東南大學
SOUTHEAST UNIVERSITY

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THE 25th INTERNATIONAL CONFERENCE ON FLUIDIZED BED CONVERSION

CONFERENCE PROGRAM

April 6-10, 2025 NANJING, CHINA

ORGANIZER:

Southeast University

CO-ORGANIZERS:

Tsinghua University
Zhejiang University
Jiangsu Engineering Thermophysics Society
Chinese Mechanical Engineering Society
Chinese Society for Electrical Engineering
China Machinery Industry Federation
China Electricity Council

SPONSORS:

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Beijing Leshi Alliance Technology Co., Ltd.

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WELCOME MESSAGE

Dear Distinguished Guests, Colleagues, and Friends,

As spring awakens the timeless charm of Nanjing, we are delighted to welcome you to the 25th International Conference on Fluidized Bed Conversion (FBC25). On behalf of Southeast University and the organizing committee, we extend our heartfelt gratitude to all the experts, researchers, and industry leaders from 23 countries who have gathered here to pioneer the next chapter in fluidized bed technology.

Since its inception in 1968, the triennial FBC conference has grown into a premier global forum for scientific exchange in fluidized bed research. Developed through collaborative efforts of globally leading research institutions, this landmark event drives interdisciplinary progress spanning fundamental theoretical exploration to cutting-edge industrial implementations. Its enduring legacy reflects the collective expertise of international academia and industry pioneers, consistently fostering paradigm-shifting innovations in the field.

Over the decades, from the technology-driven advancements in Turku (2015) and industry-oriented innovations in Seoul (2018) to the collaborative knowledge-sharing dialogues in Gothenburg (2022), FBC has consistently united minds across borders to address evolving energy and environmental challenges. Today, as Southeast University proudly hosts FBC25 in Nanjing, we not only celebrate the conference's storied past but also embrace its evolving role in nurturing international partnerships for a sustainable future.

This year's program, meticulously curated with 234 presentations across 45 sessions (including 6 plenary lectures, 24 keynote lectures, 174 oral presentations, and 30 poster exhibits), integrates two transformative forces reshaping our field:

- Green Transition Technologies: Sessions on carbon capture, chemical looping, and sustainable energy systems will spotlight pathways to decarbonize industries, aligning with global net-zero targets.
- AI-Driven Innovation: From machine learning-optimized reactor modeling to smart diagnostics for emission reduction, AI's role in accelerating fluidized bed R&D will be explored through interdisciplinary dialogues.

At this pivotal moment for our industry, FBC25 offers a unique platform to reimagine collaborative innovation. From micro-scale fluid dynamics to energy systems operating on a significantly larger scale, the journey toward net-zero demands cross-border knowledge sharing, open-access data ecosystems, and joint technological ventures. We envision this conference not merely as a venue for sharing breakthroughs but as a catalyst for enduring partnerships that transcend geographic and disciplinary boundaries.

Nanjing—a city where 1800 years of cultural heritage coexists with cutting-edge innovation—offers a symbolic setting for this convergence. Whether strolling along the Qinhuai River, where ancient scholars once debated ideas, or engaging in technical sessions at the forefront of science, may your interactions here spark collaborations that transcend disciplines and borders.

Together, let us transform the promise of fluidized bed technologies into scalable solutions for a decarbonized, digitally empowered world.

Wishing you an inspiring and productive FBC25!

Honorary Chair
Prof. Junfu Lyu
Tsinghua University

Conference Chair
Prof. Lunbo Duan
Southeast University

ORGANIZER

SOUTHEAST UNIVERSITY

Southeast University (SEU), located in Nanjing, the ancient capital city of six dynasties, is a prestigious institution of higher learning renowned both domestically and internationally. With a rich cultural heritage, SEU traces its origins back to 1902, making it one of China's most time-honored universities. Over its 120-year history, SEU has upheld a spirit of patriotism and global responsibility, relentlessly striving for excellence in scientific advancement and national rejuvenation. Over time, the university has fostered a distinguished academic ethos characterized by "rigor, truthfulness, unity, and diligence", a guiding philosophy of "achieving renown through science and serving the nation with talent", and a steadfast commitment to its motto Striving for Perfection.

SEU is a comprehensive, research-oriented institution with a strong emphasis on engineering while also encompassing a wide range of disciplines, including philosophy, economics, law, education, literature, science, medicine, management, and the arts. Notably, 12 disciplines have been designated as national "Double First-Class" construction disciplines, and 6 disciplines received an A+ rating in China's fourth round of disciplinary assessments, ranking SEU 8th nationwide. Internationally, 12 disciplines are ranked among the top 1% in the Essential Science Indicators, with engineering ranked 20th and computer science 16th, both placing in the top 0.1% globally.

SEU enjoys a distinguished reputation for its educational excellence. Committed to talent cultivation as its core mission, the university has educated over 330,000 professionals across various fields for the nation and society. More than 200 academicians from the Chinese Academy of Sciences and the Chinese Academy of Engineering have either studied or worked at SEU, further solidifying its legacy of academic and research excellence.

As one of the most active universities in China for international exchanges and cooperation, SEU has established extensive partnerships with world-renowned universities and top-tier research institutions. SEU aspires to walk shoulder to shoulder with global partners across academia, technology, and industry sectors. Together, SEU will harness the radiance of innovation to illuminate the path of transformative change, build bridges of collaboration to reach shared prosperity, and cultivate the bedrock of well-being through the transformative potential of emerging paradigms. SEU commits to forging a future where knowledge transcends boundaries, empowers communities, and unlocks humanity's collective potential.

SCHOOL OF ENERGY AND ENVIRONMENT

Tracing its roots to the 1923 steam power engineering program at National Southeastern University, the School of Energy and Environment at Southeast University has gradually evolved into a nationally respected institution known for academic dedication and collaborative research. Over decades, it has cultivated nearly 20,000 professionals, including distinguished alumni such as Academicians Xuejun Chen, Shoubo Xu, and other notable scholars, contributing to China's energy and environmental sectors.

The school focuses on two provincial key disciplines: Power Engineering & Engineering Thermophysics (ranked top 10 nationally) and Environmental Science & Engineering (top 15% nationally). Its Environment/Ecology discipline has recently entered the global ESI top 1%, reflecting sustained academic progress. With 809 undergraduate and 1,487 graduate students, the school is supported by 201 faculty members, including 1 Chinese Academy of Engineering academician, 7 NSFC Distinguished Young Scholars awardees, and 18 National Young Talent Program Recipients.

Research capabilities are enhanced through collaborative platforms such as:

- National Engineering Research Center of Power Generation Control and Safety
- State Key Laboratory of Clean and Efficient Coal-Fired Power Generation and Pollution Control (co-established with CHN Energy Investment Group)
- Key Laboratory of Energy Thermal Conversion and Control of Ministry of Education

The school has developed specialized expertise in several areas:

- Pressurized coal combustion/gasification systems
- CO_2 capture technologies through CFB and chemical looping
- Biomass conversion processes
- Solar-assisted refrigeration solutions
- Thermal power optimization methods

The school contributes to climate solutions through establishing the Yangtze River Delta Carbon Neutrality Institute and co-founding the Global Universities Carbon Neutrality Alliance. Through collaborative research and practical innovation, it advances sustainable energy transitions while supporting global decarbonization goals.

STEERING COMMITTEE

Edward J. Anthony	University of Ottawa
Umberto Arena	University of Campania “Luigi Vanvitelli”.
Alberto Gomez Barea	Universidad de Sevilla, Spain
Vesna Barisic	Sumitomo SHI FW
Prabir Basu	Mechanical Engineering Dalhousie University
Andre Chien-Song Chyang	Chung Yuan Christian University
Lunbo Duan	Southeast University
Sonja Enestam	Valmet Technologies Oy
Sabrina Francey	Hatch Engineering
Frantisek Hrdlicka	Czech Technical University in Prague
Robin Hughes	Canmet
Mikko Hupa	Åbo Akademi Process Chemistry Centre
Sebastian Kaiser	Andritz AG Power Boilers
Gorkem Kulah	Middle East Technical University
Francisco Garcia Labiano	Instituto de Carboquímica
Bo Leckner	Chalmers University of Technology
Uendo Lee	Korea Institute of Industrial Technology (KITECH)
Paola Lettieri	University College London
Fredrik Lind	E.ON AB
Adam Luckos	University of the Witwatersrand
Zhongyang Luo	Zhejiang University
Tobias Mattisson	Chalmers University of Technology
Reji Noda	Gunma University
Wojciech Nowak	AGH University of Science and Technology
Georgy A. Ryabov	All-Russian Thermal Engineering Institute
Piero Salatino	Università degli Studi di Napoli Federico II
Tadaaki Shimizu	Niigata University
Franz Winter	Vienna University of Technology
Guangxi Yue	Tsinghua University
Edgardo Zabetta	Sumitomo SHI FW

LOCAL SCIENTIFIC COMMITTEE

Rushan Bie	Harbin Institute of Technology
Hanping Chen	Huazhong University of Science and Technology
Fangqin Cheng	Shanxi University
Leming Cheng	Zhejiang University
Lunbo Duan	Southeast University
Yitian Fang	Institute of Coal Chemistry, Chinese Academy of Sciences
Wei Ge	Institute of Process Engineering, Chinese Academy of Sciences
Yurong He	Harbin Institute of Technology
Weicheng Li	DongFang Boiler Co., Ltd.
Zhenshan Li	Tsinghua University
Xiaofeng Lu	Chongqing University
Zhongyang Luo	Zhejiang University
Junfu Lyu	Tsinghua University
Qinggang Lyu	Institute of Engineering Thermophysics, Chinese Academy of Sciences
Suxia Ma	Taiyuan University of Technology
Junhua Mao	WuXi HuaGuang Environment&Energy Group Co., Ltd.
Qiangqiang Ren	Institute of Engineering Thermophysics, Chinese Academy of Sciences
Laihong Shen	Southeast University
Shaozeng Sun	Harbin Institute of Technology
Chunbo Wang	North China Electric Power University
Fengjun Wang	Harbin Boiler Company Limited
Fuchen Wang	East China University of Science and Technology
Hua Wang	Kunming University of Science and Technology
Qinhui Wang	Zhejiang University
Sheng Wang	China Energy Investment
Feng Xiao	Shanghai Boiler Works Co., Ltd.
Rui Xiao	Southeast University
Guangwen Xu	Shenyang University of Chemical Technology
Jianchun Zhang	Taiyuan Boiler Group Co., Ltd.
Changsui Zhao	Southeast University
Haibo Zhao	Huazhong University of Science and Technology
Yong Zhao	Sinopec Group Co., Ltd.
Wenqi Zhong	Southeast University
Fahua Zhu	China Energy Investment
Qingshan Zhu	Institute of Process Engineering, Chinese Academy of Sciences
Zhiping Zhu	Institute of Engineering Thermophysics, Chinese Academy of Sciences

ORGANIZING COMMITTEE WORKING GROUP

DIRECTOR

Prof. Lunbo Duan, Southeast University

COORDINATORS

Assoc. Prof. Yueming Wang, Southeast University
Dr. Shuo Zhang, Southeast University
Dr. Chun Zhu, Southeast University

COMMITTEE MEMBERS

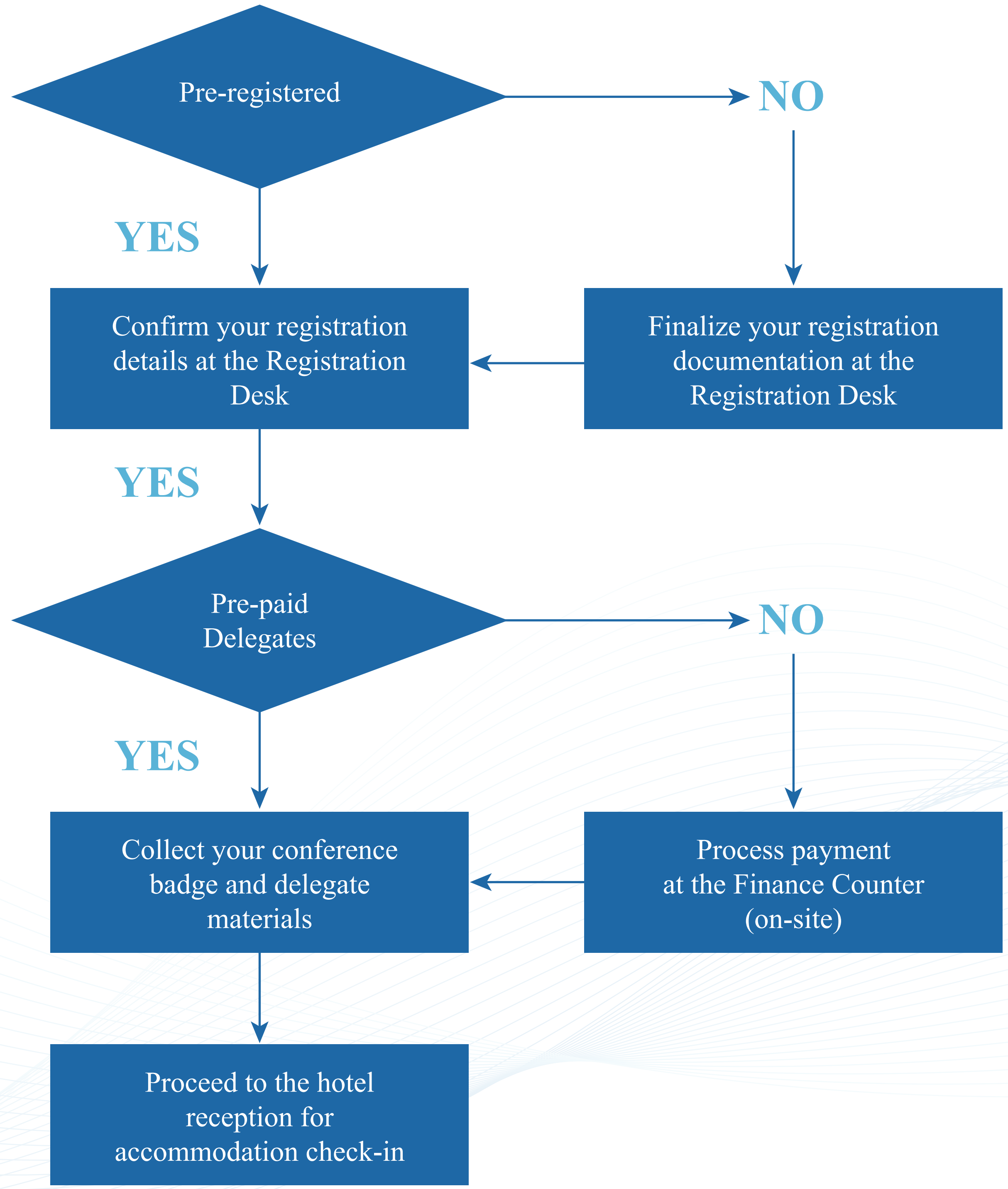
Prof. Dennis Lu, Southeast University
Prof. Zhenkun Sun, Southeast University
Ms. Jianmin Lu, Southeast University
Assoc. Prof. Hongjian Tang, Southeast University
Assoc. Prof. Minmin Zhou, Southeast University
Dr. Lin Li, Southeast University
Dr. Yuanqiang Duan, Southeast University

SPECIAL ACKNOWLEDGMENTS

We extend our sincere gratitude to all student volunteers from Prof. Lunbo Duan’s Group for their indispensable contributions to conference operations.

CONFERENCE INFORMATION

REGISTRATION PROCESS



NOTES FOR DELEGATES

- All delegates must review the conference handbook thoroughly and attend sessions punctually. Request assistance from venue staff or contact the Organizing Committee immediately if needed.
- Wear your official conference badge visibly during all sessions and events. Present meal vouchers at designated dining venues for service.
- Plenary lectures will be allocated 60 minutes, including 50 minutes for presentation and 10 minutes for Q&A.
- Keynote lectures will be allocated 30 minutes, with 25 minutes for presentation and 5 minutes for Q&A.
- Oral presentations will be allowed 20 minutes, including 15 minutes for presentation and 5 minutes for Q&A
- Presenters must strictly adhere to allocated time limits. A countdown timer will be displayed, with moderation by session chairs.
- Slides must be formatted for Microsoft PowerPoint 2013 or newer (16:9 widescreen ratio). Upload files to the session-room computer 15 minutes before your presentation.
- Poster presenters must display materials strictly within assigned poster boards.

GUIDELINES FOR SESSION CHAIRS

Role & Preparation

- Session Chairs are responsible for moderating presentations and Q&A in parallel sessions. Co-chairs must coordinate roles in advance. Two volunteers will assist with technical/logistical support.

Pre-Session Protocol

- Arrive 10 minutes prior to session start to confirm presenter attendance.
- Deliver a brief chair introduction at session commencement.
- If co-authoring a presented paper, recuse yourself from overseeing that presentation (delegate to co-chair).

Time Management

- Enforce the published timetable strictly; no presentation order changes permitted.
- If a presentation is canceled, maintain the original schedule by inserting a pause.
- Timekeeping volunteers will signal remaining presentation time using dual-sided cards: 5-minute warning and 1-minute warning.

Q&A Facilitation

- Prevent monopolization of discussion time.
- Encourage concise responses to ensure equitable participant engagement.

Intellectual Property Protection

Announce and enforce the non-recording policy:

"Photography/audio recording of slides is strictly prohibited unless explicitly authorized by the presenter."

VENUE AND ACCOMMODATION

The conference will be held at The Purple Palace Nanjing, which is the main hotel for accommodation too. To meet different needs, Hampton by Hilton Hotel is also provided as the secondary hotel. Participants are advised to register their hotel accommodation reservations through the conference registration website (https://www.fbc25.com/accommodation/).

The Purple Palace Nanjing (The Conference Venue & Main Hotel)	**南京紫金山庄** （会议地点和主酒店）
Contact: +86 025 8485 8888	联系人：赵经理 15951812887
Address: No. 18, Huanling Road, Xuanwu District, Nanjing	地址：南京市玄武区环陵路18号

Hampton by Hilton Hotel (The secondary hotel)	**希尔顿欢朋酒店** （副酒店）
Contact: +86 025 5181 8111	联系人：党经理 13260866275
Address: No. 96, Binyuan Street, Jiangning District, Nanjing	地址：南京市江宁区麒麟街道宾园街96号

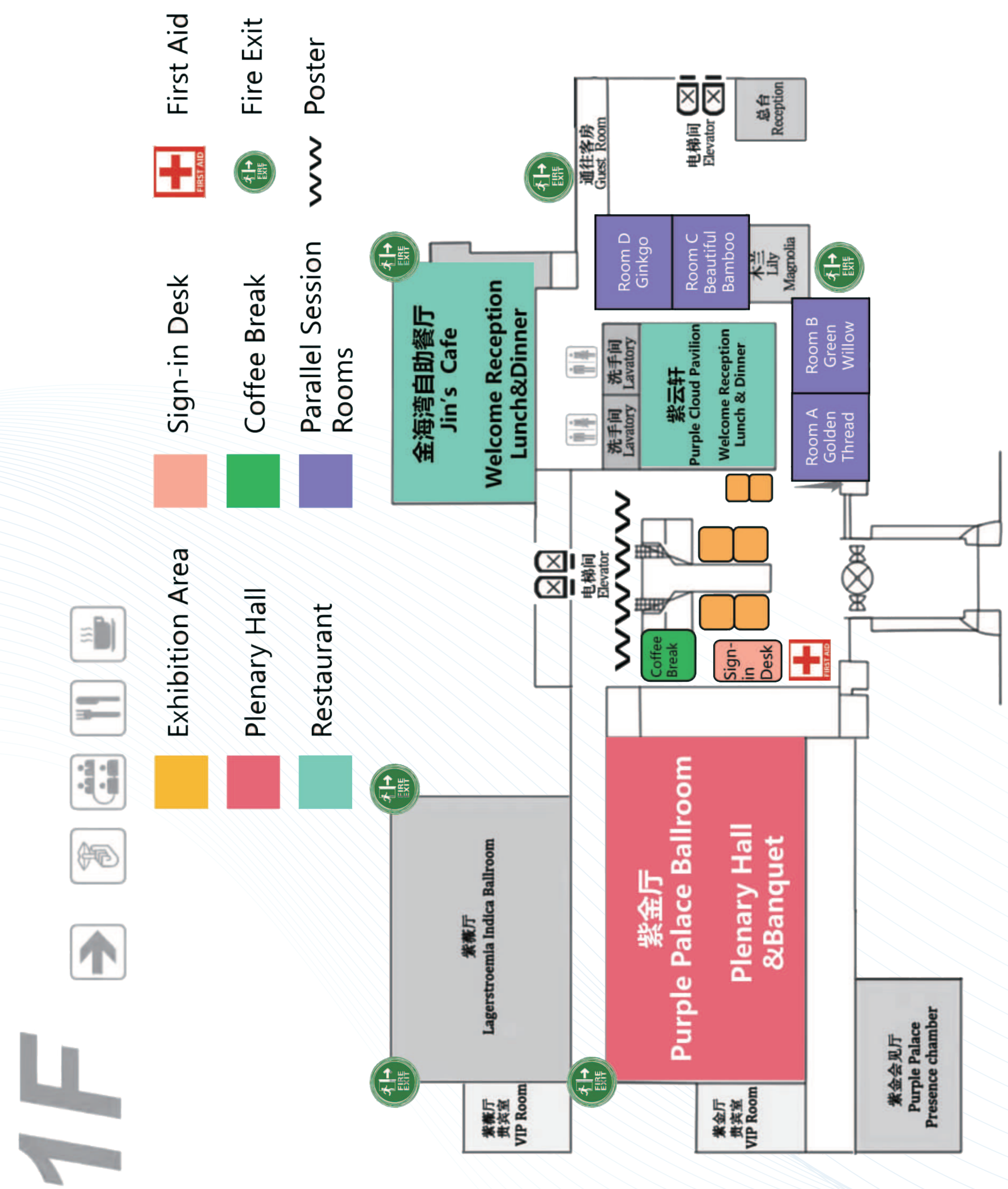
Shuttle Bus Schedule: Conference Venue and Hilton Hotel

Shuttle buses between the Purple Palace Nanjing and Hampton by Hilton Hotel will be provided, to ensure smooth and convenient transportation for all participants.The departure timetable of the shuttle bus is listed below:

