering, Osaka University, [2)]Academic Assembly, Faculty of Sustainable Design, University of Toyama

A3-2 Application of Oxygen Blast Furnace Technology to CCU for CO_2 Reduction

○Koichi Takahashi, Taihei Nouchi, Yuki Kawashiri, Yuya Morita, Yusuke Kashihara

JFE Steel Corporation

A3-3 Low carbon emission steel making technology using hydrogen: COURSE50 project

○Yutaka Ujisawa[1], Seiji Nomura[1], Takashi Watanabe[2], Shin Sugiyama[1], Natsuo Ishiwata[2], Hideki Murakami[1]

[1)]Nippon Steel Corporation, [2)]JFE Steel Corporation

A3-4 Decarbonisation of carbon-intensive industries (Iron and Steel Industries) through Power to gas and Oxy-fuel combustion

○Manuel Bailera[1,2], Takao Nakagaki[2], Irmela Kofler[3], Luis M Romeo[1]

[1)]University of Zaragoza, [2)]Waseda University, [3)]K1-MET GmbH

16:40～17:20

Plenary lecture 2

Chairperson : Yukitaka Kato (Tokyo Institute of Technology)

P2 Towards fossil-free steelmaking in Sweden and Finland

○Martin Pei

SSAB AB

17:20～17:50

Keynote lecture 3

Chairperson : Shigeru Ueda (Tohoku University)

K3 Economic assessment of biochar injection in the blast furnace

○Henrik Saxen, Mikko Helle

Abo Akademi University

RoomB (On-line)

10:50～12:10

Session B1 CO_2 capture/separation

Chairperson : Hidetaka Yamada (Kanazawa University)

B1-1 Advanced KM CDR Process™ and New KS-21 Solvent™

○Takashi Kamijo, Tomoki Noborisato, Teruaki Morihiro
Mitsubishi Heavy Industries Engineering,LTD

B1-2 Heat recovery from low-temperature off-gas for use in CO_2 separation processes

○Kazuaki Kobayashi, Hiroyuki Kozuru, Masahiro Sekiya
Nippon Steel Corporation

B1-3 Tomakomai CCS Demonstration Project – Results and Lessons Learnedk

Yoshihiro Sawada, ○Jiro Tanaka, Daiji Tanase, Takashi Sasaki, Chiyoko Suzuki
Japan CCS Co., Ltd.

B1-4 Design and Economic Analysis of Direct Air Capture of CO_2 by Temperature Vacuum Swing Adsorption using Metal Organic Frameworks

Anshuman Sinha[1], Lalit Darunte[1], Christopher Jones[1], Youn Ji Min[1],
○Yoshiaki Kawajiri[1,2], Matthew Realff[1]
[1)]School of Chemical & Biomolecular Engineering, Georgia Institute of Technology, USA,
[2)]Department of Materials Process Engineering, Nagoya University, Japan

13:40～15:00

Session B2 CO_2 capture/separation

Chairperson : Takao Nakagaki (Waseda University)

B2-1 Development of CO_2 Capture Technology with Solid Sorbent Utilizing Low-Temperature Steam

○Shohei Nishibe[1], Katsuhiro Yoshizawa[1], Takeshi Okumura[1], Ryohei Numaguchi[1],
Kazuo Tanaka[1], Hidetaka Yamada[2], Tomohiro Kinosita[2], Takayasu Kiyokawa[2],
Shin Yamamoto[2], Katsunori Yogo[2]
[1)]Kawasaki Heavy Industries, Ltd., [2)]Research Institute of Innovative Technology for the Earth

B2-2 Development of molecular gate membrane modules for pre-combustion CO_2 capture

○Teruhiko Kai, Shuhong Duan, Fuminori Ito, Kenjiro Ishiguro, Koji Baba,
Keisuke Sugita, Shin-Ichi Nakao
Molecular Gate Membrane module Technology Research Association (MGMTRA)

B2-3 Progress of Osaki CoolGen Oxygen-blown IGCC with CO_2 Capture Demonstration

○Yugo Ishizaki
OSAKI CoolGen Corporation

B2-4 Development of the High-efficiency Oxy-fuel IGCC System

○Yuso Oki[1], Kazuhiro Kidoguchi[1], Hiroki Umetsu[1], Yoshinobu Nakao[1]
[1)]CRIEPI, [2)]CRIEPI, [3)]CRIEPI, [4)]CRIEPI

15:10～16:30

Session B3 CO_2 capture/separation

Chairperson：Corey Myers (Waseda University)

