

Reviews

- 9981 DOI: 10.1021/acs.energyfuels.6b02386
Review on Premixed Combustion Technology: Stability, Emission Control, Applications, and Numerical Case Study
Sherif S. Rashwan, Medhat A. Nemitallah,* and Mohamed A. Habib

- 10015 DOI: 10.1021/acs.energyfuels.6b02739
Kinetic Hydrate Inhibitor Studies for Gas Hydrate Systems: A Review of Experimental Equipment and Test Methods
Wei Ke and Malcolm A. Kelland*

Articles

Fossil Fuels

- 10029 DOI: 10.1021/acs.energyfuels.6b01837
Comprehensive Assessment of Composition and Thermochemical Variability by High Resolution GC/QToF-MS and the Advanced Distillation-Curve Method as a Basis of Comparison for Reference Fuel Development
Tara M. Lovestead, Jessica L. Burger, Nico Schneider, and Thomas J. Bruno*

- 10045 DOI: 10.1021/acs.energyfuels.5b00692
Estimating the Pyrolysis Kinetic Parameters of Coal, Biomass, and Their Blends: A Comparative Study
Abhijit Bhagavatula,* Naresh Shah, and Rick Honaker

- 10055 DOI: 10.1021/acs.energyfuels.6b00382
Reliable and Repeatable Evaluation of Kinetic Hydrate Inhibitors Using a Method Based on Crystal Growth Inhibition
Houra Mozaffar,* Ross Anderson, and Bahman Tohid

- 10064 DOI: 10.1021/acs.energyfuels.6b01132
Supercritical Fluid Extraction of Fluid Catalytic Cracking Slurry Oil: Bulk Property and Molecular Composition of Narrow Fractions
Weidong Li, Yilong Chen, Linzhou Zhang,* Zhiming Xu, Xuewen Sun, Suoqi Zhao,* and Chunming Xu

- 10072 DOI: 10.1021/acs.energyfuels.6b01339
Total Porosity of Tight Rocks: A Welcome to the Heat Transfer Technique
Hamid Roshan,* Mustafa Sari, Hamidreza Arandiyani, Yibing Hu, Peyman Mostaghimi, Mohammad Sarmadivaleh, Hossein Masoumi, Manolis Veveakis, Stefan Iglauer, and Klaus Regenauer-Lieb
- 10080 DOI: 10.1021/acs.energyfuels.6b01447
Experimental and Numerical Investigation of Dynamic Gas Adsorption/Desorption–Diffusion Process in Shale
Jinjie Wang, Zehao Yang, Mingzhe Dong,* Houjian Gong, Qian Sang, and Yajun Li
- 10092 DOI: 10.1021/acs.energyfuels.6b01475
Pore Structure Characterization of the Lower Permian Marine-Continental Transitional Black Shale in the Southern North China Basin, Central China
Qian Chen, Jinchuan Zhang,* Xuan Tang, Wei Dang, Zhongming Li, Chong Liu, and Xuezhi Zhang
- 10106 DOI: 10.1021/acs.energyfuels.6b01603
Determination of the Active Soap Number of Crude Oil and Soap Partitioning Behavior
Lei Ding,* Guicai Zhang, Jacob Behling, Jose Luis Lopez-Salinas, Jijiang Ge, Maura C. Puerto, George J. Hirasaki, and Clarence A. Miller
- 10117 DOI: 10.1021/acs.energyfuels.6b01648
Partial Upgrading of Heavy Crude Oil by Slurry-Phase Hydrocracking with Analytical Grade and Ore Catalysts
Alexander Qitian and Jorge Ancheyta*
- 10126 DOI: 10.1021/acs.energyfuels.6b01683
Thermo-swelling Behavior of Australian Coking Coals from Different Basins: Relating to Rank and Maceral Compositions
Wei Xie,* Terry Wall, John Lucas, Merrick Mahoney, and Rohan Stanger
- 10136 DOI: 10.1021/acs.energyfuels.6b01684
Chemical Changes of Australian Coking Coals from Different Basins with Various Ranks and Maceral Compositions: Linking to Both Physical and Thermal Changes
Wei Xie,* Terry Wall, John Lucas, Merrick Mahoney, and Rohan Stanger
- 10148 DOI: 10.1021/acs.energyfuels.6b01770
Gold Core Nanoparticle Mimics for Asphaltene Behaviors in Solution and at Interfaces
Jeffrey Ollinger, Amin Pourmohammadbagher, Arthur D. Quast, Mildred Becerra, Jennifer S. Shumaker-Parry, and John M. Shaw*
- 10161 DOI: 10.1021/acs.energyfuels.6b01863
Thermal Decomposition Kinetics of Polyol Ester Lubricants
Kimberly N. Umess, Raina V. Gough, Jason A. Widegren, and Thomas J. Bruno*

