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**Thirty-Seventh Annual**  
**INTERNATIONAL PITTSBURGH**  
**COAL CONFERENCE**

University of Pittsburgh · Swanson School of Engineering

**Virtual**

**TECHNICAL PROGRAM**

**Clean Coal-based Energy/Fuels**  
**and the Environment**

***September 8-11, 2020***

Hosted by:



University of  
**Pittsburgh**

## WELCOME!

On behalf of the Conference Advisory Board, Conference Committees, and the University of Pittsburgh, we welcome you to the Thirty-Seventh Annual International Pittsburgh Coal Conference, which will be held September 8-11, 2020 online via Zoom due to COVID-19. The Conference is hosted by the University of Pittsburgh, USA.

The theme of this year's conference "Clean Coal-based Energy/Fuels and the Environment" covers wide spectrum of important topics on energy and environmental issues and technologies, which are directly related to extraction and utilization of coal and its byproducts. This year's Technical Program includes over 150 papers arranged in three parallel tracks of Oral presentations, which will be held September 9-11, 2020 from 8:00 to 15:15 and one track of Poster presentations, which will be held September 9-10, 2020 from 8:00 to 14:25. Detailed information about the technical sessions are available in page 7 of the Technical Program.

This year's invited Plenary Speakers are: (1) Dr. Brian Anderson: Director, National Energy Technology Laboratory (NETL) - Department of Energy, USA; (2) Ms. Janet Gellici: Chief Executive Officer, National Coal Council, USA; (3) Mr. James F. Wood: Director Energy Institute, Director Advanced Coal Technology Consortium, West Virginia University, USA; (4) Dr. Holly Krutka: Executive Director, School of Energy Resources, University of Wyoming, USA; (5) Mr. Daniel P. Connell: Vice President - Business Development & Technology, CONSOL Energy Inc., USA; and (6) Dr. Randall W. Gentry: Chief Research Officer and Deputy Director, Science & Technology, National Energy Technology Laboratory, USA.

We express our sincere gratitude to the Plenary Speakers and Moderators for their support and involvement, to all the authors and co-authors of the technical papers and to all the members of the Technical Program Committee. Special thanks go to the topic coordinators, co-chairs and speakers for their invaluable contributions to the 2020 technical program.

As the chair of the Advisory Board of the Conference, I deeply appreciate your participation and interest in this year's Conference and we invite you to join us next year for the Thirty-eighth Annual International Pittsburgh Coal Conference, hopefully at the Westin Convention Center Hotel in Pittsburgh, PA, USA.

Sincerely,

Massood Ramezan, Chair



Senior Technical Advisor at Key Logic Systems, USA

## The International Pittsburgh Coal Conference

### **EXECUTIVE DIRECTOR:**

Dr. Badie I. Morsi

### **CONFERENCE OFFICE:**

University of Pittsburgh, Swanson School of Engineering  
Pittsburgh Coal Conference

3700 O'Hara Street, 940 Benedum Hall, Pittsburgh, PA 15261 USA  
Tel: +1-412-624-7440 Email: [ipcc@pitt.edu](mailto:ipcc@pitt.edu) [www.pccpitt.org](http://www.pccpitt.org)

## CONFERENCE OVERVIEW

### TUESDAY, SEPTEMBER 8, 2020

OPENING CEREMONY	08:45 - 09:00
PLENARY SESSION I	09:00 - 11:00
BREAK	11:00 - 12:00
PLENARY SESSION II	12:00 - 14:00

### WEDNESDAY, SEPTEMBER 9, 2020

CONCURRENT TECH. SESSIONS	08:00 - 10:10
POSTER SESSION 1	08:00 - 10:10
BREAK	10:10 - 10:20
CONCURRENT TECH. SESSIONS	10:20 - 12:25
POSTER SESSION 2	10:20 - 12:25
BREAK	12:25 - 13:10
CONCURRENT TECH. SESSIONS	13:10 - 15:15

### THURSDAY, SEPTEMBER 10, 2020

CONCURRENT TECH. SESSIONS	08:00 - 10:10
POSTER SESSION 3	08:00 - 10:10
BREAK	10:10 - 10:20
CONCURRENT TECH. SESSIONS	10:20 - 12:25
POSTER SESSION 4	10:20 - 12:00
BREAK	12:25 - 13:10
CONCURRENT TECH. SESSIONS	13:10 - 15:15
POSTER SESSION 5	13:10 - 14:10

### FRIDAY, SEPTEMBER 11, 2020

CONCURRENT TECH. SESSIONS	08:00 - 10:10
BREAK	10:10 - 10:20
CONCURRENT TECH. SESSIONS	10:20 - 12:25
BREAK	12:25 - 13:10
CONCURRENT TECH. SESSIONS	13:10 - 15:15

### TUESDAY, SEPTEMBER 8, 2020

#### PLENARY SESSION I

08:45—11:00

**Moderator:** Mr. Richard Winschel, Longbridge Energy Consulting, USA

#### **Dr. Brian Anderson**

Director, National Energy Technology Laboratory (NETL) - Department of Energy, USA

*"Integrated Energy Systems of the Future"*

#### **Ms. Janet Gellici**

Chief Executive Officer, National Coal Council, USA  
*"COAL POWER: Smart Policies for Cleaner, Stronger Energy"*

#### **Mr. James F. Wood**

Director Energy Institute, Director Advanced Coal Technology Consortium, West Virginia University, USA  
*"U.S.-China Clean Energy Research Center"*

#### PLENARY SESSION II

12:00—14:00

**Moderator:** Mr. Richard Winschel, Longbridge Energy Consulting, USA

#### **Dr. Holly Krutka**

Executive Director, School of Energy Resources, University of Wyoming, USA

*"Driving Coal Innovation in Wyoming"*

#### **Mr. Daniel P. Connell**

Vice President - Business Development & Technology, CONSOL Energy Inc., USA  
*"Opportunities to Transform the Future of Coal through Technology"*

#### **Dr. Randall W. Gentry**

Chief Research Officer and Deputy Director, Science & Technology, National Energy Technology Laboratory, USA

