

Green Solvents for Catalysis - Environmentally Benign Reaction Media

Green Solvents For Catalysis
Environmentally Benign Reaction Media



October 13 - 16, 2002
Bruchsal/Germany

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J. A. Gladysz, University of Erlangen-Nuremberg/D
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H. Hugl, Bayer AG, Leverkusen/D
G. van Koten, University of Utrecht/NL
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Sponsored by:

Cytec Canada Int.; Solvias AG; Celanese; BASF AG; Novartis; ACE-European;
Association of Chemistry and the Environment; Bayer AG; Merck KGaA; Degussa AG;

Location

Bürgerzentrum Bruchsal
Am alten Schloss 22
76646 Bruchsal
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Conference Secretariat

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Programme

Sunday, 13 October 2002

- 12.00 - 17.00 Excursion to Heidelberg
- 18.30 Welcome Reception with beer and pretzels
- 19.45 Opening
K. Wagemann, DECHEMA e.V., Frankfurt am Main/D
W. Leitner, RWTH Aachen and Max-Planck-Institute for Coal Research, Mulheim/D
- 20.00 - 21.00 Plenary Evening Lecture
Green chemistry: Current status and future challenges, P.T. Anastas, White House
Office of Science and Technology Policy, Washington DC/USA

Monday, 14 October 2002

- Chairperson: H. Hugl, Bayer AG, Leverkusen/D
- 08.30 Keynote Lecture
Multiphase catalysis and its potential in catalytic processes, W. Keim, RWTH Aachen/D
- 09.15 Control of homogeneously catalysed reactions by phase equilibria, N. Dahmen, E.
Dinjus, S. Pitter, J. Schon, Karlsruhe Research Center/D
- 09.45 Challenges and opportunities in the use of ionic liquids: Separations, extractions, and
the choice of ionic liquid, R.D. Rogers, J.D. Holbrey, The University of Alabama,
Tuscaloosa, AL/USA
- 10.15 Coffee Break
- Chairperson: I.T. Horvath, Eotvos University, Budapest/H
- 10.45 Keynote Lecture
Green concepts in chemical development, E. Kusters, Novartis Pharma AG, Basel/CH
- 11.30 Homogeneous hydrogenation in aqueous solutions catalysed by water-soluble phosphine
complexes. Effect of the solvent on selectivity, L. Nadasdi, A. Ormos, University of
Debrecen/H; G. Laurency, Ecole polytechnique federale de Lausanne / CH, F. Joo,
University of Debrecen and Hungarian Academy of Sciences, Debrecen/H
- 12.00 Continuous hydroamination in a liquid-liquid two-phase system, V. Neff, T.E. Muller,
J.A.Lercher, Technical University of Munich, Garching/D
- 12.30 Lunch
- Chairperson: P.G. Jessop, University of California, Davis, CA/USA
- 14.00 Keynote Lecture,

Direct synthesis of propylene oxide from propylene in CO₂, T. Danciu, E.J. Beckman, University of Pittsburgh, PA/USA

- 14.45 Partial oxidation of cyclohexane in dense carbon dioxide, U. Armbruster, A. Martin, Institute of Applied Chemistry Berlin-Adlershof/D
- 15.15 Ionic liquids as novel and green reaction media for catalytic oxidation and carbonylation
J. Peng, F. Shi, Y. Deng, Chinese Academy of Sciences, Lanzhou/PRC
- 15.45 Coffee Break
- Chairperson: V. Conte, University of Rome/I
- 16.15 Keynote Lecture
Selective oxidation reactions of olefins and alcohols using environmentally benign oxidants, M. Beller, University of Rostock/D
- 17.00 Organically modified sol-gel doped materials as high-performing catalysts in supercritical carbon dioxide, R. Ciriminna, M. Pagliaro, Istituto per lo Studio dei Materiali Nanostrutturati, Palermo/I
- 17.30 - 19.30 Poster Session with local wine and snacks