- 10171 DOI: 10.1021/acs.energyfuels.6b01865
Molecular Design and Characterization of High-Cetane Alkyl Diamondoid Fuels
Benjamin G. Harvey,* Kale W. Harrison, Matthew C. Davis, Andrew P. Chafin, Joshua Baca, and Walter W. Merriman
- 10179 DOI: 10.1021/acs.energyfuels.6b01889
Molecular Interactions between a Biodegradable Demulsifier and Asphaltenes in an Organic Solvent
Anand Natarajan, Natalie Kuznicki, David Harbottle, Jacob Masliyah, Hongbo Zeng,* and Zhenghe Xu*
- 10187 DOI: 10.1021/acs.energyfuels.6b01912
Characterization of Heavy Distillation Cuts Using Fourier Transform Infrared Spectrometry: Proof of Concept
M. C. Sánchez-Lemus, F. F. Schoegl, S. D. Taylor, S. I. Andersen, M. M. Mapolelo, S. C. Mahavadi, and H. W. Yarranton*
- 10200 DOI: 10.1021/acs.energyfuels.6b01982
Insight into the Pore Structure of Tight Sandstones Using NMR and HPMI Measurements
Jin Lai,* Guiwen Wang, Zhuoying Fan, Jing Chen, Shuchen Wang, Zhenglong Zhou, and Xuqiang Fan
- 10215 DOI: 10.1021/acs.energyfuels.6b01985
Effect of Dephenolization on Low-Temperature Coal Tar Hydrogenation To Produce Fuel Oil
Menglong Niu, Xiaohong Sun, Rong Gao, Dong Li, Wengang Cui, and Wenhong Li*
- 10222 DOI: 10.1021/acs.energyfuels.6b01991
Study on the Fast Pyrolysis of Oil Sludge and Its Product Distribution by PY-GC/MS
Lei Chen, Xiaodong Zhang, Laizhi Sun, Hongjie Xu, Hongyu Si, and Ning Mei*
- 10228 DOI: 10.1021/acs.energyfuels.6b01995
Mechanistic Understanding of the Effect of Temperature and Salinity on the Water/Toluene Interfacial Tension
Cuiying Jian, Mohammad Reza Poopari, Qingxia Liu, Nestor Zerpa, Hongbo Zeng,* and Tian Tang*
- 10236 DOI: 10.1021/acs.energyfuels.6b02035
Mercury Speciation and Distribution in an Egyptian Natural Gas Processing Plant
Mohamed F. Ezzeldin, Zuzana Gajdosechova, Mohamed B. Masod, Tamer Zaki, Jörg Feldmann, and Eva M. Krupp*
- 10244 DOI: 10.1021/acs.energyfuels.6b02097
Comminution Theory of Superfine Pulverized Coal Based on Fractal Analysis of Aggregate Structures
Jiaxun Liu, Hai Zhang, Jianguo Liu, and Xumin Jiang*
- 10253 DOI: 10.1021/acs.energyfuels.6b02133
Influence of Microwave Energy on Fractal Dimension of Coal Cores: Implications from Nuclear Magnetic Resonance
Yi-du Hong, Bai-quan Lin,* Chuan-jie Zhu, and He Li

10260 DOI: 10.1021/acs.energyfuels.6b02223
Interaction between Hydrogen-Donor and Nondonor Solvents in Direct Liquefaction of Bulianta Coal
 Ben Niu, Lijun Jin, Yang Li, Zhiwei Shi, Hanxue Yan, and Haoquan Hu*

10268 DOI: 10.1021/acs.energyfuels.6b02248
Geochemistry of Trace Elements in Coals from the Yuellangtian Mine, Western Guizhou, China: Abundances, Modes of Occurrence, and Potential Industrial Utilization
 Peipei Wang,* Xiaoyun Yan, Wenmu Guo, Siyu Zhang, Zhen Wang, Yaguang Xu, and Lei Wang