*"2020: A Perspective on the Horizon Through an Innovation Lens"*

*Times listed are Eastern Standard Time (Local Pittsburgh, PA, USA)*

## Oral Presentation Sessions

		Track 1	Track 2	Track 3
<b>Wednesday (09/09/2020)</b>	8:00 - 8:05	Opening Session	Opening Session	Opening Session
	8:05 - 8:30	Gasification Technologies - 1 (Session 1)	Combustion Technologies - 1 (Session 2)	Carbon Management - 1 (Session 3)
	8:30 - 8:55			
	8:55 - 9:20			
	9:20 - 9:45			
	9:45 - 10:10			
	10:10 - 10:20	Break		
	10:20 - 10:45	Gasification Technologies - 2 (Session 4)	Combustion Technologies - 2 (Session 5)	Carbon Management - 2 (Session 6)
	10:45 - 11:10			
	11:10 - 11:35			
11:35 - 12:00				
12:00 - 12:25	Break			
12:25 - 13:10	Gasification Technologies - 3 (Session 7)	Combustion Technologies - 3 (Session 8)	Carbon Management - 3 (Session 9)	
13:10 - 13:35				
13:35 - 14:00				
14:00 - 14:25				
14:25 - 16:50				
14:50 - 15:15	Break			
<b>Thursday (09/10/2020)</b>	8:00 - 8:05	Opening Session	Opening Session	Opening Session
	8:05 - 8:30	Sustainability and the Environment - 1 (Session 10)	Clean Coal and Gas to Fuels - 1 (Session 11)	Power Plants - 1 (Session 12)
	8:30 - 8:55			
	8:55 - 9:20			
	9:20 - 9:45			
	9:45 - 10:10			
	10:10 - 10:20	Break		
	10:20 - 10:45	Gasification Technologies - 4 (Session 13)	Clean Coal and Gas to Fuels - 2 (Session 14)	Power Plants - 2 (Session 15)
	10:45 - 11:10			
	11:10 - 11:35			
11:35 - 12:00				
12:00 - 12:25	Break			
12:25 - 13:10	Energy Storage - 1 (Session 16)	Combustion Technologies - 4 (Session 17)	Carbon Management - 4 (Session 18)	
13:10 - 13:35				
13:35 - 14:00				
14:00 - 14:25				
14:25 - 14:50				
14:50 - 15:15	Break			
<b>Friday (09/11/2020)</b>	8:00 - 8:05	Opening Session	Opening Session	Opening Session
	8:05 - 8:30	Coal Science - 1 (Session 19)	Coal Ash Management - 1 (Session 20)	Value-Added Products from Coal - 1 (Session 21)
	8:30 - 8:55			
	8:55 - 9:20			
	9:20 - 9:45			
	9:45 - 10:10			
	10:10 - 10:20	Break		
	10:20 - 10:45	Clean Coal Demonstration and Commercial Projects - 1 (Session 22)	Coal Ash Management - 2 (Session 23)	Value-Added Products from Coal - 2 (Session 24)
	10:45 - 11:10			
	11:10 - 11:35			
11:35 - 12:00				
12:00 - 12:25	Break			
12:25 - 13:10	Clean Coal Demonstration and Commercial Projects - 2 (Session 25)	Coal Mining, Preparation and Handling - 1 (Session 26)	Rare Earth Elements - 1 (Session 27)	
13:10 - 13:35				
13:35 - 14:00				
14:00 - 14:25				
14:25 - 16:50				
14:50 - 15:15	Break			

*Times listed are Eastern Standard Time (Local Pittsburgh, PA, USA)*



## Poster Presentation Sessions and Exhibit

### Poster Sessions:

Wednesday (09-09-2020)		
Poster Session 1  8:00 - 10:10	8:00	Sustainability and Environment [SE]
	8:20	Coal Ash Management [CAM]
	8:40	Gasification Technologies [GT]
	9:00	Gasification Technologies [GT]
	9:20	Coal Science [CS]
	9:40	Q&A for Poster Session 1 presentations
10:10 - 10:20		Break
Poster Session 2  10:20 - 12:00	10:20	Carbon Management [CM]
	10:40	Carbon Management [CM]
	11:00	Carbon Management [CM]
	11:20	Carbon Management [CM]
	11:40	Carbon Management [CM]
	12:00	Q&A for Poster Session 2 presentations

Thursday (09-10-2020)		
Poster Session 3  8:00 - 10:10	8:00	Power Plants [PP]
	8:20	Power Plants [PP]
	8:40	Value-Added Products from Coal [VA]
	9:00	Value-Added Products from Coal [VA]
	9:20	Rare Earth Elements (REE)
	9:40	Q&A for Poster Session 3 presentations
10:10 - 10:20		Break
Poster Session 4  10:20 - 12:25	10:20	Carbon Management [CM]
	10:40	Coal Science [CS]
	11:00	Power Plants [PP]
	11:20	Power Plants [PP]
	11:40	Q&A for Poster Session 4 presentations
12:00 - 13:10		Break
Poster Session 5  13:10 - 15:15	13:10	Rare Earth Elements (REE)
	13:30	Rare Earth Elements (REE)
	13:50	Rare Earth Elements (REE)
	14:10	Q&A for Poster Session 5 presentations

### Virtual Exhibit:



Wednesday (09-09-2020)	
Exhibit	
13:10 - 15:15	<b>NETL Exhibit</b> Strategic Partnerships "How to Work With NETL" Thomas Sarkus, Manager, Industrial Partnerships

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# TECHNICAL PROGRAM—ORAL PRESENTATIONS

## ORAL SESSIONS Wednesday, September 9 08:00—15:15

### SESSION 1

#### GASIFICATION TECHNOLOGIES—1

*Diane Revay Madden and Alberto Pettinau*

**8:05 Size Distributions and Chemistry of Inorganic Particles in Residues Produced from Two Commercial Entrained-Flow Coal Gasification Plants in China**, Yafeng Wang, Yuegang Tang, China University of Mining and Technology (Beijing), CHINA; John P. Hurley, University of North Dakota, USA; Xin Guo, China University of Mining and Technology (Beijing), CHINA; Robert B. Finkelman, University of Texas at Dallas; Shane K. Butler, Alexander Azenkeng, University of North Dakota, USA.

**8:30 CFD Simulation of the Two-Stage Dry Feed Entrained Flow Gasifier**, Bo Zhang, Shaoping Shi, Yanfei Mu, Yan Shu, PhD State Key Laboratory of Coal-Based Clean Energy (Huaneng Clean Energy Research Institute), CHINA

**8:55 Performance Evaluation of Coal Pyrolysis-Based Staged Conversion Polygeneration System Coupling with a 2×300wme CFB Power Plant**, Kaikun Li, Qinhui Wang, Mengxiang Fang, Zhongyang Luo, Zhejiang University, CHINA

**9:20 Research and Development of New Biomass-Coal Co-Conversion Technology**, Fan Lulu, Co-Authors Chen Hui, Meng Xianliang, Zhou Min, Yan Xinlong, Wan Yongzhou, Xiao Lei, China University of Mining and Technology, CHINA

**9:45 Coal Hydrogasification for Aromatics and Methane Process Innovation and Industrialization**, San Zhou, Guoqing Wang, Zhichao Ma, Haoqiang Wang, Lirong Ma, ENN Science & Technology Development Co., Ltd., CHINA

### SESSION 2

#### COMBUSTION TECHNOLOGIES—1

*Evan Granite and Johan van Dyk*

**8:05 The Effect of Alkaline Earth Metals on Soot Formation and Devolatilization Kinetics During Coal Pyrolysis**, Yifan Wu, Yu Zhang, Jiankun Zhuo, Tsinghua University, Qiang Yao, Tsinghua University & Xinjiang University, CHINA

**8:30 Fireside Corrosion of Ni-Fe Based Alloy GH984G for Ultra-supercritical Coal-fired Power Plants**, Jiali Wang, Jiankun Zhuo, Tsinghua University, CHINA

**8:55 Ignition Characteristics of Single Coal Particle under Pressurized Oxy-fuel Conditions**, Qianyun Chen, Yusheng Wang, Jing Li, Zhaohui Liu, Chuguang Zheng, Huazhong University of Science and Technology, CHINA

**9:20 Elemental Mercury Removal by I-doped Bi<sub>2</sub>WO<sub>6</sub> with Remarkable Visible-Light-Driven Photocatalytic Oxidation**, Yili Zhang, ZhuoXiong, Yongchun Zhao, Junying Zhang, Huazhong University of Science & Technology, CHINA

**9:45 Experimental and Modeling Investigation of Coal/Biomass Particle-wall Collision Behaviors**, Jingyu Wang, Tsinghua University; Lele Feng, China University of Mining and Technology; Yuxin Wu, Guangxi Yue, Tsinghua University; CHINA

### SESSION 3

#### CARBON MANAGEMENT—1

*Nicholas Siefert and Omar Basha*

**8:05 120,000t/A Post-Combustion CO<sub>2</sub> Capture Unit Upgrading and New Solvent Performance Verification**, Jinyi Wang, Hongwei Niu, Dongfang Guo, China Huaneng Clean Energy Research Institute; Lianbo Liu, Beijing Key Laboratory of CO<sub>2</sub> Capture and Process; Shiwang Gao, State Key Laboratory of Coal-Based Clean Energy, CHINA