Tuesday, 15 October 2002

Chairperson: E. Dinjus, Karlsruhe Research Center/D

- 08.30 Keynote Lecture
Continuous flow homogeneous catalysis in supercritical fluid - ionic liquid biphasic systems, P.B. Webb, T.E. Kunene, D.J. Cole-Hamilton, University of St. Andrews/UK
- 09.15 Hydrogenation of fatty acid methylesters in presence of supercritical fluids -
A thermodynamic study, C. Brake, D. Richter, E. Weidner, Ruhr-University of Bochum/D
- 09.45 Expanded liquids and expanded ionic liquids as media for homogeneous catalysis, P.G. Jessop, University of California, Davis, CA/USA; C.A. Eckert, L. Liotta, Georgia Institute of Technology Atlanta, GA/USA
- 10.15 Coffee Break
- Chairperson: J.A. Gladysz, University of Erlangen-Nuremberg/D
- 10.45 Keynote Lecture
Catalysis in fluoruous media, B.-J. Deelman, ATOFINA Vlissingen B.V., Vlissingen/NL
- 11.30 Asymmetric homogeneous catalysis in perfluorous solvents, D. Sinou, J. Bayardon, D. Maillard, Universite Lyon, Villeurbanne/F; G. Pozzi, Centro CNR Sintesi e Stereochimica di Speciali Sistemi Organici, Milano/I
- 12.00 Green heterocycle synthesis facilitated via near critical water, microwaves and metal catalyst, T. Bryson, J. Berch, H. Voegtle, University of South Carolina, Columbia, SC/USA; J.M. Gibson, P. Thomas, Wingate University, NC/USA

- 12.30 Lunch
- Chairperson: M. Poliakoff, University of Nottingham/UK
- 14.00 Keynote Lecture
Homogeneous and phase-separable catalysis approaches using dense phase carbon dioxide and ionic liquids, W. Tumas, Los Alamos National Laboratory, NM/USA
- 14.45 Hydrogenation in supercritical fluids, A.P. Abbott, D.J. Birdsall, W. Eltringham, E.G. Hope, S. Lange, A.M. Stuart, University of Leicester/UK; Y. Hu, J. Xiao, University of Liverpool/UK
- 15.15 Investigating the properties of supercritical fluids with in situ NMR spectroscopy and imaging, K. Woelk, University of Bonn/D
- 15.45 Coffee Break
- Chairperson: B. Driessen-Holscher, RWTH Aachen/D
- 16.15 Keynote Lecture
Examples of developments of C-C bond formation reactions in ionic liquids, H. Olivier-Bourbigou, Institut Francais du Petrole, Rueil-Malmaison/F
- 17.00 Biphasic Pd-catalysed dimerisation of MA using an ionic liquid catalyst layer, I. Tkatchenko, S. Stutzmann, Universite de Bourgogne, Dijon/F; P. Wasserscheid, J. Zimmermann, RWTH Aachen/D
- 17.30 Synthetic strategies for fluorinated cyclopentadienyl ligands: Complex-mediated and direct routes, L.V. Dinh, C. Emnet, J.A. Gladysz, University Erlangen-Nuremberg/D
- 18.00 Efficient combination of task-specific ionic liquid and microwave dielectric heating applied to the first synthesis of a small library of 4-thiazolidinones, J. Fraga-Dubreuil, J.P. Bazureau, Universite de Rennes/F

Wednesday, 16 October 2002

- Chairperson: J. Kulpe, Celanese Ltd., Corpus Christi, TX/USA
- 08.30 Keynote Lecture
Catalysis for fine chemicals: Who needs new solvents?, H.U. Blaser, Solvias AG, Basel/CH
- 09.15 Chemical reactions in supercritical carbon dioxide: From laboratory to commercial plant, M. Poliakoff, University of Nottingham/UK; S.K. Ross, Thomas Swan & Co Ltd., Durham/UK
- 09.45 Industrial preparation of phosphonium ionic liquids, C.J. Bradaric, A. Downard, C. Kennedy, A.J. Robertson, Y. Zhou, Cytec Canada Inc., Niagara Falls/CDN
- 10.15 Coffee Break