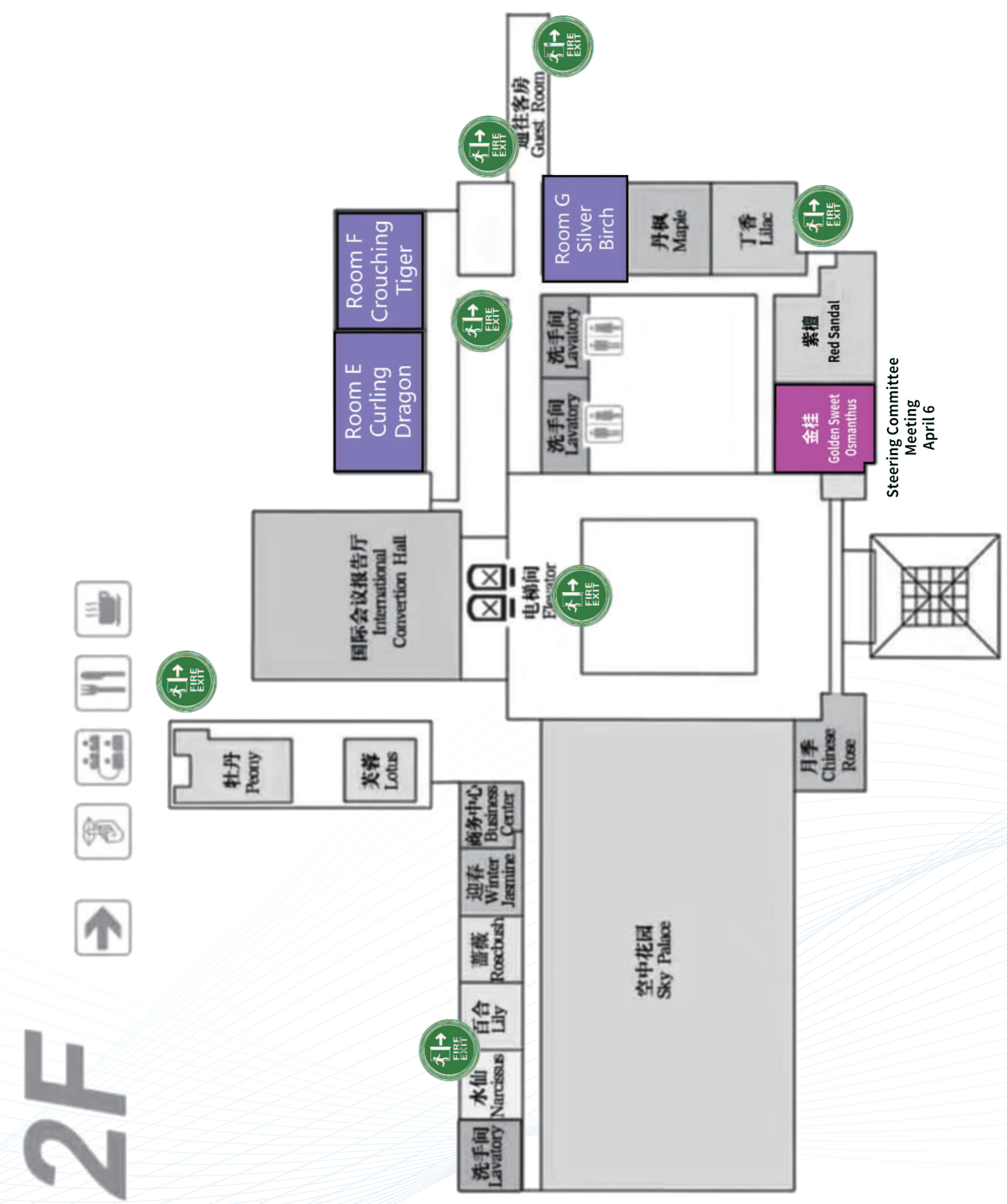
Schedule	Date	From Hampton by Hilton Hotel	From the Purple Palace Nanjing
Check-in	April 6	14:00 16:00 18:00	13:20 15:20 17:20
Conference	April 7	8:00	21:00
	April 8	8:00	21:00
	April 9	8:00	13:00

Tips:
The duration of the shuttle bus one way is about 20 mins.
To avoid missing the bus, please arrive 5 mins prior at the pick-up location (Hampton by Hilton Hotel: Reception desk; the Purple Palace Nanjing: The entrance of the conference venue), and volunteers will guide you to the shuttle bus.

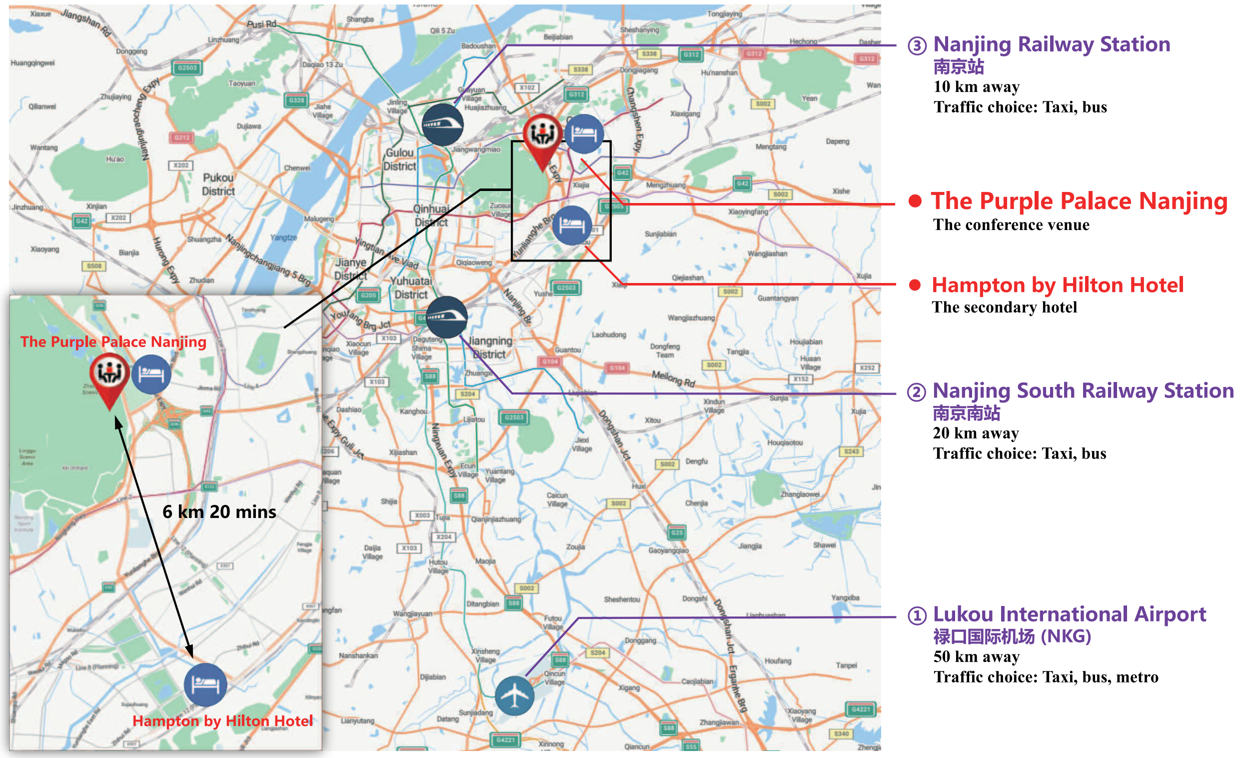
Venue: Confernce Center First Floor



Venue: Confernce Center Second Floor



TRANSPORTATION



① From Lukou International Airport

- To the Purple Palace Nanjing

Traffic choice	Route	Duration	Fare	Operating hours
By Taxi	None	~ 40 mins	100~150 CNY	24h
By Bus	Airport Bus Line 1 → Bus 309	~ 2 hours	30 CNY	Airport Bus Line 1: Every 0.5 h from 4:30 -21:00 Bus 309: 6:30-22:10

Tips:
Taxi is the fastest and easiest (16 CNY additional tolls).
Please get off the Bus 309 at Huangma (黄马) station. Turn round and walk about 100 m.
Despite bus, Metro Line S1 is also available (45 mins, 7 CNY, 6:22-23:05), and take a taxi from Nanjing South Railway Station to the conference center, which is budget-friendly (20 mins, 50 CNY, 24 h).

- To Hampton by Hilton Hotel

Traffic choice	Route	Duration	Fare	Operating hours
By Taxi	None	~ 40 mins	90~120 CNY	24h

Tips:
Taxi is the fastest and easiest (16 CNY additional tolls).

② From Nanjing South Railway Station

- To the Purple Palace Nanjing

Traffic choice	Route	Duration	Fare	Operating hours
By Taxi	None	~ 20 mins	30~50 CNY	24h
By Bus	Metro Line 3 → Bus 309	~ 1 hour	6 CNY	Metro Line 3: 5:40-23:10 Bus 309: 6:30-22:10

Tips:
Please get off the Bus 309 at Huangma (黄马) station. Turn round and walk about 100 m.

- To Hampton by Hilton Hotel

Traffic choice	Route	Duration	Fare	Operating hours
By Taxi	None	~ 20 mins	25~40 CNY	24h
By Bus	Bus 791 → Bus 841	~ 1 hour	4 CNY	Bus 791: 5:00-20:20 Bus 841: 5:45-20:30

Tips:
Please get on the Bus 791 at Jinyangdongjie (金阳东街) station on the east of the south square, transfer to the Bus 841 at Shijing (市井) station, and get off at Cangbomen (沧波门) station, cross the street and the hotel is 500 m straight north.

③ From Nanjing Railway Station

- To the Purple Palace Nanjing

Traffic choice	Route	Duration	Fare	Operating hours
By Taxi	None	~ 15 mins	20~30 CNY	24h
By Bus	Bus 309	~ 45 mins	2 CNY	6:30-22:10
Tips: Please get off the Bus 309 at Huangma (黄马) station. Turn round and walk about 100 m.				

- To Hampton by Hilton Hotel

Traffic choice	Route	Duration	Fare	Operating hours
By Taxi	None	~ 25 mins	35~50 CNY	24h
By Bus	Bus 17 → Bus 90	~ 1.5 hour	4 CNY	Bus 17: 5:40-23:10 Bus 90: 7:00-20:05
Tips: Please get on the Bus 17 at Nanguangchangdong (南广场东) station, transfer to the Bus 90 at Nanligongkejiyuan (南理工科技园) station, and get off at Zhihuilu-Cangbomenbei (智汇路-沧波门北), the hotel is 100 m on your right after the corner.				

Contact Information

If you are in need, the numbers below would be helpful:

- +86 153 6504 3527 (Assoc. Prof. Yueming Wang)
- +86 195 7735 1247 (Assoc. Prof. Minmin Zhou)
- +86 158 5069 2993 (Assoc. Prof. Hongjian Tang)

SOCIAL EVENTS

Date	Time	Social Events	Location
April 6	18:30-20:30	Welcome Reception	Purple Cloud Pavilion & Jin's Cafe
April 7	18:30-20:30	Banquet	Purple Palace Ballroom
April 7	19:00-19:40	Kunqu Opera Performance (During Banquet)	Purple Palace Ballroom

Lunch & Dinner

Date	Time	Location
April 7	12:30-13:30	Purple Cloud Pavilion & Jin's Cafe
April 8	12:30-13:30	
April 8	18:30-20:30	
April 9	12:30-13:30	

Coffee Break

Date	Time	Location
April 7	10:10-10:30	Conference Venue First Floor (Lobby)
	15:30-15:50	
April 8	10:10-10:30	
	15:30-15:50	
April 9	10:30-10:50	

Note: Vegetarian meal options are available upon request. Please notify the registration desk during check-in to ensure dietary accommodations.

Kunqu Opera Introduction

Kun Qu Opera, which originated during the Ming dynasty (14th-17th centuries) in Kunshan, a historic city within Suzhou, Jiangsu Province, is one of China's most historically significant theatrical traditions.

Recognized by UNESCO as a Masterpiece of Intangible Cultural Heritage, Kun Qu Opera has embodied the pinnacle of Chinese artistic elegance. As the "living fossil of Chinese theater", it seamlessly integrates poetry, music, and dance into an aesthetic language that not only inspired Peking Opera but continues to influence China's performing arts today.

We are delighted to announce that a traditional Kun Qu Opera performance will be featured during the banquet on the evening of April 7th for our esteemed guests. Please stay tuned for this enchanting cultural experience.

Kunqu Opera Repertoire

Time：19:00-19:40, Monday, April 7, 2025
Venue：Purple Palace Ballroom

Instrument	Performer	Affiliation
Bamboo Flute 司笛	Xu Nuoyan 徐诺颜	BA in Translation, Soochow University
Drum 司鼓	Gao Peiyu 高培玉	BS in Physics, Soochow University
Gaohu/Erhu 高胡/二胡	Jiang Xinyue 蒋心悦	MFA in Music Performance, Nanjing University of the Arts
Small Gong 小锣	Yang Siyi 杨思益	MFA in Theater, Nanjing University

ACT ONE: THE PEONY PAVILION: DECLARATIONS OF AMBITIONS
《牡丹亭·言怀》

Role	Performer	Affiliation
Liu Mengmei 柳梦梅	Zhou Tian 周恬	MFA in Traditional Opera Direction, Shanghai Theatre Academy
Guo Tuo 郭驼	Yu Xiangmeng 俞翔萌	BFA in Performing Arts, Nanjing Agricultural University

Synopsis: A young scholar, Liu Chunqing, tells of his illustrious lineage, but declining family fortune. He laments that he is dependent on labors of an old family retainer, Hunchback Guo, for livelihood. However, he is confident that he is destined for great accomplishments. He tells of a dream in which a beautiful woman holding a branch of plum blossoms, promises him success and romance. So he changed his name to Mengmei, "Plum blossom dreamer". He summons the old gardener and tells him that he is leaving to take the examination in the capital.

剧情梗概：柳梦梅乃唐朝柳宗元之后，自小孤单，穷困潦倒，依赖老仆郭驼度日。某日梦见一座花园梅树下立一美人，因而改名梦梅。为求发迹，柳决定赴临安应考。

ACT TWO: THE PEONY PAVILION: THE GARDEN EXCURSION
《牡丹亭·游园》

Role	Performer	Affiliation
Du Liniang 杜丽娘	Qin Zhuo 秦茁	MFA in Theater, Nanjing University
Chun Xiang 春香	Yang Ying 杨颖	MA in Journalism, Nanjing University

Synopsis: Du Liniang wakes from a restless sleep. She decides to dress up and go to the garden that Chunxiang talked about earlier. Chunxiang admires her dress and jewelry and she expresses her love of beauty. In the garden, Liniang is overwhelmed by the profusion of spring flowers and plants, but also saddened by her loneliness, and unappreciated beauty.

剧情梗概：杜丽娘精心打扮，满怀兴奋到后花园赏春，但良辰美景反引起她自顾凄凉。

ACT THREE: THE PEONY PAVILION: THE INTERRUPTED DREAM
《牡丹亭·惊梦》

Role	Performer	Affiliation
Du Liniang 杜丽娘	Wang Junxi 王俊茜	BFA in Traditional Opera Direction, Shanghai Theatre Academy
Liu Mengmei 柳梦梅	Fan Yupeng 范宇鹏	BEng in Pharmaceutical engineering, Southeast University

Synopsis: Returning to her chamber, Liniang expresses her longing for a lover and falls asleep. Flower goddesses appear in her dream, leading a handsome young man, who courts her and makes love to her. In the middle of this happy dream, Liniang is wakened by falling flowers.

剧情梗概：回房后杜丽娘自叹年已十六，却无知心人，闷闷盹睡。梦中花神引一书生持柳枝上，书生请丽娘题诗，两人在花神庇护下于牡丹亭缱绻缠绵。

The actors and musicians participating in this performance are all members of Southeast University's China National Arts Fund 2024 Grant-Funded Art Talent Training Project "Youth Performance Talent Training for the Youth Edition of Kunqu Opera the Peony Pavilion".
This project adopts an artistic approach combining "the most ancient + the most youthful" to establish an artistic inheritance model of "Kunqu art + university students". Fifty students were selected from twenty-nine universities to serve as actors/actresses and musicians. The program invited Bai Xianyong, Chief Producer of the original Youth Edition The Peony Pavilion, as Artistic Director, alongside performers from the iconic Youth Edition The Peony Pavilion as instructors. Through rigorous training, the students have completed a fully student-performed and student-accompanied "Campus Youth Edition of The Peony Pavilion".

TECHNICAL VISITS

Technical Visit 1:
Everbright Environmental Protection Energy (Nanjing) Co., Ltd.

Time: April 9, 2025, 13:30-17:00
Destination: No.1 Jingmai Industrial Park, Jiangning Subdistrict, Jiangning District, Nanjing (53 km, ~50 minutes by bus)

Technical Visit Transportation Tips:

- 13:30 Departure: The shuttle will leave from Hampton by Hilton and make a stop at the Purple Palace Nanjing (Conference Venue).
- 14:00 Departure: The shuttle will depart from the Purple Palace Nanjing to proceed to the technical site.
- Reminder: Arrive at least 5 minutes early to ensure timely departure. Double-check the pickup locations to avoid confusion!

Highlights

- Largest municipal solid waste incineration project in Nanjing under a BOT model
- Processes 4,000 tons of waste daily
- Generates 680 million kWh of electricity annually
- Employs multi-stage reciprocating mechanical grate furnaces tailored for high-moisture, low-calorific waste
- Features advanced emission control with dual-stage SNCR and low-temperature SCR
- First MSW incineration project in China to adopt SCR denitrification
- Integrated food waste treatment facility with resource recovery through anaerobic digestion
- Comprehensive heating supply system
- Real-time emission monitoring and online sharing

Hosts an industry-first simulation training center and offers a 720° VR cloud-based virtual tour for environmental education.

Technical Visit 2:
Wuxi Huaguang Environment & Energy Group Co., Ltd and Wuxi Youlian Thermal Power Co., Ltd, Wuxi

Time: April 10, 2025, 08:30-17:30

Destination: No.131 Meiyu Road, Xinwu District, Wuxi (181 km, 2~2.5 hours by bus)

Technical Visit Transportation Tips:

- 08:30 Departure: The shuttle will leave from the Purple Palace Nanjing (Conference Venue) and make a stop at Hampton by Hilton.
- 09:00 Departure: The shuttle will depart from Hampton by Hilton to proceed to the technical site.
- Reminder: Arrive at least 5 minutes early to ensure timely departure. Double-check the pickup locations to avoid confusion!

Highlights

Wuxi Huaguang Environment & Energy Group Co., Ltd.

- Boasts 67 years of boiler manufacturing and stands as one of China's leading CFB boiler producers.
- Specializes in eco-friendly coal-fired, zero-carbon biomass-fired, and solid waste boilers, along with HRSGs and hydrogen electrolysis equipment.
- Visit highlights include the company's development history with a 5G-enabled digital twin factory, advanced boiler production lines, and an automated hydrogen electrolyzer production line.

Wuxi Youlian Thermal Power Co., Ltd.

- A subsidiary established in 2003, operating two 100 t/h and two 150 t/h CFB boilers.
- Features ultra-low emission retrofits with SCR and ammonia-based desulfurization systems, and a biomass co-firing system utilizing approximately 10% garden waste.

Key visit areas encompass the central control room, boiler and environmental protection islands, and the biomass conveying and co-firing system.

MEDICAL INFORMATION TIPS

1. **Medical Assistance Spot** → Check-in desk with 1 doctor by turns.

Duty Time Begin	Duty Time End	Doctor Name	Phone Number
12:00 April 6	12:30 April 7	Yuejin Zhang 张跃进	+86 13912935301
12:30 April 7	15:30 April 8	Guoping Du 杜国平	+86 13815883785
15:30 April 8	17:00 April 9	Xiaoyan Chen 陈笑艳	+86 13951632139

2. **CALL 120** → State your location.

3. **ALERT STAFF** → Dial a staff member.

- +86 153 6504 3527 (Assoc. Prof. Yueming Wang)
- +86 195 7735 1247 (Assoc. Prof. Minmin Zhou)
- +86 158 5069 2993 (Assoc. Prof. Hongjian Tang)

Overall Conference Schedule

<table>
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<tr><td>19:30-21:00</td><td>Steering Committee Meeting</td><td></td><td></td><td></td><td></td></tr>
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Daily Program

Sunday, April 6, 08:30-21:00

08:30-18:30	On-site Check-in & Conference Materials Pick-up (Location: Lobby)
18:30-20:30	Welcome Reception (Location: Purple Cloud Pavilion & Jin's Cafe)
19:30-21:00	Steering Committee Meeting (Location: Room Golden Sweet Osmanthus, Second Floor)

Monday, April 7, 08:30-13:30

Opening Ceremony Host: Lunbo Duan, Southeast University, Location: Purple Palace Ballroom		
08:30-08:40	Opening Remarks & Welcome Address	**Lunbo Duan** *Southeast University, China*
08:40-08:45	Address by the Honored Guest	**Bo Leckner** *Chalmers University of Technology, Sweden*
08:45-08:50	Address by the Honored Guest	**Guangxi Yue** *Tsinghua University, China*
Plenary Session 1 Chair: Bo Leckner, Chalmers University of Technology, Location: Purple Palace Ballroom		
08:50-09:50	Latest development of circulating fluidized bed combustion technology in China	**Junfu Lyu** *Tsinghua University, China*
09:50-10:10	Group Photo (Location: Venue Entrance)	
10:10-10:30	Coffee Break (Location: Lobby)	
Plenary Session 2 Chair: Guangxi Yue, Tsinghua University, Location: Purple Palace Ballroom		
10:30-11:30	Exploring fluidized-bed reactor designs in chemical looping systems	**Francisco García-Labiano** *Instituto de Carboquimica (ICB-CSIC), Spain*
11:30-12:30	Modelling of reacting flows and industry applications	**Yansong Shen** *University of New South Wales, Australia*
12:30-13:30	Lunch (Location: Purple Cloud Pavilion & Jin's Cafe)	

Monday, April 7, 13:30-20:30 (Parallel Sessions & Poster Session)

Room	Golden Thread	Green Willow	Beautiful Bamboo	Ginkgo	Curling Dragon	Crouching Tiger	Silver Birch
13:30-15:30	**1A** Combustion I	**1B** Energy Storage	**1C** Computing & Simulation I	**1D** Optimization & Design I	**1E** Carbon Capture & Utilization	**1F** Particle Behavior &Fluid Dynamics I	**1G** Sustainable and Green Transition Technologies I
15:30-15:50	Coffee Break (Location: Lobby)						
15:50-17:20	**2A** Advanced Diagnostics I	**2B** Advanced Diagnostics II	**2C** Computing & Simulation II	**2D** Optimization & Design II	**2E** Reforming & H_2 Production	**2F** Particle Behavior &Fluid Dynamics II	**2G** Sustainable and Green Transition Technologies II
17:20-18:20	Poster Session (Location: Lobby)						
18:30-20:30	Banquet (Location: Purple Palace Ballroom)						

Tuesday, April 8, 08:30-13:30 (Parallel Sessions)

Room	Golden Thread	Green Willow	Beautiful Bamboo	Ginkgo	Curling Dragon	Crouching Tiger	Silver Birch
08:30-10:10	**3A** Pyrolysis & Cracking I	**3B** Pyrolysis & Cracking II	**3C** Computing & Simulation III	**3D** Optimization & Design III	**3E** Solid Looping: Scale-Up	**3F** Particle Behavior & Fluid Dynamics III	**3G** Sustainable and Green Transition Technologies III
10:10-10:30	Coffee Break (Location: Lobby)						
10:30-12:20	**4A** Combustion II	**4B** Combustion III	**4C** "AI+" I	**4D** Optimization & Design IV	**4E** Chemical Looping Combustion	**4F** Particle Behavior & Fluid Dynamics IV	**4G** Sustainable and Green Transition Technologies IV
12:30-13:30	Lunch (Location: Purple Cloud Pavilion & Jin's Cafe)						

Tuesday, April 8, 13:30-20:30 (Parallel Sessions)

Room	Golden Thread	Green Willow	Beautiful Bamboo	Ginkgo	Curling Dragon	Crouching Tiger
13:30-15:30	**5A** Combustion IV	**5B** Gasification I	**5C** Computing & Simulation IV	**5D** Optimization & Design V	**5E** Solid Looping Process	**5F** Mixing & Segregation I
15:30-15:50	Coffee Break (Location: Lobby)					
15:50-17:40	**6A** Combustion V	**6B** Gasification II	**6C** "AI+" II	**6D** Emissions & Environmenta Impact	**6E** Chemical Looping Gasification	**6F** Mixing & Segregation II
18:30-20:30	Dinner (Location: Purple Cloud Pavilion & Jin's Cafe)					

Wednesday, April 9, 08:30-13:30

Plenary Session 3 Chair: Changsui Zhao, Southeast University, Location: Purple Palace Ballroom		
08:30-09:30	Novel fluidized bed reactors for thermochemical conversion of biomass residues to biofuels and biochar	**Xiaotao Bi** *The University of British Columbia, Canada*
09:30-10:30	Selected topics in chemical reaction engineering of fluidized bed thermochemical conversion of biomass	**Piero Salatino** *Università degli Studi di Napoli Federico II, Italy*
10:30-10:50	Coffee Break (Location: Lobby)	
Plenary Session 4 Chair: Edward J. Anthony, University of Ottawa, Location: Purple Palace Ballroom		
10:50-11:50	Integrated solutions featuring fluidized bed technology for CO_2 neutral/negative industry	**Vesna Barišić** *Sumitomo SHI FW Oy, Finland*
Closing Ceremony Host: Changsui Zhao, Southeast University, Location: Purple Palace Ballroom		
11:50-12:05	Award Ceremony for Best Paper and Best Poster	**Junfu Lyu** *Tsinghua University, China*
12:05-12:10	Closing Address	**Changsui Zhao** *Southeast University, China*
12:30-13:30	Lunch (Location: Purple Cloud Pavilion & Jin's Cafe)	

Note to All Participants:
Please be advised that the closing ceremony will highlight the **announcement of the Best Paper Award and Best Poster Award.** Award recipients will be invited to the stage for recognition. We kindly encourage all attendees to join us in celebrating these achievements.