10282 DOI: 10.1021/acs.energyfuels.6b02256
Multiscale Description of Shale Pore Systems by Scanning SAXS and WAXS Microscopy
 L. Leu,* A. Georgiadis, M. J. Blunt, A. Busch, P. Bertier, K. Schweinar, M. Liebi, A. Menzel, and H. Ott

10298 DOI: 10.1021/acs.energyfuels.6b02274
Pyrolysis and Combustion Enhance Recovery of Gas for Two China Shale Rocks
 Wei Chen,* Yafeng Lei, Yilin Chen, and Jiafeng Sun

10306 DOI: 10.1021/acs.energyfuels.6b02279
Qualitative Discrimination Analysis of Coals Based on Their Laser-Induced Breakdown Spectra
 A. Metzinger, D. J. Palásti, É. Kovács-Széles, T. Ajtai, Z. Bozóki, Z. Kónya, and G. Galbács*

10314 DOI: 10.1021/acs.energyfuels.6b02288
Determination of the Hydrogen-Donating Ability of Industrial Distillate Narrow Fractions
 Qiang Sheng, Gang Wang,* Mengchao Duan, Allin Ren, Libo Yao, Miao Hu, and Jinsen Gao

10322 DOI: 10.1021/acs.energyfuels.6b02297
Improvement of the Thermal Cracking Product Quality of Heavy Vacuum Residue Using Solvent Deasphalting Pretreatment
 Mohammad Hamidi Zirasefi, Farhad Khorasheh,* Javad Ivakpour,* and Aylin Mohammadzadeh

10330 DOI: 10.1021/acs.energyfuels.6b02374
Catalytic Bitumen Partial Upgrading under Methane Environment over Ag-Mo-Ce/ZSM-5 Catalyst and Mechanistic Study Using *N*-Butylbenzene as Model Compound
 Lulu Zhao, Peng He, Jack Jarvis, and Hua Song*

10341 DOI: 10.1021/acs.energyfuels.6b02388
Analysis of Geologically Relevant Metal Porphyrins Using Trapped Ion Mobility Spectrometry–Mass Spectrometry and Theoretical Calculations
 Paolo Benigni, Carlos Bravo, J. Martín E. Quirke, John D. DeBord, Alexander M. Mebel, and Francisco Fernandez-Lima*

10348 DOI: 10.1021/acs.energyfuels.6b02400
Investigating the Fractal Characteristics of Pore-Fractures in Bituminous Coals and Anthracites through Fluid Flow Behavior
 Zhongqiu Ouyang, Dameng Liu,* Yidong Cai, and Yanbin Yao

10358 DOI: 10.1021/acs.energyfuels.6b02428
Effects of H₂O Addition on Oil Sand Bitumen Cracking Using a CeO₂–ZrO₂–Al₂O₃–FeO_x Catalyst
 Hisaki Kondoh, Natsumi Hasegawa, Takuya Yoshikawa,* Yuta Nakasaka, Teruoki Tago, and Takao Masuda

10365 DOI: 10.1021/acs.energyfuels.6b02443
Oil Yield Characterization by Anisotropy in Optical Parameters of the Oil Shale
 Xin Y. Miao, Hong L. Zhan,* Kun Zhao,* Yi Z. Li, Qi Sun, and Ri M. Bao

10371 DOI: 10.1021/acs.energyfuels.6b02505
Location and Surface Species of Fluid Catalytic Cracking Catalyst Contaminants: Implications for Alleviating Catalyst Deactivation
 U. J. Etim, Pingping Wu, Peng Bai,* Wei Xing, Rooh Ullah, Fazle Subhan, and Zifeng Yan*

10383 DOI: 10.1021/acs.energyfuels.6b02530
Experimental Investigation of Pore Structure Damage in Pulverized Coal: Implications for Methane Adsorption and Diffusion Characteristics
 Kan Jin, Yuanping Cheng,* Qingquan Liu, Wei Zhao, Liang Wang, Fei Wang, and Dongmei Wu

Biofuels and Biomass

10396 DOI: 10.1021/acs.energyfuels.6b01226
***In Situ* Reforming of the Volatile by Char during Sewage Sludge Pyrolysis**
 Guotao Yu, Yuheng Feng,* Dezhen Chen, Min Yang, Tianchi Yu, and Xiaohu Dai

10404 DOI: 10.1021/acs.energyfuels.6b01320
Time-Lag Models for Continuous Stirred Tank and Plug Flow Digesters for Biogas Production
 Aritra Das, Chanchal Mondal, and Siddharth G. Chatterjee*