B3-1 Development and Evaluation of New Amine Solvent using Mikawa PCC Pilot Plant

○Koshito Fujita, Shinji Murai, Daigo Muraoka, Yasuhiro Kato, Hayato Morigaki
Toshiba Energy Systems & Solutions Corporation

B3-2 Carbon capture initiatives at Air Liquide: From industrial recovery to utilization

○Marvin Benzaqui, Juan Paulo Wiff, Laurent Prost
Air Liquide Laboratories

B3-3 Molten ionic oxides for new class of high temperature looping CO_2 capture

○Takuya Harada[1], Cameron Halliday[2], T. Alan Hatton[2]
[1)]Department of Chemical Science and Engineering, Tokyo Institute of Technology, [2)]Department of Chemical Engineering, Massachusetts Institute of Technology

RoomC (On-line)

10:50～12:10

Session C1 Chemical industry

Chairperson：Yukitaka Kato (Tokyo Institute of Technology)

C1-1 New Catalytic Reactions for CO_2 Hydrogenation

Noritatsu Tsubaki[1], ○Guohui Yang[1], Kimihito Suzuki[2], Kenji Nakao[2], Yuzuru Kato[3], Kentaroh Morita[3]
[1)]Univ. of Toyama, [2)]Nippon Steel Co., [3)]Nippon Steel Engineering Co.

C1-2 Fluidized bed gasification of empty fruits bunches with clay mineral bed materials

○Reiji Noda, Sun Yan, Purima Zuldian
Gunma Univ.

C1-3 Direct Transformation of CO_2 and Diols to Polycarbonate Diols by Cerium Oxide Catalyst

○Masazumi Tamura[1], Yu Gu[1], Kenji Nakao[2], Kimihito Suzuki[2], Kentaro Morita[3], Yuzuru Kato[3], Yoshinao Nakagawa[1], Keiichi Tomishige[1]
[1)]Tohoku University, [2)]Nippon Steel Corporation, [3)]Nippon Steel Engineering Co., Ltd.

C1-4 Dimethyl carbonate synthesis from CO_2 and methanol combined with the hydration of 2-cyanopyridine using CeO_2 catalyst

○Keiichi Tomishige[1], Masazumi Tamura[1], Yoshinao Nakagawa[1], Kimihito Suzuki[2], Kenji Nakao[2], Yuzuru Kato[3], Kentaro Morita[3], Hidefumi Harada[4], Yousuke Shinkai[4]

[1)]Tohoku University, [2)]Nippon Steel Corporation, [3)]Nippon Steel Engineering Co., Ltd., [4)]Mitsubishi Gas Chemical Co. Inc.

13:40～15:00

Session C2 System modeling and analysis

Chairperson : Nobuhiro Maruoka (Tohoku University)

C2-1 Exergy-based analysis of different carbon capture and utilization technologies

○Ichiro Daigo[1], Jun Yanai[2], Junxi Liu[3], Takeo Hoshino[3]

[1)]Research Center for Advanced Science and Technology, The University of Tokyo, [2)]School of Engineering, The University of Tokyo, [3)]Graduate School of Engineering, The University of Tokyo

C2-2 Impact of hydrogen ironmaking on reactive nitrogen emission

○Kiwamu Katagiri, Kazuyo Matsubae

Tohoku University

C2-3 Methodology of Exergy-based Life Cycle Sustainability Assessment for Next Generation Vehicles

○Keisuke Onishi[1], Ichiro Daigo[2], Takeo Hoshino[1]

[1)]Department of Materials Engineering, The University of Tokyo, [2)]Research Center for Advanced Science and Technology, The University of Tokyo

C2-4 Effect of electricity mix for total material requirement of hydrogen steelmaking process

○Shunsuke Kashiwakura[1], Shoki Kosai[1], Kenichi Nakajima[2], Eiji Yamasue[1]

[1)]Ritsumeikan University, [2)]National Institute for Environmental Studies

15:10～16:30

Session C3 Megatrends in industrial sector, Generation and utilization of heat and power

Chairperson : Takahiro Nomura (Hokkaido University)

C3-1 Long-term experiment of hot spring heat recovery using a rotary heat exchanger by controlling precipitation

○Nobuhiro Maruoka[1], Takuya Yamamoto[1], Satoshi Endo[2], Tadanobu Aizawa[2], Toshimitsu Ono[2], Hiroshi Sasaki[3], Keisuke Ura[4], Nobuhiro Ito[4], Katsuhiro Oyama[5], Keiichiro Maeda[5]