Plenary Lecture I

Monday, April 7 | Purple Palace Ballroom | 08:50-09:50
Chair: Bo Leckner (Chalmers University of Technology, Sweden)

Latest development of circulating fluidized bed combustion technology in China

Junfu Lyu
Tsinghua University, China

Bio:
Dr. Junfu Lyu, professor at the Department of Energy and Power Engineering, Tsinghua University. Prof. Lyu has been engaged in the R&D of technologies in the field of thermal engineering, leading several national and international cooperative research projects. He has led the research and successful demonstration of the world's first 600MW supercritical and 660MW ultra-supercritical circulating fluidized bed (CFB) boilers, the boiler using saline wastewater from oil production to produce superheated steam, the ultra-low pollutant emission CFB boiler, the heat recovery boiler, and the biomass-fired CFB boiler with high steam parameters, etc. The relevant equipment has been widely applied at home and abroad and demonstrates excellent performance, promoting the development of disciplines including gas-solid/gas-liquid two-phase flow, heat transfer, combustion, etc.
Prof. Lyu currently serves as a member of the Academic Committee of Tsinghua University. He is also the Chief Expert of the Expert Committee of the China Electricity Council. He once served as the Vice Chairman/Chairman of the IEA-FBC TCP, and the Chairman of the 9th/10th International Conferences on Coal Combustion. His research achievements have won several national-level science & technology prizes in China, and he has been honored with multiple individual awards. Up to now, he has authorized over 70 invention patents, published over 500 research papers, and edited 5 books. In 2023, he was elected as an academician of the Chinese Academy of Engineering (CAE).

Abstract:
Cost-effective and reliable coal-fired power generation has strongly supported the rapid economic growth in China over the past years. Circulating fluidized bed (CFB) boiler achieves satisfactory combustion performance through gas-solid fluidization, which has the capabilities of burning low-quality fuels, low-cost pollution control, and deep peak regulation, and will also play an important role in the new power system dominated by renewable energy sources.
This report elaborates on the significant progress of CFB combustion technology in China in recent years. In terms of the research on supercritical (SC)/ultra-supercritical (USC) CFB boiler technology, several theoretical and engineering challenges have been overcome, including the hydrodynamic data and design experience for SC/USC unit systems, the characteristics of solid suspension density and heat transfer in large-scale furnaces, etc. On this basis, the 600MW SC CFB boiler (Baima, China) and a series of 350MW SC CFB boilers are developed. The availability of the SC CFB boiler satisfies the power generation demand, similar with the pulverized coal-fired boiler units, which encourages the development of USC CFB boiler. The world's first 660MW USC CFB boiler (Binchang, China) have been successfully established and put into operation in 2024. The boiler operational performance is better than expected, demonstrating superior economic efficiency. Other two 700MW CFB boilers (Honghe, China; Shaoguan, China) are in commissioning.
In terms of the study of flexibility-enhanced CFB boiler technology, the dynamic response characteristics of in-furnace heat and mass transfer have been re-understood. Accordingly, several technical measures for long-term hot standby operation and rapid load change of CFB boilers have been proposed. Practice on two 300 MW subcritical and one 350 MW supercritical CFB boilers show that, the unit's output power can rapidly drop at a rate of around 10% Pe/min and then maintain long-term stable operation at an ultra-low load of 2-4 MWe, with a total hot standby duration nearly 2 hours. In addition, the load increasing rate can reach up to 4.7% Pe/min. It indicates that CFB boiler units possess the full-load peak regulation capability, providing strong support for the high-proportion consumption of renewable energy.
In addition, important breakthroughs have also been achieved, involving the biomass-fired CFB boiler with high steam parameters, the deep clearification of sintering flue gas based on CFB combustion technology, the oxy-CFB combustion technology, and the chemical looping combustion technology, etc. Some of these technologies have been successfully applied in engineering projects and have yielded good benefits.
In the future, efforts will be made to develop more advanced CFB combustion technologies that integrate safety, cleanliness, high-efficiency, high-flexibility, low carbon emissions, and intelligence, thus ensuring the high-quality development of the economy, society and environment.

Plenary Lecture II

Monday, April 7 | Purple Palace Ballroom | 10:30-11:30
Chair: Guangxi Yue (Tsinghua University, China)

Exploring fluidized-bed reactor designs in chemical looping systems

Francisco García-Labiano
Instituto de Carboquímica (ICB-CSIC), Spain

Bio:
Francisco García-Labiano is a Scientific Researcher and responsible of the "Combustion & Gasification" group at the Instituto de Carboquímica (ICB) in Zaragoza belonging to the Spanish National Research Council (CSIC). He holds a Chemistry degree, an MSc and a PhD in Chemical Engineering from the University of Zaragoza. From 2021 to 2024, he served as Deputy Coordinator of the Global Area Matter at CSIC.
His research focuses on environmental challenges in energy production, with extensive experience in clean coal technologies, including sulfur removal during fluidized bed combustion/gasification. Since 2000, he has contributed significantly to Chemical Looping Combustion (CLC) technology, a leading CO_2 Capture and Storage (CCS) approach to mitigate global warming. His more recent work emphasizes using renewable fuels (biomass, waste) in different Chemical Looping processes to achieve negative CO_2 emissions in CLC or produce clean syngas for liquid biofuels production through CL Reforming (CLR) or gasification (CLG). Fluidized bed technology is a critical component in all these processes, offering enhanced efficiency, fuel flexibility, and improved heat and mass transfer.
He has participated in over 20 international projects belonging to different EU Framework Programs (FP5, FP6, FP7, H2020, Horizon Europe) and 15+ national projects. He has authored 220+ publications, six patents, and several book chapters. Special mention deserves his 2012 review, Progress in Chemical-Looping Combustion and Reforming Technologies, which is a reference work in the field. Recognized as a Highly Cited Researcher (Clarivate Analytics, 2015–2018, Engineering area), he has supervised eight Ph.D. theses, managed a Marie Curie Fellowship, and contributed to over 150 national and international conferences.

Abstract:
Chemical looping technology has undergone significant development over the past 25 years. This technology relies on the use of an oxygen carrier (OC) to transport both oxygen and heat between two interconnected reactors, known as fuel and air reactors. The gas produced at the outlet of the fuel reactor is a nitrogen-free stream, offering numerous advantages over conventional processes. This unique characteristic has positioned Chemical Looping Combustion (CLC) as one of the most cost-effective CO_2 capture technologies available today. In this context, fluidized bed (FB) reactors have emerged as the preferred technology due to their superior capabilities in solid transport and maintaining uniform reactor temperatures. Furthermore, the use of FB allows for the utilization of a wide variety of fuels, including gaseous, liquids, and solid types. While much of the early development of CL focused on fossil fuels such as natural gas and coal, recent years have witnessed a growing emphasis on renewable fuels like biogas and biomass. This shift aligns with the rising interest in Bioenergy with CO_2 Capture and Storage (BECCS) technologies, which present an opportunity for CL to achieve negative CO_2 emissions at a relatively low cost.
The purpose of this work is to not only highlight the design characteristics of CL technology but also to provide a comprehensive overview of the units operated over the past 25 years, ranging from laboratory-scale setups to commercial units. Most of them feature a CFB-BFB/CFB configuration, where the air reactor is always designed as a circulating Fluidized Bed (CFB). However, achieving high fuel conversion efficiency in the fuel reactor often requires design enhancements. Strategies to improve efficiency include increasing the solid residence time (e.g., using a CFB instead of a bubbling fluidized bed or incorporating a carbon stripper) and enhancing gas-solid contact, such as employing a two-stage bubbling fluidized bed (BFB) design for the fuel reactor.
To date, more than 40 CL units have been operated worldwide, accumulating over 15,000 hours of operational experience. In addition, CL has gained relevant confidence by achieving Technological Readiness Level (TRL) of up to 6-7. Notable recent milestones include the successful self-heating operation (70 hours) of the 5 MWth CLC unit in Deyang, China, as part of the CHEERS project, and the demonstration of over 130 hours of autothermal operation of the Biomass Chemical Looping Gasification (BCLG) process at a 1 MWth scale in TUDA, Germany, under the CLARA project.
To achieve maturity and establish CL as a viable technology for utility companies, innovative concepts are being explored. The use of oxygen carrier particles as bed material in large FBC in the Oxygen Carrier Aided Combustion (OCAC) provides confidence on OCs lifetime. Flexible units capable of combining CLC and CFB technologies allow for adaptability to different combustion modes based on upon market conditions. Other advancements, such as the use of BCLG for producing various liquid biofuels and the development of pressurized systems, significantly enhance the likelihood of success for CL technology in the near future.
Keywords: Chemical Looping, CO_2 capture, Combustion, Gasification

Plenary Lecture III

Monday, April 7 | Purple Palace Ballroom | 11:30-12:30
Chair: Guangxi Yue (Tsinghua University, China)

Modelling of reacting flows and industry applications

Yansong Shen
University of New South Wales, Australia

Bio:
Dr Yansong Shen is a full Professor in the School of Chemical Engineering at the University of New South Wales (Tenured), and is holding a prestigious Australian Research Council (ARC) Future Fellow. He is the Director of ARC Research Hub for Photovoltaic Solar Panel Recycling and Sustainability (A$13M). He obtained his BEng and MEng degrees from Northeastern University (China) and PhD degree from UNSW. He initiated and is leading a vibrant research lab - Process Modelling and Optimization of Reacting Flows "ProMO Lab" (www.promo.unsw.edu.au). He published over 250 peer-reviewed papers in top-tier multidisciplinary journals, secured 14 ARC and >40 highly competitive research grants from national and international funding agencies, in total over AUD A$40M, established industry engagements in Australia and overseas, and won several honours and highly-competitive national fellowships e.g. ARC APDI Fellowship (2012) and ARC Future Fellowship (2019). His group designed and scaled-up several new technologies including new low-carbon ironmaking technologies, iron ore and coal/biomass processing and upgrading, and reactors design including green hydrogen electrolysers and hydrogen storage tanks. Many of them have been patented, implemented and practised in industries with measurable benefits. He was selected as the President of the Australasian Particle Technology Society, Chartered member IChemE, TMS, AIST, and invited/plenary speaker at several international conferences.

Abstract:
Process design and control play a significant role in modern industries. Most processes and reactors are very complex, as they usually involve not only multiphase flows but also heat and mass transfers related to chemical reactions and their interactions – the so-called reacting flow. The operation must be optimized in order to be competitive and sustainable, particularly under more and more demanding economic and environmental conditions. This will need continuous innovative research and development. Computer simulation and modelling, supported by online data and experiments, have emerged as an indispensable adjunct to the traditional modes of investigation for the design, control and optimization of processes, reactors, and devices. In this presentation, Prof. Shen will report his core research on process modelling of reacting flows and its applications to a range of complex processes and reactors in conventional and emerging industries. Several examples of industry applications will be used for demonstration. The modelling works are indeed helpful to understand fundamentals and optimize & develop new, cleaner and more efficient technologies with measurable industrial outcomes.

Plenary Lecture IV

Wednesday, April 9 | Purple Palace Ballroom | 08:30-09:30
Chair: Changsui Zhao (Southeast University, China)

Novel fluidized bed reactors for thermochemical conversion of biomass residues to biofuels and biochar

Xiaotao Bi
The University of British Columbia, Canada

Bio:
Dr. Xiaotao Bi is the Methanex professor in the Department of Chemical and Biological Engineering at the University of British Columbia and the Director of UBC Clean Energy Research Centre (www.cerc.ubc.ca). He is a Fellow of Canadian Academy of Engineering and Engineering Canada.
His research spans from fundamentals of fluid-particle systems to industrial applications of fluidized bed reactors, with the current focus on development of fluidized bed reactors for biomass gasification, torrefaction, and catalytic pyrolysis, and integrated assessments of bioenergy systems. He has published 450+ peer-reviewed journal papers with a Google H-Index of 86. He was the recipient of a number of awards including the AIChE Particle Technology Forum Lectureship Award (2012), CSChE Industrial Practice Award (2020), BC Bioenergy Sector Award (2022), CIESC Thermochemistry Award (2023) and International CFB & Fluidization Achievement Award (2024).

Abstract:
Biomass residues are renewable biogenic-carbon sources and have the potential to replace fossil-carbon fuels to reduce greenhouse gas emissions. Thermochemical pathways such as gasification and pyrolysis have been applied to convert biomass into drop-in biofuels, but still face both technical and economic challenges. Among the technical challenges is the poor quality of intermediates, e.g. syngas of low heating value and high tar content and bio-oil of high oxygen content and high acidity, which making them different to be upgraded to gaseous or liquid biofuels. Novel methods have been explored to improve the quality of intermediates, such as steam/oxygen gasification with catalytic tar cracking for making clean syngas and catalytic pyrolysis under plasma/microwave heating to improve bio-oil quality.
At UBC Clean Energy Research Centre, we developed a horizontal gas-pulsating fluidized bed microwave reactor for catalytic pyrolysis of biomass residues. We systematically evaluated K_3PO_4, K_2CO_3, clinoptilolite, bentonite and their combinations as potential additives for enhancing microwave absorption and catalyzing pyrolysis of biomass to improve bio-oil and biochar qualities in a bench microwave reactor. All of them demonstrated good catalytic activities in microwave-assisted pyrolysis, resulting in reduced acidity, viscosity and water content of bio-oil product. Biochar produced has a high porosity and shows good performance in capturing heavy metals and emerging water pollutants. Based on the performance of a bench scale microwave reactor, a continuously operated pilot reactor has been developed and commissioned with some unique features: stable fluidization of sawdust particles via gas-pulsation, narrow residence time distribution of sawdust particles via a horizontal configuration, and uniform microwave heating using a shallow particle bed. Hydrodynamics, particle residence time distribution and biomass pyrolysis performance of the pilot microwave-assisted gas-pulsating horizontal fluidized bed reactor are studied systematically to validate the superior performance of the novel fluidized bed reactor.
This presentation will also showcase the results generated from a pilot steam/oxygen two-stage fluidized bed reactor at UBC Pulp and Paper Centre for gasification of biomass residues to generate low-tar and high heating value syngas for high-value applications (e.g. lime kilns, methanation and F-T synthesis). The effect of various important process parameters, including equivalent ratios (ER) and steam-to-biomass ratio (S/B), reactor temperatures on syngas yield and composition, and tar yield will be presented.

Plenary Lecture V

Wednesday, April 9 | Purple Palace Ballroom | 09:30-10:30
Chair: Changsui Zhao (Southeast University, China)

Selected topics in chemical reaction engineering of fluidized bed thermochemical conversion of biomass

Piero Salatino
Università degli Studi di Napoli Federico II, Italy

Bio:
Piero Salatino is Professor of Chemical Engineering and faculty member of the Department of Chemical, Materials and Industrial Production Engineering of the University of Naples Federico II. Chairman of MedITech, Italian Competence Center on Industry 4.0 enabling technologies. Dean of the School of Polytechnic and Basic Sciences of the University of Naples Federico II (2013-2020); Dean of the Engineering Faculty of the University of Naples Federico II (2010-2013); Director of the Combustion Research Institute - National Research Council (2008-2010).
Piero Salatino is an internationally recognized researcher and scholar in the fields of chemical reactor engineering, powder technology, thermochemical conversion of solid fuels, bioprocess engineering, with a scholarly record of more than 350 scientific articles in international archival journals and more than 400 articles in proceedings of international conferences. Member/past member of the editorial boards of Powder Technology, Fuel Processing Technology, Industrial & Engineering Chemistry Research, Combustion & Flame, Combustion Science and Technology, Scientific Reports, Frontiers in Energy Research. Former President of the Italian section of the Combustion Institute (1997-2005), he is member of the historical Accademia Pontaniana.

Abstract:
Fluidised bed thermochemical processing of biomass (combustion, gasification, pyrolysis) has a long track record of success and offers a number of viable routes for the effective utilisation of biomass for renewable energy and/or sustainable production of chemicals. As advanced biorefinery-oriented biomass utilisation schemes come of age, chemical reaction engineers are increasingly challenged to improve the design and operation of fluidised bed converters to achieve ever more "premium" performance: reduced pollutant emissions, maximum yield and selectivity, improved reliability and robustness of operation. Despite the attractive features of fluidised beds, precise tailoring of process conditions is required to drive biomass conversion along the prescribed chemical pathways.
The lecture addresses the topic with a comprehensive overview of the basic physico-chemical processes associated with fluidised bed thermal conversion of biomass: particle heating and drying, thermal depolymerisation and devolatilisation, heterogeneous and gas phase reactions, hydrodynamic interaction of biomass-generated fluids with the fluidised suspension, particle and volatile segregation, particle attrition/fragmentation and fine particle generation. The relevance of the fundamental processes to reactor engineering is critically discussed, with particular emphasis on the mechanisms responsible for particle and gas phase mixing/segregation. The development of design criteria inspired by chemical reaction engineering principles, with due consideration of the complex phenomenology of biomass thermal conversion in fluidised beds, is exemplified with reference to selected cases belonging to the pyrolysis-based biorefinery pathway.

Plenary Lecture VI

Wednesday, April 9 | Purple Palace Ballroom | 10:50-11:50
Chair: Edward J. Anthony (University of Ottawa, Canada)

Integrated solutions featuring fluidized bed technology for CO_2 neutral/negative industry

Vesna Barišić
Sumitomo SHI FW Oy, Finland

Bio:

Dr. Vesna Barišić is currently Principal Engineer in Technology Team at Sumitomo SHI FW (SFW) with extensive expertise in combustion chemistry, and so-called SAFEC countermeasures. SAFEC is SFW term that stands for slagging, agglomeration, fouling, erosion, and corrosion phenomena in fluidized beds. She has over two decades of experience in research and development related to thermal conversion processes, emissions reduction, and innovative solutions for decarbonization in the energy sector.

Vesna received D.Sc. (Tech), degree in Chemical Engineering at Åbo Akademi University in Finland focusing on NO and N_2O emissions in fluidized bed combustion of biomass and waste.

In her current position at SFW, Vesna oversees fuel assessment and SAFEC countermeasure strategies supporting proposals, projects, and service activities.

During her career, Vesna was leading R&D team at SFW and actively working on characterization methods and modeling of fuel's ash behavior in fluidized bed combustion, lab to full scale testing, emissions, and innovative decarbonization technologies.

Vesna was leading SFW activities in several joint research projects supported by national and EU funding agencies, focusing on fuel and operational flexibility, retrofitting existing coal-fired CFBs to meet low CO_2 emission targets, novel materials for pressure parts, and CO_2 capture strategies.

Abstract:

The paper discusses innovative decarbonization solutions featuring fluidized bed technologies to achieve net zero or even net negative CO_2 emissions in energy generation, waste recovery, transportation, and hard-to-abate industries. These integrated solutions are being developed at Sumitomo SHI FW (SFW) to meet the international climate change mitigation goals and our customer' objectives of sustainable, reliable, and economically viable energy supply. All SFW technologies are designed for lowest CO_2 emissions, however integrating multiple solutions can lead to even lower emissions and ultimately negative CO_2.

This paper discusses integration of following technology areas that can enable reaching various, user-specific decarbonization goals:

1. Energy Generation from residual biomass and/or waste fraction using CFB or BFB technologies.
2. Carbon Capture based on:

a. SFW CaL+: Calcium looping for post-combustion CO_2 capture from, primarily but not exclusively, cement and steel industries based on CFBs,

b. SFW Oxy+: Oxy-fuel combustion for high-purity and net negative CO_2 capture with simultaneous energy generation based on CFBs,

c. SFW HPC+: Post-combustion CO_2 capture using Hot Potassium Carbonate enables net negative CO_2 capture when combined to, for example, CFB or BFB energy generation, or other sources of CO_2.

3. Gasification for fuel synthesis converts biomass and waste into syngas, producing aviation fuels, methane, hydrogen, and chemicals in CFB gasifiers. It enables CO_2-negative outcomes when combined with CO_2 capture technologies.
4. Energy Storage, based on Liquid Air Energy Storage (LAES), stores excess renewable energy for grid stability. Benefits of integration with above technologies (1-3) as well as with hydrogen electrolysis, and/or gas processes is also discussed.

