



## THE 2011 AUSTRALIAN SYMPOSIUM ON COMBUSTION

29<sup>th</sup> November to 1<sup>st</sup> December 2011  
Shoal Bay Resort, Shoal Bay, NSW (Australia)  
Hosted by the University of Newcastle, Australia  
[WWW.2011acs.com](http://WWW.2011acs.com)



### **INVITATION**

The organising committee of the biennial meeting of the Australian and New Zealand Section of the Combustion Institute warmly invites you to join us at the 2011 Australian Combustion Symposium. The Discipline of Chemical Engineering and the Priority Research Centre for Energy at the University of Newcastle have the honour of hosting this joint meeting which brings together academics, researchers, engineers and technologists with interests in all aspects of combustion science and technology. The theme for the 2011 symposium is “*Combustion Research in a Carbon-Constrained World*”, reflecting the challenging environment confronting our profession in this century. For full details about the Symposium please refer to the following Web Site: [WWW.2011acs.com](http://WWW.2011acs.com)

### **AREAS OF INTEREST**

Areas of interest include (but are not limited to):

- Design, operation, measurement and modelling of practical combustion systems such as, industrial furnaces, cement kilns and industrial burners
- Coal combustion and gasification technologies: pulverised fuels and fluidised beds
- Advanced low emission coal technologies
- Combustion kinetics and chemistry
- Laminar flame dynamics
- Turbulent premixed and non-premixed combustion
- Combustion diagnostic and flame measurements
- Ignition, explosion and fire safety
- Self-heating and spontaneous combustion
- Combustion byproducts (NO<sub>x</sub>, SO<sub>x</sub>, HF, HCl, dioxins)
- Effects of mineral matters, ash and particulate
- Combustion of miscellaneous fuels such as, biomass, bagasse, refused-derived fuels and waste
- Heat transfer, radiation
- Laser diagnostics and imaging
- Any other areas of combustion science

### **PAPER SUBMISSION**

For the first time in the ACS series, the authors are no longer required to submit a standalone abstract and are invited to provide their full manuscript for review. This single step submission process should significantly reduce the workload for authors and reviewers thereby improve the quality and effectiveness of the review process. All papers will be reviewed by at least two reviewers and accepted papers will be published under an ISBN registration in the Conference Proceedings, edited by Profs Kennedy, Moghtaderi, and Dlugogorski. The deadline for submission of Full Manuscripts is **19 Aug, 2011**.

### **CONFERENCE VENUE & ACCOMMODATION**

The 2011 Australian Combustion Symposium will be held at the Withesands Conference Centre at Shoal Bay Resort & Spa (Beachfront Shoal Bay NSW 2315, Australia), located 50 min drive north of Newcastle. A block booking has been made at the Shoal Bay Resort & Spa to provide conference delegates with discounted accommodation. Please contact the reservation at Shoal Bay Resort & Spa and organise your own accommodation (<http://shoalbayresort.com.au>). A range of other accommodations are also available near Shoal Bay. For a complete list please refer to the conference website.

### ***IMPORTANT DATES***

15 June 2011	Call for papers
1 July 2011	Early bird registration opens
19 Aug 2011	Full paper submission
19 Oct 2011	Reviewer comments and notification of acceptance
28 Oct 2011	Early bird registration closes
9 Nov 2011	Submission of revised manuscript(s)

### ***ORGANISING COMMITTEE***

Prof Bogdan Z Dlugogorski, The University of Newcastle (Conference Chair)

Prof Behdad Moghtaderi, The University of Newcastle (Chair of the Organising Committee)

Prof Eric M Kennedy, The University of Newcastle (Chair of the Scientific Committee)

Prof Assaad Masri, The University of Sydney (Chair, ANZ Section, the Combustion Institute)

### ***CONTACTS US***

- For enquiries related to registration please contact us at [Admin@2011ACS.com.au](mailto:Admin@2011ACS.com.au)
- For enquiries related to paper submission please contact us at [Paper@2011ACS.com.au](mailto:Paper@2011ACS.com.au)
- For any other enquiries please contact Ms Chi Crosskill:

Chi Crosskill

Ph +61 2 4985-4455

Fax: +61 2 4921-6893

Email: [Chi.Crosskill@newcastle.edu.au](mailto:Chi.Crosskill@newcastle.edu.au)

# AUSTRALIAN COMBUSTION SYMPOSIUM

2011

SHOAL BAY, N.S.W

NOVEMBER 29 TO DECEMBER 1, 2011

PROCEEDINGS

*Edited by: Eric Kennedy, Bogdan Dlugogorski, Behdad Moghtaderi and Assaad Masri,*