[1)]Tohoku University, [2)]Mabuchi engineering Co., Ltd, [3)]Nagasaki University, [4)]Industrial Technology Institute, Miyagi Prefectural Government, [5)]Japan Sustainable Free Powered Energy System Exploit & Promotion Association (JASFA)

C3-2 Development of composite materials using calcium hydroxide and silicon-silicon carbide ceramic supports for high-temperature thermochemical energy storage

○Shigehiko Funayama[1], Takahiro Furuya[2], Hiroki Takasu[1], Yukitaka Kato[1]

[1)]Laboratory for Zero-Carbon Energy, Institute of Innovative Research, Tokyo Institute of Technology, [2)]Graduate Major in Nuclear Engineering, Department of Transdisciplinary Science and Engineering, Tokyo Institute of Technology

C3-3 Formation Behavior of Surface Layer on Iron-Base Heat Storage Materials by Aluminizing

○Daisuke Maruoka[1], Kosuke Sato[2], Shun Miura[3], Taichi Murakami[1], Eiki Kasai[1]

[1)]Graduate School of Environmental Studies, Tohoku University, [2)]Mitsui Mining & Smelting Co., Ltd., [3)]Kobe Steel Ltd.

C3-4 The Challenges of the Steel Industry - Leaving Carbon behind

○Alexander Fleischanderl

Primetals Technologies Austria GmbH

On-line

12:10～13:40

Poster Session

PS-1 Equilibrium between titanium and oxygen in Fe-Ti molten alloy containing high concentration Ti at 1873K

○Yong Woo Kim[1], Sun-Joong Kim[2]

[1)]Dept. of Advanced Materials Engineering, Master, Chosun University, Gwangju, 61452, KOREA, [2)]Dept. of Materials Science & Engineering, Professor, Chosun University, Gwangju, 61452, KOREA

PS-2 Development of CO_2 conversion process using coke oven

○Kenji Nakao, Hiraku Sato, Noriyuki Yamane, Kimihito Suzuki, Masayuki Nishifuji

Advanced Technology Research Laboratories, Nippon Steel Corporation

PS-3 Electrolysis performance of a metal-supported solid oxide electrolysis cell for low-carbon iron making process

○Sho Kuzukami[1], Yuko Maruyama[1], Shuzo Tominaga[1], Hiroki Takasu[2], Yukitaka Kato[1]

[1)]Graduate Major in Nuclear Engineering, Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, [2)]Laboratory for Zero-Carbon Energy, Institute of Innovative Research, Tokyo Institute of Technology

PS-4 Extraction of phosphorus from steelmaking slag using carbon dioxide

○Takeshi Toyama[1], Ayaka Inagaki[1], Nobuhiro Maruoka[2]

[1)]College of Science and Technology, Nihon University, [2)]Institute of Multidisciplinary Research for Advanced Materials, Tohoku University

PS-5 Grinding-based enhancement of CO_2 mineralization rate and extent using steel slag

○Jun Sasagawa, Takao Nakagaki, Corey Myers
Waseda University

PS-6 High-Thermal-Conductivity, High-Durability Phase-Change Composite enhanced by a new type of Carbon fibre sheet matrix

○Kaixin Dong[1], Deqiu Zou[2], Cheng Wang[3], Kenji Shimono[4], Takahiro Nomura[5]
[1)]Graduate School of Engineering, Hokkaido University, Kita 13 Nishi 8, Kita-ku, Sapporo, Hokkaido, 060-8628, Japan, [2)]Faculty of Maritime and Transportation, Ningbo University, Ningbo 315211, Zhejiang, China, [3)]Jiangsu Provincial Key Laboratory of Oil & Gas Storage and Transportation Technology, Changzhou University, Changzhou 213016, Jiangsu, China, [4)]Azumi Filter Paper CO., LTD., 4-2-15, Komatsu, HigashiYodogawa-ku, Osaka 533-0004, Japan, [5)]Faculty of Engineering, Hokkaido University, Kita 13 Nishi 8, Kita-ku, Sapporo 060-8628, Japan

PS-7 Evaluation of chemical heat pump performance of magnesium chloride and ammonia system

○Saki Yoshida[1], Junko Kaneko[1], Hiroki Takasu[2], Yukitaka Kato[2]
[1)]Graduate Major in Nuclear Engineering, Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, [2)]Laboratory for Zero-Carbon Energy, Institute of Innovative Research, Tokyo Institute of Technology

PS-8 Effect of nozzle position and separation angle on perfect mixing time during bottom gas injection using water model.