Keywords: net zero CO_2 emissions, CFB, BFB, carbon capture, gassification, LEAS

Keynote Lecture 01

Monday, April 7 | Room Golden Thread (Session 2A) | 15:50-16:20

Radiation-based imaging techniques for detailed investigation of particle flows

J. Ruud van Ommen
Delft University of Technology, The Netherlands

Bio:

Ruud van Ommen (PhD 2001, currently full professor) is a chemical engineer by training. He has been visiting professor at Chalmers University of Technology (Gothenburg, Sweden) and the University of Colorado (Boulder, USA). He has a broad expertise in multiphase reactors and particle technology. In the past decade, he expanded his research to the scalable production of advanced, nanostructured materials. In 2011, he started an ambitious program (funded by an ERC Starting Grant) to investigate the interplay between agglomeration and coating of nanoparticles in the gas phase. This fundamental work has led to practical applications, e.g. for energy conversion and storage, and for pharmaceuticals production. He is co-founder of Powall, a spin-off company working on nanocoating particles. The second part of his research efforts are embedded in TU Delft's e-Refinery institute. The efforts of van Ommen's team are mostly aimed at developing scalable reactor configurations for e.g. CO_2 reduction, and production of the required materials.

Abstract:

There is an increasing interest in fine particles, a few micron or less than a micron in diameter. Such particles are often difficult to process because of their cohesive nature. Similar problems are encountered for wetted particles. This means, for example, that a regular fluidized bed does not provide sufficient mixing for such cohesive particles, but that additional methods such as stirring or vibration should be applied. This makes the particle flow even more complex than the already complicated behaviour of a fluidized bed. In recent years, we have developed and deployed X-ray imaging and single-photon emission radioactive particle tracking to obtain detailed information about vibrated fluidized beds, stirred fluidized beds and horizontal stirred beds. In this work, we will discuss some examples of results obtained with these techniques.

The X-ray setup consists of a triplet of cone-beam sources (X-ray tubes) and three 1548-by-1524 pixel detector panels. It can be used to study systems up to 20 cm in diameter. For imaging, we often use only a single source and detector panel. The X-ray imaging reveals that for a fluidized bed of micro-silica, vibration reduces channelling, but does not significantly change the agglomerate size. Vertical vibration shows to be much more effective than elliptical vibration. However, it cannot prevent stratification in the bed. When using a stirrer to enhance the powder mixing, the design of the stirrer is of large influence: it should maximize the sweeping coverage and avoid the creating of gas pathways. When required, the three sources and panels can be used to make a full 3D tomographic reconstruction of a system under study.

While the X-ray imaging gives precise information about the density distribution, single-photon emission radioactive particle tracking can be used to obtain the trajectory of a representative particle. We use a polystyrene bead with an activated gold core – emitting gamma-rays – as the tracer particle. Three identical γ-radiation slit collimator detectors are placed equidistantly around the horizontal stirred bed. We demonstrate that increasing the agitator rotation speed and the fill level of the bed both lead to an increase in the solids circulation.

Keywords: X-ray imaging, tracer particle, cohesive flow, tomography, particle tracking

Keynote Lecture 02

Tuesday, April 8 | Room Golden Thread (Session 4A) | 10:30-11:00

Seen, known and thoughts through ~40 years CFB researches

Leming Cheng
Zhejiang University, China

Bio:

Leming Cheng is a professor at the Institute for Thermal Power Engineering and the State Key Laboratory of Clean Energy Utilization, Zhejiang University. He engages in research on clean combustion theory and engineering technology, including circulating fluidized bed, dual-bed fluidized bed systems, large-scale fluidized bed numerical simulation, pressurized circulating fluidized bed; porous media combustion, heat storage and energy saving, low calorific value gas utilization, near-zero emissions, measurement of combustion products of special fuels.

Dr. Cheng's main research area is circulating fluidized bed theory and technology, with 38 years of research and engineering experience to date. This includes the test rig design and construction, measurement technology, lab tests, component testing and design, CFB boiler thermal calculation and design, model and simulation, commissioning and optimization of CFB boilers.

He is an expert of the Expert Group for the independent development of 600MW ultra-supercritical circulating fluidized bed boilers by the National Development and Reform Commission, expert of the Expert Group for the development and engineering demonstration of Weihe 660MW ultra-supercritical CFB boilers, an expert of the National Power Industry CFB Collaboration Network Expert Committee.

He has led and participated in over 60 national, provincial and enterprise research projects, including the National Program on Key Basic Research Project (973 Program), the National Natural Science Foundation of China, 863 Program, the Eleventh Five-Year Plan Program, the Twelfth Five-Year Plan Program, the Thirteenth Five-Year Plan Program, the Fourteenth Five-Year Plan Program, the Main Direction Program of Knowledge Innovation of Chinese Academy of Sciences, the Ph.D. Programs Foundation of Ministry of Education of China.

He has published over 100 academic papers, co-authored 4 monographs, co-translated 1 monograph and awarded more than 50 invention patents.

Abstract:

The CFB combustion technology has been developed to a so high level today. More than 50 units of 350 MW CFB boiler were put into operation and the largest operated one is 660 MW CFB boiler with ultra-critical steam parameters.

Myself experienced the development of the CFB theoretical and technology since 1987. It would be interesting to looking back the development of the CFB technology from lab experiments, numerical simulation to the industrial application.

The presentation discusses the issues I impressed. The content includes the test method and facilities, measurement technique, boiler and parts' design, field commissioning, operation problems and solution, model development, software development, numerical simulation, industrial application related to hydrodynamics, combustion, heat transfer, emissions, fouling and ash deposition, wear and etc.

Hydrodynamic is the fundamental of the CFB technology. All issues in a CFB system are related each other and should be considered together in the development of the technology and problem solving. Numerical solution has become a useful tool in the design of the large-size CFB boilers. Outlook of the CFB technology is also discussed.

Keynote Lecture 03

Tuesday, April 8 | Room Golden Thread (Session 6A) | 15:50-16:20

Char gasification in chemical looping combustion

Haibo Zhao
Huazhong University of Science and Technology, China

Bio:
Professor Haibo Zhao received the Ph.D. degree in Thermal Engineering from Huazhong University of Science and Technology in 2007. He is currently the Vice Director of State Key Laboratory of Coal Combustion at Huazhong University of Science and Technology. His research area is chemical looping combustion, as well as combustion synthesis of functional nanoparticles. He has won the National Excellent Youth Fund, Alexander von Humboldt Foundation Fellowship and the Fellow of The Combustion Institute. His research work has won the Outstanding Paper Award of the International Combustion Institute, the Best Paper Award of the International Chemical Looping Conference.

Abstract:
Chemical looping combustion (CLC) has emerged as a cost-effective technology for carbon capture at the combustion source. After decades of development, the CLC process has been demonstrated in units of different size, from bench scale to megawatt-scale pilot plants, however, more research is still needed to bring the technology to a fully commercial level. The first challenge is the severe rate mismatch of different reactions of solid fuel. Due to insufficient char gasification rate, most of the reported continuous CLC units could not attain both Carbon capture efficiency and coal combustion efficiency above 95%, therefore, it is necessary to enhance the char gasification rate. In this report, the particle-resolved simulation with heterogeneous reactions was conducted, in which the effects of both internal and external heat/mass transfer on char conversion characteristics were carefully studied. A quantitative formula was attained to describe the complex relationship between rich H_2O-char gasification, rich CO_2-char gasification and lean O_2-char combustion, providing appropriate condition to attain significant enhancement of char conversion rate during solid fuel CLC.
Keywords: Chemical Looping Combustion, Single Particle Modelling, Heterogeneous Reaction, Oxygen Uncoupling, Oxygen Carrier

Keynote Lecture 04

Monday, April 7 | Room Green Willow (Session 2B) | 15:50-16:20

Advanced measurement techniques for gas-solids fluidized beds for coal and biomass combustion

Haigang Wang
University of Chinese Academy of Sciences, China

Bio:
Haigang Wang is a principal research scientist in the Institute of Engineering Thermodynamics at the Chinese Academy of Sciences, where he also received his PhD in the same field. He was working with the University of Manchester as research associate during 2005 and 2010. Haigang Wang's research interests include flow dynamics simulation and measurement of multi-phase flows, mathematical modeling and process control for fluidized bed drying, process tomography and 3D image reconstruction, monitoring and control for granulation, drying and coating processes in the pharmaceutical industry. Dr. Wang has participated in several key projects as PI funding by EPSRC, TSB in UK and NSFC projects in China related with energy and pharmaceutical industry. He has been shortlisted as a finalist for the IET Innovation awards (highly commended for the IET Innovation Awards for Measurement in Action for 2009). He has published more than 200 scientist papers including the best paper award in international process tomography conference in 2008 in Poland and one international patent which has been demonstrated in GEA-Aeromatic in Switzerland and UK, AstraZeneca in Sweden and DuPont in USA. Three invited reviewer papers have been published in Power Technology, Chemical Enginering Science and Applied Thermal Engineering. He has given several keynote lectures in international conference including 2014 IEEE Imaging System and Technology Conference in Greece, 2015 Asian Particle Technology Conference in South Korea, 2018 World Congress on Particle Technology Congress in USA and 2019 International Fluidization XVI conference in China, 2024 CFB14 conference in Taiyuan and APT2024 in Syndey. Dr. Haigang Wang is Editor of Measurement Digitatizon, Associate Editor of Measurement Energy, Guest Editor for Applied Thermal Enginering and Flow Measurement and Instrumentation.

Abstract:
Gas-solids fluidized beds are typical used in power and energy industry for coal and biomass combustion, as well as gasification process. The complex and dynamic flow behaviors within these reactors present significant challenges to improving energy efficiency and minimizing environmental impacts. Understanding the hydrodynamics and developing reliable methods to measure the process parameters are essential to control and optimize the performance of the process. This talk will provide a comprehensive analysis of the current measurement approach and sensor technology used in gas-solids fluidized beds. Traditional measurement techniques with recent advances in sensor technology for industrial applications will be given which focused on key parameters including solids concentration, velocity, flux, temperature, and emissions. Fluidized bed process control based on these measurements and the potential for integrating machine learning techniques will be given. Finally, the challenges faced in large-scale fluidized beds and explores the development of measurement technologies for high-temperature and high-pressure environments will also be given and discussed.
Keywords: Fluidized beds, Measurement, Probes, Process tomography, Machine learning

Keynote Lecture 05

Tuesday, April 8 | Room Green Willow (Session 4B) | 10:30-11:00

Basic research and technology development about clean and low-carbon utilization of solid waste containing carbon

Fangqin Cheng
Shanxi University, China

Bio:
Professor Fangqin Cheng is the Director of State Key Laboratory of Technologies for Efficient Utilization of Coal Waste Resources. In recent years, Prof. Cheng has mainly engaged in research and development in solid waste recycling and utilization. She has led to completion a number of major national and provincial projects on the utilization of coal gangue, fly ash, low grade resources. In 2021, Professor Cheng was awarded with “The Second Class National Prize for Progress in Science and Technology” recognizing her achievements in coal waste utilization.

Abstract:
This keynote speech presents the basic research and technology development about clean and low-carbon utilization of solid waste containing carbon, such as coal gangue, coal slime and so on. The general idea of coal gangue utilization based on the properties of resource and environment. An innovative technology of oxy-combustion, NH_3 combustion, and the new development of depth peak regulation digital platform were comprehensively introduced. These basic research and technology development will provide a way of resource utilization for solid waste containing carbon.
Keywords: Solid waste; Resource utilization; Clean; Low-carbon

Keynote Lecture 06

Tuesday, April 8 | Room Green Willow (Session 6B) | 15:50-16:20

The possibility of using gasification in dual FB-CFB reactors and iron oxides chemical cycles

Georgy A. Ryabov
All Russian Thermal Engineering Institute (VTI), Russia

Bio:

Was born on November, 7, 1947 in Moscow, Russia. In 1972 graduated from power Engineering faculty (on specialty "steam generators of power plants") of Moscow Power Engineering Institute. Since 1972 till now he is working in All-Russian Thermal Engineering Institute as engineer, senior engineer, junior and senior researcher, chief of Special boiler laboratory.

He was responsible for studies relations to hydrodynamics and steam-water separation into equipment of Nuclear and Thermal Power Plants. In 1986 granted the Master (Cand. Sc.) degree in engineering. Since 1988 he has responsible for VTI programmes on Circulating Fluidized Bed Boilers, investigations on solid fuels combustion and hydrodynamics processes in CFB boiler. In 2016 granted the Doctor of Engineering. He is a member of Advisory body of International Conferences on FBC and CFB. He is a member of executive committee of IEA Fluidized Bed Conversion Implementation Agreement.

He is the author of more than 300 scientific publications and 12 inventions. The field of his scientific interest is: hydrodynamics and heat-mass transfer in CFB and FB units, solid fuels (coal, wastes and biomass) combustion processes, environments, CO_2 capture (CLC and oxyfuel), polygeneration systems with power and useful product generation.

Abstract:

Recently, attention has been drawn to a process that combines a chemical cycle and steam reforming to produce ultrapure hydrogen without additional purification steps and a CO_2 stream ready for disposal or use. The process makes it possible to produce hydrogen from natural gas and fuel gasification products, including biomass, using three interconnected reactors with metal oxides by supplying steam with simultaneous CO_2 capture. The efficiency of the process is largely determined by the content of CO and H_2 in the synthetic gas, on the one hand, and ballast gases, on the other. Often, to reduce the content of ballast gases (nitrogen), oxygen blast in a gas generator is used. Another way to increase the energy value of synthetic gas could be the use of gasification in a system of dual reactors. Such systems are becoming widespread in relation to technologies for generating electricity, heat and useful products (generator gas, motor fuels).

A new system has been developed that combines the benefits of biomass fuel, chemical cycling and syngas production in a multi-generation dual reactor system, which looks promising in achieving maximum efficiency in the carbon-negative hydrogen production process. The methodology and results of calculations are presented. The maximum calculated efficiency for hydrogen 75.93% is given, which fits well into the overall picture of the results of modeling similar systems for producing hydrogen in chemical cycles with metal oxides and can be considered as a guideline when developing technical solutions within the framework of the proposed basic technological scheme. The option of supplying additional dried fuel to the reactor was considered as an alternative way to ensure the ash temperature required for gasification at the outlet of the CFB reactor, as well as the option of using a mixture of woody biomass and the Kuznetsk coal enrichment product as fuel. Calculations were performed for two extreme cases of iron oxides reduction to Fe and FeO.

The hydrodynamic parameters of CFB reactors were calculated in order to achieve the specified flow rates of circulating material required to maintain temperatures in the reactors. The dimensions of the reactors are determined and diagrams of their relative placement are presented. A methodology is presented and an assessment of capital and operating costs is performed. The cost of hydrogen over the life cycle of the installation has been estimated (in various options from 1.45 to 1.93 US dollars / kg) under conditions of using biomass in the absence of taken into account CO_2 emissions. About 2/3 of the CO_2 consumption is already ready for storage, so it remains to remove CO_2 only from the flue gas stream from the CFB reactor of the gas generator. This value is at the level of known data for similar natural gas plants and is lower compared to the technology of steam reforming of natural gas with CO_2 capture.

Keywords: Hydrogen production, carbon footprint, biomass, steam reforming, chemical cycles, CO_2 capture, dual fluidized bed reactors

Keynote Lecture 07

Monday, April 7 | Room Beautiful Bamboo (Session 2C) | 15:50-16:20

CFD-DEM simulations of fluidization and heat transfer behavior of spherocylindrical particles in a spouted bed

Ramesh K. Agarwal
Washington University in St. Louis, USA

Bio:
Prof. Ramesh Agarwal is the William Palm Professor of Engineering in the department of Mechanical Engineering and Materials Science at Washington University in St. Louis. From 1994 to 2001, he was the Bloomfield Distinguished Professor and Executive Director of the National Institute for Aviation Research at Wichita State University in Kansas. From 1978 to 1994, he was the Program Director and McDonnell Douglas Fellow at McDonnell Douglas Research Laboratories in St. Louis. Dr. Agarwal received PhD in Aeronautical Sciences from Stanford University in 1975, M.S. in Aeronautical Engineering from the University of Minnesota in 1969 and B.S. in Mechanical Engineering from Indian Institute of Technology, Kharagpur, India in 1968. Over a period of 50 years, Dr. Agarwal has worked in Computational Fluid Dynamics, Computational Acoustics and Electromagnetics, Computational Materials Science and Manufacturing, Multidisciplinary Design & Optimization, and their applications to problems in mechanical and aerospace engineering, and in energy and environment. He has made both fundamental and applied contributions to modeling, simulation and optimization of aerospace products, turbomachinery and pumps, chemical looping combustion (CLC), geological sequestration of carbon and wind turbines among others. His most recent work involves application of Machine Learning/Neural Networks to these disciplines to improve performance. He is the author and coauthor of over 600 publications and has given many plenaries, keynote, and invited lectures at various national and international conferences worldwide in over sixty countries. He serves on many university (some international), government and industry advisory boards. He is a Fellow of 32 professional societies including American Institute of Aeronautics and Astronautics (AIAA), American Society of Mechanical Engineers (ASME), Institute of Electrical and Electronics Engineers (IEEE), Society of Automotive Engineers (SAE), American Association for Advancement of Science (AAAS), American Physical Society (APS), and U.K. Institute of Physics (IOP) among others. He has received many prestigious honors and national/international awards from various professional societies and organizations including the AIAA Reeds Aeronautics Award, SAE Medal of Honor, ASME Montgomery Distinguished Aerospace Innovation Award, SAE Aerospace Innovation Award, ASME Fluids Machinery Design Award, ASME Honorary Fellowship, Royal Aeronautical Society Honorary Fellowship and European Academy of Sciences and Arts membership.

Abstract:
Fluidization of spherocylindrical particles is often involved in biomass combustion, drug delivery, food drying, etc. By spherocylindrical particles we mean elongated spherical particles, such as non-spherical capsule pills and biomass fuels. Knowledge of the flow and heat transfer mechanisms of spherocylindrical particles can improve related industrial processes. However, the particle restitution coefficient has an important influence on the gas-solid two-phase flow process in a fluidized bed because it reflects the degree of kinetic energy recovery after particle collision. Therefore, the coupled CFD-DEM method is used in this study, and the accuracy of the computational model is verified by high-speed photographic experiments. The kinetic and heat transfer characteristics of spherocylindrical particles with different recovery coefficients are investigated from both microscopic and macroscopic perspectives, which mainly include particle collision, energy characteristics, mixing behavior, and particle heat transfer. The results show that the collision frequency, mixing mass, velocity, and drag force of the particles increase as the particle restitution coefficient increases. Furthermore, the cooling rate of the particles is accelerated. This indicates that the restitution coefficient of particles is one of the parameters that cannot be neglected in the study of fluidized bed particle flow and heat transfer.
Keywords: Fluidization, Spherocylinserical partile, CFD-DEM, Spouted bed, Particle mixing, Heat transfer

Keynote Lecture 08

Tuesday, April 8 | Room Beautiful Bamboo (Session 3C) | 08:30-09:00

Numerical modelling of particle dispersion in liquids using DEM-SPH

Charley Wu
University of Surrey, UK

Bio:
Prof. Chuan-Yu (Charley) Wu is a professor of chemical engineering in the Department of Chemical and Process Engineering at the University of Surrey. UK. Prof. Wu has been the coordinator of two European Union (FP7 and H2020) consortia IPROCOM (2013-2016, €3.8m) and MATHEGRAM (2019-2023, €4.2m), which involve the development of computational tools for pharmaceuticals, and granular materials. Prof. Wu is an executive editor for Powder Technology, a leading peer reviewed journal on particle systems. He is also the Chief Editor for the "Materials Processing Engineering" subject of "Frontier in Chemical Engineering". He co-authored a monograph on "Particle Technology and Engineering" published by Elsevier in 2016 and edited two books entitled "Discrete Element Modelling of Particulate Media" and "Particulate Materials: Synthesis, Characterisation, Processing and Modelling" published by RSC publishing. He also edited five journal special issues and published over 160 scientific papers. He has given more than 100 invited presentations and seminars at international conferences, industrial companies and universities worldwide. Prof. Wu is a member of the advisory and editorial board for "Particuology", "Acta Pharmaceutica Sinica B (APSB) " and "Journal of Engineering".
Prof. Wu's expertise lies in discrete element methods, finite element analysis, Machine learning, modelling and simulations, pharmaceutical engineering, particle technology and granular materials. Prof. Wu has been working closely with global companies over the last 20 years in developing advanced numerical modelling techniques for manufacturing pharmaceuticals and fine chemicals. His research has been supported by global pharmaceutical companies including Pfizer, AstraZeneca, Genentech, Sanofi, Janssen, Alkermes and MSD, in addition to EPSRC and EU.

Abstract:
Mixing powdered substances in liquids using stirrers is a common process in various industries, including chemicals, pharmaceuticals, food and drinks This phenomenon is typically studied numerically due to the complexities associated with nonlinear fluid-particle interactions. In this study, a solver combining Smoothed Particle Hydrodynamics (SPH) and the Discrete Element Method (DEM) was developed to investigate the mixing behaviour of particles in a water tank under the influence of a stirrer operating at varying speeds. The SPH method is utilised to simulate the fluid phase, while the DEM captures the dynamics and interactions of the solid particles. A fully resolved coupling between solid and fluid particles is achieved by discretising the solid particles into surrogate SPH particles. Validation of the solver involves assessing the fluid dynamics through a Poiseuille flow problem and verifying the DEM performance via benchmark tests, including particle-particle and particle-wall interactions. The coupled model is further validated using simulations of a single particle entering a two-dimensional steady tank and a three-dimensional case of a settling cubic particle. Following validation, the mixing behaviour is examined in two scenarios: one involving spherical particles of uniform radius and another featuring particles of two different radii. The results demonstrate that at lower stirrer speeds, particles initially aggregate and remain near the centre of the tank. As the stirrer speed increases, the circulation induced by the fluid motion causes particles to accumulate near the tank corners.

Keynote Lecture 09

Tuesday, April 8 | Room Beautiful Bamboo (Session 3C) | 09:00-09:30

LBM-DEM model for fast simulation of gas-solid fluidization and LMFD software

Limin Wang
Institute of Process Engineering, Chinese Academy of Sciences, China

Bio:
Limin Wang is a professor of Institute of Process Engineering (IPE), Chinese Academy of Sciences (CAS), and the director of Mesoscience Division. In 2008, He received his Ph.D. in Chemical Engineering from IPE, CAS. He was a postdoctoral fellow at Centre National de la Recherche Scientifique (CNRS), France from 2008 to 2009. He was selected as a member of Youth Innovation Promotion Association of CAS in 2012, and he won the Hou Debang Chemical Technology Youth Award in 2017 and the Young Particle Scientist Award in 2020. Prof. Wang's research interests focus on turbulent and multiphase flows, mesoscience, and industrial simulation software development. He currently holds several key positions, such as Secretary-General of Simulation & Virtual Process Engineering Committee, Youth Committee member of Chinese Society of Particuology, editorial board member of Granular Matter and a corresponding expert of Engineering. He has published over 100 peer-reviewed articles such as Nature Communications and has developed a GPU-Accelerated Lattice-based Multiphase Fluid Dynamics (LMFD) software. He is co-author of "Fundamentals and Applications of Computational Fluid Dynamics" and has contributed to three Springer monographs. He has successively presided over 20 projects such as National Key R & D Program, National Numerical Windtunnel Project, NSFC, as well as projects funded by GE, Unilever, Total, Baosteel, and CATL.