Chairperson: G. van Koten, University of Utrecht/NL

- 10.45 Aqueous biphasic catalysis as a powerful tool for catalyst recycling, A. Behr, M. Urschey, V.A. Brehme, University of Dortmund/D
- 11.15 How sustainable are ionic liquids? J. Ranke, UFT Centre for Environmental Research and Environmental Technology, Bremen/D; J. Hoffmann, B. Ondruschka, M. Nuchter, University of Jena/D; J. Filser, T. Frische, K. Molter, B. Oberheitmann, B. Jastorff, UFT Centre for Environmental Research and Environmental Technology, Bremen/D
- 11.45 Keynote Lecture
Management of emerging technologies: Lessons from and for green solvents, C.J. Adams, The Institute of Applied Catalysis, London/UK
- 12.30 Panel Discussion

Posterprogramm

P 01

Hydroformylation of high olefins in supercritical carbon dioxide - A study for a sustainable technology
F. Patcas, S. Pitter, O. Walter, E. Dinjus, Karlsruhe Research Center/D

P 02

Reaction monitoring in conventional and green solvents by ReactIR
S. Csihony, H. Mehdi, R. Tuba, L.T. Mika, I.T. Horvath, Eotvos University of Budapest/H

P 03

Synthesis and properties of ionic liquids derived from the 'chiral pool'
P. Wasserscheid, A. Bosmann, C. Bolm, RWTH Aachen/D

P 04

Dehydration of fructose to 5-hydroxymethylfurfural in sub- and supercritical organic solvents
M. Bicker, H. Vogel, Darmstadt University of Technology/D

P 05

Reforming of methane by CO₂ in presence of cobalt-based catalysts
R. Bouarab, E.N. Polytechnique, El Harrach/DZ and U.S.T.H.B, El Alia/DZ and CNRS Villeurbanne/F;
O. Cherifi, U.S.T.H.B, El Alia/DZ; A. Auroux, CNRS, Villeurbanne/F

P 06

Chemical reactions in near-critical and supercritical water
E. Garcia-Verdugo, M. Poliakoff, University of Nottingham/UK

P 07

Immobilised rhodium and nickel catalysts: Greener chemistry by better recycling
C. Merckle, S. Reinhard, J. Blumel, University of Heidelberg/D

P 08

Noble-metal catalysed selective oxidation of alcohols in carbon dioxide-based solvents

R. Glaser, M. Schmidt, University of Stuttgart/D

P 09

Acrylate dimerisation in ionic liquid-supercritical carbon dioxide

D. Ballivet-Tkatchenko, M. Picquet, CNRS-Universite de Bourgogne, Dijon/F; M. Solinas, G. Francio, Max-Planck-Institute for Coal Research, Mulheim/D; P. Wasserscheid, RWTH Aachen/D; W. Leitner, RWTH Aachen and Max-Planck-Institute for Coal Research, Mulheim/D

P 10

1,3-Dialkylimidazolium-2-carboxylates: An entry to halogen-free ionic liquids, heterocarbenes and ionic ligands

E. Bouajila, D. Poinot, I. Tommasi, I. Tkatchenko, CNRS-Universite de Bourgogne, Dijon/F

P 11

Hydrogeneoimidazolium salts: Bifunctional media for catalysis

M. Picquet, I. Tommasi, I. Tkatchenko, CNRS-Universite de Bourgogne, Dijon/F; P. Wasserscheid, J. Zimmermann, RWTH Aachen/D

P 12

Unprecedented synthesis of 1,3-dialkylimidazolium-2-carboxylate: A carbon dioxide transfer agent to active C-H bonds

I. Tommasi, M. Aresta, University of Bari/I; I. Tkatchenko, Universite de Bourgogne, Dijon/F

P 13

Stereoselective synthesis in supercritical carbon dioxide

M.A. Ali, A.A. Clifford, C.M. Rayner, University of Leeds/UK

P 14

Selective oxidation of alkanes with molecular oxygen in compressed carbon dioxide

N. Theyssen, Max-Planck-Institute for Coal Research, Mulheim/D; W. Leitner, RWTH Aachen and Max-Planck-Institute for Coal Research, Mulheim/D