○Mi-Ran Na[1], Sun-Joong Kim[2]
[1)]Department of Advanced Materials Engineering, Chosun University, Gwangju, Republic Korea (South Korea), [2)]Department of Materials Science & Engineering, Chosun University, Gwangju, Republic Korea (South Korea)

PS-9 Influence of sintering time and slag basicity on calcium-ferrite formation in sintered ore and changes in temperature

○Geun Yong Ryu[1], Sun-Joong Kim[2], Ki-Woo Lee[3], Ju-Hee Choi[4]
[1)]Department of Advanced Materials Engineering, Chosun University, Gwangju, Republic Korea (South Korea), [2)]Department of Materials Science & Engineering, Chosun University, Gwangju, Republic Korea (South Korea), [3)]Ironmaking Technology Development Team, Hyundai steel, Dangjin, Republic Korea (South Korea)

PS-10 Development of the technology for producing Ferro-coke: Influence of solid content in the new binder

○Shohei Wada, Takahiro Shishido, Ryuichi Kobori, Koji Sakai, Noriyuki Okuyama
KOBE STEEL

PS-11 Utilization of waste hot water from hot-spring towards low carbon cultivation of tropical crops in greenhouse: The case of cacao in snowy region

○Takayuki Takehi, Hajime Ohno, Yuta Nakayasu
Tohoku University

Thu 16 December

RoomA (On-line)

9:00～9:40

Plenary lecture 3

Chairperson : Shigeru Ueda (Tohoku University)

P3 Carbon Neutral Goals and Strategies in Korea's Coal Based Steel Industry

○Sang-Ho Yi
POSCO

9:40～10:10

Keynote lecture 4

Chairperson : Takao Nakagaki (Waseda University)

K4 MIDREX® Process: Bridge to Ultra-low CO_2 Ironmaking

○Todd Astoria
Midrex Technologies, Inc.

10:20～12:00

Session A4 Iron and steel making industry

Chairperson : Yutaka Ujisawa (Nippon Steel Corporation)

A4-1 Evaluation of CO_2 mitigation in oxygen blast furnace steelworks

○Ryoma Kataoka[1], Kento Nakamura[1], Takao Nakagaki[1], Koichi Takahashi[2], Koichi Tsutsumi[2]
[1)]Waseda University, [2)]JFE Steel

A4-2 Thermodynamic Analysis on Minimum Carbon Usage in Ironmaking Process

○Hiroshi Nogami
Tohoku University

A4-3 Towards low-carbon ironmaking process: exergy analysis and CO_2 emission evaluation on the proposed utilization of ethanol as reducing agents

○Ade Kurniawan, Takahiro Nomura
Hokkaido University, Faculty of Engineering, Center for Advanced Research of Energy and Materials

A4-4 Reduction of CO_2 Emission through a Dry Quenching Method of Steelmaking Slags: Rotary Cylinder Atomizing of Molten Slag

○Yoshiaki Kashiwaya[1], Yutaro In-Nami[1], Takahiro Nomura[3], Tomohiro Akiyama[3]
[1)]Kyoto University, Graduate School of Energy Science, [2)]Student of Hokkaido University, [3)]Hokkaido University

A4-5 Study on composite material in thermochemical energy storage system for iron and steel making industry

○Rui Guo[1], Shigehiko Funayama[1], Hiroki Takasu[2], Yukitaka Kato[2]

[1)]Graduate major of Nuclear Engineering, Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology., [2)]Laboratory for Zero-Carbon Energy Institute of Innovative Research,Tokyo Institute of Technology, 2-12-1-N1-22, Ookayama, Meguro-ku, Tokyo, 152-8550, Japan

13:20～14:40

Session A5 Iron and steel making industry

Chairperson : Takanori Yoshioka (Sanyo Special Steel Co., Ltd.)

A5-2 Synthesis of Carbide by Using Biomass as Antioxidant for Carbon Containing Refractories

○Tomoyuki Maeda, Hatsuo Taira

Okayama Ceramics Research Foundation

A5-3 Study of changing behavior of inclusion composition in type 304 stainless steel during RHOB-LF process

Takanori Yoshioka, ○Yuta Shimamura

Sanyo Special Steel Co., Ltd.