10417 DOI: 10.1021/acs.energyfuels.6b01345
Selective Production of Formic Acid by Wet Oxidation of Aqueous-Phase Bio-oil
 Niels Müller,* Romina Romero, Héctor Grandón, and Cristina Segura

10425 DOI: 10.1021/acs.energyfuels.6b01343
Predicting the Cetane Number of Biodiesel Fuels from Their Fatty Acid Methyl Ester Composition
 Shashank Mishra, K. Anand,* and Pramod S. Mehta

10435 DOI: 10.1021/acs.energyfuels.6b01470
Influence of Fuel Ash Characteristics on the Release of Potassium, Chlorine, and Sulfur from Biomass Fuels under Steam-Fluidized Bed Gasification Conditions
Placid A. Tchoffor,* Farzad Moradian, Anita Pettersson, Kent O. Davidsson, and Henrik Thunman

10443 DOI: 10.1021/acs.energyfuels.6b01743
Biofuels and Bio-based Production via Supercritical Water Gasification of Peach Scraps
A. Molino,* V. Laroocca, V. Valerio, M. Martino, T. Marino, J. Rimauro, and P. Casella

10448 DOI: 10.1021/acs.energyfuels.6b01876
Assessment on the Application of Commercial Medium-Grade Charcoal as a Substitute for Coke Breeze in Iron Ore Sintering
Zhiyun Ji, Xiaohui Fan,* Min Gan,* Xuling Chen, Qiang Li, and Tao Jiang

10458 DOI: 10.1021/acs.energyfuels.6b01877
Effect of Hot Vapor Filter Temperature on Mass Yield, Energy Balance, and Properties of Products of the Fast Pyrolysis of Pine Sawdust
Yuanfei Mei, Ronghou Liu,* Weixuan Wu, and Le Zhang

10470 DOI: 10.1021/acs.energyfuels.6b02007
Predicting the Chemical Composition of Aqueous Phase from Hydrothermal Liquefaction of Model Compounds and Biomasses
René B. Madsen, Patrick Biller, Mads M. Jensen, Jacob Becker, Bo B. Iversen, and Marianne Glasius*

10484 DOI: 10.1021/acs.energyfuels.6b01999
Enhanced Biogas and Biohydrogen Production from Cotton Plant Wastes Using Alkaline Pretreatment
Mohsen Ghasemian, Hamid Zilouei,* and Ahmad Asadinezhad

10494 DOI: 10.1021/acs.energyfuels.6b02086
Lignin from *Eucalyptus* spp. Kraft Black Liquor as Biofuel
Andrés Dieste,* Leonardo Clavijo, Ana I. Torres, Stéphan Barbe, Ignacio Oyarbide, Leonardo Bruno, and Francisco Cassella

10499 DOI: 10.1021/acs.energyfuels.6b02115
Physical and Chemical Stability of Bagasse Biocrude from Liquefaction Stored in Real Conditions
Jana Kosinkova, Jerome A. Ramirez, Zoran D. Ristovski, Richard Brown, and Thomas J. Rainey*

10505 DOI: 10.1021/acs.energyfuels.6b02146
Interaction Characteristics of Mineral Matter and Nitrogen during Sewage Sludge Pyrolysis
Li-Hong Wei,* Li-Na Wen, Mei-Jia Liu, and Tian-Hua Yang

10511 DOI: 10.1021/acs.energyfuels.6b02151
Enhanced Production of Methane from Waste Activated Sludge by Pretreatment Using a Gas Diffusion Cathode
Yufeng Jia, Huajun Feng,* Dongsheng Shen, Yuyang Zhou, Yanfeng Wang, Wei Chen, and Bin Huang

10516 DOI: 10.1021/acs.energyfuels.6b02105
Methane Production and Kinetic Modeling for Co-digestion of Manure with Lignocellulosic Residues
Muhammad Awais, Merlin Alvarado-Morales, Panagiotis Tsapekos, Muhammad Gulfray, and Irini Angelidaki*

10524 DOI: 10.1021/acs.energyfuels.6b02194
Separation and Hydroprocessing of HZSM-5 Catalytic Olive Mill Waste Sludge Bio-oil
Bingji Ma* and Foster Agblevor