P 15

1-n-butyl-3-methylimidazolium([BMIM]) octylsulfate - an even 'greener' ionic liquid

P. Wasserscheid, R. van Hal, RWTH Aachen/D

P 16

A green protocol for biocatalysis: Ionic liquids and supercritical carbon dioxide for batchwise and continuous-flow processes

M.T. Reetz, W. Wiesenhofer, Max-Planck-Institute for Coal Research, Mulheim/D; G. Francio, W. Leitner, RWTH Aachen and Max-Planck-Institute for Coal Research, Mulheim/D

P 17

Activation, tuning and immobilisation of homogeneous catalysts in ionic liquids/supercritical carbon dioxide

M. Solinas, G. Francio, RWTH Aachen and Max-Planck-Institute for Coal Research, Mulheim/D; A. Bosmann, P. Wasserscheid, RWTH Aachen/D; W. Leitner, RWTH Aachen and Max-Planck-Institute for Coal Research, Mulheim/D

P 18

Maximising the efficacy of catalysis with designer solvents

J. Ross, J. Xiao, University of Liverpool/UK

P 19

Imidazolium salts/heterocyclic carbenes and their reactivities: Implications for their use in catalysis and as ionic liquids

K.J. Cavell, Cardiff University/UK

P 20

Heterogeneously catalysed hydrogenation reactions in ionic liquids

K. Anderson, D.W. Rooney, C. Hardacre, The Queen's University Belfast/UK

P 21

Transition metal catalysed CO/olefin co-polymerization in room temperature ionic liquids

J.D. Holbrey, K.H. Shaughnessy, M.A. Klingshirn, G.A. Broker, R.D. Rogers, The University of Alabama, Tuscaloosa, AL/USA

P 22

Environmentally benign Suzuki reaction in multi-phase systems promoted by supported detergents

E. Paetzold, G. Oehme, University of Rostock/D; I. Jovel, Latvian Institute of Organic Synthesis, Riga/LV

P 23

Diffusion and viscosity in reaction mixtures comprising supercritical CO₂ as solvent - an in situ high-pressure NMR study

H.G. Niessen, P. Trautner, K. Woelk, University of Bonn/D; H. Stemmer, Max-Planck-Institute for Coal Research, Mulheim/D; W. Leitner, RWTH Aachen and Max-Planck-Institute for Coal Research, Mulheim/D

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Epoxidation of electrophilic alkenes in ionic liquids

O. Bortolini, Dipartimento di Chimica, Ferrara/I; V. Conte, University of Rome/I; C. Chiappe, Dipartimento di Chimica

Bioorganica e Biofarmacia, Pisa/I; C. Fantin, S. Maietti, Dipartimento di Chimica, Ferrara/I

P 25

Enzymatic esterification in ionic liquids integrated with pervaporation for water removal

L. Gubicza, N. Nemestothy, K. Belafi-Bako, University of Kaposvar, Veszprem/H

P 26

Oligonuclear copper complexes of modified amino carbohydrates possessing catecholoxidase activity

M. Gottschaldt, D. Klemm, R. Wegner, H. Gørls, E.-G. Jäger, University of Jena/D

P 27

Colloid-catalysed homogeneous hydrogenation in supercritical CO₂

H.G. Niessen, A. Eichhorn, J. Bargon, K. Woelk, University of Bonn/D

P 28

Pyridinium and 1-methylimidazolium halide, dihalohydrogenate(I) and haloaluminate ionic liquids

G. Driver, K.E. Johnson, University of Regina, Saskatchewan/CDN

P 29

Modelling of the reaction mixture fractionation for dimethyl carbonate synthesis under supercritical carbon dioxide

D. Ballivet-Tkatchenko, L. Plasseraud, CNRS-Universite de Bourgogne, Dijon/F; S. Camy, J.-S. Condoret, CNRS-ENSIACET, Toulouse/F

P 30

Solvent-free synthesis of ionic liquids under microwave irradiation

J. Hoffmann, M. Nuchter, B. Ondruschka, University of Jena/D

P 31 Cancelled

Aromatisation and oxidative dehydrogenation of n-butane on supported Mo₂C catalysts
F. Solymosi, R. Nemeth, A. Szechenyi, University of Szeged/H

