

Bunsen Discussion Meeting on Laser-induced incandescence: Quantitative interpretation, modelling, application Duisburg, Sept. 25-28, 2005

Sunday, Sept. 25: Conference

18:00 Informal get together

Monday, Sept. 26: Conference

8:30 Welcome

***Experimental investigation and modelling of the dependencies of LII signal
experimental conditions: Heat conduction / accommodation coefficients***

8:45 **Heat conduction issues in laser-induced incandescence**
S.-A. Kuhlmann, J. Reimann, S. Will
Technische Thermodynamik, Universität Bremen, Germany

Laser fluence

9:05 **A detailed experimental and theoretical comparison of spatially-resolved laser-
induced incandescence signals**
H. Bladh², J. Delhay¹, Y. Bouvier¹, E. Therssen¹, P-E. Bengtsson², P. Desgroux¹
¹PC2A, UMR CNRS 8522, Université des Sciences et Technologies de Lille, Lille,
France
²Division of Combustion Physics, Lund Institute of Technology, Lund, Sweden

Particle size / agglomeration / modification

9:25 **Investigations of the mechanisms involved in LII particle detection**
H. A. Michelsen, M. Y. Gershenson, P.O. Witze
Sandia National Laboratories, Livermore, CA 94551

9:45 **Influence of polydisperse distributions of both primary particle and aggregate
sizes on soot temperature in low-fluence laser-induced incandescence**
F. Liu¹, M. Yang¹, F. A. Hill², G. J. Smallwood¹, D. R. Snelling¹
¹ICPET, National Research Council Canada, Ottawa, Ontario, Canada
² Department of Systems Design Engineering, University of Waterloo, Waterloo,
Ontario, Canada

10:05 **2-Color LII measurements of carbon black: Interpretation for quantitative
measurement of fineness**
B.J. Stagg
Columbian Chemicals Company, 1800 West Oak Commons Court, Marietta, GA
30062

10:25 Coffee break

Refractive index

- 11:10 Wavelength-dependence of refractive index function of soot particle by two-color laser induced incandescence**
Y. Bouvier, E. Therssen, P. Desgroux.
Lab. Physicochimie des Processus de Combustion et de l'Atmosphère (PC2A),
Université des Sciences et Technologies de Lille. 59655 Villeneuve d'Ascq Cedex-
France

Calibration

- 11:30 An LII technique independent of *ex-situ* calibration by detecting absolute light intensity**
D. R. Snelling¹, G. J. Smallwood¹, F. Liu¹, Ö. L. Gülder², W. D. Bachalo³
¹ICPET, National Research Council Canada, Ottawa, Ontario, Canada
²University of Toronto, Institute for Aerospace Studies, Toronto, Ontario, Canada
³Artium Technologies, Sunnyvale, CA, USA

Bath gas

- 11:50 Laser-induced processes in carbon generated in an argon arc**
J.D. Black¹, M.P. Johnson²
¹Strategic Research Centre, Rolls-Royce plc, Derby, DE24 8BJ, UK
²JJ Thomson Physical Laboratory, University of Reading, Whiteknights, Reading,
RG6 6AF, UK

12:10 Lunch

Pressure

- 13:40 An investigation of soot nanoparticulate in a vacuum**
V. Beyer, G. Sherwood, D.A. Greenhalgh
Department of Automotive, Mechanical and Structural Engineering, Cranfield University
- 14:00 Laser-induced incandescence measurements in a laminar co-annular non-premixed methane/air flame at pressures up to 1.0 MPa**
K. A. Thomson, D. R. Snelling, G. J. Smallwood, F. Liu
ICPET, National Research Council Canada, Ottawa, Ontario, Canada
- 14:20 Laser-induced incandescence and shifted vibrational CARS in laminar premixed flames at atmospheric and elevated pressures**
K.P. Geigle¹, M.S. Tsurikov¹, W. Meier¹, V. Krüger², R. Hader³
¹Institute of Combustion Technology, German Aerospace Center (DLR), Stuttgart, Germany
²Robert Bosch GmbH, Gerlingen, Germany
³Institut de Génie Mécanique, Université Larbi Ben M'Hidi, Oum El Bouaghi, Algeria
- 14:40 LII in high-pressure flames with simultaneous gas-phase temperature measurement (preliminary)**
M. Hofmann¹, H. Kronemayer¹, C. Schulz²
¹PCI, Universität Heidelberg, Germany
²IVG, Universität Duisburg-Essen, Germany
- 15:00 Soot particulate size measurements in a heavy duty Diesel engine**
B. Bougie, L.C. Ganippa, A.P. van Vliet, N.J. Dam, W.L. Meerts, J.J. ter Meulen
Applied Molecular Physics, Institute for Molecules and Materials, Radboud University Nijmegen,