Abstract:
Two distinct coupled lattice Boltzmann method and discrete element method (LBM-DEM) approaches were developed for modeling gas-solid fluidization at different levels (different time-spatial scales and accuracy), namely lattice Boltzmann based particle-resolved direct numerical simulation (LB-based PR-DNS) [1] and lattice Boltzmann based discrete particle simulation (LB-based DPS) [2]. LB-based PR-DNS where particle size is much larger than lattice size, can directly simulate the flow and detailed dynamic interaction at gas-solid interface, while LB-based DPS where lattice size is much larger than particle diameter, achieves a good balance between computational accuracy, time consumption and computational efficiency, and it can obtain local information such as particle trajectories, as well as the macro information such as time-averaged flow field (Figure 1). To improve computational efficiency,GPU parallel computation of LBM-DEM is implemented [3]. Finally, GPU-accelerated LBM-DEM models, both LB-based DNS and DPS, are powerful tools in exploring gas-solid fluidization, which enabled development of lattice-based multi-fluids dynamics (LMFD) simulation software and new constitutive relationships are proposed with consideration of scale-dependence [4-6].

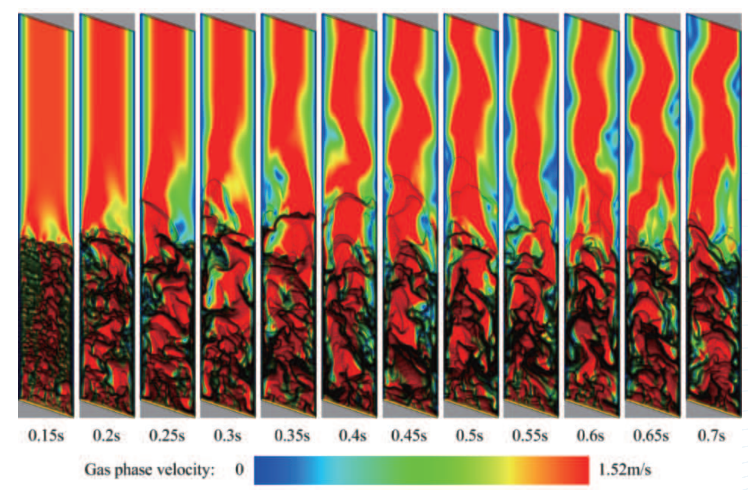

Figure 1. Snapshots of LBM-DEM simulated gas-solid fluidization.

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Keywords: LBM-DEM, PR-DNS, discrete particle simulation, gas-solid fluidization, LMFD software

Keynote Lecture 10

Tuesday, April 8 | Room Beautiful Bamboo (Session 4C) | 10:30-11:00

AI-based understanding and prediction of fluidized bed phenomena

Jia Wei Chew
Chalmers University of Technology, Sweden

Bio:
Jia is a Professor of Chemical Engineering at Chalmers University of Technology in Sweden. Prior to this, she was the Technical Director at Particulate Solid Research Incorporated in Chicago. And before that, she was an Associate Professor of Chemical Engineering at Nanyang Technological University in Singapore. Her research focusses are on multiphase flow and separations. She has over 270 publications and 10 patents/technical disclosures. Her research has been recognized by the AIChE (American Institute of Chemical Engineers) Particle Technology Forum (PTF) Best Ph.D. Dissertation Award, the Singapore Youth Award and the AIChE PTF Sabic Young Professional Award.

Abstract:
Fluidized beds remain at the forefront of the present time-critical sustainability challenges, e.g., carbon capture by particulate sorbents, methane-to-hydrogen, plastic-to-chemicals, etc. In view of the exigency towards net-zero, today's scale-up efforts need to be accelerated, leveraging the advanced new tools that have become readily available. This talk focuses on leveraging AI tools to address some of the barriers in the design and scale-up of fluidized beds.

The first part discusses using black-box machine-learning methods in fluidization to advance understanding and provide adequate predictions. Experimental fluidized bed riser data encompassing different fluidization regimes and particle types were collated to train data-driven models to attempt to (i) provide mechanistic insights on various fluidization phenomena, and (ii) develop models to provide predictive capability without physical governing equations. Random forests were used to determine the relative influence of the parameters, self-organizing maps were utilized to assess the interplay among the variables, while neural networks were employed to develop predictive models. The tools were applied for various fluidization phenomena of interest, spanning overall entrainment, local mass flux, clusters, bubbles, and species segregation.

The second part overviews the judicious incorporation of AI tools to expedite fluidized bed scale-up to exploit the benefits for novel green applications. Advanced new tools have become readily available, but the problem is that such tools are often neglected, inadequately implemented, ineffectively resourced and/or poorly understood. Here, the traditional pathway for scale-up is first laid out, then a new pathway that leverages the accessible advanced tools is proposed.

Keynote Lecture 11

Tuesday, April 8 | Room Beautiful Bamboo (Session 6C) | 15:50-16:20

Demonstration of advanced predictive and prescriptive algorithms to control large scale CFB unit based on digital twin technique

Wojciech Adamczyk
Silesian University of Technology, Poland

Bio:
Wojciech Adamczyk has been serving as a professor in the Department of Thermal Technology at the Silesian University of Technology since 2022. He participates in executing projects and scientific research that are crucial for technological advancements in Poland and Europe. The solutions developed, including AI-supported diagnostic systems for industrial uses, are globally innovative. Due to the professor's scientific expertise, distinctive technological solutions are devised and applied in various industries, such as the energy sector. He oversaw the efforts of research groups involved in projects funded by both national and international sources. These projects frequently entail research performed within a scientific-industrial consortium. The professor's research unveils new pathways, such as in the area of utilizing green ammonia as an energy carrier. Adamczyk is deeply involved in researching the application of green ammonia as a fuel to achieve decarbonization in the agricultural and energy sectors.

Abstract:
This study showcases the use of sophisticated predictive and prescriptive AI algorithms to manage a large-scale CFB unit. The effectiveness of these algorithms was exhibited through their implementation in a CFB~1300 power unit with a 460 MWe capacity. An AI-based prescriptive technique was devised to govern specific power plant equipment and optimize boiler performance. This system's prowess was highlighted by its ability to automatically detect issues in two vital components of the power unit: the electrical transformer and the combustion chamber's membrane wall. The proposed approach incorporates an informatics architecture that unifies adaptive predictive and prescriptive models with control mechanisms. This fusion encompasses optimization algorithms, digital twins (which are numerical representations of crucial components), databases, and algorithms designed for managing the states of components. Moreover, this study introduces an innovative hybrid modeling framework for a CFB boiler. The approach integrates a computational fluid dynamics (CFD) model with practical macro-scale models and a data-driven reduced order model to represent the boiler's physical and empirical dynamics comprehensively. By employing a range of modeling strategies, the system effectively characterizes process features at multiple scales, facilitating a rapid and precise prediction mechanism. The inclusion of the CFD model refines the results of the macro-scale models by offering detailed flow insights, while the reduced order model significantly decreases computation time by a factor of 1350. Validation of the hybrid model and its components was conducted using actual measurement data, demonstrating high accuracy in predicting crucial process variables. The designed model functions as a predictive and prescriptive tool to assist operators in optimizing boiler operations and averting irregularities.
Keywords: numerical modeling, combustion, digital power plant, prediction, optimization, prescription

Keynote Lecture 12

Monday, April 7 | Room Ginkgo (Session 2D) | 15:50-16:20

Measurements of the gas-solid non-uniformity characteristics in a 600 MW supercritical circulating fluidized bed boiler

Jianbo Li
Chongqing University, China

Bio:
Dr Jianbo Li is currently an associate professor at Chongqing University. His research interests focus on optimization of large-scale CFB combustion systems, control of ash deposition and bed agglomeration during CFB combustion of high-alkali fuel, and recently the fluidised combustion of ammonia. He has led two National Natural Science Foundation projects, directed a sub-project of the National Key R&D Program, and is advancing 8 industry-university collaborative R&D initiatives. With regards to scholar outputs, he has published over 60 SCI/EI-indexed journal papers.

Abstract:
This keynote speech presents a systematic study on the non-uniformity characteristics of gas-solid flow and the resulting combustion in a 600MW supercritical circulating fluidised bed (CFB) boiler. Through on-site testing, the response of coal feeding system, distribution of primary air, diffusion of secondary air, lateral diffusion of coal particles, and the distributions of CO and nitrogen oxides within the furnace were comprehensively analysed. Based on these findings, technical approaches to enhance the flow and combustion uniformity in the CFB furnace are proposed, which will provide a theoretical foundation for the low-load operation and rapid load variation of the studied large-scale CFB boilers and the alike.

Keynote Lecture 13

Tuesday, April 8 | Room Ginkgo (Session 4D) | 10:30-11:00

Some operating issues with high ash fuels in CFBC boilers and possible solutions

Alar Konist
Tallinn University of Technology, Estonia

Bio:
Professor Konist is the Director of the Department of Energy Technology and leads the Sustainable Energy and Fuels Research Group at Tallinn University of Technology. He completed his postdoctoral work at Brown University in 2014/2015 and has represented Estonia in the IEA and IEA-CERT (2012-2014). Prof. Konist collaborates extensively with both private and state-owned energy companies.
His research focuses on sustainable energy, cleaner production, and the utilization of solid residues like ash. He is particularly involved in CCS and CCU technologies, including oxyfuel CFBC technology and chemical loop gasification (CLG). Additionally, he explores oil shale activation and the co-pyrolysis/co-gasification of biomass and oil shale.
Prof. Konist is a member of the Executive Committee and Chair of the IEA Technology Collaboration Programme in Fluidised Bed Conversion (FBC) of fuels. He played a key role in designing and constructing a new research laboratory for thermochemical processes, aimed at renewable energy and alternative fuels. In 2023, he was nominated by the Estonian Academy of Sciences and elected by EASAC to the working group on the Security of Sustainable Energy Supply (SoSES).

Abstract:
High ash content in fuels can cause several operational problems in CFBC boilers, including agglomeration, fouling, and increased wear on boiler components. Agglomeration occurs when ash particles stick together, forming larger clumps that can disrupt fluidization and lead to operational instability. Fouling, the build-up of ash on heat transfer surfaces, reduces efficiency and can cause overheating and damage to boiler tubes. In addition, the abrasive nature of high ash fuels accelerates wear on critical components, increasing maintenance costs and downtime.
Several strategies can be employed to address these issues. Optimizing bed temperature and fluidization velocity can help prevent agglomeration and maintain stable operation. Regular cleaning and maintenance schedules are essential to manage fouling and ensure efficient heat transfer. The use of advanced materials and coatings can reduce wear and extend the life of boiler components. In addition, the implementation of real-time monitoring and control systems can improve operational efficiency and predict potential failures before they occur.
Circulating Fluidized Bed Combustion (CFBC) boilers are widely used for difficult to burn fuels and are preferred for their fuel flexibility, load variability and low emissions. One of the advantages of CFBC technology is its ability to utilize difficult-to-fire fuels such as high ash, coarser, less homogeneous fuels, and various fuel blends with different ratios. High-ash fuels present unique operational challenges. Especially when they contain high concentrations of alkali metals and corrosive elements such as chlorine and fluorine, or have extremely low calorific values.
In Estonia, low-grade, high-ash fuel - oil shale - has been used for more than a century for power and shale oil production, providing Estonia with energy security. CFBC technology has been adapted to the specific characteristics of oil shale for power production already in 2003 and 2004 when 2x215 MWel units were commissioned and for shale oil production in 2012 when Enefit280 shale oil plant was commissioned. As the CFBC technology provided in 2003 proved its suitability for oil shale power production, another 300 MWel CFBC unit was procured and commissioned in 2018. As it was not tailored to the specific requirements and characteristics of oil shale, the CFBC boiler has faced severe operational problems.
This paper examines some of the operational problems and possible solutions, drawing on the experiences from the Enefit280 shale oil plant and the Auvere 300 MWel CFBC power plant.
Experiences from the Enefit280 and Auvere 300 MWel power plants highlight the importance of proactive design, maintenance and operational strategies in managing high ash fuels in CFBC boilers. By implementing these solutions, power plants can improve reliability, reduce maintenance costs and ensure sustainable operation.
Keywords: CFBC, high ash fuels, Oil Shale, semicoke

Keynote Lecture 14

Tuesday, April 8 | Room Ginkgo (Session 6D) | 15:50-16:20

Stability and emission of circulating fluidized bed combustion of low-carbon gaseous fuel

Yang Zhang
Tsinghua University, China

Bio:
Dr Yang Zhang is currently an associate professor at Tsinghua University. He received his Bachelor's and Ph.D. degrees in Thermal Engineering from Tsinghua in 2009 and 2015, respectively. He visited University of California, Berkeley as a visiting scholar in Department of Mechanical Engineering (2011-2012), and was a postdoctoral research associate in Centre for Energy, the University of Western Australia. He joined the Department of Energy and Power Engineering in 2017. His research interests include combustion of low-carbon fuels, combustion for multiple products, and thermal energy storage. Zhang has published ~ 200 research papers and awarded ~ 40 patents. Zhang has developed key innovations that have been successfully commercialized, delivering significant economic and environmental benefits. His research has driven advancements in sustainable energy solutions through practical applications. Recognized for his outstanding contributions, Zhang has received multiple prestigious awards, including the China Electric Power Youth Science and Technology Award, the Environmental Protection Science and Technology Progress Award, and the Mechanical Industry Science and Technology Award. Zhang's research group is supported by the National Natural Science Foundation of China, National Key R&D Program, and industrial partners as CHN Energy, SPIC, CHINA Huaneng, SINOPEC, etc.

Abstract:
Circulating fluidized bed (CFB) combustion technology is distinguished by its extensive fuel flexibility. The integration of various low-carbon fuels as partial substitutes for coal in CFB boilers represents a pivotal strategy in the pursuit of decarbonization objectives. The transition from high-carbon coal to carbon-free gaseous fuels, such as industrial off-gas, hydrogen, and ammonia, among other fuels, introduces marked variations in particle circulation, combustion behaviors, emissions, and heat transfer properties. These disparities pose novel challenges to the fuel adaptability aspect of CFB combustion technology, necessitating further research and innovation to enhance its operational efficiency and environmental performance.
The exceptional fuel flexibility of CFB combustion technology is manifest in three principal dimensions: i) the augmentation of fuel ignition and burnout processes, ii) the economically pollution control strategies, and iii) the robust operation in heating surface security. The substantial heat capacity of the bed material and the efficient circulation of solids are instrumental in broadening the fuel flexibility of CFB combustion technology.
In the case of ammonia fuels, CFB technology promotes combustion stability by leveraging the high heat capacity of the bed material at elevated temperatures and optimizes nitrogen oxide (NO_x) emissions control through the refinement of gas-solid flow dynamics within the furnace. The high thermal inertia, coupled with intense gas-solid mixing, facilitates the ignition and stability of fuel combustion, while the controlled combustion atmosphere minimizes NO_x formation. These attributes of CFB render it a promising candidate for the efficient and cost-effective combustion of ammonia-based fuels.
Moreover, the application of CFB combustion technology to the incineration of ultra-low-calorific-value industrial off-gases constitutes a method for the conversion of waste into energy, substantially enhancing the economic viability of waste gas management. The industrial application of CFB for the treatment of sintered flue gas, a prototypical ultra-low-calorific-value industrial off-gas, has demonstrated its superior performance.
Analyses indicate that CFB combustion technology is poised to continue expanding its advantages in terms of broad fuel adaptability to low-carbon gaseous fuels. Facing the significant demands of the profound revolution in energy consumption, supply, technology, and systems, CFB combustion technology holds promising prospects. There is a need to further exploit its potential to enhance fuel adaptability through adjustments in fluidization states, thereby developing a new generation of CFB combustion technology that can accommodate a variety of low-carbon fuels, with low costs for pollutant control and a wide range of load variation. This will provide support for the accelerated construction of a new type of power system.
Keywords: circulating fluidized bed; decarbonization; low-carbon gaseous fuel; ammonia fuel; sintering flue gas

Keynote Lecture 15

Monday, April 7 | Room Curling Dragon (Session 2E) | 15:50-16:20

Design of oxygen carriers for chemical looping reforming

Kongzhai Li
Kunming University of Science and Technology, China

Bio:
Dr. Kongzhai Li is a full Professor in the Faculty of Metallurgy and Energy Engineering at Kunming University of Science and Technology. He has published over 170 journal articles in Chem, JACS, Nature Communications, Chemical Society Reviews, ACS catalysis, etc. and book chapters. His H-index is 51 with a total citation of 7655. He is also an inventor/co-inventor of 37 Chinese patents and patent applications. He has hosted and completed 22 research projects, including National Key Research and Development Program of China and Key Program of the Joint Fund of the National Natural Science Foundation of China. He has been selected as a young scholar of the "Chang Jiang Scholars Program" sponsored by the Ministry of Education and awarded the title of "Yunling Scholar" in Yunnan Province. Additionally, he has also been honored with the Special Prize for Natural Science in Yunnan Province. His research interests are primarily in chemical looping conversion technologies and energy/environmental catalysis.

Abstract:
Conversion of methane to syngas using a chemical-looping concept is a novel method for syngas generation. The design and elaboration of suitable oxygen carriers is a key issue to optimize this method. Since methane is a very stable molecule, the activation of methane should be one of the most important factors that must be considered for designing high performance oxygen carrier. In this paper, we will make a brief introduction on the design of oxygen carriers for chemical looping reforming of methane, especially in improving methane activation and lattice oxygen mobility. The performance of ceria-based and perovskite oxides, which are modified by different active species, will be introduced in detail. The effects of composition, structure and morphology on the reactivity of oxygen carriers as well as the roles of different components of oxygen carriers in affecting the methane activation and lattice oxygen activity will be discussed. In situ experiments, isotopic tracing technology and DFT calculations are performed to investigate the reaction mechanisms of methane conversion and water/CO_2 splitting.

Keynote Lecture 16

Tuesday, April 8 | Room Curling Dragon (Session 3E) | 08:30-09:00

Oxygen carrier design for chemical looping combustion of solid fuel

Laihong Shen
Southeast University, China

Bio:
Professor Laihong Shen, a distinguished scholar from the School of Energy and Environment at Southeast University, is a globally renowned pioneer in chemical looping technology (CLT). With a Ph.D. in Thermal Engineering from Southeast University and foundational research at Sweden's Chalmers University of Technology, he has shaped the theoretical and practical frontiers of energy conversion and carbon capture. Professor Shen is celebrated for groundbreaking innovations such as oxygen carrier graded oxidation, solid-fuel chemical looping combustion (first piloted with biomass in 2008), and the revolutionary gushing fluidized bed system, which transformed gas-solid interaction efficiency. Leading China's National Key R&D Program on coal-based Chemical Looping Technology, he has driven scalable solutions for low-carbon energy systems. His prolific academic legacy includes 200+ publications, 20+ patents, and recognition as an Elsevier Highly Cited Researcher. A co-founder of the International Chemical Looping Conference series and mentor to over 20 doctoral graduates, Professor Shen continues to define the future of sustainable energy.

Abstract:
Oxygen carriers (OCs) for chemical looping combustion (CLC) of solid fuels must meet stringent performance criteria, including high redox reactivity, robust mechanical stability, and excellent cyclic durability to withstand high-temperature redox cycles. Resistance to ash deposition and carbon fouling is critical for maintaining activity with ash-rich fuels like coal or biomass.OCs must also exhibit thermal stability across a wide temperature range and adaptability to impurities such as sulfur or chlorine compounds, ensuring efficient fuel conversion without secondary pollution. Cost-effectiveness and environmental compatibility are essential, favoring abundant, non-toxic materials like iron- or calcium-based oxides over expensive or scarce metals. These requirements are vital for achieving high fuel conversion efficiency, CO_2 capture readiness, and scalable deployment of CLC systems for solid fuels.

Keynote Lecture 17

Tuesday, April 8 | Room Curling Dragon (Session 3E) | 09:00-09:30

Demonstration of 5MW chemical looping combustion and gasification with biomass pellet as fuel

Zhenshan Li
Tsinghua University, China

Bio:

Zhenshan Li is a tenured Professor at Department of Energy and Power Engineering, Tsinghua University, China. Prof. Li got his PhD degree on Power Engineering and Engineering Thermolphysics from Tsinghua University on 2006, and since then worked at Department of Energy and Power Engineering, Tsinghua University.

Prof. Li has mainly focused on the chemical looping technology, heterogeneous reaction kinetics and CO_2 capture etc. Specific research interests include the scale-up of CLC technology and development of long-life oxygen carrier material for CLC. He was the project leader of 5 MWth CLC pilot demonstration which has achieved more than 500 hours of continuous auto-thermal operation with different solid fuels. Prof. Li is now the leader of National Key Research and Development Program of China and focusing on the commercial demonstration of 20MW CLC technology in power plant.

As the first or corresponding author, Prof. Li has published over 100 SCl indexed papers, 1 book with the title 'Principle of gas-solid reaction'. As the first investor, he has more than 20 patents in the energy field. Prof. Li has the undergraduate course 'Energy Chemistry' and graduate courses 'Gas-Solid Surface Reaction and Transport' and 'Optimization of thermal system and equipment'.

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Abstract:

An auto-thermal continuous operation of biomass chemical looping combustion and gasification in a $5MW_{th}$ CLC pilot plant is demonstrated. In this CLC pilot unit, the air reactor is a fast fluidized bed while the fuel reactor is a turbulent fluidized bed. The solid circulation from the fuel reactor to the air reactor is controlled by the overflow method. Industrial wood pellets are used as solid fuel, and two ilmenites are used as oxygen carrier. During operation, all solid fuel was fed into the dense bed of fuel reactor, while only air was fed into the air reactor. No electric or other external heating was applied, which means that the whole pilot unit was heated by the heat released from the oxidation of oxygen carrier inside the air reactor. Hence, auto-thermal CLC operation was successfully achieved. Heating up the unit was relatively fast and was completed in 24 hours, furthermore, switching to CLC mode was straight forward and only took within one hours. During operation, the temperature of whole loops was stable. The temperatures of air reactor and fuel reactor were 900 - 1020°C and 850 - 980 °C, respectively. Based on the operational data, for the case of chemical looping combustion, the maximum CO_2 capture efficiency of the wood pellet fed CLC unit was more than 95%, and the minimum oxygen demand for unburnt gases from the fuel reactor was about 8%. The char conversion is higher than 99%.