**8:30 Simultaneous Removal of Carbon Dioxide and Multi-pollutants from Flue Gas by Cryogenic Pentane Scrubbing**, Shiqing Wang, Huaneng Clean Energy Research Institute; Shiwang Gao, Beijing Key Laboratory of CO<sub>2</sub> Capture and Process; Jinyi Wang, Huaneng Clean Energy Research Institute; Hongwei Niu, Beijing Key Laboratory of CO<sub>2</sub> Capture and Process; Lianbo Liu, Huaneng Clean Energy Research Institute; CHINA

**8:55 CO<sub>2</sub> Capture by Supported Phosphonium Dual Functionalized Ionic Liquids @ MCM-41**, Rui-nan Wang, Taiyuan University of Technology; Cui-ping Ye, Taiyuan University of Technology, Training Base of State Key Laboratory of Coal Science and Technology Jointly Constructed by Shanxi Province and Ministry of Science and Technology; Xia Gao, Taiyuan University of Technology; Wen-ying Li, Training Base of State Key Laboratory of Coal Science and Technology Jointly Constructed by Shanxi Province and Ministry of Science and Technology; CHINA

**9:20 Oxidation States of Pt Nanoparticles Induced Selectivity Change of Photocatalytic CO<sub>2</sub> Reduction Over Pt/TiO<sub>2</sub> Catalysts**, Junyi Wang, Zhuo Xiong, Yongchun Zhao, Junying Zhang, Huazhong University of Science & Technology, CHINA

### SESSION 4

#### GASIFICATION TECHNOLOGIES—2

*Andreas Richter and Rolf Maurer*

**10:20 Underground Coal Gasification as a Transitional Fuel in South Africa**, David Love, Golder; Johan Brand, Africary; Robert Gumbi, Oxeye Energy; Shehzaad Kauchali, University of the Witwatersrand; Shaun Pershad, Eskom Holdings SOE; Christien Strydom, North West University and South African Underground Coal Gasification Association; SOUTH AFRICA

**10:45 Geochemical Assessment of the Underground Coal Gasification Geo-reactor**, Lehlohonolo Mokhahlane, University of the Witwatersrand, SOUTH AFRICA

**11:10 Particle Morphology Evolution During Char Conversion Process Applied for CFD Modeling an Entrained-Flow Gasifier**, Cong Bang Nguyen, Johannes Scherer, Mathias Harwich, Andreas Richter, TU Bergakademie Freiberg, GERMANY

**11:35 Numerical Study on the Effect of Particle Residence Time on Kinetics Evaluation of Gasification Reaction in a Drop-Tube Furnace**, Fengbo An, Andreas Richter, TU Bergakademie Freiberg, GERMANY

**12:00 New Approach for Flame Image Segmentation Based on Machine Learning Algorithms**, Mohsen Gharib, Andreas Richter, TU Bergakademie Freiberg, GERMANY

### SESSION 5

#### COMBUSTION TECHNOLOGIES—2

*Evan Granite and Thomas Sarkus*

**10:20 Dynamic Simulation of the Flue Gas Behavior in a Conceptual 10 Mwth Oxy-Circulating Fluidized Bed Combustor**, Hoangkhoi Nguyen, Byungho Song, Kunsan National University; Dowon Shun, Jaehyeon Park, Jaegoo Lee, Korea Institute of Energy Research; SOUTH KOREA

**10:45 The Pressurized Oxycombustion Behavior of Turkish Lignites in the Bubbling Fluidized Bed Combustor**, Ufuk Kayahan, TUBITAK Marmara Research Center Energy Institute; Nevzat Ula, Marmara University; Berrin Engin, Aslı Sayar, Namık Ünlü, TUBITAK Marmara Research Center Energy Institute, TURKEY

**11:10 Characterization of Oxy-Coal Swirl Injector**, MD. Mohieminul I. Khan, Ana Rios, Mehrin Chowdhury, Ahsan Choudhuri, The University of Texas at El Paso, USA

**11:35 Effects of Supercritical, CO<sub>2</sub>-dilution on the Flame Dynamics and Morphology in a Coal-Fired Allam Cycle Combustor**, Samuel Ogunfuye, Abdulafeez Adebisi, V'yacheslav Akkerman, West Virginia University, USA

# TECHNICAL PROGRAM—ORAL PRESENTATIONS

**12:00 Developing an Intensified and Cost-Effective Coal-Fueled Chemical Looping Combustion Process**, Ayo Omosebi, Kunlei Liu, University of Kentucky, USA

## SESSION 6

### CARBON MANAGEMENT —2

*Nicholas Siefert and Bingyun Li*

**10:45 Evaluation of CO<sub>2</sub> Leakage Potential through Injection and Monitoring Wells at The Shenhua CCS Demonstration Project: Impact of Well Permeability Variation**, Liwei Zhang, Manguang Gan, Chinese Academy of Sciences, CHINA; Minh C. Nguyen, University of Wyoming, USA; Philip H. Stauffer, Los Alamos National Laboratory, USA; Ning Wei, Jun Li, Hongwu Lei, Yan Wang, Xiaochun Li, Chinese Academy of Sciences, CHINA

**11:10 Effects of MDEA Concentration and Nanofluid-Types on the CO<sub>2</sub> Absorption and Desorption Performance of MDEA-based Nanofluids**, Liu Yang, Chengdong Kong, Zhongxiao Zhang, Jian Liu, Shanghai Jiao Tong University, CHINA

**11:35 Renewable Fuels Production from Fossil-Derived CO<sub>2</sub>: The Sotacarbo Experimental Results**, Alberto Pettinau, Mauro Mureddu, Sarah Lai, Francesca Ferrara, Sotacarbo S.p.A., ITALY

**12:00 Assessment of Microwave CO<sub>2</sub> Gasification for Different Rank Coals**, Candice Ellison, Victor Abdel-Sayed, Mark Smith, Dushyant Shekhawat, DOE/National Energy Technology Laboratory, USA

## SESSION 7

### GASIFICATION TECHNOLOGIES —3

*Gary Stiegel and Alberto Pettinau*

**13:10 Neutron-Scattering Diagnostics for Improved Gasifier Modeling**, Charles E.A. Finney, Costas Tsouris, D. Barton Smith, James E. Parks ii, Oak Ridge National Laboratory, Oak Ridge, USA

**13:35 Modeling Updraft Moving-bed Gasifier Performance for Industrial Scale CHP Applications**, Liqiang Lu, Jia Yu, Mehrdad Shahnam, Diane R. Madden, William A. Rogers, National Energy Technology Laboratory; Rolf E. Maurer, David P. Thimsen, Hamilton Maurer International, Inc.; Brent J. Sheet, University of Alaska Fairbanks; USA; Alberto Pettinau, Sotocarbo S.p.A., ITALY

**14:00 Technoeconomic Analysis of Oxygen-Nitrogen Separation from Air for Oxygen Enrichment Using Membranes**, Birendra Adhikari, Christopher J. Orme, John R. Klaehn, Frederick F. Stewart, Idaho National Laboratory, USA

**14:25 Hydrogen Enrichment for a Solid Oxide Fuel Cell/Gas Turbine (SOFC/GT) Hybrid Power Generation System Using Mechanical Gas Separation**, John VanOsdol, Dave Tucker, Larry Shadle, National Energy Technology Laboratory, USA

**14:50 Overview of U.S. Department of Energy Office of Fossil Energy's Solid Oxide Fuel Cell Program**, Shailesh D. Vora, National Energy Technology Laboratory, USA