- 15:20** **Modeling of time-resolved laser-induced incandescence (TIRE-LII) transients for particle sizing in high-pressure spray combustion environments**
T. Dreier¹, B. Bougie², L. Ganippa², N. Dam², T. Gerber¹, J.J. ter Meulen²
¹Reaction Analysis Group, Dept. of General Energy, Paul Scherrer Institut, Villigen PSI, Switzerland
²Institute for Molecules and Materials, Radboud University, ED Nijmegen, The Netherlands

15:40 **Coffee break**

Non-soot LII

- 16:20** **Application of TR-LII for the study of carbon vapor condensation at room temperature**
A. Eremin¹, E. Gurentsov¹, M. Hofmann², C. Schulz³
¹Institute for High Energy Density RAS, Moscow, Russia
²PCI, Universität Heidelberg, Heidelberg, Germany
³IVG, Universität Duisburg-Essen, Duisburg, Germany
- 16:40** **Planar laser-induced incandescence of iron particles in welding fumes**
O. Lucas², Z. Alwahabi¹, V. Linton²
Schools of Chemical¹ and Mechanical² Engineering, University of Adelaide, Adelaide, SA 5005, Australia
- 17:00** **Time-resolved laser-induced-incandescence (TR-LII) for iron-particle sizing**
B. Kock, J. Knipping, H.R. Orthner, C. Kayan, C. Schulz, P. Roth
IVG, Universität Duisburg-Essen, 47057 Duisburg, Germany
kock@uni-duisburg.de
- 17:20** **Laser-induced incandescence of free and surface-adsorbed particles**
T. Schittkowski, D. Böker, D. Brüggemann
Lehrstuhl für Technische Thermodynamik und Transportprozesse (LTTT)
Universität Bayreuth, Germany

Applications of LII

- 17:40** **In-situ determination of gas-to-particle reaction generated nanoscaled particles**
M. Charwath, Th. Lehre, R. Suntz and H. Bockhorn
Institut für Chemische Technik und Polymerchemie
Universität Karlsruhe (TH)
- 18:00** **Two-Dimensional Imaging of Soot Volume Fraction and OH in Turbulent Jet Diffusion Flames Spanning low to high Mixing Rates**
N. H. Qamar¹, Z.T. Alwahabi¹, G. J. Nathan², K.. D. King¹
Schools of Chemical¹ and Mechanical² Engineering, The University of Adelaide, Adelaide, SA 5005, Australia

20:00 **Conference Dinner**

Tuesday, Sept. 27: Workshop

8:30 Modeling of the LII Process

Hope Michelsen, CRF, Sandia Natl. Labs, Livermore, CA, US
Boris Kock, IVG Universität Duisburg-Essen, Germany

- I.a Structure of model approaches. A Review
 - which different levels of complexity are applied by the different models?
- I.b Energy- and mass balance during particle heating and cooling
 - separation of heating and cooling or simulation of the complete process
 - considered heat fluxes
 - temperature dependence of the heat capacity
 - solution of the differential equation-system (heat- and mass balance)
- I.c Different models for heat fluxes
 - different Knudsen regions
- I.d Simulation of radiation signals
 - influence of particle size distribution
 - consideration of the radial and temporal distribution of laser fluence
- I.e Material properties
 - influence on the model

10:15 Coffee break

11:00 Experimental

Greg Smallwood, National Research Council, Canada
Max Hofmann, Universität Heidelberg, Germany
Coralie Shoemaker, Université de Lille, France

- II.a Excitation
 - wavelength
 - influence of radial and temporal energy distribution
 - devices for homogenisation of laser fluence
- II.b Signal Detection
 - one- or two-dimensional signal detection
 - detection wavelengths
 - potential interferences
- II.c Influence of laser fluence
 - on signals: excitation curve
 - on particles: change of aggregate structure and particle morphology
- II.d Two-color applications for direct temperature measurement

12:30 Lunch

14:30 Signal evaluation

Stefan Will, Universität Bremen, Germany
Rainer Suntz, Universität Karlsruhe, Germany
Bas Bougie, Radboud University Nijmegen, Netherlands

- III.a Determination of particle size or size distribution from measured signals
 - Fitting of measured curves or numerical solution of Fredholm integral equation
- III.b Influence of the particle shape / degree of agglomeration
- III.c Determination of particle volume fraction from the measured signals
 - techniques available for the calibration
 - problem of calibration (optical properties, effect of fuel and flame conditions)
 - correction of temperature difference between calibration and measurement
- III.d Complementary techniques

16:15 Coffee break

17:00 Comparison of different approaches of all involved group
Greg Smallwood, NRC, Canada
Christof Schulz, IVG, Universität Duisburg-Essen, Germany

- IV.a Comparison of the measurements and results at the model flame
- IV.b Comparison of the evaluation of the model signals

Wednesday, Sept. 27: Workshop

8:30 In-depth discussion in split groups

12:30 Lunch

14:00 Report of the results of the in-depth discussion

15:00 Definition of hot topics for upcoming meeting

16:00 Coffee break

17:00 Lab tour