The results of 5MWth biomass gasification test over 40 hours were studied in detail, during which all the fuel was fed into the fuel reactor (FR). Inert bed material was used as a heat carrier to dilute oxygen carrier, thereby limiting oxygen transport to the fuel reactor. The overall air ratio in the fuel reactor was around 0.6. A cold gas efficiency (CGE) of around 30 % was achieved in the non-optimized pilot plant, indicating that higher values can be reached if the air ratio can be further reduced. The carbon conversion was almost 100 % benefiting from the high reactor temperature, extended residence time and high cyclone efficiency in the unit. The syngas has a very high quality with methane concentrations in the range of 4 vol. % to 10 vol. % and almost no tar was detected. Hence, this study achieved stable auto thermal chemical looping gasification operation with sufficiently high FR temperatures. Chemical looping gasification technology shows an advantage in syngas production, as a relatively high-quality syngas was achieved without optimizing the operating parameters.

Keywords: chemical looping, combustion, gasification, biomass, 5MW pilot

Keynote Lecture 18

Tuesday, April 8 | Room Curling Dragon (Session 4E) | 10:30-11:00

Impacts of wheat straw ash on performance of ilmenite in fluidized bed chemical looping combustion: reactivity, microstructure, attrition and agglomeration

Dongfang Li
Kunming University of Science and Technology, China

Bio:

Dr. Dongfang Li is currently a professor at the School of Metallurgy and Energy Engineering, Kunming University of Science and Technology (KUST). Prior to KUST, he served as a research professor at Pusan National University and senior associate at OCI company in South Korea. He was recognized as a Yunnan Provincial Xingdian Young Talent and actively contributes to the scholarly community through editorial roles including youth editorial board member of Hunan Electric Power (Chinese), guest editor of Thermal Power Generation (Chinese) and Energies, secretary-general of the international conference on circulating fluidized bed boiler. He serves as PI of research projects funded by the National Natural Science Foundation of China, Yunnan Provincial Department of Science and Technology, and collaborative industry-academia initiatives between Chinese and Korean enterprises.

His research area is energy conversion technologies, mainly focusing on circulating fluidized bed combustion, chemical looping materials and process design, and biomass-based hydrogen production. His work has yielded over 30 SCI papers and contributions to two textbooks.

Abstract:

Chemical looping combustion (CLC) is a promising technology for achieving CO_2-negative emissions. However, ash-related issues present significant challenges because the interactions between biomass ash components and oxygen carriers substantially impact the physical and chemical performance of the CLC system. This study investigates the influence of wheat straw ash (WA) addition ratio (0-15%) on the reactivity, attrition, and agglomeration behaviors of ilmenite in a fluidized bed reactor, with the underlying mechanisms of performance variation being comprehensively analyzed. The results indicate that the attrition rate of ilmenite increases with WA addition. Furthermore, CO conversion is significantly influenced by the addition of WA, with the highest cumulative CO conversion achieved at a 10% WA addition ratio. The reactivity of ilmenite is significantly enhanced by WA addition due to the formation of K3FeO2 phases and the increase in the concentration of oxygen vacancies. When the WA addition ratio rose to 15%, the promotional effect weakened due to sintering and agglomeration. Based on 3D structural reconstruction of the agglomerates using X-ray microtomography technology, two agglomeration mechanisms were identified: one is a neck-structured agglomerate formed due to the low-melting material resulting from the interaction between Fe from the ilmenite and K from the WA; the other is a coating-induced agglomerate formed due to the fused alkali silicate from WA. This work provides valuable guidance for the effective utilization of biomass in a fluidized bed CLC system.

Keywords: Chemical looping combustion; Ilmenite; Attrition; Fluidized bed; Agglomeration

Keynote Lecture 19

Tuesday, April 8 | Room Curling Dragon (Session 6E) | 15:50-16:20

Chemical looping gasification of organic solid waste

Zhen Huang
Guangzhou Institute of Energy Conversion, Chinese Academy of Science, China

Bio:
Dr. Huang Zhen is a Professor and doctoral supervisor at the Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences. He is a Young Top-Notch Talent of National High-level Talent Special Support Program, the Project Leader of the National Key R&D Program, a Distinguished Professor of the Chinese Academy of Sciences, a Recipient of the Guangdong Youth Innovation Award, and a Guangdong Outstanding Young Scientist. He focuses on the resource and energy utilization of organic solid waste. He has published over 160 SCI journal papers and obtained 12 authorized invention patents (including 2 PCT patents). He has been awarded the First Prize of the Guangdong Natural Science Award, the Second Prize of the Henan Natural Science Award, and the Outstanding Young Scientist Award from the China Renewable Energy Society. Additionally, he serves as the Deputy Director of the National Energy Biofuels R&D Center, Member of the Engineering Thermochemistry Technical Committee of the Chemical Industry and Engineering Society of China (CIESC), Secretary-General of the Urban-Rural Mining Industry-University-Research Alliance, and Deputy Secretary-General of the Guangdong Society of Engineering Thermophysics.

Abstract:
Chemical looping gasification (CLG) of organic solid waste (OSW) is a novel technology for high-quality syngas production. Compared to traditional gasification methods, CLG of OSW produces syngas more efficiently with low tar content, a controllable H_2/CO ratio, and minimal N/S/Cl pollutants. Our research team developed a series of oxygen carrier tailored for various types of OSWs, and established a novel strategy for oxygen carrier design. Based on that, we investigated the CLG process using agricultural/industrial organic solid waste as feedstock, achieving a tar cracking rate greater than 90% and N/S/Cl pollutants removal efficiency close to 95%. The microscopic reaction mechanisms of OCs were theoretically elaborated upon utilizing the Distributed Activation Energy Model (DAEM) and the classical kinetic model. Further elucidation was achieved through in situ Spherical Aberration Corrected Transmission Electron Microscope (AC-TEM) experiments, which shed light on the release and recovery pathways of lattice oxygen within the OC particles. A continuous integrated fluidized bed system for chemical looping gasification, with a scale of 3-5 kg/h (maximum thermal power 20 kW_{th}), was constructed to enable the steady production of high-quality syngas. Furthermore, an internal hydrogen replenishment technology was proposed for chemical looping gasification to produce clean syngas with a controllable H_2/CO ratio. This process can produce clean syngas with a controllable H_2/CO ratio of 2.85 for H_2/CO and 0.62 for CO_2/CO. Additionally, it was observed that most of the nitrogen elements in the organic solid waste could be converted to N_2 by managing the appropriate oxygen equivalence ratio, while sulfur and chlorine elements could be transformed into sulfate and chloride salts, respectively. These salts are subsequently solidified within the OC, achieving an integrated synergistic removal of pollutants.
Keywords: chemical looping gasification, organic solid waste, tar, N/S/Cl pollutants

Keynote Lecture 20

Monday, April 7 | Room Crouching Tiger (Session 2F) | 15:50-16:20

High-G fluidization in vortex chambers

Juray De Wilde
Université catholique de Louvain, Belgium

Bio:
Juray De Wilde received his BSc, MSc (1995) and PhD (2001) from the Ghent University (Gent, Belgium), working on the transient kinetic testing of SO_2-NO_x adsorption and the development of an in-house CFD solver and code for 3D simulations of gas-solids flows in riser reactors. Following post-docs in 2003-2004 at Princeton University (Prof. Sundaresan) and Ghent University, he joined the Université catholique de Louvain (UCLouvain) as associate professor in 2005. He received his tenure in 2008 and professor rank in 2012. He received a Dow Corning award in 2012. In 2015-2016, Prof. De Wilde was invited as visiting professor at the National Energy Technology Laboratory (NETL) of the US Department of Energy by the Oak Ridge Institute for Science and Education to work on high-G fluidized bed technology.
Prof. De Wilde's research focuses on the multiscale modeling of single and multiphase chemical reactors, studying intrinsic reaction kinetics and transport phenomena. He is the co-holder of 3 patents and published his work in 70 papers in international peer reviewed journals. With Prof. Froment, he is co-author of the 3th edition of the text book Chemical Reactor Analysis and Design (Wiley, 2010). Prof. De Wilde worked extensively with the industry on high-G fluidized beds and on structured catalytic reactors. In 2022-2023, in collaboration with ZoneFlow Reactor Technologies and Honeywell-UOP, a unique SMR pilot plant was designed and successfully operated at UCLouvain to test innovative SMR catalysts.

Abstract:
High-G fluidization in vortex chambers is discussed. In a first part of the presentation the basic functioning of vortex chambers is explained. Fluidizing gas is introduced via tangential slots and evacuated via a centrally positioned chimney. As a result a strong free vortex is generated in the chamber. Particles introduced in the rotating gas flow are entrained, forming a rotating fluidized bed. The gas flows from the periphery towards the chimney and the particle bed is radially fluidized with a bed density depending on the generated centrifugal force and radial gas-solid drag force.
In a second part of the presentation, main fluid dynamics characteristics are illustrated by means of experimental observations and CFD simulations. The fluid dynamics in the chamber is indeed complex with secondary flows being generated by the presence of the end walls of the chamber. Furthermore, the vortex chamber slot design, the solids inlet design and the chimney design can affect the strength of the centrifugal force and related bed density and uniformity.
In a last part of the presentation, it is shown how fluidization in a high-G field increases the gas-solid slip velocities, as such intensifying gas-solid mass, heat and momentum transfer. This allows ca. one order of magnitude process intensification by more efficient gas-solid contact, gas-solid separation, and in certain applications particle-particle segregation. Various example applications that have been studied are discussed: particle drying, fine particle coating and spray drying. The advantages and disadvantages of using vortex chamber technology will be highlighted.
Keywords: High-G fluidization, vortex chamber technology, process intensification, particle drying, particle coating, spray drying.

Keynote Lecture 21

Tuesday, April 8 | Room Crouching Tiger (Session 4F) | 10:30-11:00

Developing advanced models for understanding and improving spray fluidized coating process

Daoyin Liu
Southeast University, China

Bio:
Daoyin Liu, Dr., Professor. He received his Bachelor's degree and Ph.D. from Southeast University in 2005 and 2011, respectively. After graduation in 2011, he began teaching at the same university. From 2014 to 2015, he was a visiting scholar at Delft University of Technology in the Netherlands. His research primarily focuses on thermal energy engineering, numerical simulation of multiphase flow and reactions, and preparation of micro-nano powder materials. He has led over 20 research projects, including those funded by the National Natural Science Foundation of China, sub-projects of National Key R&D Program, and industry-sponsored R&D initiatives. He has published more than 100 papers, authored two textbooks, and obtained over 10 authorized invention patents.

Abstract:
Spray fluidized bed is widely used in particle coating technology, which brings together the processes of fluidization, spray and drying. However, the complex physical process and influence factors are the challenges of the further development of spray fluidized bed technology. In this study, the relationship between particle growth and spray fluidized bed operating conditions, seed particle properties and coating solution properties are firstly explored by experiments. The mechanisms of wet particle agglomeration are studied by single–droplet experiments and volume of fluid (VOF) method, including droplet-particle collision and wet particle collision. Combined with the wet particle collision mechanism and discrete element method (DEM), a comprehensive model including fluidization, particle drying, wet particle collision and particle growth is developed. The gas-solid flow characteristics of the spray fluidized bed, including moisture and temperature distribution, are investigated. The spray, drying and thermal balance regions are defined, and the residence time distribution of particles in each region is obtained. Based on the above, a novel spray fluidized bed reactor that can adjust the cycle time distribution of particles and drying conditions in the bed is proposed, which achieves the effective control of the particle coating shell structure and growth uniformity. The study has provided theoretical tools for promoting the development of spray fluidized bed technology.
Keywords: Spray fluidized bed, particle coating, mathematic models

Keynote Lecture 22

Tuesday, April 8 | Room Crouching Tiger (Session 6F) | 15:50-16:20

Gas-solid fluidized dry separation of fine coal

Chenlong Duan
China University of Mining and Technology, China

Bio:
Chenlong Duan received his Ph.D. from China University of Mining and Technology in 2007, and currently is a professor and the Dean of the Academy of Science and Technology in CUMT, Xuzhou, China. He has been granted the National Science Fund for Distinguished Young Scholars in 2021. Professor Duan has won the State Science and Technology Advancement Award (2nd Prize), the State Technological Innovation Award (2nd Prize), and the Science and Technology Advancement Award of Ministry of Education (Grand Prize).

Abstract:
Coal is China's primary energy source and functions as the foundation and stabilizer for national energy security. More than two-thirds of China's coal reserves are located in arid and high-altitude areas, where traditional wet coal preparation methods encounter significant obstacles, including water scarcity and coal slurry contamination. Addressing the global challenge of fine coal (<6mm) separation, our team has dedicated years of research to innovatively propose the "vibration-displacement-airflow-temperature composite force field dry separation" technology system. This innovation addresses the efficiency constraint in separating moist fine coal, reducing the lower limit of separation size from the conventional 6mm to 1mm, therefore providing a novel approach for clean and efficient coal utilization. Key scientific contributions: (1) Explained the mechanical behavior of impact contacts between moist particles and an elastic screening surface, revealing the kinetics of vibration-induced segregation in complex particle assemblies and their stratification characteristics. The research clarified the kinetics of moist particle screening and their spatiotemporal distribution, resulting in the development of an interactive screening dynamics model for the elastic screening process. (2) Clarified the mechanisms of energy transfer and the transformation of flow patterns in gas-solid separation fluidization. The research elucidated the density segregation kinetics of particles and the segregation mechanisms of coal particles during vibrational fluidization. A composite force field model was created for the disaggregation and drying of damp particles, along with the formulation of a density segregation mechanism for composite force field fluidized separation. (3) Explained the multi-scale correlation processes in gas-solid fluidized separation, revealed the scaling stability of fine coal separation in multi-force field fluidized beds, and developed distributed-microporous-small-bed, high-frequency-low-amplitude gradient aeration process. Proposed a zonal and staged gas-solid fluidized drying design, engineered an innovative gas-solid fluidized bed drying system, and devised an integrated process for low-quality fine coal comprising "dry screening, drying, dehydration, and dry upgrading". (4) Demonstration projects have been initiated in dry and high-altitude mining regions, such as Inner Mongolia and Xinjiang, with an annual processing capacity of 6.0 Mt. The calorific value of clean coal has increased by 20%-35%, while the calorific value of the selected fine coal has grown by a minimum of 500 kcal/kg, with coal slurry water pollution nearing zero. Certified by the China National Coal Association as "internationally leading" and listed among "China's Top Ten Scientific and Technological Advances in Higher Education Institutions."

Keynote Lecture 23

Monday, April 7 | Room Silver Birch (Session 2G) | 15:50-16:20

Thermochemical conversion of hydrocarbons based on fluidized bed technologies

Uendo Lee
Korea Institue of Industrial Technology, Republic of Korea

Bio:

Uendo Lee earned his PhD in Mechanical Engineering from the Korea Advanced Institute of Science and Technology (KAIST) in 2005, after which he spent two years as a visiting scholar at Sandia National Laboratories. He has been with the Korea Institute of Industrial Technology (KITECH) since 2008, working on a wide range of projects encompassing both experimental and computational research, all linked by a focus on reacting flows. His current interests include multiphase flows, thermochemical conversion of biomass, CO_2-free hydrogen production, fluidized bed boiler simulations, and liquid metal systems.

Abstract:

Fluidized bed technology has been extensively utilized for many years to produce energy and fuel through the thermochemical conversion of hydrocarbons. Representative applications include catalytic reactors employed in refining and petrochemical processes, as well as fluidized bed boilers for power generation and various industrial applications. In recent years, the growing demand for greenhouse gas reduction in response to climate change has catalyzed significant advancements in energy system research and development. For instance, the transition towards utilizing natural gas instead of solid or liquid hydrocarbons, while the bioenergy sector, recognized as a carbon-neutral fuel source, has been steadily expanding. Moreover, the significance of carbon-free fuels such as hydrogen and ammonia has been increasingly underscored, with active research being conducted on their production and utilization through pyrolysis and gasification technologies.

The transition from hydrocarbons to low-carbon fuels necessitates the minimization of carbon dioxide emissions during the conversion process and the reduction of carbon-related compounds in the resulting fuels or exhaust gases. This transformation requires substantial modifications to existing energy and fuel production processes. While the scope of fluidized bed technology may appear to be narrowing in this context, it remains critically important in the production and utilization of carbon-free fuels. For example, solid-gas fluidized bed systems are actively employed in the pyrolysis and gasification processes for generating clean synthetic fuels from biomass or waste materials. Additionally, fluidized bed technology plays a vital role in the pyrolysis of natural gas, particularly in the production of turquoise hydrogen, which has recently gained significant attention, alongside the use of solid and liquid catalysts.

In the process of extracting hydrogen from hydrocarbon fuels, it is essential to minimize CO_2 emissions, which necessitates the extraction of carbon in solid form. This requirement presents challenges related to multiphase flow dynamics, ultimately converging on the application of fluidized bed technology. In this presentation, we will focus on the application of fluidized bed technology in the hydrogen production process through the thermochemical conversion of hydrocarbons, with particular emphasis on biomass and natural gas.

Keywords: Thermochemical conversion, Fluidized bed technology, Biomass gasification, Turquoise hydrogen, Molten metal

Keynote Lecture 24

Tuesday, April 8 | Room Silver Birch (Session 4G) | 10:30-11:00

Advancing thermochemical conversion in fluidized beds for resource efficiency and climate action

David Pallarès **Carolina Guío-Pérez**

Chalmers University of Technology, Sweden

Bio:

David Pallarès took his PhD in 2008 at Chalmers University of Technology (Sweden), where he continued his academic career to become professor of Industrial Energy Conversion in 2021. He co-leads the Fluidization research group at Chalmers and is Sweden's representative in the Technology Collaboration Programme for Fluidized Bed Conversion of the International Energy Agency.

Carolina graduated as chemical engineer from the Universidad Nacional de Colombia. After completing her PhD at the Vienna Technical University, she continued her work at the BOKU university, Universidad Nacional de Colombia, and is now co-leader of the Fluidization research group at Chalmers University of Technology.

Abstract:

The deployment of fluidization in new industrial applications will gain stronger relevance as we transit the sixth wave of Industrialism, driven by the paradigm of sustainability. Within the field of thermochemical conversion, the focus of development and innovation is shifting from the mature applications (oil cracking and air-fired coal combustion) towards those making use of renewable energy sources, enabling the production, transport and storage of green energy and maximizing efficient use of resources and circularity of production chains. Examples of this are fluidized bed applications targeting biomass conversion into intermediate products and energy vectors, carbon capture applications, or energy storage. Importantly, while previous development of fluidized bed applications has been of an incremental character, the development of new applications in the ongoing transition will follow a more disruptive approach based on the generation and use of generic knowledge, the ability to identify and fill key knowledge gaps, and the mastering of advanced modelling tools.

This work maps some of the opportunities that the new global scenario brings to fluidized bed technology within the field of thermochemical conversion, pinpointing key knowledge gaps to be addressed as well as modeling and measurement techniques allowing to fill them.

Keywords: sustainability, fluidized bed technology, carbon capture, polygeneration, bioeconomy, energy storage

Parallel Sessions 1A-1C

Monday, April 7, 2025 13:30-15:30

Room	A Golden Thread	B Green Willow	C Beautiful Bamboo
Sessions	Combustion I	Energy Storage	Computing & Simulation I
Chairs	J. Ruud van Ommen Tae-Young Mun	Haigang Wang Diana Carolina Guio Perez	Limin Wang Charley Wu
13:30	138 Progress in the characterization of pollutant emissions from ammonia-coal co-combustion in circulating fluidized bed **Canbin Huang** *Nanjing Normal University, China* *Tsinghua University, China*	123 Modeling, process simulation and scale-up of a solar fluidized bed thermochemical battery **S. Padula** *STEMS, Consiglio Nazionale delle Ricerche, Italy* *Università degli Studi di Napoli Federico II, Italy*	060 Computational fluid dynamics analysis of gas solid flow in a dual circulation fluidized bed for a biomass-fueled chemical looping combustion system **Xue Lyu** *Huazhong University of Science and Technology, China*
13:50	218 Experimental research on emission characteristics of biomass NH_3 co-firing in a bubbling fluidized bed reactor **Haotian Ma** *Pusan National University, Republic of Korea*	142 Investigation on the long-period banked-fire operation characteristics of CFB boiler units coupled with thermal energy storage **Peixing Han** *Huairou Laboratory, China*	086 Computational study on waste tire fast pyrolysis in a conical spouted bed reactor **Myung Kyu Choi** *Yonsei University, Republic of Korea*
14:10	071 Evaluation the co-firing limit of ammonia in a circulating fluidized bed under different thermal loads **Kun Li** *Zhejiang University, China*	151 Techno-economic assessment of a thermochemical energy storage process for the production of district heating **D.C. Guío-Pérez** *Chalmers University of Technology, Sweden*	110 Numerical investigation on liquid-solid two-phase flow and stress distribution characteristics in a batch slag-discharge lock hopper **Wenlong Du** *Nanjing Normal University, China*
14:30	174 Effect of N_2O concentration on bed temperature, residence time and O_2 concentration in flue gas during ammonia combustion using a lab-scale fluidized bed combustor **Ho Tae Im** *Korea Institute of Energy Research (KIER), Republic of Korea*	193 Study on the thermal storage performance of TiO_2-modified calcium-based pellets by pressurized fluidization **Yao Fu** *Southeast University, China*	172 Food grain particle shrinkage model development in drying based study in FBD by using TFM, CFD-DEM and RPT based experimental techniques **Mahesh Nadda** *Indian Institute of Technology Jammu, India*
14:50	080 Effect of bed materials on the dissociation characteristics of ammonia in a bubbling fluidized bed **Zipeng Guo** *Chongqing University, China*	145 Techno-economic assessment of energy storage integration in fluidized bed systems for low-carbon power generation **Keying Li** *Tsinghua University, China* *Huairou Laboratory, China*	213 High-fidelity numerical simulation of multicomponent combustible industrial solid waste in a circulating fluidized bed **Minmin Zhou** *Southeast University, China*
15:10			129 Numerical investigation of multicomponent gas mixing characteristics in a bubbling fluidized bed based on MP-PIC method **Changhao Ma** *Tsinghua University, China* *Huairou Laboratory, China*