10534 DOI: 10.1021/acs.energyfuels.6b02199
Antioxidant Consumption Kinetics and Shelf-Life Prediction for Biodiesel Stabilized with Antioxidants Using the Rancimat Method
Jian Zhou,* Yun Xiong, and Yonggang Shi

10543 DOI: 10.1021/acs.energyfuels.6b02222
Ash Formation in Pilot-Scale Pressurized Entrained-Flow Gasification of Bark and a Bark/Peat Mixture
Charlie Ma,* Markus Carlborg, Henry Hedman, Jonas Wennebro, Fredrik Weiland, Henrik Wiinikka, Rainer Backman, and Marcus Öhman

10555 DOI: 10.1021/acs.energyfuels.6b02267
***Hevea brasiliensis* (Rubber Seed) Oil: Extraction, Characterization, and Kinetics of Thermo-oxidative Degradation Using Classical Chemical Methods**
Samuel E. Onoji,* Sunny E. Iyuke, and Anselm I. Igbafe

10568 DOI: 10.1021/acs.energyfuels.6b02276
Pyrolysis of Rice Husk and Corn Stalk in Auger Reactor. 1. Characterization of Char and Gas at Various Temperatures
Yang Yu, Yang Yang, Zhicai Cheng, Paula H. Blanco, Ronghou Liu, A. V. Bridgwater, and Junmeng Cai*

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Mixing of Fast Pyrolysis Oil and Black Liquor: Preparing an Improved Gasification Feedstock
Erik Furusjö* and Esbjörn Pettersson

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Development of Ga Salt of Molybdophosphoric Acid for Biomass Conversion to Levulinic Acid
Vijay Bhooshan Kumar, Indra Neel Pulidindi, Rahul Kumar Mishra, and Aharon Gedanken*

10592  DOI: 10.1021/acs.energyfuels.6b02468

Efficient Biogas and Ethanol Production from Safflower Straw Using Sodium Carbonate Pretreatment
Seyed Sajad Hashemi, Keikhosro Karimi,* Mohammad Javad Nosratpour, and Ilona Sárvári Horváth

10602  DOI: 10.1021/acs.energyfuels.6b02519

In-Situ Transesterification of *Chlorella vulgaris* Using Carbon-Dot Functionalized Strontium Oxide as a Heterogeneous Catalyst under Microwave Irradiation
Alex Tangy, Vijay Bhooshan Kumar, Indra Neel Pulidindi, Yael Kinel-Tahan, Yaron Yehoshua, and Aharon Gedanken*

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Catalytic Conversion of Biomass-Derived Ethanol to Liquid Hydrocarbon Blendstock: Effect of Light Gas Recirculation
Zhenglong Li, Andrew Lepore, Brian H. Davison, and Chaitanya K. Narula*


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Catalytic Fast Pyrolysis of Bagasse Using Activated Carbon Catalyst to Selectively Produce 4-Ethyl Phenol
Qiang Lu,* Xiao-ning Ye, Zhi-bo Zhang, Min-Shu Cui, Hao-qiang Guo, Wei Qi,* Chang-qing Dong, and Yong-ping Yang


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Effects of Water Washing and Torrefaction Pretreatments on Corn Stalk Pyrolysis: Combined Study Using TG-FTIR and a Fixed Bed Reactor
Kehui Cen, Dengyu Chen,* Jiayang Wang, Yitong Cai, and Lei Wang

Environmental and Carbon Dioxide Issues

10635  DOI: 10.1021/acs.energyfuels.6b01372

Experiment and Kinetic Study of Elemental Mercury Adsorption over a Novel Chlorinated Sorbent Derived from Coal and Waste Polyvinyl Chloride
Yang Xu, Xiaobo Zeng, Bi Zhang, Xianqing Zhu, Mengli Zhou, Renjie Zou, Ping Sun, Guangqian Luo,* and Hong Yao*

10643  DOI: 10.1021/acs.energyfuels.6b01776

Methane and Carbon Dioxide Adsorption on Illite
Junfang Zhang,* Michael B. Clennell, Keyu Liu, Marina Pervukhina, Guohui Chen, and David N. Dewhurst

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Effect of H₂O Vapor on the Adsorption and Desorption Behavior of CO₂ in a Solid Amine Sorbent
Anahita Abdollahi Govar, Armin D. Ebner, and James A. Ritter*