## SESSION 8

### COMBUSTION TECHNOLOGIES —3

*Nicholas Siefert and Ting Wang*

**13:10 CFD Investigation of the Impact of a Pulverized Coal Particles Size on Staged, Pressurized Oxy-Combustion (SPOC)**, Alain Islas, Ansan Pokharel, V'yacheslav Akkerman, West Virginia University; Zhiwei Yang, Richard L. Axelbaum, Washington University in Saint Louis; USA

**13:35 Commissioning of a Pilot-Scale, Dry-Feed, Pressurized Oxy-Combustion System**, Zhiwei Yang, Dishant Khatri, Piyush Verma, Tianxiang Li, Adewale Adeosun, Benjamin M. Kumfer, Richard L. Axelbaum, Washington University in Saint Louis, USA

**14:00 Oxygen Uncoupling and Reduction Reactivity of Mixed Metal Oxides Cu-Fe and Mn-Fe for High Temperature Coal Chemical Looping Combustion**, Ping Wang, Department of Energy (DOE)/National Energy Technology Laboratory (NETL); Co-Authors: Nicholas Means, Chemical Engineer, Leidos Research Support Team; Bret Howard, Department of Energy (DOE)/National Energy Technology Laboratory (NETL); USA

**14:25 Recycle of Oxygen Carriers in Chemical Looping Combustion: Impact of Coal Ash-derived Chemical Impurities**, Logan Hughey, Kevin J. Whitty, The University of Utah, USA

**14:50 Process Design and Analysis of a Novel Carbon-Capture-Ready Process for Flexible-Load Power Generation: Modular Pressurized Air Combustion**, Piyush Verma, Zhiwei Yang, Washington University in Saint Louis, Saint Louis; Scott Hume, Andrew Maxson, Electric Power Research Institute, Inc.; Richard L. Axelbaum, Washington University in Saint Louis; USA

## SESSION 9

### CARBON MANAGEMENT —3

*Omar Basha and Ahmed Aboudheir*

**13:10 Synthesis of Tri- and Tetra-esters for Use as Physical Carbon Capture Solvents**, Robert Thompson, Jeffrey Culp, Surya Tiwari, National Energy Technology Laboratory, USA

**13:35 Joint Study to Develop an Integrated Commercial Scale CCUS Project in the Ordos Basin Presenting**, Zunsheng Jiao, University of Wyoming; Gao Ruimin, Research Institute of Yanchang Petroleum Group; Zhou Lifa, Northwest University; Wei Ning, Institute of Rock and Soil Mechanics; Wang Heng, University of Wyoming; Zhao Yongpan, Research Institute of Yanchang Petroleum Group; Yuri Ganshin, Fred McLaughlin, Scott Quillinan, University of Wyoming; USA

**14:00 CO<sub>2</sub>-Fracturing Fluid Driven Geochemical Alterations at the Shale Matrix-Fracture Interface**, Angela Goodman, Sean Sanguinito, Patricia Cvetic, Barbara Kutchko, United States Department of Energy, National Energy Technology Laboratory; Sittichai Natesakhawat, University of Pittsburgh; USA

**14:25 Observed Variation of CO<sub>2</sub>-Brine Contact Angles on Sandstone**, Foad Haeri, Deepak Tapriyal, Sean Sanguinito, Fan Shi, National Energy Technology Laboratory; Samantha J. Fuchs, The University of Texas at Austin; Laura Dalton, John Baltrus, Bret Howard, Dustin Crandall, Christopher Matranga, Angela Goodman, National Energy Technology Laboratory; USA

**14:50 Valorization of CO<sub>2</sub> Emissions of Steam Methane-Reforming with Co-Production of High-Value Carbon Materials Via MW Plasma**, Aayush Mantri, Vignesh Viswanathan, George Skoptsov, President & CEO, H Quest Vanguard, Inc., USA

**ORAL SESSIONS**  
**Thursday, September 10**  
**08:00—15:15**

## SESSION 10

### SUSTAINABILITY & THE ENVIRONMENT —1

*Leslie Ruppert and Evan Granite*

**8:05 Net Zero Operation of Coal-Fired Power Plant Using Surplus Renewable Energy**, Fumihiko Yoshida, Yuji Hanai, Isamu Watanabe, Hiromi Shirai, Central Research Institute of Electric Power Industry, JAPAN

**8:30 Country-specific Role and Value of Carbon Capture and Sequestration in the Power Systems**, Yoga Wienda Pratama, Niall Mac Dowell, Centre for Environmental Policy – Imperial College London, UK

**8:55 Potential Oil Supply and CO<sub>2</sub> Demand from CO<sub>2</sub> Enhanced Oil Recovery in the United States**, David Morgan, Travis Warner, Donald Remson, National Energy Technology Laboratory, USA



## TECHNICAL PROGRAM—ORAL PRESENTATIONS

**9:20 Technoeconomic and Life Cycle Analysis of Bio-Energy with Carbon Capture and Storage (BECCS) Baseline**, Timothy Fout, Timothy J. Skone, National Energy Technology Laboratory; Kyle Buchheit, Engineer, KeyLogic, Inc.; Eric Lewis, Engineer, Deloitte Consulting, LLP; Kishore Mahbubani, Derrick Carlson, KeyLogic, Inc.; USA

**9:45 Evaluating Capacitive Deionization and Zeolite Dewatering as Effective Treatment Options for CO<sub>2</sub>-Enhanced Water Recovery Streams**, Ayokunle Omosebi, Jinwen Wang, Kunlei Liu, University of Kentucky, USA

### SESSION 11

#### CLEAN COAL AND GAS TO FUELS —1

*Atsushi Ishihara and Diane Revay Madden*

**8:05 Hydrodeoxygenation of Dibenzofuran Over Boron-promoted Ni/SiO<sub>2</sub> Catalysts**, Di Liu, Zhen-yi Du, Jie Feng, Wen-ying Li, Taiyuan University of Technology, CHINA

**8:30 Phenanthrene Hydrogenation Saturation over Ni/NiAl<sub>2</sub>O<sub>4</sub> Catalyst Prepared by Modified Sol-gel Method**, Dao-Cheng Liu, Jie-Ying Jing, Jiu-Zhan Wang, Jie Feng, Wen-Ying Li, Taiyuan University of Technology, CHINA

**8:55 Effect of Ni<sub>2</sub>P Loading on the Structure and Phenanthrene Hydrogenation Saturation Performance of Ni<sub>2</sub>P/ Al<sub>2</sub>O<sub>3</sub> Catalyst**, Jiu-Zhan Wang, Dao-Cheng Liu, Jie-Ying Jing, Zhi-Fen Yang, Jie Feng, Wen-Ying Li, Taiyuan University of Technology, CHINA

**9:20 Hydrothermal Synthesis of Efficient NiMoS/SBA-15 Catalysts for the Hydrodesulfurization**, Tian-You Cui, Antony Rajendran, Wen-Ying Li, Taiyuan University of Technology, CHINA

### SESSION 12

#### POWER PLANT —1

*Ting Wang and Gary Stiegel*

**8:05 Direct Injection Carbon Engine (DICE)—The opportunity for Coal in a Renewables World**, Louis Wibberley, CSIRO Energy, AUSTRALIA

**8:30 Particle Size Distribution of Coal in a Pulverized Mixture of Torrefied Biomass**, Kiyoshi Sakuragi, Maromu Otaka, Central Research Institute of Electric Power Industry, JAPAN

**8:55 Formation of Agglomerates and Clinkers by Caking Coal in a 550MWe CFB Boiler**, Seok-Gi Ahn, Sung-Mook Jung, Korea Southern Power Co., Ltd., SOUTH KOREA