Parallel Sessions 1D-1G

Monday, April 7, 2025 13:30-15:30

D Ginkgo	E Curling Dragon	F Crouching Tiger	G Silver Birch
Optimization & Design I	Carbon Capture & Utilization	Particle Behavior & Fluid Dynamics I	Sustainable and Green Transition Technologies I
Jianbo Li Mengxiang Fang	Kongzhai Li Daofeng Mei	Juray De Wilde Qiangqiang Ren	Uendo Lee Runxia Cai
208 Combustion behavior and NO emission of oxygen carrier aided combustion in a 75 t/h biomass-fired circulating fluidized bed boiler **Guang Sun** *Southeast University, China*	090 S self-doped porous carbon for efficient CO_2 capture **Zi Liu** *Southeast University, China*	026 Effect of fine particle on fluidization behavior of multi-walled carbon nanotube in a gas-solid fluidized bed **Suyoung Kim** *Korea National University of Transportation, Republic of Korea*	212 Determination of optimal NH_3 cofiring condition in fluidized bed reactor for NO_x reduction: low operating load and air staging ratio **Jae-Sung Kim** *Pusan National University, Republic of Korea*
092 Study on the influence of coal injection and air distribution strategy on the fire restart of subcritical CFB boiler **Dongxiong Li** *Shanxi University, China*	005 Investigation of moisture swing-based carbon capture using fluidized bed **Jongmin Choi** *Soonchunhyang University, Republic of Korea*	194 Growth characteristics and properties of TiO_2 films synthesized by fluidized bed atomic layer deposition **Liyuan Zhang** *Southeast University, China*	209 Experimental study on catalytic precracking of ammonia based on hydrogen-ammonia mixed combustion **Manman Luo** *Southeast University, China*
007 Thermodynamic and hydrodynamic stabilization of load changes in a 1 MW_{th} CFB combustion pilot plant via partial flue gas recirculation **Alexander Kuhn** *Technical University of Darmstadt, Germany*	081 Understanding the effect mechanism of Mn/Ce co-doped on the integrated calcium looping and reverse water-gas shift reaction of CaO-based materials **Youhao Zhang** *Shandong University, China*	051 Hydrodynamic and thermal analysis of pistachio nut splitting in a fountain confined conical spouted bed **Mikel Tellabide** *University of the Basque Country, Spain*	197 An experimental investigation into the characteristics of ammonia oxidation and behaviors of NO_x emission in a bubbling fluidized bed **Jia Cao** *Chongqing University, China*
102 Experimental study on the gas distribution along the furnace height in a CFB at a wide load **Qingyu Zhang** *Zhejiang University, China*	040 Commercialization of calcium looping for carbon-intense industries: Status update on TRL 6 piloting activities **Martin Haaf** *Sumitomo SHI FW Energia Oy, Finland*	149 CFD-DEM analysis of vibro-assisted fluidisation of fine particles **Shangyi Yin** *Nanjing Normal University, China*	176 Application of wet fluidized bed torrefaction to convert potato peels waste into valuable fuel and fertilizer **R.L. Isemin** *Tambov State Technical University, Russia*
108 Experimental and simulation study on efficient denitration of SNCR based on ammonia pre-activation **Chen Luo** *Huairou Laboratory &* *Taiyuan University of Technology, China*	073 Comparative study of fluidized-bed and fixed-bed reaction for integrated CO_2 capture and in-situ methanation **Lingfeng Fan** *Southeast University, China*	072 Advanced cold flow model investigation of particle hydrodynamics and vertical distribution in a circulating fluidized bed **A. Konior** *Technische Universität Wien, Austria*	069 CPFD modeling of air-steam gasification of brewer's spent grains in a circulating fluidized bed **Huawei Jiang** *Qingdao University, China*
198 Simulation study of the performance of banked fire of circulating fluidized bed boiler **Qiao Xue** *Taiyuan University of Technology, China*	029 Fluidized bed sorption-enhanced CO_2 methanation using zeolites as water sorbents **Fiorella Massa** *STEMS, Consiglio Nazionale delle Ricerche, Italy* *Università degli Studi di Napoli Federico II, Italy*	199 The effect of submicron particle layer properties on microparticle impact characteristics **Yuxing Wang** *Southeast University, China*	189 Autothermal technology demonstration of phosphogypsum thermal decomposition pilot simulation system **Pengxing Yuan** *Southeast University, China*

Parallel Sessions 2A-2C

Monday, April 7, 2025 15:50-17:20

Room	A Golden Thread	B Green Willow	C Beautiful Bamboo
Sessions	Advanced Diagnostics I	Advanced Diagnostics II	Computing & Simulation II
Chairs	Qinhui Wang J. Ruud van Ommen	Diana Carolina Guio Perez Haigang Wang	Charley Wu Limin Wang
15:50	Keynote: Radiation-based imaging techniques for detailed investigation of particle flows **J. Ruud van Ommen** *Delft University of Technology, The Netherlands*	Keynote: Advanced measurement techniques for gas-solids fluidized beds for coal and biomass combustion **Haigang Wang** *University of Chinese Academy of Sciences, China*	Keynote: CFD-DEM simulations of fluidization and heat transfer behavior of spherocylindrical particles in a spouted bed **Ramesh K. Agarwal** *Washington University in St. Louis, USA* **Ling Zhou** *Jiangsu University, China*
16:20	039 ECT measurement of the coupling between jet and downer **Lining Wu** *China University of Petroleum-Beijing, China*	021 Traversing nuclear densitometer probe for local density measurements inside fluidized beds **A. Mezo** *Coanda Research and Development Corporation, Canada*	074 A novel CFD-DEM coupled DDPM modelling of fluid flow, heat, and mass transfer in the dense fluid-particle systems within micro-fluidized bed involving surface reactions **Xueyu Tang** *Tsinghua University, China* *Huairou Laboratory, China*
16:40	148 Powder flow rate measurement in a pipe based on ultrasonic sensing **Yanqin Li** *Zhengzhou University, China*	175 Online corrosion monitoring of solid waste fluidized bed boilers using electrochemical techniques **Yafang Wang** *Southeast University, China*	124 Design and modeling of a pilot-scale fluidized bed conversion plant **Fanfan Xu** *Tallinn University of Technology, Estonia*
17:00		038 Advanced diagnostics for circulation balance monitoring in CFBs **Liukkonen Mika** *Sumitomo SHI FW Energia Oy, Finland*	186 Numerical simulation of CO_2 concentration distribution and heat transfer behavior in the microenvironment beneath positive pressure protective clothing **Zimian Yin** *Nanjing Normal University, China*

Parallel Sessions 2D-2G

Monday, April 7, 2025 15:50-17:20

D Ginkgo	E Curling Dragon	F Crouching Tiger	G Silver Birch
Optimization & Design II	Reforming & H_2 Production	Particle Behavior & Fluid Dynamics II	Sustainable and Green Transition Technologies II
Mengxiang Fang Jianbo Li	Daofeng Mei Kongzhai Li	Qiangqiang Ren Juray De Wilde	Runxia Cai Uendo Lee
Keynote: Measurements of the gas-solid non-uniformity characteristics in a 600 MW supercritical circulating fluidized bed boiler **Jianbo Li** *Chongqing University, China*	Keynote: Design of oxygen carriers for chemical looping reforming **Kongzhai Li** *Kunming University of Science and Technology, China*	Keynote: High-G fluidization in vortex chambers **Juray De Wilde** *Université catholique de Louvain, Belgium*	Keynote: Thermochemical conversion of hydrocarbons based on fluidized bed technologies **Uendo Lee** *Korea Institue of Industrial Technology, Republic of Korea*
216 Introduction to the long-period operation of the world's first 600MW supercritical CFB boiler **Junfeng Wang** *Tsinghua University, China* *Sichuan Baima CFB Demonstration Power Plant Co., Ltd., China*	030 Simulation of a sorption-enhanced steam methane reforming process in fluidized bed reactors by Aspen Plus **Fabrizio Scala** *STEMS, Consiglio Nazionale delle Ricerche, Italy* *Università degli Studi di Napoli Federico II, Italy*	018 Establishment of a particle circulation rate model for a J-type loop seal in circulating fluidized bed: Application to polyethylene pyrolysis **Wanxuan Cai** *Gunma University, Japan*	056 Study on energy conversion performance of anaerobic microbial fluidized bed hydrogen-electricity co-generation system **Yangfan Song** *North China Electric Power University, China*
162 Safety analysis of high-temperature steam system operation in ultra-supercritical CFB boilers under emergency water cutoff conditions **Hu Wang** *CHN ENERGY Investment Group Co., Ltd., China* *Chongqing University, China*	014 Chemical looping reforming of biomass for green hydrogen **Zhiqiang Wu** *Xi'an Jiaotong University, China*	002 Study of solid particles circulation in a fluidized bed **R.L. Isemin** *Tambov State Technical University, Russia*	137 Process simulation of biohydrogen production in fluidized bed via inline and offline steam reforming of bio-oil **E. Mulu Fetene** *Università degli Studi di Napoli Federico II, Italy*
107 Numerical investigation on the evolution of temperature fields during long-term banked-fire operation of a CFB boiler **Zhengping Wang** *Tsinghua University, China* *Huairou Laboratory, China*	066 Decomposition of CH_4 using modified Fe/CaO solid waste catalyst pellets in a fluidized bed for production of H_2 and carbon-based anode material **Zhiwei Chu** *Shandong University, China*	182 Capillary bridge behavior between spheres: Insights from experiment and numerical simulation **Lei Yang** *Institute of Process Engineering, Chinese Academy of Sciences, China*	143 Conversion of biogenic residues via dual fluidized bed steam gasification in 100 kW and 1 MW scale **David Kadlez** *Technische Universität Wien, Austria*

Parallel Sessions 3A-3C

Tuesday, April 8, 2025 08:30-10:10

Room	A Golden Thread	B Green Willow	C Beautiful Bamboo
Sessions	Pyrolysis & Cracking I	Pyrolysis & Cracking II	Computing & Simulation III
Chairs	Xiaofeng Lu Liangyong Chen	Dongjae Kim Alberto Abad	Jia Wei Chew Jaroslaw Krzywanski
08:30	020 Experimental study and application of machine learning methods of lignocellulose biomass fast pyrolysis in fluidized bed **Longfei Li** *Zhejiang University, China*	050 Effects of high sodium content on low-rank coal pyrolysis and neural network prediction of Na and Cl release **Zhihua Tian** *Zhejiang University, China*	**Keynote:** Numerical modelling of particle dispersion in liquids using DEM-SPH **Charley Wu** *University of Surrey, UK* (8:30-9:00)
08:50	104 Steam cracking of untreated pyrolysis oil and mixed plastic waste in a semi-industrial dual fluidized bed **Chahat Mandviwala** *Chalmers University of Technology, Sweden*	117 Turquoise hydrogen production via hydrocarbon pyrolysis in a molten metal bubble column reactor **Geun Yong Park** *Korea Institute of Industrial Technology, Republic of Korea*	**Keynote:** LBM-DEM model for fast simulation of gas-solid fluidization and LMFD software **Limin Wang** *Institute of Process Engineering, Chinese Academy of Sciences, China* (9:00-9:30)
09:10	109 Optimization of biomass cyclone pyrolyzer in operating parameters and reactor structure **Haorui Niu** *Taiyuan University of Technology, China*	061 Effect of phosphorous/nitrogen additions on structure evolution and stability of biochar **Han Zhang** *Qingdao University of Science and Technology, China*	
09:30	128 Heat supply for a molten metal bubble column reactor using partial oxidation of fuel **H.T. Kim** *Korea Institute of Industrial Technology, Republic of Korea*	019 Research on the migration and transformation mechanism of alkali metals in the co-pyrolysis of high sodium coal and biomass based on fluidized bed boiler **Xu Li** *Zhejiang University, China*	152 Numerical study of fluid-dynamics in a bubbling fluidized bed with solids crossflow **Munavara Farha** *Chalmers University of Technology, Sweden*
09:50	015 Experimental study on biomass integrated fluidization pressurized hydropyrolysis vapor upgrading to produce aviation fuel with NiMo-doped catalysts **Feiting Miao** *Zhejiang University, China*	127 Hydrogen and carbon production technology from pyrolysis of hydrocarbon gases **Y.J. Chang** *Korea Institute of Industrial Technology, Republic of Korea*	164 Exploring a steady-state multiscale CFD method for fluidization **Wei Wang** *Institute of Process Engineering, Chinese Academy of Sciences, China*

Parallel Sessions 3D-3G

Tuesday, April 8, 2025 08:30-10:10

	D Ginkgo	E Curling Dragon	F Crouching Tiger	G Silver Birch
	Optimization & Design III	Solid Looping: Scale-Up	Particle Behavior & Fluid Dynamics III	Sustainable and Green Transition Technologies III
	Alar Konist Xuebin Wang	Dongfang Li Bernd Epple	Daoyin Liu Ling Zhou	David Pallarès Zhenkun Sun
	087 Investigation into the heat transfer characteristics of a novel bottom ash heat recovery system for circulating fluidized bed boiler: A pilot-scale experimental and numerical study **Zheng Gan** *Sichuan Baima CFB Demonstration Power Plant Co., Ltd., China* *Chongqing University, China*	**Keynote:** Oxygen carrier design for chemical looping combustion of solid fuel **Laihong Shen** *Southeast University, China* (8:30-9:00)	196 Numerical simulation of nanoparticle fluidization-atomic layer deposition process at reactor scale **Zuyang Zhang** *Southeast University, China*	089 Impact of operating conditions and biochar particle size distribution on methane cracking rates in a fluidized bed reactor **N.I. Canabarro** *SINTEF Industry, Norway*
	105 Dynamic response characteristics for various conditions in circulating fluidized bed **Hongliang Xiao** *Huairou Laboratory, China*	**Keynote:** Demonstration of 5MW chemical looping combustion and gasification with biomass pellet as fuel **Zhenshan Li** *Tsinghua University, China* (9:00-9:30)	027 Entrainment characteristics of iron ore particles in a gas fluidized bed **Min Ji Lee** *Korea National University of Transportation, Republic of Korea*	079 Investigation of CO_2 capture performance and influence mechanism of K_2CO_3@ZrO_2 composite DAC adsorbent **Zhuang Qi** *Southeast University, China*
	082 Operating characteristics and advantages of horizontal circulating fluidized bed boiler for different biomass fuels **Kunlin Cong** *Tsinghua University, China* *Nowva Energy Co., Ltd., China*		159 Identification of the flow structure of dense phase in a gas-solid fluidized bed in bubbling fluidization regime with Geldart B+A particles **Xuesen Chai** *China University of Mining and Technology, China*	008 Challenges in fluidization technology **J. Ruud van Ommen** *Delft University of Technology, The Netherlands*
	088 An experimental investigation into the fluidization properties for particles of a Bell-type air cap coupled with a Helmholtz chamber **Rongdi Zhang** *Chongqing University, China*	140 TRL 7-8 demonstration of carbon capture for waste-to energy applications via calcium looping: engineering and design of a new pilot plant **Martin Haaf** *Sumitomo SHI FW Energia Oy, Finland*	059 Agglomeration mechanisms of a quartz bed - Comparison of fuel and synthetic ash compounds in defluidization tests with a laboratory FBC **Sevonius Christoffer** *Åbo Akademi University, Finland*	166 Experimental and numerical investigation on convective heat transfer coefficient of vertical plates in a fluidized bed **Wenhan Li** *Tsinghua University, China*
	187 Investigation on the rapid load adjustment capability of circulating fluidized bed boilers based on theoretical analysis and industrial practices **Xiwei Ke** *Huairou Laboratory, China* *North China Electric Power University, China*	044 Numerical design and simulation analysis of a 100 MW_{th} biomass chemical-looping combustion system **Ao Li** *Huazhong University of Science and Technology, China*	033 Study on the agglomeration mechanism in the spray fluidized bed granulation process **Han Pu** *Southeast University, China*	122 Directly irradiated fluidized bed autothermal reactor: Experimental characterization and operation cycle **S. Padula** *STEMS, Consiglio Nazionale delle Ricerche, Italy* *Università degli Studi di Napoli Federico II, Italy*

Parallel Sessions 4A-4C

Tuesday, April 8, 2025 10:30-12:20

Room	A Golden Thread	B Green Willow	C Beautiful Bamboo
Sessions	Combustion II	Combustion III	"AI+" I
Chairs	Liangyong Chen Xiaofeng Lu	Alberto Abad Dongjae Kim	Jaroslaw Krzywanski Jia Wei Chew
10:30	**Keynote:** Seen, known and thoughts through 40 years CFB researches **Leming Cheng** *Zhejiang University, China*	**Keynote:** Basic research and technology development about clean and low-carbon utilization of solid waste containing carbon **Fangqin Cheng** *Shanxi University, China*	**Keynote:** AI-based understanding and prediction of fluidized bed phenomena **Jia Wei Chew** *Chalmers University of Technology, Sweden*
11:00	200 The Role of Oxygen Carriers as Fluidized Bed Materials: Aided vs Catalytic Effects and Mechanisms **Lu Chen** *Southeast University, China*	048 Exploration of boundary conditions and lower limit of calorific value of ultra-low calorific value solid waste for stable combustion in CFB boiler **Yuyang Zeng** *Tsinghua University, China*	180 Prediction of oxygen release performance in metal oxides based on text mining and data-driven method **Yushuang Jiang** *Southeast University, China*
11:20	222 The study on the simulation optimization of biomass oxy-fuel combustion in a circulating fluidized bed based on intrinsic reaction kinetics **Dawei Guo** *Harbin Institute of Technology, China*	091 Study of sewage sludge combustion in a bubbling fluidized bed **E. Pitsukha** *A. V. Luikov Heat and Mass Transfer Institute,* *National Academy of Sciences of Belarus, Republic of Belarus*	012 Hybrid fuzzy-deep learning approach for generative adaptive emission prediction system in industry: FLAME-GAS Model **J. Krzywanski** *Jan Dlugosz University in Czestochowa, Poland*
11:40	037 Oxy-fuel co-combustion of biomass and coal blends in a 10 kW_{th} fluidized bed rig **Y.Mukhambet** *Nazarbayev University, Republic of Kazakhstan*	146 Research and application of municipal solid waste circulating fluidized bed combustion technology **Weixiong Zheng** *Tsinghua University & Huairou Laboratory, China*	047 Integrating machine learning predictions of pyrolysis products for improved biomass gasification MP-PIC simulations **Zhao Yang** *Huazhong University of Science and Technology, China*
12:00	084 Mechanism of NO to NH_3 conversion during NO reduction over biomass char in a fluidized bed under a H_2O atmosphere ***Chen Ge*** *University of Science & Technology Beijing, China*	043 Research on key technologies of circulating fluidized bed boiler fired gasification fine slag **Yu Li** *Nanjing Tech University, China*	011 Modeling and optimization of the drying process based on gas-solid fluidization **Dongjae Kim** *Soonchunhayng University, Republic of Korea*

Parallel Sessions 4D-4G

Tuesday, April 8, 2025 10:30-12:20

D Ginkgo	E Curling Dragon	F Crouching Tiger	G Silver Birch
Optimization & Design IV	Chemical Looping Combustion	Particle Behavior & Fluid Dynamics IV	Sustainable and Green Transition Technologies IV
Xuebin Wang Alar Konist	Bernd Epple Dongfang Li	Ling Zhou Daoyin Liu	Zhenkun Sun David Pallarès
Keynote: Some operating issues with high ash fuels in CFBC boilers and possible solutions **Alar Konist** *Tallinn University of Technology, Republic of Estonia*	**Keynote:** Impacts of wheat straw ash on performance of ilmenite in fluidized bed chemical looping combustion: reactivity, microstructure, attrition and agglomeration **Dongfang Li** *Kunming University of Science and Technology, China*	**Keynote:** Developing advanced models for understanding and improving spray fluidized coating process **Daoyin Liu** *Southeast University, China*	**Keynote:** Advancing thermochemical conversion in fluidized beds for resource efficiency and climate action **David Pallarès & Carolina Guío-Pérez** *Chalmers University of Technology, Sweden*
064 Real-time monitoring of external ash flow rate in CFB boilers considering refractory heat transfer characteristics **Hu Wang** *CHN ENERGY Investment Group Co., Ltd. & Chongqing University, China*	031 New concept of fuel reactor for chemical looping combustion **T.Czakiert** *Czestochowa University of Technology, Poland*	004 Helium-based cold model simulations for green hydrogen iron ore reduction studies **Nigitz Valentina** *Technische Universität Wien, Austria*	001 Closing the metal fuel cycle: Enhanced iron oxide powder reduction via fluidized bed operations across different regimes **N.C. Stevens** *Eindhoven University of Technology, The Netherlands*
112 Effects of alternative bed materials on the operation characteristics of a furfural residue-fired CFB boiler **Xin Yu** *Huairou Laboratory, China*	144 In-situ formation of calcium manganite from natural manganese ore and lime in a 300 W dual-fluidized-bed reactor for chemical looping combustion **Xiaoyun Li** *Chalmers University of Technology, Sweden*	136 Experimental study on the interaction between liquids and particles in fluidized bed **M. Troiano** *Università degli Studi di Napoli Federico II, Italy*	025 Hydrogenation of siderite for zero-carbon iron fuel production and iron combustion via chemical looping in fluidized bed **Tao Song** *Nanjing Normal University, China*
231 Application of high-temperature wear-resistant coatings and high thermal conductivity composite materials in large-scale CFB boilers **Yueming Wang** *Yixing Guoqiang Furnace Industry Co., Ltd., China* *Southeast University, China*	221 Performance of $CaMn_{0.625}Ti_{0.125}Fe_{0.125}Mg_{0.125}O_3$ in chemical looping combustion of biomass **Wen Luo** *Huazhong University of Science and Technology, China*	158 Effects of fines and moisture on the incipient fluidization of the gas-solid fluidized bed for dry mineral separation **Anyu Wang** *China University of Mining and Technology, China*	116 Calcium looping in directly irradiated fluidized beds with CaO/SiC mixtures for improved absorption of solar energy **Roberto Solimene** *STEMS, Consiglio Nazionale delle Ricerche, Iatly*
	099 Fate of potassium and impact on corrosion in the air reactor in chemical looping combustion **E.Vainio** *Åbo Akademi University, Finland*	207 Elucidating relationship between particle moisture and coating characteristics in a Wurster fluidized bed **Jinnan Guo** *Southeast University, China*	075 Hydrogen-based, low-temperature reduction of iron oxide in a bubbling fluidized bed **Victor Purnomo** *Chalmers University of Technology, Sweden*