P 32

Hydroamination of cyclohexadiene with aniline
B. Drießen-Holscher, C. Steffens, RWTH Aachen/D

P 33

Kinetics of alkanes and cycloalkanes transformation over ionic liquids
V.A. Ksenofontov, A.N. Pryakhin, L.M. Kustov, Zelinsky Institute of Organic Chemistry, Moscow/RUS

P 34

Fluorous catalysis with dirhodium(II) perfluorocarboxylates
A. Biffis, E. Castello, M. Zecca, M. Basato, Università di Padova/I

P 35 Cancelled

Green catalysed oxidation of hydrocarbons in alternative solvent systems generated by PARIS II
T.M. Becker, M.A. Gonzalez, P.F. Harten, United States Environmental Protection Agency, Cincinnati, OH/USA

P 36

Stereoselective hydrogenation of sorbic acid
B. Drießen-Holscher, W. Kalz, RWTH Aachen/D

P 37

Study of some Pd-catalysed C-C coupling reactions in ionic liquid
I. Kmentova, B. Gotov, ? Toma, Comenius University, Bratislava/SK

P 38

Tailor-making ionic liquids
M. Deetlefs, K.R. Seddon, The Queen's University of Belfast/UK

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A copper-free sonogashira coupling reaction in ionic liquids
T. Fukuyama, M. Shinmen, S. Nishitani, M. Sato, I. Ryu, Osaka Prefecture University, Osaka/J

P 40

Investigating ionic liquids by in situ NMR and IR spectroscopy
J. Stadler, H.G. Niessen, P. Trautner, K. Woelk, University of Bonn/D; P. Wasserscheid, RWTH Aachen/D;
R. Giernoth, University of Cologne/D

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Bicyclic phosphites as ligands for the hydroformylation of 1-octene
B. Drießen-Holscher, E. Hermanns, RWTH Aachen/D

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Clean synthesis in ionic liquids
M.J. Earle, The QUILL Centre, Belfast/UK

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Stereoselectivity and kinetic of the electrophilic bromination of alkynes in ionic liquids

C. Chiappe, Dipartimento di Chimica Bioorganica e Biofarmacia, Pisa/I; V. Conte, University of Rome/I; D. Pieraccini, Dipartimento di Chimica Bioorganica e Biofarmacia, Pisa/I

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Direct mono-N-alkylation of amines in ionic liquids

C. Chiappe, D. Pieraccini, Dipartimento di Chimica Bioorganica e Biofarmacia, Pisa/I

P 45

Efficient synthesis of isoquinoline derivatives in a room temperature ionic liquid

Z.M.A. Judeh, C.B. Ching, J. Bu, National University of Singapore/SGP; A. McCluskey, The University of Newcastle, Callaghan/AUS

P 46

A novel class of ionic liquids: Benzylimidazolium salts

S. Guernik, S. Geresh, Ben-Gurion University of the Negev/IL

P 47

A highly fluorinated room temperature ionic liquid exhibiting fluorinated biphasic behaviour and efficient catalyst recycling

J. van den Broeke, F. Winter, Utrecht University/NL; B.-J. Deelman, ATOFINA Vlissingen/NL; G. van Koten, Utrecht University/NL

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Asymmetric catalysis using the "Light Fluorinated" approach

E.G. Hope, A.M. Stuart, A. West, University of Leicester/UK

P 49

Polymeric catalyst in direct L-sorbose oxidation

E. Sulman, V. Matveeva, N. Lakina, Tver Technical University/RUS; L. Bronstein, Indiana University, Bloomington IN/USA; S. Sidorov, Russian Academy of Science, Moscow/RUS

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Polymerisation of phenylacetylene catalysed by RhTp(cod) and RhBp(cod) complexes in ionic liquids

