Central States Section of the Combustion Institute Spring Technical Meeting 2008

Tuscaloosa, Alabama, USA
20 – 22 April 2008

# TABLE OF CONTENTS

## SESSION A1: DIAGNOSTICS I

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1-01</td>
<td>BARRIER OPTIMIZATION BY OPTICAL ANALYSIS OF COMPRESSED HYDROGEN GAS LEAKS</td>
<td>1</td>
</tr>
<tr>
<td>Seydou Diop, Ajay Agrawal, Robert Schefer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1-02</td>
<td>SIMULTANEOUS HYDROXYL AND PRESSURE TIME-SERIES MEASUREMENTS IN A SELF-EXCITED ACOUSTICALLY-DRIVEN TUBE COMBUSTOR</td>
<td>12</td>
</tr>
<tr>
<td>A1-03</td>
<td>AN INJECTION-SEEDED OPTICAL PARAMETRIC (OP) AND PULSE DYE-AMPLIFIED (PDA) LASER SOURCE FOR COMBUSTION DIAGNOSTICS</td>
<td>19</td>
</tr>
<tr>
<td>A. H. Bhuiyan, D. R. Richardson, S. V. Naik, R. P. Lucht</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1-04</td>
<td>SINGLE-SHOT MEASUREMENTS OF NITRIC OXIDE IN ATMOSPHERIC-PRESSURE FLAMES USING VIBRATIONAL ELECTRONIC-RESONANCE-ENHANCED COHERENT ANTI-STOKES RAMAN SCATTERING</td>
<td>25</td>
</tr>
<tr>
<td>Ning Chai, Sameer V. Naik, Robert P. Lucht, Normand M. Laurendeau, Sukesh Roy, James R. Gord</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1-05</td>
<td>SIMULTANEOUS WATER VAPOR CONCENTRATION AND TEMPERATURE MEASUREMENTS IN UNSTEADY HYDROGEN FLAMES</td>
<td>33</td>
</tr>
<tr>
<td>D. Blunck, S. Basu, Y. Zheng, J. Gore</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## SESSION B1: 1C ENGINES I

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1-01</td>
<td>ANALYSIS OF CYCLIC VARIABILITY IN SPARK-ASSISTED HCCI COMBUSTION USING A DOUBLE WIEBE FUNCTION</td>
<td>40</td>
</tr>
<tr>
<td>William J. Glewen, Robert M. Wagner, K. Dean Edwards, C. Stuart Daw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1-02</td>
<td>DIESEL ENGINE AUTOIGNITION AND FLAME STRUCTURE IN HIGH- AND LOW-TEMPERATURE COMBUSTION MODES</td>
<td>47</td>
</tr>
<tr>
<td>Satbir Singh, R. D. Reitz, M. P. B. Musculus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1-03</td>
<td>INDICATION OF THE LEVEL OF CYLINDER PRESSURE RISE RATE OF AN INTERNAL COMBUSTION ENGINE USING VIBRATION AND ACOUSTIC EMISSIONS</td>
<td>54</td>
</tr>
<tr>
<td>J. Massey, J. Drallmeier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1-04</td>
<td>ON THE QUANTITATIVE DEFICIENCIES OF IDEAL AIR-STANDARD ENGINE CYCLES</td>
<td>61</td>
</tr>
<tr>
<td>R. Shyani, T. J. Jacobs, J. A. Caton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1-05</td>
<td>AN ACTIVE VAPOR UTILIZATION SYSTEM FOR EMISSIONS REDUCTIONS IN GASOLINE-FUELED VEHICLES</td>
<td>N/A</td>
</tr>
<tr>
<td>John Crawford, Michael J. Alfiff, Marcus D. Ashford</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## SESSION C1: CATALYTIC AND HETEROGENEOUS COMBUSTION

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-01</td>
<td>CATALYTIC EFFECTS OF CUO ON REACTIONS LEADING TO POLYCYCLIC AROMATIC HYDROCARBONS</td>
<td>67</td>
</tr>
<tr>
<td>Nimesh B. Poddar, Mary J. Wornat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1-02</td>
<td>EFFECT OF MASS TRANSFER ON THE PERFORMANCE OF SELECTIVE CATALYTIC REDUCTION (SCR) SYSTEMS</td>
<td>71</td>
</tr>
<tr>
<td>Nimrod Kapas, Tariq Shamim, Paul Laing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1-03</td>
<td>EFFECT OF CERIA NANOPARTICLES ON EARLY SOOT FORMATION IN TOLUENE/OXYGEN/ARGON MIXTURES</td>
<td>77</td>
</tr>
<tr>
<td>B. Rotavera, E. L. Petersen, A. Kumar, S. Seal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1-04</td>
<td>NUMERICAL MODELING OF FLAME PROPAGATION THROUGH PULVERIZED COAL CLOUD IN O2/CO2</td>
<td>83</td>
</tr>
<tr>
<td>Li Qiao</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1-05</td>
<td>BLOW-OFF LIMITS WITH OXY-COAL COMBUSTION</td>
<td>90</td>
</tr>
<tr>
<td>Ari Roisman, Melissa Holtmeyer, Scott A. Skee, Richard L. Axelbaum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A3-02: FREQUENCY AND SPATIAL DEPENDENCE OF CROSS CORRELATION VELOCIMETRY
S. Rockwell, A. S. Rangwala ................................................................. 202