THE COMBUSTION INSTITUTE/AUSTRALIAN & NEW ZEALAND SECTION  
c/-Graduate School of the Environment  
Macquarie University NSW 2109 Australia  
Tel: +61 2 9850 6958  
Fax: +61 2 98507972

WEBSITE: <http://www.anz-combustioninstitute.org/>

This symposium was organised by;

Priority Research Centre for Energy

And

Discipline of Chemical Engineering  
Faculty of Engineering and Built Environment  
The University of Newcastle  
Callaghan, NSW Australia

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## *Preface*

It is a pleasure to present these Proceedings of the Australian Combustion Symposium, which is biennial event sponsored by the Australia and New Zealand Section of the Combustion Institute. This symposium series is highly relevant considering that combustion remains central to global concerns about energy conversion technologies and the environment. Recent symposia were held in Brisbane (2009), Sydney (2007), Adelaide (2005; in conjunction with ASPACCC05), Melbourne (2003), and Adelaide (2001). This conference was held amidst the scenic surroundings of the Whitesands Conference Centre, Shoal Bay Resort & Spa, in Port Stephens, NSW Australia.

These proceedings contain four invited lectures delivered by speakers of international repute, covering the topical issues of biofuels, flameless combustion, fire dynamics and the carbon economy. A record number of fifty five contributed papers, selected from a total of sixty submitted manuscripts, were accepted for publication following reviews by the technical committee. The total number of participants was sixty three.

The Bilger Lecture was delivered by Frederick L Dryer, (Princeton University, USA). The other Keynote Speakers were Professor Trouvé (University of Maryland, USA), Professor Bassam Dally (University of Adelaide, Australia) and Professor Dongke Zhang (University of Western Australia).

Topics covered by the contributed papers include turbulent combustion, chemical looping, kinetics, diagnostic, ignition and pollutant formation.

The organising committee expresses its thanks to all who contributed to the symposium, especially members of the Technical Committee for the time they spent on their thoughtful and helpful reviews.

The editors

November 2011

## *Committees*

### *Organising*

Prof Bogdan Dlugogorski, The University of Newcastle (Conference Chair)  
Prof Behdad Moghtaderi, The University of Newcastle (Chair of the Organising Committee)  
Prof Eric Kennedy, The University of Newcastle (Chair of the Scientific Committee)  
Prof Assad Masri, The University of Sydney (Chair, ANZ Section, the Combustion Institute)

### *Technical*

A/Prof Richard Brown (Queensland University of Technology)  
Dr Matthew Cleary (University of Queensland)  
Prof Bogdan Dlugogorski (The University of Newcastle)  
A/Prof Damon Honnery (Monash University)  
Prof Eric Kennedy, Chair of Scientific Committee (The University of Newcastle)  
Prof Assad Masri (The University of Sydney)  
Prof Behdad Moghtaderi (The University of Newcastle)  
Prof Graham Nathan (The University of Adelaide)  
Prof Peter Nelson (Macquarie University)  
Prof Hongwei Wu (Curtin University of Technology)  
Prof Dongke Zhang (The University of Western Australia)

*Program*

Tuesday 29 <sup>th</sup> November 2011 Shoal Bay resort & Spa	
17.00-19.00	Registration and Welcoming reception Shoal Bay Resort & Spa
19.00-21.00	Combustion Institute ANZ Section General Meeting Sea room

Wednesday 30 <sup>th</sup> November 2011 Shoal Bay Resort & Spa Whitesands Conference Centre			
07.30-08.45	Registration		
08.45-9.00	Welcome <i>Bogdan Z Dlugogorski (Conference chair)</i> <i>Eric Kennedy (Chair, technical committee)</i> <i>Behdad Moghtaderi (Chair, organising committee)</i>		
09.00-10.00	Bilger Lecture (Sea Room) Emulating the Combustion Behavior of real Petroleum-Derived and Alternative Fuels <i>Frederick L Dryer</i> Chair: M Brear		
10.00-10.20	Refreshment break		
Room	Sea room	Sun room	Star room
	Turbulent Combustion Chair: A Masri	Modelling and simulation Chair: B Moghtaderi	Heterogeneous reactions Chair: B Dlugogorski
10.20-10.40	ACS053 A priori assessment of algebraic wrinkling models of premixed turbulent flames in the thin reaction zones	ACS061 A model for non-premixed combustion at high pressure supercritical conditions based on flame	ACS007 Effect of a homogenous combustion catalyst on the combustion characteristics of single droplets of diesel and