Parallel Sessions 5A-5C

Tuesday, April 8, 2025 13:30-15:30

Room	A Golden Thread	B Green Willow	C Beautiful Bamboo
Sessions	Combustion IV	Gasification I	Computing & Simulation IV
Chairs	Sung Won Kim Tao Song	Georgy Ryabov Zhijie Fu	Wojciech Adamczyk Laihong Shen
13:30	237 A coupled network kinetic model for secondary reaction in fast pyrolysis of tar-rich coal: From mechanism to reactor simulation **Panxi Yang** *Xi'an Jiaotong University, China*	093 Thermochemical conversion of biomass and plastics in steam: The relevance of an active bed in a large scale dual fluidized bed **Renesteban Forero Franco** *Chalmers University of Technology, Sweden*	160 Optimization study of CPFD numerical simulation of ammonia-doped combustion in circulating fluidized bed boiler **Yixiang Zhang** *Xi'an Jiaotong University, China*
13:50	125 Evaluation of the relationship between straw fouling tendencies and fuel indices in CFB **R.Rajczyk** *Czestochowa University of Technology University, Poland*	078 CPFD simulation study on oxygen enrichment characteristics of biomass in industrial circulating fluidized bed gasifier **Zhiwei Hu** *Huazhong University of Science and Technology, China*	115 1D Numerical simulation of ammonia co-firing in a circulating fluidized bed boiler **Geun Yong Park** *Korea Institute of Industrial Technology, Republic of Korea, Republic of Korea*
14:10	006 Experimental study on the effects of high-temperature gas-solid mixed fuel properties on jet flame behavior **Yu Lu** *Institute of Engineering Thermophysics,Chinese Academy of Sciences, China*	053 Model-based estimation of fuel mixing in a lab-scale bubbling fluidized bed biomass CO_2 gasifier **Antti Pitkäoja** *Lappeenranta-Lahti University of Technology LUT, Finland*	130 Numerical simulation of coal-ammonia co-combustion in 350MW supercritical CFB boiler based on CPFD method **Zepeng Yang** *North China Electric Power Unicersity, China*
14:30	131 A novel coal purification-combustion system: combustion characteristics at different air-staging in combustion unit **Shaobo Han** *Institute of Engineering Thermophysics, Chinese Academy of Sciences, China*	113 Experimental and numerical investigation on the fluidized bed gasification characteristics for combustible gas production **Bin Wen** *Tsinghua University & Huairou Laboratory, China*	119 Experiments and ab initio simulation on the ammonia conversion characteristics over metal oxide surfaces **Bingjun Du** *Tsinghua University and Huairou Laboratory , China*
14:50	067 Evolutionary behavior of bed materials in oxygen carrier aided combustion of biomass **Yingjie Mi** *Huazhong University of Science and Technology, China*	155 Kinetics of biomass-char catalyzed with potassium in a fluidized bed gasifier **W.A. González** *University of Seville, Spain*	211 CPFD simulation of injection positions and PA/SA ratios on ammonia co-firing in a 550 MWe USC CFB boiler for carbon-free power generation **Joonwoo Kweon** *Pusan National University, Republic of Korea*
15:10			215 Numerical simulation study on the fluidization characteristics of a 700MW CFB boiler and its impact on boiler efficiency **Wenqiang Chen** *Shanghai Boiler Works Co., Ltd, China*

Parallel Sessions 5D-5F

Tuesday, April 8, 2025 13:30-15:30

D Ginkgo	E Curling Dragon	F Crouching Tiger
Optimization & Design V	Solid Looping Process	Mixing & Segregation I
Yang Zhang Yerbol Sarbassov	Zhen Huang Fabrizio Scala	Chenlong Duan Franz Winter
171 Biomass co-combustion experiment in the 465 t/h CFB boiler **Zhigang Yang** *Sinopec (Tianjin) Petrochemical Co., Ltd., China*	024 Utilizing magnetic fines in fluidized beds for continuous hydrogen production **Ivana Staničić** *Chalmers University of Technology, Sweden*	085 Experimental investigation of the lateral gas mixing in a fluid-dynamically downscaled circulating fluidized bed furnace **Jing Shi** *Chalmers University of Technology, Sweden*
100 Modeling and simulation of circulating fluidized bed boiler based on operation data **Yundong Zhao** *Tsinghua University, China*	028 Dolomites as CO_2 sorbents in fluidized bed sorption-enhanced gasification **Fabrizio Scala** *STEMS, Consiglio Nazionale delle Ricerche & Università degli Studi di Napoli Federico II, Italy*	106 Numerical investigation on the secondary air jet characteristics in a circulating fluidized bed **Xudong Zhong** *Huairou Laboratory, China*
065 Comparative analysis of thermal inertia in refractory materials for large-scale CFB boilers with external heat exchangers **Zhonghao Dong** *Chongqing University, China*	035 Enhancing solid circulation in chemical looping processes based on cold-flow model tests **Philipp Mohn** *Technical University of Darmstadt, Germany*	003 Evaluating solids mixing and segregation in binary fluidized beds using pressure signal analysis **N.Zeinalizadeh** *Sharif University of Technology, Iran*
229 Heavy metal analysis during the incineration of sewage sludge in BFB rig **Yerbol Sarbassov** *Nazarbayev University, Republic of Kazakhstan*	041 Dynamic Monte Carlo reactor modeling of calcium looping with sorbent purge and utilization decay **Jun Young Kim** *The Catholic University of Korea, Republic of Korea*	083 Decarbonization of CFB boiler fly ash by using a pulsating fluidized bed **Chen Xu** *SINOPEC Maoming Petrochemical Co. and China University of Mining and Technology, China*
009Scalable production of nanostructured materials for energy and health applications using gas phase deposition **J. Ruud van Ommen** *Delft University of Technology, The Netherlands*	178 Collaborative modelling of gas-solid reacting flow in a fuel reactor equipped with process controllers in chemical looping combustion/conversion **Guoyin Yu** *University of New South Wales, Australia*	134 The impact of fluid-dynamical scaling on the vertical distribution of solids in binary fluidized beds **Azka Rizwana Siddiqui** *Chalmers University of Technology, Sweden*
046 Research progress in the treatment of pollutants in sintering flue gas by combustion technology **Jinjiang Zhao** *Henan Polytechnic University, China*	192 Chemical looping air separation with $Sr_{0.8}Ca_{0.2}Fe_{0.9}Co_{0.1}O_{3-\delta}$ perovskite sorbent: packed bed modeling, verification, and optimization **Runxia Cai** *Shanghai Jiao Tong University, China*	181 Mixing/segregation characteristics and bubble behaviors of density-segregated binary particles in a pressurized fluidized bed **Xiaoli Zhu** *China University of Petroleum (East China), China*

Parallel Sessions 6A-6C

Tuesday, April 8, 2025 15:50-17:40

Room	A Golden Thread	B Green Willow	C Beautiful Bamboo
Sessions	Combustion V	Gasification II	"AI+" II
Chairs	Tao Song Sung Won Kim	Zhijie Fu Georgy Ryabov	Laihong Shen Wojciech Adamczyk
15:50	**Keynote:** Char gasification in chemical looping combustion **Haibo Zhao** *Huazhong University of Science and Technology, China*	**Keynote:** The possibility of using gasification in dual FB-CFB reactors and iron oxides chemical cycles **Georgy A. Ryabov** *All Russian Thermal Engineering Institute (VTI), Russia*	**Keynote:** Demonstration of advanced predictive and prescriptive algorithms to control large scale CFB unit based on digital twin technique **Wojciech Adamczyk** *Silesian University of Technology, Poland*
16:20	157 Measuring intrinsic reaction kinetics using bubbling fluidized bed reactors **Juray De Wilde** *Université catholique de Louvain, Belgium*	063 Pilot tests of gasification process in a novel turbulent fluidized bed gasifier for biomass **Kunlin Cong** *Tsinghua University, China*	165 Bridging the gap between periodic domain and fluidized bed **Yuxuan Zhou** *Institute of Process Engineering, Chinese Academy of Sciences, China*
16:40	097 Igniting hydrogen bubbles: unveiling combustion dynamics in a fluidized bed of silica sand **Yujia Wang** *University of Cambridge, UK*	052 Investigation of biomass CO_2-H_2O-O_2 circulating fluidized bed gasification for methanol production **Antti Pitkäoja** *Lappeenranta-Lahti University of Technology LUT, Finland*	132 Advanced computational methods for optimizing process parameters in chemical looping combustion **L. Lasek** *Jan Dlugosz University in Czestochowa, Poland*
17:00	096 Theoretical screening method of perovskite oxygen carriers with high lattice oxygen activity during biomass chemical looping combustion **Xiaobiao Ma** *Huazhong University of Science and Technology, China*	049 Investigation on the impact of air equivalence ratio on the characteristics of lignite coal partial gasification products in fluidized bed **Bin Zhang** *Zhejiang University, China*	223 Machine learning-empowered CO_2 adsorption towards environmental sustainability **Xiangzhou Yuan** *Southeast University, China*
17:20	057 The study and application of comprehensive utilization of biomass resources based on biogas technique and heat and power cogeneration system **Junping Gu** *University of Science and Technology Beijing, China*	154 Pilot-scale hot syngas cleaning for two-stage fluidized bed biomass gasification to renewable natural gas **Zhijie Fu** *The University of British Columbia, Canada*	094 Fluidization behavior analysis of iron ore dry-process powder in hydrogen-based direct reduction using deep learning **Chuanhao Wang** *University of Science and Technology Beijing, China*

Parallel Sessions 6D-6F

Tuesday, April 8, 2025 15:50-17:40

Room	D Ginkgo	E Curling Dragon	F Crouching Tiger
Sessions	Emissions & Environmental Impact	Chemical Looping Gasification	Mixing & Segregation II
Chairs	Yerbol Sarbassov Yang Zhang	Fabrizio Scala Zhen Huang	Franz Winter Chenlong Duan
15:50	**Keynote:** Stability and emission of circulating fluidized bed combustion of low-carbon gaseous fuel **Yang Zhang** *Tsinghua University, China*	**Keynote:** Chemical looping gasification of organic solid waste **Zhen Huang** *Guangzhou Institute of Energy Conversion, Chinese Academy of Science, China*	**Keynote:** Gas-solid fluidized dry separation of fine coal **Chenlong Duan** *China University of Mining and Technology, China*
16:20	022 Mathematical model for the determination of nitrous oxide (N_2O) and nitrogen oxides (NO_x) emissions during thermal sewage sludge treatment in fluidized bed furnaces and validation in Praxis **Daniel Bernhardt** *TU Dresden, Chair for Energy Process Engineering, Germany*	070 Chemical looping gasification with microalgae: Intrinsic gasification kinetics of char derived from fast pyrolysis **Daofeng Mei** *Instituto de Carboquímica (ICB-CSIC), Spain*	135 Segregation of large and lighter particles in a bubbling fluidized bed with solids cross flow **Azka Rizwana Siddiqui** *Chalmers University of Technology, Sweden*
16:40	054 Purification reaction and nitrogen conversion mechanism of high alkali coal **Linxuan Li** *Institute of Engineering Thermophysics, Chinese Academy of Sciences, China*	068 Chemical-looping gasification of biomass in the Chalmers semi-commercial CFB using copper smelter slag as oxygen carrier **Carl Linderholm** *Chalmers University of Technology, Sweden*	118 Investigation on the fluidization dynamics in a Geldart D/B binary particle system with significant density disparity **Weiqin Lu** *Tsinghua University & Huairou Laboratory, China*
17:00	121 Development of an efficient NO_x removal technology using a molten metal reactor system **Jung Hyeon Park** *Korea Institute of Industrial Technology, Republic of Korea*	217 A study on the oxygen exchange and migration mechanism of $NiFe_2O_4$ with H_2O during biomass char chemical looping gasification using ^{18}O isotope tracing method **Yan Lin** *Guangzhou Institute of Energy Conversion, China*	153 Spatial and temporal analysis of particle segregation in a binary mixture within pseudo-2D fluidized beds **López Jessenia** *University of Seville, Spain*
17:20	111 Numerical simulation of flue gas deacidification in a dry-process tower with CPFD method **Rudan Feng** *Shanxi Research Institute for clean energy of Tsinghua University, China*	036 Modelling the chemical looping gasification of biomass for high-quality syngas production with CO_2 capture **Alberto Abad** *Instituto de Carboquímica (ICB-CSIC), Spain*	150 Experimental analysis of the solids mixing in bubbling fluidized beds measured with magnetic solids tracing **David Pallarès** *Chalmers University of Technology, Sweden*

ACKNOWLEDGMENT

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ABOUT US

东方电气集团东方锅炉股份有限公司（简称“东方锅炉”）是中国东方电气集团有限公司（简称“东方电气”）下属核心企业。东方电气是中国发电设备研发设计制造和电站工程承包特大型企业，是中央确定的涉及国家安全和国民经济命脉的国有重要骨干企业、国务院国资委监管企业。

东方锅炉1966年起源于四川自贡，经过50余年的发展，现已成为中国一流的火力发电设备、核电站设备、电站辅机、化工容器、煤气化等设备的设计供货商和节能环保工程、电站改造、氢能制储运、太阳能光热等工程服务提供商。东方锅炉深入贯彻新发展理念，秉承东方电气“同·创”文化，始终坚持以客户需求为导向，以品质诚信赢得市场，肩负“绿色动力，驱动未来”的使命，竭诚为国内外广大客户提供技术领先、质量优良、服务一流、绿色环保的能源和环保装备。在“十四五”期间将成为具有全球竞争力的一流能源、环保、化工领域设备供应商和综合服务提供商。

Dongfang Boiler Co., Ltd.(DBC)is a core subsidiary of Dongfang Electric Corporation (DEC). DEC is one of the largest backbone enterprise groups under the direct supervision of ChineseLentral Government, specialized in R&D, manutacturing ot power equipment and general contractingof power plant projects.

Founded in Zigong in 1966, DBc, after more than 50 years of development, has become China'sfirst-class designer and supplier of thermal power equipment, nuclear power plant equipment, powerplant auxiliaries, chemical vessels and coal gasification equipment. Now we are, as well, anengineering service provider for energy conservation and environmental protection projects, powerplant retrofit, hydrogen energy production, storage and transportation and concentrating solarpower projects. DBC always bears the new development philosophy and DEc's "Co-creation"culture in mind, doing it utmost to satisfy the needs of customers as its orientation and to win themarket with quality and integrity. Shouldering the mission of "Shape the Future with Green Power'DBC stays committed to providing the advanced, high-quality, and environmental friendly equipmentwith the first-class service for energy and environmental protection industries in the world. DurincChina's "14th Five-Year Plan" period, DBC strives to be a supplier of first-class equipment andcomprehensive service with global competitiveness in the fields of energy, environmental protectionand chemical industry.

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DONGFANG BOILER CO., LTD.

商业模式
BUSINESS MODEL

A 装备制造与服务
Manufacturing and Service

东方锅炉不断发展新技术、新材料、新工艺，以提高火力发电、核电、环保、电站辅机、化工容器、煤气化等设备装备的先进性和可靠性。

We have made continuous development in new technologies, materials and processes to improve the advancement and reliability of our thermal power equipment, nuclear power equipment, environmental protection equipment, power station auxiliaries, chemical vessels, coal gasification equipment.

B 系统集成和工程总包
System Integration and EPC

东方锅炉拥有专业的核心装备设计制造能力、丰富的项目管理经验、设备远程故障诊断及运维技术，能够为客户提供全方位一站式系统服务，从单元工程延伸到总承包。包括：火力发电、节能环保等工程的技术支持、工程设计、设备集成、采购配套、调试投产、技术培训、过程运维等全过程服务。以PC、EPC等多种服务模式，向客户提供交钥匙工程和系统解决方案。

DBC is experienced in core equipment design and manufacturing, project management, equipment remote diagnosis and maintenance technologies. Our one-stop services, including unit engineering and EPC, also aim to address client's overriding concerns. In addition, we can also offer customers whole process services for thermal power equipment and energy conservation and environmental protection projects, including technical support, engineering, equipment integration, procurement support, commissioning, technical training, operation and maintenance, in PC, EPC and other service modes.

C 资源开发及管理
Resource Development and Management

东方锅炉在节能环保、新能源等方面，既可根据客户需求提供烟气治理、水处理与固体废弃物利用的项目咨询、技术研发、工程设计和运行管理等全过程、高品质的一体化服务，又可通过参与投资，与客户形成利益共同体携手发展新技术、新产业。

In terms of energy conservation, environmental protection and new energy, we provide the full cycle and high quality integrated services such as project consultation, technology R&D, engineering and operation management of flue gas treatment, water treatment and solid waste utilization in accordance with the requirement of customers; at the same time, we are ready to establish a community of interests with customers through investment, thus jointly developing core technologies and new industries.

服务理念
SERVICE CONCEPT

东方锅炉贯彻国家能源安全新战略，以技术创新驱动服务能力提升，秉承“终身服务、终身先进”的全生命周期服务理念，不懈为客户创造长期价值。

In an effort to respond to the nation's new energysecurity strategy, we are endeavored to enhance ourservice capability through technologicalinnovation andadhere to the full life-cycle service concept of"Lifetime Services and Advancement", thus creatinglong-term value for customers unremittingly.

https://www.dbc.com.cn/

哈尔滨锅炉厂有限责任公司
HARBIN BOILER COMPANY LIMITED
哈电集团

Introduction

Harbin Boiler Company Limited (HBC), established in 1954, is a core subsidiary of Harbin Electric Group Company Limited and a leading figure in the research and manufacturing of large-scale power station boilers in China.

As the pioneer and benchmark enterprise in circulating fluidized bed (CFB) boiler technology in China, HBC has propelled the industrialization of clean and efficient coal utilization through continuous technological innovation and engineering practices, providing critical support for China's "Dual Carbon" goals.

Main products

- Power station boilers
- Power station auxiliary equipment
- Petrochemical containers
- Nuclear power products
- New energy products
- Environmental protection business

Powering the world

Bringing light to humanity

CFB Boiler Technology

In the field of CFB boilers, HBC has achieved leapfrog development—from technology introduction to independent innovation, culminating in global technological leadership.

Looking to the future, HBC will continue to deepen research and development in low-carbon technologies, centering on the principles of "high efficiency, cleanliness, and intelligence," to contribute Chinese solutions to global energy sustainability.

http://www.hbc.com.cn

Yixing Guoqiang Furnace Industry CO., LTD

Yixing Guoqiang Furnace Industry Co., Ltd., established in 1997, is a leading manufacturer specializing in the production and sales of wear-resistant refractory materials for circulating fluidized bed boilers. The company's legal representative is Guoqiang Lin, and it operates with a registered capital of 28 million yuan. With a focus on product technology development, application innovation, and continuous product upgrades, We have built a strong portfolio of high-performance products. These include high-temperature wear-resistant coating products (such as GQ-218, GQ-318, and GQ-518), as well as composite wear-resistant materials featuring various thermal conductivity coefficients. Through constant innovation and refinement, the company has established itself as a reliable partner in the field of refractory materials, delivering durable solutions that meet the evolving demands of industrial applications.

1、GQ series of high-temperature wear-resistant coating products

① The application of a variety of oxide aggregate and ultra micro powder, ensures that the material itself has erosion resistance and wear resistance after sintering;

②The use of adhesive ensures the full combination of high-temperature wear-resistant coating and the original refractory material substrate, the new and old materials sintering into a whole;

③Through the optimization of the raw material, adjust the formula, in the high strength characteristics, both excellent hot shock stability, can resist the heat shock brought by frequent start and stop furnace;

④High temperature wear-resistant coating for different temperature steps of the boiler, set special combination formula, to ensure that the material can play its excellent performance under all working conditions.

2、Multiple high strength and high thermal conductivity composite wear-resistant materials (special materials for reducing bed temperature)

High thermal conductivity composite wear-resistant material is a series of new materials with comprehensive advantages, such as excellent wear resistance, erosion resistance, erosion resistance and heat shock stability, etc. Its thermal conductivity can also be arbitrarily prepared according to the needs.

Due to the high thermal conductivity of multiple, high-strength and high-thermal conductivity composite wear-resistant materials, If the dense phase area of the circulating fluidized bed boiler and the suspension screen are replaced with multiple high strength and high thermal conductivity composite wear-resistant materials to increase the heat transfer capacity per unit heating area of the corresponding area, Not only can achieve the purpose of reducing the bed temperature, Can also reduce the bed temperature control means, In particular, reduce the boiler operation air volume, reduce the amount of material, reduce the amount of limestone and other auxiliary cooling measures, So as to reduce the boiler operation energy consumption, reduce the flue gas speed in the furnace, Slow down the boiler wear, prolong the boiler operation cycle, reduce gas emissions and other effects, Achieve energy saving and consumption reduction and environmental protection standard.

无锡市宜刚耐火材料有限公司
Wuxi City Yigang Refractories Co., LTD

宜刚索引 Yigang Index

● National specialized new small giant enterprise, the core main product is circulating fluidized bed boiler wear-resistant refractory materials
● Member unit of the National Technical Committee for Standardization of Refractory Materials
● Member unit of National Fossil fuel power station Standardization Technical Committee
● Member unit of the National Environmental Protection Product Standardization Technical Committee
● Jiangsu Province specialized new small giant enterprise, the core main product is circulating fluidized bed boiler wear-resistant refractory materials
● Jiangsu Province Supercritical Fluidized Bed Boiler Refractory Engineering Technology Research Center was settled and director unit
● Wuxi Environmental Refractory Engineering Technology Research Center was settled and director unit
● Focus on the design, manufacture, installation and maintenance of CFB boiler wear-resistant refractory materials for more than 35 years
● Engaged in urban solid waste incinerator corrosion resistant refractory design, manufacturing, installation, dry-out more than 20 years
● Equipped more than 80 CFB boilers of 300MW and above at home and abroad, and completed more than 20 high-tonnage boilers of the national circulating fluidized bed boiler key export project
● Equipped with 11 sets of the world's largest supercritical CFB furnaces above 600MW and 660MW and 700MW
● Equipped more than 1000 municipal solid waste incinerators of more than 20 types in more than 10 countries
● Equipped the world's largest daily urban waste treatment capacity of 6,400 tons
Compile and participate in the preparation of national and industry standards
GB/T23294-2009 Wear-resistant refractory material
GB/T18750-2008 Domestic Incineration furnace and waste heat boiler
GB50972-2014 Code for construction and quality acceptance of CFB boilers
DL/T777-2012 Boiler Refractory material for thermal power plant
DL/T1035.5-2006 Guidelines for maintenance of CFB boilers, the maintenance of refractory and wear-proof layers
YB/T4109-2002 Wear-resistant refractory castables for circulating fluidized bed boiler
YB/T4132-2005 Wear-resistant refractory plastics for circulating fluidized bed boiler
YB/T4133-2005 Wear-resistant refractory mortar for circulating fluidized bed boiler
YB/T4108-2002 Wear-resistant refractory bricks for circulating fluidized bed boiler
● Undertook and completed the research and development sub-project of wear-resistant refractory products and engineering supporting technologies for 600MW supercritical CFB boilers in the national "11th Five-Year Plan" science and technology plan
● Undertook the "Research and development and manufacture of wear-resistant refractory materials for ultra-supercritical circulating fluidized bed boiler" project in the national "13th Five-Year Plan" science and technology plan
● Won the first prize of China Electric Power Science and Technology Progress Award (600MW supercritical CFB boiler technology development and engineering demonstration project)
● First prize of Jiangsu Science and Technology Award
● National Ceramic Industry Meritorious Enterprise Award
● Jiangsu Province ceramic industry enterprise taxpayer、Jiangsu Province Enterprise Graduate Workstation
● Advanced quality management industry in Jiangsu Province、Integrity five-star enterprise in Jiangsu Province
● China's top 100 furnace construction enterprises、National furnace engineering construction model enterprise