A5-4 The effect of densification on charcoal properties

○Hamideh Kaffash, Merete Tangstad

Norwegian University of Science and Technology

A5-5 An Empirical Comparative Study of Renewable Biochar and Fossil Carbon as Carburizer in Steelmaking

Ryan Robinson[1], ○Liviu Brabie[1], Pettersson Magnus[1], Marko Amovic[2], Rolf Ljunggren[2]

[1)]Hoganas AB, [2)]Cortus Energy AB

RoomB (On-line)

10:20～12:00

Session B4 CO_2 capture/separation

Chairperson : Teruhiko Kai (Research Institute of Innovative Technology for the Earth (RITE))

B4-1 Development of CO_2 Chemical Adsorption Technology

○Yoichi Matsuzaki[1], Shin Yamamoto[2], Hidetaka Yamada[2], Firoz Alam Chowdhury[2], Kazuya Goto[2]

[1)]Nippon Steel Corporation, [2)]Research Institute of Innovative Technology for the Earth

B4-2 CO_2 separation by using gas fraction PSA for CO_2 utilization processes

○Nobuyuki Shigaki, Yasuhiro Mogi, Takashi Haraoka, Goro Okuyama

JFE Steel Corporation

B4-3 Stability of Amine Solid Sorbents for Postcombustion CO_2 Capture

○Quyen Thi Vu, Hidetaka Yamada, Katsunori Yogo
Research Institute of Innovative Technology for the Earth

B4-4 Preparation of AEI-type zeolite membrane and its separation property

○Motomu Sakai[1], Yusuke Hashizume[2], Masahiko Matsukata[1,2,3]
[1)]Research Organization for Nano & Life Innovation, Waseda University, [2)]Department of Applied Chemistry, Waseda University, [3)]Advanced Research Institute for Science and Engineering, Waseda University

B4-5 Materials informatics for designing CO_2 capturing liquids with selectivity

○Hirotoshi Mori, Nahoko Kuroki
Chuo University

13:00～14:40

Session B5 CO_2 conversion/utilization/sequestration

Chairperson : Hirotoshi Mori (Chuo University)

B5-1 Effective Synthesis of CO by Electro-reduction of CO_2 Gas with Water using a SPE-electrolysis Cell

Ichiro Yamanaka, ○Siyuan Jia, Yuki Senba, Shoji Iguchi
Tokyo Institute of Technology

B5-2 Electrochemical CO_2 Conversion Using a Zero-gap Electrolysis Cell

○Yusuke Kofuji, Yasuhiro Kiyota, Akihiko Ono, Satoshi Mikoshiba, Ryota Kitagawa
Corporate Research & Development Center, Toshiba Corporation

B5-3 CO_2 Reduction into Fuel by Pd/TiO_2 Photocatalyst Changing the Combination of H^+ Provider

○Akira Nishimura, Tadaaki Inoue, Yoshito Sakakibara, Masafumi Hirota, Akira Koshio
Mie University

B5-4 Decomposition of CO_2 Gas in Molten Salt

○Ryosuke O. Suzuki[1,2], Fumiya Matsuura[1], Takafumi Wakamatsu[1], Itsuki Iwamoto[1], Ryota Kanda[2], Masayuki Takahashi[1], Shungo Natsui[1,3], Tatsuya Kikuchi[1]
[1)]Faculty of Engineering, Hokkaido University, [2)]Science Lab. SUZUKI, [3)]Institute of Multidisciplinary Research for Advanced Materials, Tohoku University

B5-5 Co-encapsulated MFI zeolite catalyst for FTTO

○Masahiko Matsukata, Soushi Kasuya, Motomu Sakai
Waseda University

RoomC (On-line)

10:20～12:00

Session C4 CO_2 conversion/utilization/sequestration

Chairperson : Yukitaka Kato (Tokyo Institute of Technology)

C4-1 Upgrading of CO_2 to fuel and chemicals through CO_2 recycling technology

Takumi Endo[1], Hiroyuki Kamata[3], Atsushi Nonomura[1], Yasuro Yamanaka[2], Kentaro Nariai[3], Takuya Hashimoto[4], Chee Kok Poh[5], Kelvin Kwok[5], Jie Chang[5], Shi Chang Teo[5], Chuandayani Gunawan Gwie[5], Terence Seah[5], Luwei Chen[5], Armando Borgna[5], ○Jun Tsujikawa[3]