	for large-eddy simulation: dynamic formulation  <i>O. Chatakonda</i> <i>E.R. Hawkes</i> <i>R. Sankaran</i> <i>J.H. Chen</i>	structure analysis  <i>G. Lacaze</i> <i>J. C. Oefelein</i>	biodiesel  <i>Mingming Zhu</i> <i>Yu Ma</i> <i>Dongke Zhang</i>
10.40-11.00	ACS046 The effect of radial injection on the particle distribution of an initially biased turbulent jet  <i>C.H. Birzer</i> <i>P.A.M. Kalt</i> <i>G.J. Nathan</i>	ACS040 Thermodynamic Analysis of a Steam Injected Gas Turbine Air Compressor  <i>M.J. Blom</i> <i>A.P. Wiese</i> <i>M.J. Brear</i> <i>C. Manzi</i> <i>A. Kitchener</i>	ACS005 Combustion of pre-dried brown coal in a utility furnace using recycled flue gas  <i>Z. F. Tian</i> <i>P. J. Witt</i> <i>M. Schwarz</i> <i>W Yang</i>
11.00-11.20	ACS052 Evaluation of mixing models for transported probability density function simulations of a non-premixed turbulent jet flame  <i>A. Krisman</i> <i>E.R. Hawkes</i> <i>S. Kook</i> <i>J.H. Chen</i>	ACS019 Numerical Modeling of Underground Coal Gasification :Euler-Euler Multiphase Model  <i>C. R. Chodankar</i> <i>B. Feng</i> <i>A. Y. Klimenko</i>	ACS034 On the Reactivity of Ethane and Propylene on a Platinum Surface  <i>J. Badra</i> <i>A.R. Masri</i>
11.20-11.40	ACS009 Sparse-Lagrangian MMC: numerical algorithms and an OpenFOAM implementation  <i>Y. Ge</i> <i>M.J. Cleary</i>	ACS031 Computed and Measured Ignition Delay and Flame Lift-off in Diesel Jets  <i>C. Bajaj</i> <i>M. Ameen</i> <i>J. Abraham</i>	ACS058 The Feasibility of Using Nitrocellulose as an Alternative Fuel to Replace Fossil Fuels  <i>Mengyang Sun</i> <i>Bassam B. Dally</i> <i>Farid C. Christo</i>
11.40-12.00	ACS043 A comparative study of LPG and gasoline direct injection sprays  <i>Q. Zakka</i> <i>L. Esclapez</i> <i>M.J. Brear</i>	ACS054 Computational study of stratified charge compression ignition engines with late injection under low-load conditions  <i>Haoyang Zhang</i> <i>Evatt R. Hawkes</i> <i>Sanghoon Kook</i>	ACS025 Influence of heating rate and particle size on thermo-swelling properties of heating coal  <i>W. Xie</i> <i>R. Stanger,</i> <i>J. Lucas,</i> <i>T. Wall,</i> <i>M.R. Mahoney</i>
12.00-12.20	ACS002 A CMC Model for Reactive Flows through Porous Media with Altering Pore Structures  <i>D.M. Saulov</i> <i>C.R. Chodankar</i> <i>M.J. Cleary</i> <i>A.Y. Klimenko</i>	ACS011 Combustion Control of a Diesel HCCI Engine Using Zero-Dimensional Single-Zone Model.  <i>A. Aziz Hairuddin</i> <i>Talal F. Yusaf</i> <i>Andrew P. Wandel</i>	