**9:20 Mathematical Model to Predict the Behavior of a Supercritical Once-Through**

**Boiler in a Thermal Power Plant**, Xuandai Ngo, Byungho Song, Kunsan National University; Jaehyeon Park, Dowon Shun, Jaegoo Lee, Korea Institute of Energy Research; SOUTH KOREA

**9:45 High-precision Modelling of Key Components in Power Plants with Double Reheat**, Jianxi Yu, Pei Liu, Zheng Li, Tsinghua University, CHINA

### SESSION 13

#### GASIFICATION TECHNOLOGIES —4

*Johan van Dyk and Rolf Maurer*

**10:20 R-GASTM GASIFICATION TECHNOLOGY (A Gasification Technology suitable for high ash content and high ash flow temperature)**, J. van Dyk, A. Kramer, D. Stevenson, GTI, USA

**10:45 Novel Mixed Matrix Membranes for Separation of Oxygen from Air: Structure and Function of Polysulfone-Nanodiamond Composites**, Frederick F. Stewart, Idaho National Laboratory; U. (Balu) Balachandran, Argonne National Laboratory; Christopher J. Orme, Idaho National Laboratory; Tae H. Lee, Argonne National Laboratory; John R. Klaehn, Idaho National Laboratory; Andrew P. Han, Pennsylvania State University; Kaitlyn M. Hillery, Fort Hays State University; USA

**11:10 Developing an Air Separation Reactor: Design from the Carrier to the Reactor**, Jonathan W. Lekse, Eric J. Popczun, Sittichai Natesakhawat, Ting Jia, Yuhua Duan, Mary Ann Clarke, Deepthi Chandramouli, Mehrdad Shahnam, William A. Rogers, National Energy Technology Laboratory, USA

**11:35 Microwave-Assisted Conversion of Low Rank Coal**, Victor Abdelsayed, National Energy Technology Laboratory and Leidos Research Support Team; Mark Smith, Dushyant Shekhawa, National Energy Technology Laboratory; USA

**12:00 Techno-Economic Analysis of Integrated Gasification Fuel Cell Power Systems**, Gregory A. Hackett, National Energy Technology Laboratory, Arun K.S. Iyengar, National Energy Technology Laboratory / KeyLogic, lex A. Noring, National Energy Technology Laboratory / KeyLogic, Dale L. Kearns, National Energy Technology Laboratory / Deloitte, Richard A. Newby, National Energy Technology Laboratory / KeyLogic, USA

### SESSION 14

#### CLEAN COAL AND GAS TO FUELS —2

*Diane Revay Madden and John Duddy*

**10:20 Hydrodesulfurization of Dibenzothiophene over NiMoS<sub>2</sub> Supported**

**on Two-dimensional Metal Oxide Catalysts**, Meng Zhang, Huan-Huan Fan, Bao-Xing Wang, Jie Feng, Wen-Ying Li, Taiyuan University of Technology, CHINA

**10:45 A Century of Innovative Coal-To-Liquids Technologies: Where Do We Go from Here?**, K. David Lyons, U.S. DOE/ National Energy Technology Laboratory; Christopher Munson, Charles Pruss, Henry A. Long, III, Massood Ramezan, KeyLogic Systems, Inc; USA

**11:10 Development of a Flow Regime Map for Slurry Bubble Column Reactors using Power Spectral Density Function Analysis**, Obinna Chiekezi, North Carolina A&T State University; Badie I. Morsi, University of Pittsburgh; and Omar M. Basha, North Carolina A&T State University; USA

**11:35 Assessing the Viability of K-Mo<sub>2</sub>C for Reverse Water-Gas Shift Scale-Up: Molecular to Laboratory to Pilot-Scale**, Marc D. Porosoff, Mitchell Juneau, University of Rochester, USA

**12:00 Operating Cost Assurances Through Continuous High Efficiency Treating Chemistry**, S Todd Beasley, HTC Purification Corp., CANADA

### SESSION 15

#### POWER PLANTS —2

*Ting Wang and Gary Stiegel*

**10:20 Condenser Efficiency Improvements Through Nanocomposite Surface Treatment Technology**, Vinod Veedu, Matthew Nakatsuka, Erika Brown, Oceanit, USA

**10:45 Evaluation of High Temperature Distributed Sensing Using Gold-Coated Optical Fiber and OFDR Technique**, Juddha Thapa, Jared M. Charley, Leidos Research Support Team; Benjamin T. Chorpene, NETL; USA

**11:10 Vertical Surface Dropwise Condensation Heat Transfer Using Self-Healing Coatings**, Sean Hoenig, Richard Bonner, Advanced Cooling Technologies, Inc., USA

**11:35 Cost and Performance of Bituminous Coal and Natural Gas Plants with Carbon Capture and Storage**, Robert E. James III, US DOE NETL; Alex Zoelle, Marc Turner, Norma Kuehn, Leidos Research Support Team; Mark Woods, Key Logic; Travis Shultz, US DOE NETL; USA

**12:00 New Closed Cycle Cryogenic Electric and Coal-Fired Power Production Systems**, James Burkhart, NASA Glenn Research Center, USA



# TECHNICAL PROGRAM—ORAL PRESENTATIONS

## SESSION 16

### ENERGY STORAGE —I

*Briggs White and Richard Bajura*

**13:10 Department of Energy's Advanced Energy Storage Program**, Briggs White, NETL, USA

**13:35 Techno-Economic Analysis of the Utility-Scale Energy Storage Concepts Integrated with Fossil Fuel-Based Power Generation**, Nenad Sarunac, Professor, EPIC UNC Charlotte; Carlos Romero, Shalinee Kishore, Alberto J. Lamadrid, Mr. Zheng Yao, Energy Research Center, Lehigh University; Rick Mancini, Pramod Kulkarni, John Fernandes, Fu-An Yu, Customized Energy Solutions; Mark D. D'Agostini, Global Combustion Technology Development, Air Products and Chemicals, Inc.; USA

**14:00 Conceptual Design Study of a Thermal Energy Storage System Using Granular Solids for Coal-fired Boilers**, Benjamin T. Chorpeneing, Pamela Miceus, E. David Huckaby, National Energy Technology Laboratory, USA

**14:25 Concrete Thermal Energy Storage Enabling Flexible Operation without Coal Plant Cycling**, Scott Hume, Andrew Maxson, Electric Power Research Institute, Inc.; Jennifer Tuey, Bright Energy LLC; Joshua Barron, Research Engineer, Southern Company; Daniel Mardovin, AECOM; USA

## SESSION 17

### COMBUSTION TECHNOLOGIES —4

*Rolf Maurer and Andreas Richter*

**13:10 Simulation-Based Parametric Study of Operating Conditions for a CLOU Reactor Burning Coal**, Zachary Reinking, Kevin J. Whitty, University of Utah; JoAnn S. Lighty, Boise State University; USA

**13:35 Performance and Flexibility Improvements of Staged Pressurized Oxy-Combustion**, Scott Hume, Electric Power Research Institute, Inc.; Richard L. Axelbaum, Zhiwei Yang, Washington University in St. Louis; Bhupesh Dhungel, Research Scientist, American Air Liquide, Inc., USA; Jonathan D. Slater, Raghbir S. Panesar, Doosan Babcock Limite; UK

**14:00 Impact of Particle Injection on Gaseous Flow at Elevated Pressure**, Ansan Pokharel, Ismail B. Celik, V'yacheslav Akkerman, West Virginia University; Zhiwei Yang, Richard L. Axelbaum, Washington University in Saint Louis, Saint Louis; USA

**14:25 Mechanism of Methane /Char Chemical Looping Reduction over Calcium-doped Copper Oxide as Oxygen Carrier**, Hanjing Tian, Lei Bai, Jarrett Riley, West Virginia University, USA