A3-03: NITRIC OXIDE CONCENTRATION AND LIFETIME MEASUREMENTS USING PICOSECOND TIME-RESOLVED LASER-INDUCED FLUORESCENCE
K. K. Vendatesan, A. C. Noble, K. A. Kirkegaard G. B. King, N. M. Laurendeu, M. W. Renfro ................................................................. 210

A3-04: FLAME STRUCTURE MEASUREMENTS AND PRINCIPAL COMPONENT ANALYSIS IN SELF-EXCITED ACOUSTICALLY-DRIVEN PREMIXED FLAMES
K. M. Kopp-Vaughan, M. W. Renfro, G. B. King, M. Gluesenkamp ................................................................. 215

A3-05: FIBER-OPTIC SPARK DELIVERY FOR GAS-PHASE LASER INDUCED BREAKDOWN SPECTROSCOPY
C. E. Dumitrescu, P. Puzinauskas, S. Olcmen ................................................................. 221

SESSION B3: BIOFUELS

B3-01: BIOFUELS FOR NAVY USE: PROMISES AND PROBLEMS

B3-02: EFFECT OF FUEL INJECTION CONCEPT ON COMBUSTION PERFORMANCE OF LIQUID BIOFUELS
Benjamin M. Simmons, Heena V. Panchasara, Ajay K. Agrawal ................................................................. 236

B3-03: A COMPARATIVE STUDY OF N-HEPTANE, METHYL ESTER, AND DIMETHYL ETHER AUTOIGNITION AND NO BEHAVIOR
Seth Hoffman, John Abraham, Olivier Herbinet ................................................................. 243

B3-04: THE DEVELOPMENT OF A DIESEL ENGINE EXPERIMENTAL RESEARCH FACILITY FOR BIODIESEL COMBUSTION STUDIES
Jason Esquivel, Brandon Tompkins, Timothy J. Jacobs ................................................................. 268

B3-05: ASSESSMENT OF THE VALIDITY OF MODELING LIGHT BIOMASS COMBUSTION IN A FLUIDIZED STOKER BOILER USING FLUENT COMMERCIAL FLOW SOFTWARE
X. Zhang, A. Rainier ................................................................. 274

SESSION C3: FIRE, SOOT AND PARTICULATES

C3-01: ANALYSIS OF HOLD TIME FOR TOTAL FLOODING CLEAN EXTINGUISHING AGENTS
Ali S. Rangwala, Todd M. Hetrick ................................................................. 279

C3-02: EXAMINATION OF POLYMER DEGRADATION AND TRANSPORT USING POPULATION BALANCE TECHNIQUES
Morgan C. Bruns, J.H. Koo, Ofodike A. Ezekoye ................................................................. 289

C3-03: FIRE SIGNATURES OF SPACECRAFT MATERIALS: GASES, CONDENSABLES AND PARTICULATES
Randy Vander Wal, Jane Novak, Vladimir Pushkarev ................................................................. 296

C3-04: FINGERPRINTING SOOT (TOWARDS SOURCE IDENTIFICATION): PHYSICAL STRUCTURE AND CHEMICAL COMPOSITION
Randy L. Vander Wal, Vicky M. Bryg, Michael D. Hays ................................................................. 301

C3-05: VAPORIZATION OF SINGLE- AND TWO-COMPONENT TIO2 AND SIO2 NANOPARTICLES AND THEIR RESULTING EMISSION SPECTRA
A. B. Barrett, E. L. Petersen ................................................................. 304

C4-01: HIGH-POWERED MICROSCOPY AND BURNING RATES OF SOLID COMPOSITE PROPELLANTS CONTAINING NANOPARTICLES
M. Stephens, E. Petersen, D. Reid, M. Janish, S. Seal ................................................................. N/A

SIMPLIFIED CORRELATION MODELS FOR CO/H2 CHEMICAL REACTION TIMES
N.S. Donato, E. L. Petersen ................................................................. 313

SESSION A4: REACTION KINETICS II

A4-02: EXPERIMENTS AND KINETICS MODELING OF METHANE-ETHANE-OXYGEN MIXTURES DILUTED IN ARGON
Christopher J. Aul, Eric L. Petersen, Brian C. Walker, Henry J. Curran ................................................................. 321
A4-03: POLYCYCLIC AROMATIC HYDROCARBONS FORMATION FROM 1,3-BUTADIENE PYROLYSIS............................................................................................................................... 327
Shiju Thomas, Mary J. Wornat

A4-04: INTERPRETATION OF SHOCK-TUBE IGNITION MEASUREMENTS OF CERTAIN UNDILUTED ALKANE-AIR MIXTURES AT HIGHER PRESSURES AND LOWER TEMPERATURES............................................................................................................................... 332
Eric L. Petersen, Henry J. Curran