A.M. Trzeciak, J.J. Ziolkowski, University of Wrocław/PL

P 51

Immobilisation of azabisoxazolines and the use in asymmetric catalysis

A. Gissibl, C. Geiger, H. Werner, M. Glos, O. Reiser, University of Regensburg/D

P 52

Enzyme catalysis in ionic liquids - investigation of water activity

M. Eckstein, U. Kragl, Rostock University/D; P. Adlercreutz, Lund University/S

P 53

Nanofiltration of solutions with ionic liquids

J. Krockel, M. Eckstein, U. Kragl, Rostock University/D

P 54

Extraction of organic sulphur compounds by ionic liquids - a novel concept for deep desulphurisation of fuels

J. Eßer, A. Jess, University of Bayreuth/D; A. Bosmann, P. Wasserscheid, RWTH Aachen/D

P 55

Biphasic Suzuki cross coupling under thermomorphic conditions with soluble polyethyleneglycol (PEG) - supported phosphines

M.R. an der Heiden, H. Plenio, Technical University of Darmstadt/D

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Catalyst recycling in sonogashira coupling using polyethyleneglycol (PEG) - tagged phosphines in liquid-liquid biphasic systems

A. Kollhofer, H. Plenio, Technical University of Darmstadt/D

P 57

Characterisation of ionic liquids by mass spectrometry

T.T. Chang, M.J. Piquette, Cytec Industries, Stamford, CT/USA; C.J. Bradaric, A. Downard, A.J. Robertson, Cytec Canada Inc., Niagara Falls/CDN

P 58

Decomposition of trifluoroacetic acid to fluoride ions by a homogeneous photocatalyst in water

H. Hori, Y. Takano, H. Einaga, National Institute of Advanced Industrial Science and Technology, Tsukuba/J

P 59

Nucleophilic displacements in supercritical carbon dioxide under phase-transfer catalysis conditions

A. Loris, M. Selva, P. Tundo, Dipartimento di Scienze Ambientali dell'Universita Ca' Foscari, Venezia/I

P 60

Supported ionic liquid phase (SILP) catalysis - applicability exemplified by Rh-catalysed hydroformylation in [BMIM][PF6]

A. Riisager, K.M. Eriksen, R. Fehrmann, Technical University of Denmark, Lyngby/DK; P. Wasserscheid, RWTH Aachen/D

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Recovery of ionic liquids from mixtures using CO₂ as a separation switch

A.M. Scurto, RWTH Aachen/D; S.N.V.K. Aki, J.F. Brennecke, University of Notre Dame, IN/USA

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Intermolecular hydroaminations in liquid-liquid two-phase catalysis

J. Bodis, Ch. Hauser, T.E. Muller, J.A. Lercher, Technical University of Munich, Garching/D

P 63

Recycling of lanthanum catalyst by ion exchange in the preparation of organic compounds

M. Lahtinen, I. Walavaara, R. Aksela, Kemira Oyj, Espoo Research Centre, Espoo/FIN, V. Tonteri, R. Jokela, Helsinki University of Technology, Espoo/FIN

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Synthesis and catalytic activity of rhodium complexes of phosphino - functionalised polyvinylalcohol

M. Ahlmann, O. Walter, Karlsruhe Research Center/D

P 65

Hydroformylation in the fluorous phase

D.J. Adams, University of Leicester/UK; D.J. Cole-Hamilton, D.F. Foster, University of St. Andrews/UK; D. Gudmunsen,

E.G. Hope, A.M. Stuart, University of Leicester/UK

P 66

Organic chemistry in high-temperature water: One-pot synthesis of benzimidazoles from aldrich to X-ray

L. Dudd, M. Poliakoff, University of Nottingham/UK

P 67

Epoxidation catalysed by chiral Mn(salen) complexes in ionic liquids: A greener and more economic process

S. Liu, K. Smith, University of Wales Swansea/UK

P 68

Catalytic function of metal oxide catalysts for biomass gasification in supercritical water

M. Watanabe, H. Ura, H. Inomata, M. Osada, T. Sato, K. Arai, Tohoku University, Sendai/J

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Metal complexes catalyzed oxidation of organic compounds in CO₂ - expanded organic solvents

B. Rajagopalan, G.T. Musie, M. Wei, B. Subramaniam, D.H. Busch, University of Kansas, Lawrence, KS/USA