**14:50 Amine Sorbents for Selective Recovery of Heavy Metals from Coal Waste Effluent Streams**, Qiuming Wang, Walter C. Wilfong, Brian W. Kail, Fan Shi, Tuo Ji, McMahan L. Gray, National Energy Technology Laboratory, Department of Energy, USA

## SESSION 18

### CARBON MANAGEMENT —4

*Bingyun Li and Ahmed Aboudheir*

**13:10 Economic Analysis of Flexible Carbon Capture Systems**, Yash Kumar, Pamela Shirley, KeyLogic Systems; Shangmin Lin, Deloitte Consulting LLC; Jeff Hoffmann, Joel Theis, National Energy Technology Laboratory; Arun Iyengar, KeyLogic Systems; USA

**13:35 SimCCS: An Open-source Tool for Optimizing CO<sub>2</sub> Capture, Transport, and Storage Infrastructure**, Richard S. Middleton, Los Alamos National Laboratory; Kevin M. Ellett, Indiana University; Brendan A. Hoover, Los Alamos National Laboratory; Xiaochun Li, Ning Wei, Chinese Academy of Sciences; Sean P. Yaw, Montana State University; USA

**14:00 Microwave-Assisted Sorbent Regeneration for Post-Combustion CO<sub>2</sub> Capture from a Humidified Flue Gas**, Candice Ellison, James Hoffman, Dushyant Shekhawat, DOE/National Energy Technology Laboratory; USA

**14:25 Carbon Capture Program at DOE/NETL: Overview**, Dan Hancu, DOE/NETL, USA

**14:50 Electrocatalytic Conversion of CO<sub>2</sub> and Water into Industrially Relevant Chemicals**, Douglas R. Kauffman, National Energy Technology Laboratory, USA

**ORAL SESSIONS**  
**Friday, September 11**  
**8:00 -15:15**

## SESSION 19

### COAL SCIENCE —I

*Allan Kolker and Francis Lau*

**8:05 Analysis of Thermal Behavior of Crystalline Minerals in Argonne Premium Coals Under Air and Argon Atmospheres**, Atsushi Ishihara, Mie University; Kentarou Takai, Tadanori Hashimoto; USA

**8:30 Molecular Dynamics Simulation of Methane Adsorption on High-Rank Coal**, Zhiyuan Yang, Yinyan Li, Xue wenying, Xiaoyu Song, Zhiqiang Yin, Xi'an University of Science and Technology, CHINA

**8:55 Beneficiation of Coal Using Supercritical Water and Carbon Dioxide Extraction: Sulfur Removal**, Matthew J. DeCuir, Virginia Commonwealth University; Ram B. Gupta, Virginia Commonwealth University; Bhima Sastri, U.S. Department of Energy; USA

**9:20 Design of a Pilot Scale Spouted Bed Reactor for Thermal Desorption of Contaminants from Coal**, Gerrit Botha, Quang Truong, Srujan Rokkam, Advanced Cooling Technologies, Inc.; Carlos Romero, Lehigh University; Zheng Yao, Energy Research Center, Lehigh University; Bhima Sastri, U.S. Department of Energy; USA

**9:45 Development of A Unified and Comprehensive American Coal Database (acd) to Support Source to End Coal Resource Analytics**, Devin Justman, Leidos Research Support Team; Kelly Rose, National Energy Technology Laboratory (NETL); Randall (Burt) Thomas, Scientist, Leidos Research Support Team; USA

## SESSION 20

### COAL ASH MANAGEMENT —I

*Peter Hsieh and Mary Anne Alvin*

**8:05 Utilization of Fly Ash Generated by Pulverized Coal Combustion Boiler Dumped in a Coastal Landfill Site**, Hirokazu Murata, Shimizu Corporation, JAPAN

**8:30 Effect of Temperature and Ash Composition on Sodium Release and Occurrence Modes Transition in High-Alkali Coals**, Zishun Li, Tai Zhang, Zhaohui Liu, Huazhong University of Science and Technology, CHINA

**8:55 Continuous, Real-Time TSS Monitoring Verifies Effluent Quality and Coal Ash Management Performance While Reducing Compliance Costs**, Dave Fraley, YSI Incorporated; Chris Bauman, Dave Donahue, Xylem Inc.; USA

**9:20 Measurement of Heat Work Through Viscous Deformation During Coal Ash Fusibility Testing**, Peter Y. Hsieh, US DOE/NETL, USA

# TECHNICAL PROGRAM—ORAL PRESENTATIONS

## SESSION 21

### VALUE-ADDED PRODUCTS FROM COAL —1

*Zhiyuan Yang and John Duddy*

**8:05 Study On Controllable Synthesis of 9-Fluorenylmethanol by 9-Hydroxymethylation of Fluorene with Two-Step Method,** Mei-Xin Guo, Taiyuan

University of Technology; Cui-Ping Ye, Taiyuan University of Technology and Training Base of State Key Laboratory of Coal Science and Technology Jointly Constructed by Shanxi Province and Ministry of Science and Technology; Tian-Tian Shi, Rui-Nan Wang, Ya-Fei Qiao, Mei-Sheng Liang, Taiyuan University of Technology; CHINA

**8:30 Medium-Low-Temperature Coal Tar Refining System for Co-production of Naphthenic Oil and Phenolic Compounds,** Yi Huang, Wen-Ying Li, Jie Feng, Professor, Taiyuan University of Technology, CHINA

**8:55 A Brief History of Coal-To-Olefins Technologies,** Dave Lyons, U.S. DOE/National Energy Technology Laboratory; Michael Angyus, Henry A. Long, III, Massood Ramezan, KeyLogic Systems, Inc; USA

**9:20 Development of X-MAT® Coal Core Composites for Roofing Materials and Lithium Ion Battery Anode Applications,** William Easter, Semplastics, USA

**9:45 Overview of NETL Advanced Coal Processing Program,** Joseph Stoffa, National Energy Technology Laboratory, USA

## SESSION 22

### CLEAN COAL DEMONSTRATION AND COMMERCIAL PROJECTS —1

*Venkat Venkataraman and Thomas Sarkus*

**10:20 Application of Clean Coal Technologies for Development of Thar Coal in Pakistan,** Farid A Malik, FC College, A Chartered University, PAKISTAN

**10:45 Long Term Performance Evaluation & Commercial Plant Design for CO<sub>2</sub> Capture from Coal Flue Gases Using a Novel Catalyst-promoted Solvent,** Ahmed Aboudheir, Aboudheir Consulting Ltd, CANADA; Maohong Fan, University of Wyoming, USA

**11:10 Modeling and Simulation of the Pilot Solvent Test Unit at the National Carbon Capture Center,** Ahmed Aboudheir, Aboudheir Consulting Ltd, CANADA; Justin Anthony, Southern Company Services Inc., USA

**11:35 Coal-Based Power Plants of the Future: Electricity and Ammonia Polygeneration,** Howard Bugg, Jesse Goellner, Allegheny Science and Technology, USA

**12:00 U.S. Department of Energy National Carbon Capture Center, Supporting Technology Scale-up and International Collaboration,** Doug McCarty, Southern Company, USA

## SESSION 23

### COAL ASH MANAGEMENT —2

*Peter Hsieh and Jinichiro Nakano*

**10:20 Navigating the U.S. Coal Ash Market,** Mark Rokoff, AECOM; Dave Cox, FirmoGraphs; John Priebe, AECOM; USA

**10:45 Concentration of Rare Earth Elements into a Single Compound in Molten Coal Ash,** Jinichiro Nakano, Anna Nakano, U.S. Department of Energy National Energy Technology Laboratory, and Leidos Research Support Team; Jack Widmer, U.S. Department of Energy National Energy Technology Laboratory, and Oak Ridge Institute for Science and Education; USA