SESSION B4: IC ENGINES II

B4-01: IGNITION IN PILOT-IGNITED NATURAL GAS ENGINES: MULTI-ZONE MODELING AND EXPERIMENTAL RESULTS
Sundar R. Krishnan, Kalyan K. Srinivasan, K. Clark............................................................................................................................... 336

B4-02: USING CNG AND DIESEL IN THE CITY BUS TRANSPORT IN SKOPJE, ECOLOGICAL BENEFITS
Dame Dimitrovski............................................................................................................................... 342

B4-03: STRATEGIES FOR EMISSION REDUCTIONS FROM AIR-COOLED SPARK-IGNITED SMALL ENGINES
Chandan Mahato, Raju V. Dantuluri, Paul Pazinauskas, Clark Midkiff, Jennifer Beasley
............................................................................................................................... N/A

B4-04: POTENTIAL PROCESSES FOR "REVERSIBLE" COMBUSTION WITH APPLICATION TO RECIPIROCATING INTERNAL COMBUSTION ENGINES
K.T. Patrawaka, J.A. Caton............................................................................................................................... 347

9:00 – 9:20 C4-01: HIGH-POWERED MICROSCOPY AND BURNING RATES OF SOLID COMPOSITE PROPPELLANTS CONTAINING NANOPARTICLES
M. Stephens, E. Petersen, D. Reid, M. Janish, S. Seal............................................................................................................................... 353

SESSION C4: METALS AND METAL SYSTEMS II

C4-02: MAKING BURN TIME MEASUREMENTS IN A HETEROGENEOUS SHOCK TUBE
P. Lynch, H. Krier, N. Glumac............................................................................................................................... 360

C4-03: ENERGY TRANSPORT IN NANOCOMPOSITE ENERGETIC MATERIALS: MECHANISMS VERSUS MODES
Steven Dean, Michelle L. Pantoya, Alex Gash............................................................................................................................... 365

C4-04: RAPID COMBUSTION OF ALUMINUM IN HYPERSONIC JETS PENETRATING THROUGH WATER
B. Fant, J. Rudolphi, H. Krier, N. Glumac, R. Brown, J. Sinibaldi............................................................................................................................... 370

SESSION A5: TURBULENT FLAMES

A5-01: ASSESSMENT OF EMISSIONS PREDICTION CAPABILITY OF RANS BASED PDF MODELS FOR LEAN PREMIXED COMBUSTION OF METHANE
D. Parsons, J. Nanduri, I. Celik, P. Strakey............................................................................................................................... 376

A5-02: FLAME BRUSH DYNAMICS IN A HARMONICALLY OSCILLATING, TURBULENT JET FLAME
Sai Kumar Thumuluru, Karthik Periagaram, Tim Lieuwen............................................................................................................................... 382

A5-03: LARGE EDDY SIMULATION OF TURBULENT BUNSEN FLAMES WITH A THICKENED-FLAME APPROACH
Ashoke De, Sumanta Acharya............................................................................................................................... 390

A5-04: EFFECT OF SWIRL ON COMBUSTION DYNAMICS IN LEAN PREMIXED LOW-SWIRL BURNERS
Yun Huang, Albert Ratner............................................................................................................................... 400

SESSION B5: LAMINAR FLAMES II/S PRAYS

B5-01: NUMERICAL INVESTIGATIONS OF EXTINCTION/REIGNITION OF LAMINAR DIFFUSION FLAMELETS UNDER OSCILLATING SCALAR DISSIPATION RATES
R. Venugopal, J. Abraham............................................................................................................................... 406

B5-02: CANDLE WITH IMPROVED COMBUSTION
Susumu Matsuyama............................................................................................................................... 413
B5-03: NORMAL AND INVERSE LAMINAR JET-DIFFUSION FLAMES UNDER OXYGEN ENHANCEMENT AND GRAVITY VARIATION ........................................................................................................... N/A

B5-04: A COMPUTATIONAL EXAMINATION OF THE FLOW-BLURRING CONCEPT FOR LIQUID FUEL ATOMIZATION ........................................................................................................ 421
Will Schreiber

SESSION C5: SESSION BURNERS AND BURNER SYSTEMS

C5-01: VISUAL FLAME STRUCTURE OF HYDROGEN-RICH FLAMES IN A LOW-SWIRL BURNER ................................................................................................................................. 425
Daniel Sequera, Ajay K. Agrawal

C5-02: MESO-SCALE HEAT-RECIRCULATING LIQUID-FUELED COMBUSTOR WITH COMBUSTION WITHIN POROUS INERT MEDIA ........................................................................ 434
S. Vijaykant, Ajay K. Agrawal

C5-03: STABILITY OF LIFTED FLAMES IN CENTERBODY BURNER ........................................................................................................... 442
Viswanath Katta, William Roquemore

C5-04: NUMERICAL ANALYSIS OF COMBUSTION BEHAVIOR OF PULVERIZED COAL IN BLAST FURNACE RACEWAY ................................................................................................. 448
Fengguo Tian, Lijian Sun, Bin Wu, Chenn Q. Zhou, Yongfu Zhao

Author Index