10661 DOI: 10.1021/acs.energyfuels.6b02019

Seed-Assisted Hydrothermal Treatment with Composite Silicon–Aluminum Additive for Solidification of Heavy Metals in Municipal Solid Waste Incineration Fly Ash
De-zhi Shi,* Chao Zhang, Jin-lu Zhang, Peng-fei Li, and Yun-mei Wei

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Thermal Degradation of Aminosilicone Carbamates
Robert J. Perry,* Matthew P. Rainka, Mark D. Doherty, Benjamin R. Wood, Omkar Namjoshi, Daniel Hatchell, Hanbi Liu, and Gary T. Rochelle

10679 DOI: 10.1021/acs.energyfuels.6b02395

Effect of Microwave Treatment on the Reactivity of Synthetic Coal Char for NO Reduction
Jianmin Gao,* Ximei Li, Zhenzu Wei, Li Xu, Huashan Wang, Guangbo Zhao, Shaohua Wu, and Qian Du

10686 DOI: 10.1021/acs.energyfuels.6b02475

Effect of Carbonic Anhydrase on CaCO₃ Crystallization in Alkaline Solution
Murat Molva, Sevgi Kilic, and Ekrem Ozdemir*

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Simultaneous HCl/SO₂ Capture by Calcined Limestone from Hot Gases
Geng-Min Lin and Chien-Song Chyang*

Efficiency and Sustainability

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Waste Gypsum Board and Ash-Related Problems during Combustion of Biomass. 2. Fixed Bed
Anders Rebbing, Ida-Linn Näzelius, Patrycja Piotrowska, Nils Skoglund,* Christoffer Boman, Dan Boström, and Marcus Öhman

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Effect of Steam-Assisted Gravity Drainage Produced Water Properties on Oil/Water Transient Interfacial Tension
Maryam Razi, Shayandev Sinha, Prashant R. Waghmare, Siddhartha Das,* and Thomas Thundat*

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Techno-Economic Analysis of a Sustainable Coal, Wind, and Nuclear Hybrid Energy System
Kyle L. Buchheit,* Joseph D. Smith, Uday Guntupalli, and Chen Chen

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Preparation and Characterization of Activated Carbons from Bamboo Sawdust and Its Application for CH₄ Selectivity Adsorption from a CH₄/N₂ System
Hongyan Pan, Jingyun Zhao, Qian Lin,* Jianxin Cao,* Fei Liu, and Bellei Zheng

Catalysis and Kinetics

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Fabrication of Magnetic NH₂-MIL-88B (Fe) Confined Brønsted Ionic Liquid as an Efficient Catalyst in Biodiesel Synthesis
Zuowang Wu, Chong Chen, Hui Wan,* Lei Wang, Zhong Li, Bingxue Li, Qirui Guo, and Guofeng Guan*

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A Novel Technique To Predict the Solubility of Planar Molecules
S. Panzuela,* M. Bernabel, E. Velasco, R. Delgado-Buscalioni, and P. Tarazona*

10758 DOI: 10.1021/acs.energyfuels.6b01994
Kinetic Studies of CO₂ Capture Using K₂CO₃/Activated Carbon in Fluidized Bed Reactor
Aditya Prajapati, T. Renganathan,* and K. Krishnalal

10770 DOI: 10.1021/acs.energyfuels.6b02208
Eight-Lump Reaction Kinetic Model for the Maximizing Isoparaffin Process for Cleaning Gasoline and Enhancing Propylene Yield
Hongbo Jiang* and Shuai Huang

10777 DOI: 10.1021/acs.energyfuels.6b02228
Design and Preparation of Nanoscale Catalysts for Slurry Bed Hydrocracking Using the Microemulsion Method
Marzieh Shekarriz,* Jamshid Zarkesh, and Ali Jebrelli

Combustion

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Compressed-Liquid Densities of Three "Reference" Turbine Fuels
Stephanie L. Outcalt

10789 DOI: 10.1021/acs.energyfuels.6b01947
Application of Eddy Dissipation Concept for Modeling Biomass Combustion, Part 1: Assessment of the Model Coefficients
M. Farokhi and M. Birouk*

10800 DOI: 10.1021/acs.energyfuels.6b01948
Application of Eddy Dissipation Concept for Modeling Biomass Combustion, Part 2: Gas-Phase Combustion Modeling of a Small-Scale Fixed Bed Furnace
Mohammadreza Farokhi and Madjid Birouk*