12.20-13.30	Lunch		
13.30-14.30	<p>Invited Lecture (Sea Room)</p> <p>Structure of Turbulent Jets Flames under Hot Coflow Conditions</p> <p><i>Bassam Dally</i></p> <p>Chair: A Masri</p>		
Room	Sea room	Sun room	Star room
	Turbulent Combustion Chair: A Wandel	Ignition Chair R Brown	Diagnostics Chair P Ashman
14.30-14.50	<p>ACS036 Study of Random Particle Interactions for Analysis of Diffusion Lengths in Turbulence Combustion Modeling</p> <p><i>M. M. Noor</i> <i>T. F. Yusaf</i> <i>Andrew P. Wandel</i></p>	<p>ACS042 Performance of Natural Gas, Hydrogen and Syngas Fuels in an Internal Combustion Engine</p> <p><i>P.J. Orbaiz</i> <i>P.A Dennis</i> <i>P. Abbasi Atibeh</i> <i>B. Alfons</i> <i>H.C. Watson</i> <i>M.J. Brear</i></p>	<p>ACS022 New Seeding Methodology for Two-line Atomic Fluorescence Part I: Non-reacting Flow</p> <p><i>Q.N. Chan</i> <i>P.R. Medwell</i> <i>B.B. Dally</i> <i>Z.T. Alwahabi</i> <i>G.J. Nathan</i></p>
14.50-15.10	<p>ACS020 A Stochastic Micromixing Model based on the Turbulent Diffusion Length Scale</p> <p><i>Andrew Wandel</i></p>	<p>ACS051 Effects of Cross Flow on Ethanol Port Fuel Injection (PFI) Sprays</p> <p><i>S. Padala</i> <i>Y. Bao</i> <i>S. Kook</i> <i>E.R. Hawkes</i></p>	<p>ACS023 New Seeding Methodology for Two-line Atomic Fluorescence Part II: Reacting Flows</p> <p><i>P.R. Medwell</i> <i>Q.N. Chan</i> <i>B.B. Dally</i> <i>Z.T. Alwahabi</i> <i>G.J. Nathan</i></p>
15.10-15.40	Refreshment break		
15.40-16.00	<p>ACS008 A gradient/fractal model for determining the mixing particle distance in Multiple Mapping Conditioning</p> <p><i>Y.Ge</i> <i>M.J. Cleary</i> <i>A.Y. Klimenko</i></p>	<p>ACS017 Effect of Fuel Ratio and Ignition Delay on the Rate of Flame Spread over a Porous Bed Wetted with a Flammable Liquid</p> <p><i>J Zanganeh</i> <i>B Moghtaderi</i></p>	<p>ACS050 Diesel Knock Visualisation in a Small-Bore Optical Engine</p> <p>ASC050 video</p> <p><i>A.M. Rusly</i> <i>R. Zhang</i> <i>S. Kook</i> <i>E.R. Hawkes</i></p>
16.00-16.20	<p>ACS044 MILD Oxy-Combustion of Gaseous Fuels</p> <p><i>P. Li</i></p>	<p>ACS045 Ignition Delay in an Ethanol Fumigated Common Rail Diesel Engine</p>	<p>ACS032 Quantitative measurements of sodium release from combusting South Australian brown coal particles using Planar</p>

	<i>B.B. Dally</i> <i>J. Mi</i> <i>M. Simpson</i>	<i>T.A. Bodisco</i> <i>R.J. Brown</i>	Laser Induced Fluorescence  <i>Philip J. van Eyk</i> <i>Peter J. Ashman</i> <i>Graham J. Nathan</i>
16.20-16.40	ACS037 Flame structure of jets in confined crossflows  <i>C.H. Birzer</i> <i>R.M. Kelso</i> <i>B.B. Dally</i>	ACS047 A numerical study of the autoignition of dimethyl ether with temperature inhomogeneities  <i>Haoyang Zhang</i> <i>Evatt R. Hawkes</i> <i>Jacqueline H. Chen</i> <i>Sanghoon Kook</i>	
16.40-18.30	Break		
18.30-22.00	Conference Banquet		

Thursday 1 <sup>st</sup> December 2011 Shoal Bay Resort Spa			
09.00-10.00	Invited Lecture (Sea Room) The Mechanisms of Diffusion Flame Extinction, their Contribution to Fire Dynamics, and the Challenges Found in their CFD Description  <i>Arnaud Trouvé</i>  Chair B Dlugogorski		
10.00-10.20	Refreshment break		
Room	Sea room	Sun room	Star room
	Turbulent combustion Chair: G Nathan	Emission of pollutants Chair E Kennedy	Chemical looping Combustion Chair B Moghtaderi
10.20-10.40	ACS027 N-heptane spray modelling in a constant volume chamber with the Lagrangian probability density function approach  <i>Y. Pei</i>	ACS024 Endex pre-combustion CO <sub>2</sub> capture  <i>R. Ball</i> <i>M.G. Sceats</i>	ACS018 Thermogravimetric Analysis of NiO/SiO <sub>2</sub> Oxygen Carriers under CO/Air Environment for Chemical Looping Combustion