[1)]Basic Design Group, Basic Design Department, Engineering Center, Carbon Solution Business Unit, Resources, Energy & Environment Business Area, IHI, [2)]R&D Department, Engineering Center, Carbon Solution Business Unit, Resources, Energy & Environment Business Area, IHI, [3)]Applied Physics & Chemistry Group, Technology Platform Center, Technology & Intelligence Integration, IHI, [4)]Energy Solution Group, Regional Innovation & Solution Centre, IHI ASIA PACIFIC PTE. LTD., [5)]Process and Catalysis Research Division, Institute of Chemical and Engineering Sciences, A*STAR (Agency for Science, Technology and Research)

C4-2 Novel iron-making process using organic acid derived from CO_2

○Shinji Kudo, Phatchada Santawaja, Aska Mori, Jun-Ichiro Hayashi

Kyushu University

C4-3 Maximizing conversion of CO_2 and waste brine into construction materials

○Corey Adam Myers, Takao Nakagaki, Yuto Watanabe

Waseda University

C4-4 Mineral Carbon Capture and Utilization Technology using Concrete Sludge

○Takeshi Sasaki[1], Yasuyuki Hayakawa[1], Atsushi Iizuka[2], Akihiro Yamasaki[3]

[1)]Nippon Concrete Industries Co., Ltd., [2)]Tohoku University, [3)]Seikei University

C4-5 Fixation of Carbon Dioxide by Using Concrete Sludge

○Masahiro Abe, Shunsuke Tanaka, Miyuki Noguchi, Akihiro Yamasaki

Department of Materials and Life Science, Faculty of Science and Technology, Seikei University

13:00～14:40

Session C5 Hydrogen-based energy system

Chairperson : Hideki Murakami (Nippon Steel Corporation)

C5-1 R&D of CO_2-free hydrogen production technology using thermochemical water-Splitting iodine-sulfur process

○Shinji Kubo, Hiroaki Takegami, Nobuyuki Tanaka, Hiroki Noguchi, Yu Kamiji, Myagmarjav Odtsetseg

Japan Atomic Energy Agency

C5-2 Development of Metal Composite Hydrogen Permeable Membrane by Reverse Build-up Method

○Yasunari Shinoda[1], Masakazu Takeuchi[1], Hiroki Takasu[2], Yukitaka Kato[2]

[1)]Graduate Major in Nuclear Engineering, Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, [2)]Laboratory for Zero-Carbon Energy, Institute of Innovative Research, Tokyo Institute of Technology

C5-3 International Liquefied Hydrogen Supply Chain pilot demonstration project

○Ryo Chishiro, Yasushi Yoshino, Kenjiro Shindo

Kawasaki Heavy Industries, LTD.

C5-4 Development of hydrogen combustion technology that contributes to decarbonization of industrial furnaces.

○Shuhei Taguchi, Kenichi Tomozawa

ChugaiRo Co.,Ltd.

C5-5 CO_2 methanation over Ru/ZrO_2 catalysts

○Shohei Tada[1], Hironori Nagase[2], Rei Naito[2], Ryuji Kikuchi[2]

[1)]Ibaraki University, [2)]The University of Tokyo

Fri 17 December

Noh Theatre (Nara Kasugano International Forum 甍 IRAKA)

11:00～11:20

Opening

11:20～12:00

Plenary lecture 4

Chairperson : Hideki Murakami (Nippon Steel Corporation)

P4 Japan's Green Growth Strategy to Support 2050 Carbon Neutral Goal

○Takeo Hoshino
The University of Tokyo

13:30～14:10

Plenary lecture 5

Chairperson : Yukitaka Kato (Tokyo Institute of Technology)

P5 The role of CCUS for the pathways toward carbon neutrality

○Keigo Akimoto
Research Institute of Innovative Technology for the Earth (RITE)

14:10～14:50

Plenary lecture 6

Chairperson : Yukitaka Kato (Tokyo Institute of Technology)

P6 Net Zero by 2050: A Roadmap for the Global Energy Sector

○Peter Levi
International Energy Agency

15:05～16:05

Panel Discussion with RITE collaboration **Pathways toward Carbon Neutral Industries after COP26**

Panelists : Prof. Kenji Yamaji (Research Institute of Innovative Technology for the Earth, RITE)
Dr. Peter Levi (International Energy Agency)
Dr. Keigo Akimoto (RITE)
Moderator : Yukitaka Kato (Tokyo Institute of Technology)

16:05～16:40

Awards/Photo/Closing **Awards/Photo/Closing**

Program & Extended Abstracts of CUUTE-1

The First Symposium on Carbon Ultimate Utilization Technologies for the Global Environment, CUUTE-1

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