**11:35 Experimental Investigation on The Effect of Using a Pondered Ash on The Mechanical Properties and Durability of OPC and Geopolymer Concrete,** Omar Alsanusi Amer, Prasad Rangaraju, Weiqi Wang, Clemson University, USA

## SESSION 24

### VALUE-ADDED PRODUCTS FROM COAL —2

*John Duddy and Evan Granite*

**10:20 Bespoke, High-Purity Coal Tar with Microwave Plasma Pyrolysis,** Vignesh Viswanathan, Aayush Mantri, George Skoptsov, H Quest Vanguard, Inc., USA

**10:45 Incorporation of Lightweight CFOAM® Carbon Foam Aggregates into Concrete,** Rudolph Olson III, CFOAM LLC; Dan Connell, CONSOL Energy; USA

**11:10 Incorporation of Graphite into Coal-Based CFOAM® Carbon Foam,** Rudolph Olson III, CFOAM LLC; Dan Connell, CONSOL Energy; USA

**11:35 Economic and Environmental Impacts of High-Value Pitch Carbon Fiber Manufacturing,** Sujit Das, Prashant Nagapurkar, Oak Ridge National Laboratory, USA

**12:00 On Understanding the Effectiveness of Coal Feedstock as Composite Filler,** Madhusudhan R. Pallaka, Sarah D. Burton, John C. Linehan, Keerti S. Kappagantula, Pacific Northwest National Lab, USA

## SESSION 25

### CLEAN COAL DEMONSTRATION AND COMMERCIAL PROJECTS —2

*Thomas Sarkus and Venkat Venkataraman*

**13:10 Flameless Pressurized Oxy-fuel (FPO) Technology Update, Scale-up and Commercialization Objectives,** Richard Horner, University of Wyoming, USA; Massimo Malavasi ITEA S.p.a., ITALY

**13:35 DOE Transformative Power Generation Program: Coal FIRST, Existing Plants and Advanced Technologies,** John Rockey, DOE/NETL, USA

**14:00 Collaboration and Knowledge Sharing on the Ordos CCS project: Updates from the US-China Clean Energy Research Center – Advanced Coal Technology Consortium,** Philip H. Stauffer, Los Alamos National Laboratory, USA; Xiaochun Li, Liwei Zhang, Chinese Academy of Sciences, CHINA; Minh Nguyen, U. of Wyoming, USA; Manguang Gan, Jun Li, Ning Wei, Chinese Academy of Sciences, CHINA; X. Zhang, Schlumberger Software Integrated Solutions; Anthony Ku, NICE America Research, USA and National Institute of Clean and low carbon Energy, CHINA

**14:25 Conceptual Design and Pre-FEED Study of a Supercritical Pressurized Fluidized Bed Combustion Power Plant with CO<sub>2</sub> Capture,** Daniel P. Connell, CONSOL Energy Inc.; Harvey Goldstein, David Stauffer, Esko Polvi, Worley Group, Inc.; Tom Porterfield, Farnham & Pfile Engineering, Inc.; Evan Blumer, OsoMono LTD; Barbara Arnold, PrepTech, Inc.; USA

**14:50 Coal-Based Power Plants of the Future – Hybrid Coal and Gas Boiler and Turbine Concept with Post Combustion Carbon Capture (HGCC),** Nicole Nguyen, Barr Engineering Co.; Rob Broglio, Doosan Heavy Industries and Construction; Bruce Browsers, Chad Haugen, Barr Engineering Co.; USA; Kihyun Lee, Sung-Gju Kang, Doosan Heavy Industries and Construction, SOUTH KOREA; Srivats Srinivasachar, Envergenx LLC; Steve Benson, Microbeam Technologies Inc.; Mike Jones, MLJ Consulting, LLC; Junior Nasah, University of North Dakota; USA

## SESSION 26

### COAL MINING, PREPARATION AND HANDLING —1

*Daniel Connell and Richard Winschel*

**13:10 A New Rock Mass Cuttability Classification for Roadheaders,** Sair Kahraman, Behnaz Dibavar, Masoud Rostami, Hacettepe University; Mustafa Fener, Ankara University; TURKEY

## TECHNICAL PROGRAM—ORAL PRESENTATIONS

**13:35 Predictive Coal-Methane-Air Fire Scenario in a Cylindrical Obstructed Mining Passage**, Samuel Ogunfuye, Furkan Kodakoglu, Co-Author: Lateef Kareem, V'yacheslav Akkerman, West Virginia University, USA

**14:00 Evaluating CFD and Modeling Techniques for a Multi-Nodal Sensor Network Designed for the Detection and Control of Methane in Longwall Coal Mines**, Brian Cappellini, Amber Barr, Derek Johnson, Nigel Clark, West Virginia University, USA

**14:25 Design and Development of Multi-Nodal Methane Monitoring System for Improved Mine Safety**, Amber Barr, Brian Cappellini, Derek Johnson, Nigel Clark, West Virginia University, USA

### SESSION 27

#### RARE EARTH ELEMENTS —1

*Brian Shaffer and Allan Kolker*

**13:10 Rare Earth Elements from Coal and Related Materials: An Overview of Research at the National Energy Technology Laboratory**, Thomas J. Tarka, National Energy Technology Laboratory, USA

**13:35 Entry Points into a Domestic Rare Earth Element Supply Chain: Understanding the Opportunity for Coal-Derived Products**, William Summers, National Energy Technology Laboratory, USA

**14:00 Recovery of Rare Earth Elements and Critical Minerals from Coal-Based Resources**, Mary Anne Alvin, National Energy Technology Laboratory, USA

**14:25 Completed Testing of Bench-Scale Rare Earth Element Extraction from North Dakota Lignites and Implications for Pilot-Scale Extraction**, Nolan Theaker, University of North Dakota, USA

**14:50 Visible & Near Infrared (VNIR), Short-Wavelength Infrared (SWIR) and Thermal Infrared (TIR) Spectroscopy of Coal Fly Ash: Implications for Remote Sensing Detection of Rare Earth Elements**, Bernard E. Hubbard, Allan Kolker, U.S. Geological Survey; James C. Hower, University of Kentucky; Clint Scott, U.S. Geological Survey; USA



# TECHNICAL PROGRAM—POSTER PRESENTATIONS

## POSTER SESSIONS Wednesday, September 9 08:00—12:25

### POSTER SESSION 1

*Francis Lau*

**8:00 Mercury Adsorption Characteristics for Waste Material Sorbents**, Jeongmin Park, Sang-Sup Lee, Chungbuk National University, SOUTH KOREA

**8:20 Flow Uniformization in an Electrostatic Precipitator with Perforated Plates**, Dong-Uk Kim, Sang-Sup Lee, Chungbuk National University, SOUTH KOREA

**8:40 A One-dimensional Steady-state Model of Transport Bed Coal Gasification with in-situ CO<sub>2</sub> Capture using CaO Sorbent**, Zaya Li, Bo Wang, Xiaojin Guo, Lifeng Zhao, CAS Key Laboratory of Advanced Energy and Power, Institute of Engineering Thermophysics, Chinese Academy of Sciences and University of Chinese Academy of Sciences, CHINA

**9:00 Study On the Coal Pyrolysis and Simi-Char Combustion Behavior During the Poly Generation Process for Power Generation**, Shuaidan Li, Hougang Wang, Lei Zhang, China Huadian Electric Power Research Institute Co., LTD., CHINA