	<i>E.R. Hawkes</i> <i>S. Kook</i>		<i>Hui Song</i> <i>Kalpiti Shah</i> <i>Elham Doroodchi</i> <i>Behdad Moghtaderi</i>
10.40-11.00	ACS026 Modelling n-heptane spray and combustion in conventional and low-temperature diesel engine conditions  <i>Y. Pei</i> <i>E.R. Hawkes</i> <i>S. Kook</i>	ACS010 Evaluation of an iron-based organometallic combustion catalyst for reductions of exhaust emissions from diesel engines  <i>Yu Ma</i> <i>Mingming Zhu</i> <i>Dongke Zhang</i>	ACS033 Chemical looping combustion of syngas with ceria-supported oxygen carriers  <i>H.B. Huang</i> <i>C.W. Kwong</i> <i>L. Aisyah</i> <i>P.J. Ashman</i> <i>Y.C. Leung</i>
11.00-11.20	ACS014 Sparse-Lagrangian MMC Simulations of a Lifted Hydrogen Flame in a Vitiated Coflow  <i>B. Sundaram</i> <i>M.J. Cleary</i>	ACS056 Predicting the heat of formation of chlorinated phenols and associated chlorine isotopologues  <i>A. Alsoufi</i> <i>B.Z. Dlugogorski</i> <i>J.C. Mackie</i> <i>M. Stockenhuber</i> <i>E.M. Kennedy</i>	ACS012 Application of Chemical Looping Combustion for Solar Thermal Energy Storage  <i>S. M. Jafarian</i> <i>M. Arjomandi</i> <i>G. Natban</i> <i>S. M. Nasebi</i>
11.20-11.40	ACS001 On the flame length in firewhirls  <i>A.Y. Klimenko</i> <i>F.A. Williams</i>	ACS057 Formation of Toxic Species in Oxidation of 4-Chlorobiphenyl  <i>S. Hou</i> <i>D.A. Wojtalewicz</i> <i>J.C. Mackie</i> <i>E.M. Kennedy</i> <i>B.Z. Dlugogorski</i>	ACS028 Performance Characteristics of a Novel Integrated Gasification Chemical Looping Combustion for Solid Fuels  <i>Yongxing Zhang</i> <i>Kalpiti Shah</i> <i>Behdad Moghtaderi</i>
11.40-12.00	ACS049 On The Fractal Dimension of Low Damköhler Number Flames  <i>O. Chatakonda</i> <i>E.R. Hawkes</i> <i>A.J. Aspden</i> <i>A.R. Kerstein</i> <i>J.H. Chen</i>	ACS015 Low Temperature Oxidation of Biphenyl in an Alumina Reactor: Possible Initiation by O <sub>2</sub> (1Δ)  <i>S. Summoogum</i> <i>B.Z. Dlugogorski</i> <i>E.M. Kennedy</i> <i>J.C. Mackie</i>	ACS016 Chemical Looping Air Separation (CLAS) for Oxygen production: Thermodynamic and Economic Aspects  <i>Kalpiti Shah</i> <i>Behdad Moghtaderi</i> <i>Terry Wall</i>
12.00-13.00	Lunch		
13.00-14.00	Invited Lecture (Sea Room)  Challenges for Combustion Science and Technology in a Carbon-Constrained World  <i>Dongke Zhang</i>  Chair: T Wall		

Room	Sea room	Sun room	Star room
	Turbulent combustion Chair: E Hawkes	Ignition, fuels and engines Chair: B Dally	Chemical kinetics and mechanism Chair: B Dlugogorski
14.00-14.20	ACS021 A dynamic model for flame wrinkling in large-eddy simulation  <i>E.R. Hawkes</i> <i>O. Chatakonda</i> <i>H. Kolla</i> <i>A.R. Kerstein</i> <i>J.H. Chen</i>	ACS039 Emission Constrained Minimisation of Fuel Consumption in Spark Ignition Engines  <i>D.I. Andrianov</i> <i>M.J. Brear</i> <i>C. Manzie</i>	ACS041 A Comparison of Reference Engine Autoignition with Detailed Kinetic Modelling for a range of Primary Reference Fuels.  <i>K.J. Morganti</i> <i>T.M. Foong</i> <i>M.J. Brear</i> <i>G. da Silva</i> <i>F.L Dryer</i>
14.20-14.40	ACS038 Flow-Fields and Droplet Statistics in Turbulent Jets and Flames of Dilute Acetone Sprays  <i>W. O'Loughlin</i> <i>A.R. Masri</i>	ACS004 Cryogenic Oxygen/Hydrogen Flame Response to Acoustic Excitation in a Rectangular Rocket Combustor  <i>J.S. Hardi</i> <i>M. Oswald</i> <i>B. Dally</i>	ACS059 Rate constants for Reactions of Ethylbenzene with Hydroperoxyl Radical and Oxygen Molecule  <i>M. Altaravneh</i> <i>B.Z. Dlugogorski</i> <i>E. M. Kennedy</i> <i>J.C. Mackie</i>
14.40	Conference close		

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