10809 DOI: 10.1021/acs.energyfuels.6b01457
Combustion Behavior of Relatively Large Pulverized Biomass Particles at Rapid Heating Rates
Chinsung Mock, Hookyung Lee, Sangmin Choi, and Vasilije Manovic*

10823 DOI: 10.1021/acs.energyfuels.6b01549
Kinetic Simulations of H₂ Production from H₂S Pyrolysis in Sulfur Recovery Units Using a Detailed Reaction Mechanism
Arjun Ravikumar, Abhijeet Raj,* Salisu Ibrahim, Ramees K. Rahman, and Ahmed Al Shoaibi

10835 DOI: 10.1021/acs.energyfuels.6b01772
Comparison of Combustion and Emission Characteristics of an Indonesian Lignite Washery Tailing Slurry with a Bituminous Coal in a Bench-Scale Bubbling/Circulating Fluidized Bed Combustor
Dandan Chen, Qing Yang, Xuguang Jiang,* Guojun Lv, Zengyi Ma, Jianhua Yan, Kefa Cen, Xuehai Yu, Haiyan Liao, and Hua Zhao

10847 DOI: 10.1021/acs.energyfuels.6b01852
Simplified Chemical Reaction Mechanism for Surrogate Fuel of Aviation Kerosene and Its Verification
Yingwen Yan, Yunpeng Liu, Dong Di, Chao Dai, and Jinghua Li*

10858 DOI: 10.1021/acs.energyfuels.6b01955
Industrial Trials of High-Temperature Selective Noncatalytic Reduction Injected in the Primary Combustion Zone in a 50 MWe Tangentially Firing Pulverized-Coal Boiler for Deeper NO_x Reduction
Degui Bi, Jian Zhang, Zhongxiao Zhang,* Yanyan Rong, Pujie Yue, Zhenhua Fu, and Xinqiang Ji

10868 DOI: 10.1021/acs.energyfuels.6b01977
Determination of the Apparent Carbon Oxidation Reaction Order by a Microfluidized Bed and Its Application to Kinetic Models
Kaidi Li, Yuan Fang, Guangqian Luo,* Jin Li, Chao Chen, Renjie Zou, Cheng Liu, and Hong Yao*

10875 DOI: 10.1021/acs.energyfuels.6b02186
Development of a Reduced *n*-Decane/ α -Methylnaphthalene/Polycyclic Aromatic Hydrocarbon Mechanism and Its Application for Combustion and Soot Prediction
Liang Qiu, Xiaobei Cheng,* Xin Wang, Zhongqiu Li, Ying Li, Zhaowen Wang, and Hui Wu

10886 DOI: 10.1021/acs.energyfuels.6b02245
Ignition of the Coal-Water Slurry Containing Petrochemicals and Charcoal
Geniy V. Kuznetsov, Sergey Yu. Lyschikov, Sergey A. Shevryev, and Pavel A. Strizhak*

10893 DOI: 10.1021/acs.energyfuels.6b02318
Influence of Stoichiometry and Mixing on NO_x Reduction in Waste-to-Energy Plants
Kristina Speth,* Martin Murer, Robert von Raven, and Hartmut Spliethoff

10900 DOI: 10.1021/acs.energyfuels.6b02457
Experimental and Kinetic Modeling Study of CH₃OCH₃ Ignition Sensitized by NO₂
W. Ye, J. C. Shi, R. T. Zhang, X. J. Wu, X. Zhang, M. L. Qi,* and S. N. Luo*

Process Engineering

10909 DOI: 10.1021/acs.energyfuels.6b01708
Oxidative Desulfurization of Model Diesel Using Ionic Liquid 1-Octyl-3-methylimidazolium Hydrogen Sulfate: An Investigation of the Ultrasonic Irradiation Effect on Performance
Mahdieh Safa, Babak Mokhtarani,* Hamid Reza Mortaheb,* and Kurosh Tabar Heidar

10917 DOI: 10.1021/acs.energyfuels.6b01822
 Effect of Kaolinite on Water-in-Oil Emulsion Formed by Steam Injection during Tertiary Oil Recovery: A Case Study of an Omani Heavy Oil Sandstone Reservoir with a High Kaolinite Sludge Content
 Ibrahim Al Hadabi,* Kyuro Sasaki, and Yuichi Sugai

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 Integration of Fischer-Tropsch and Oilsands Bitumen Production Processes
 Arno de Klerk*