**9:20 Construction of Micropore Structures in Macromolecule of Buertai Coal**, Zhiyuan Yang, Zhiqiang Yin, Wenying Xue, Zhuoyue Meng, Yinyan Li, Anning Zhou, Xi'an University of Science and Technology, CHINA

### POSTER SESSION 2

*Omar Basha*

**10:20 Design Optimization, Thermal Management and Scale-Up of Microchannel Reactors for the Conversion of CO<sub>2</sub> Rich Syngas**, Chiemeka Chukwudoro, Nafeezuddin Mohammad, Shyam Aravamudhan, Debasish Kuila, Omar M. Basha, North Carolina A & T State University, USA

**10:40 Theoretical Modeling of Mixed-Solids as High-Performance CO<sub>2</sub> Sorbents Operating Under Desired Conditions**, Yuhua Duan, US Department of Energy, National Energy Technology Laboratory, USA

**11:00 A Novel Microwave-Accelerated Regeneration Process for Post-combustion Carbon Capture**, Tuo Ji, Fan Shi, Walter C. Wilfong, Qiuming Wang, Brian W. Kail, McMahan L. Gray, Department of Energy, National Energy Technology Laboratory, USA

**11:20 Development of a Continuous Nanotechnology Process for Converting**

**Carbon Dioxide to Valuable Products**, Rui Wang, Husain E. Ashkanani, University of Pittsburgh; Bingyun Li, West Virginia University; and Badie I. Morsi, University of Pittsburgh; USA

**11:40 Evolution of Basic Immobilized Amine Sorbent Pellets for Post-Combustion CO<sub>2</sub> Capture**, W. Chris Wilfong, Leidos Research Support Team, National Energy Technology Laboratory; McMahan L. Gray, Physical Scientist, National Energy Technology Laboratory; Brian Kail, Qiuming Wang, Tuo Ji, Fan Shi, Victor Kusuma, Leidos Research Support Team, National Energy Technology Laboratory, U.S. Department of Energy; Parag Shah, Nicholas Fusco, PQ Corporation; USA

## POSTER SESSIONS Thursday, September 10 08:00—15:15

### POSTER SESSION 3

*Massood Ramezan*

**8:00 Study on Ultra-Low Emission (ULE) Reduction Effects of SO<sub>2</sub> and NO<sub>x</sub> in Coal-Fired Power Plants**, Xiaomiao Jiao, National Institute of Clean-and-Low-Carbon Energy (NICE); Xiao Liu, National Institute of Clean-and-Low-Carbon Energy (NICE); Xinbin Wu, Shenhua Geological Exploration Company, Shenhua Environment Remote Sensing and Monitoring Center; You Zhou, National Institute of Clean-and-Low-Carbon Energy (NICE); CHINA

**8:20 Economic Study on Plasma Gasification of Municipal Solid Waste Coupled with Coal-Fired Power Plant Project**, Shuaidan Li, Lei Zhang, Hougang Wang, Xiaojiang Li, China Huadian Electric Power Research Institute Co., LTD., CHINA

**8:40 Performance of Graphene-Based Composite Porous Carbon for Adsorption and Separation of Methane**, Zhiyuan Yang, Xiaoqian Ju, Hongbin Liao, Zhiqiang Yin, Xi'an University of Science and Technology, CHINA

**9:00 Analysis of Liquefaction Recycle Solvent by Comprehensive Two-dimensional Gas Chromatography**, Huan-Huan Fan, Meng Zhang, Xing-Bao Wang, Jie Feng, Wen-Ying Li, Training Base of State Key Laboratory of Coal Science and Technology Jointly Constructed by Shanxi Province and Ministry of Science and Technology, Taiyuan University of Technology, CHINA

**9:20 Testing of Several Industrial Methods for Extracting Rare-Earth Elements from Ash and Slag Waste of the Primorskaya Hydroelectric Power Plant**, A. L. Shkuratov, Senior Lecturer, Far Eastern Federal University, 690920, Vladivostok, Russkiy island, Ajax, FEFU Campus, Laboratory building,

Department of Physical and Analytical Chemistry, RUSSIA

### POSTER SESSION 4

*Leslie Ruppert*

**10:20 Effect of Power Plant Capacity on the CAPEX, OPEX, and LCOC of the CO<sub>2</sub> Capture Process in Pre-Combustion Applications**, Husain E. Ashkanani, Rui Wang, U.S. Department of Energy, National Energy Technology Laboratory and University of Pittsburgh; Wei Shi, U.S. Department of Energy, National Energy Technology Laboratory and Leidos Research Support Team, National Energy Technology Laboratory; Nicholas S. Siefert, U.S. Department of Energy, National Energy Technology Laboratory; Robert L. Thompson, U.S. Department of Energy, National Energy Technology Laboratory and Leidos Research Support Team, National Energy Technology Laboratory; Kathryn Smith, U.S. Department of Energy, National Energy Technology Laboratory and University of Pittsburgh; Janice A. Steckel, Isaac K. Gamwo, David Hopkinson, U.S. Department of Energy, National Energy Technology Laboratory; Kevin Resnik, U.S. Department of Energy, National Energy Technology Laboratory and Leidos Research Support Team, National Energy Technology Laboratory; Badie I. Morsi, U.S. Department of Energy, National Energy Technology Laboratory and University of Pittsburgh; USA

**10:40 The Omnis Separation Plant; Transforming Coal Waste into High-Value Products for Agriculture, Power and Industry**, Greg Smith, Omnis Energy LLC, USA

**11:00 Investigation of Air Extraction Integration and Carbon Capture in IGCC**, Shisir Acharya, Ting Wang, University of New Orleans, USA

**11:20 The Allam Cycles for Fossil Fueled Power Plants**, Richard Dennis, National Energy Technology Laboratory (NETL), USA

### POSTER SESSION 5

*Evan Granite*

**13:10 Technoeconomic Assessment for Extraction of Rare Earth Elements from Acid Mine Drainage**, Alison Fritz, Stanford University/ National Energy Technology Laboratory; Thomas Tarka, National Energy Technology Laboratory; USA

**13:30 An Updated CoalQual for Utilization of Abundant Domestic Coal**, Priscilla Prem, Evan Granite, Murphy Keller, Ward Burgess, National Energy Technology Laboratory, USA

**13:50 Rare Earth Transformations During Coal Combustion – Implications for Potential Recovery**, Jeremy Rivkin, Murphy Keller, Ward Burgess, Evan Granite, National Energy Technology Laboratory, USA

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20th Annual - 2003	\$30.00
21st Annual - 2004	\$30.00
22nd Annual - 2005	\$30.00
23rd Annual - 2006	\$30.00
24th Annual - 2007	\$30.00
25th Annual - 2008	\$30.00
26th Annual - 2009	\$30.00
27th Annual - 2010	\$30.00
28th Annual - 2011	\$30.00
29th Annual - 2012	\$30.00
30th Annual - 2013	\$30.00
31st Annual - 2014	\$30.00
32nd Annual - 2015	\$30.00
33rd Annual - 2016	\$30.00
34th Annual - 2017	\$30.00
35th Annual - 2018	\$30.00
36th Annual - 2019	\$50.00





**ANNOUNCING**

**THIRTY-EIGHTH ANNUAL  
INTERNATIONAL  
PITTSBURGH COAL CONFERENCE**

**Hosted by:**



**University of Pittsburgh**

**Location: Westin Convention Center Hotel,  
Pittsburgh PA, USA**

**Date: TBA**

Abstracts must be submitted by March 1, 2021. Please submit an abstract including title, topic area, authors, affiliations, and contact information via email to:

[ipcc@pitt.edu](mailto:ipcc@pitt.edu)

**PCC WEBSITE: [www.pccpitt.org](http://www.pccpitt.org)**