10937 DOI: 10.1021/acs.energyfuels.6b02116
 Analytical Techniques for Analyzing Thermally Degraded Monoethylene Glycol with Methyl Diethanolamine and Film Formation Corrosion Inhibitor
 Khalifa AlHarooni,* David Pack, Stefan Iglauer, Rolf Gubner, Varun Ghodkay, and Ahmed Barifcani

Communications

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 Identification of Lignin-Derived *p*-Bis(2,6-dimethoxyphenol)yl Compounds in Bio-oil with Mass Spectrometry
 Min Li, Dong Liu,* Xing-Shun Cong,* Jun-Hui Wu, Chong-Chong Wu, and Wei Xia

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Review on Premixed Combustion Technology: Stability, Emission Control, Applications, and Numerical Case Study

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ABSTRACT: Recently, premixed combustion dominated the field of combustion research worldwide. The current work is a review that addresses the stability, approaches, and emission control of premixed flames in different applications. The study addresses the recent developments made to overcome the combustor operability issues, including flame stability and emission control. The influences of oxidizer and fuel flexibility using oxy-fuel combustion and hydrogen enrichment on combustion efficiency and flame stability are investigated. Furthermore, the influences of operating and combustor design conditions on flame characteristics are discussed. Recent developments in swirl-stabilized combustor are analyzed and summarized. The effect of premixing on emissions is investigated, considering a variety of design and operating conditions in different applications. As per this survey, the application of fully premixed combustion in the industrial area is even so defined; all the same, promising designs are under development. The challenges regarding the application of the premixed combustion technology in the industrial field are discussed. The role of numerical CFD techniques to predict the reacting flow field and heat release in premixed combustion mode is addressed. A numerical case study is presented to address the premixed combustion characteristics in a swirl stabilizer gas turbine combustor.

1. INTRODUCTION

Power generation industries rely mainly on combined cycle steam power plants and gas turbine engines for energy production from gaseous fuels, thanks to the new heat recovery technologies which utilize the heat rejected to the atmosphere and convert it into power, which, in turn, increases the overall thermal efficiency of combined cycles to up to 60%.¹ Hence, the importance of durable and low emission gas turbine combustion systems is significantly developing. Many combustion technologies have been introduced to industries for the sake of environmentally friendly perspectives. For instance, a recent technology of the integrated gasification combined cycle (IGCC) encourages the utilization of hydrogen enrichment for many power generation strategies. IGCC systems commonly utilize syngas with different compositions from solid fuels such as coal, waste products, or biomass with different gasification processes.^{2–4} These IGCC systems have lower CO₂ emissions from power generation.

During the last three decades, lean premixed combustion (LPM) technology became the power generation standard in many applications. This can be ascribed to the fact that it enables lower NO_x and CO emissions. Flame instability in premixed combustion is one of the recent major issues, especially in gas turbine applications. Therefore, homogeneous mixing of air with methane under extra lean conditions with the aid of hydrogen enrichment, as an approach for enhancing flame stability, will result in improvement in flame stability and reduction in NO_x emissions. However, operation under hydrogen enrichment brings its own challenges in terms of flashback phenomenon, due to its higher flame temperature, that causes overheating of the burner components.^{5–7}

Accordingly, combustion operability issues are too significant and compose the focus of the current review paper.

Gas turbine engines for power generation have used combustors operated with diffusion flames due to their reasonable performance and higher stability characteristics. Unfortunately, this kind of combustors is no longer preferred due to the associated unacceptable concentrations of NO_x. The increase in the restricted environmental regulations encouraged researchers to develop combustors that can meet such restrictions.^{8,9} Hence, new technologies and concepts have been introduced in the last two decades to the stationary gas turbines for the power generation industry, such as LPM and catalytic combustion.^{10,11} The catalytic combustion is found to be highly expensive and less durable with low safety as well, while in LPM, the air and fuel are introduced upstream to a form homogeneous mixture. In gas turbines, the combustion chambers are operated under excess air dilution to decrease the flame temperature and, then consequently, the thermal NO_x emissions are significantly reduced and in some applications they could be virtually eliminated. However, the LPM is associated with combustion instabilities as a result of the unsteady flow oscillations. This is a common problem while operating the gas turbines under LPM.¹² At certain levels, these oscillations could cause operation interference with extreme oscillations. This can lead to system failure as shown in Figure 1. The figure compares a damaged gas turbine burner due to combustion instabilities compared to a new burner.¹⁵

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