



# DECHEMA

Gesellschaft für Chemische Technik  
und Biotechnologie e.V.

## ICCDU XVII

23-27 June 2019  
Aachen, Germany

From Science to Application

### PROGRAMME

23 – 27 June 2019 · Aachen · Germany

# ICCDU 2019 17<sup>th</sup> International Conference on Carbon Dioxide Utilization

[www.dechema.de/ICCDU2019](http://www.dechema.de/ICCDU2019)



Room: Brüssel		Room: K 2	
Chair: W. Leitner, RWTH Aachen/D; MPI for Chemical Energy Conversion, Mülheim/D			
08:30	PLENARY LECTURE Sustainable polymers based on CO <sub>2</sub> H. Bach <sup>1</sup> ; <sup>1</sup> Covestro Deutschland AG, Leverkusen/D	08:30	PLENARY LECTURE Sustainable polymers based on CO <sub>2</sub> H. Bach <sup>1</sup> ; <sup>1</sup> Covestro Deutschland AG, Leverkusen/D
Room: Brüssel		Room: K 2	
CO <sub>2</sub> TO CHEMICALS CO <sub>2</sub> to Hydrocarbons		CO <sub>2</sub> TO CHEMICALS CO <sub>2</sub> for organic synthesis	
Chair: E. Dinjus			
09:20	Fe-Cu Bimetallic Catalysts for CO <sub>2</sub> Hydrogenation to C <sub>2</sub> + Hydrocarbons C. Song <sup>1</sup> ; N. Borenboon <sup>2</sup> ; W. Wang <sup>3</sup> ; X. Jiang <sup>4</sup> ; X. Nie <sup>5</sup> ; G. Zhang <sup>6</sup> ; X. Guo <sup>7</sup> ; P. Prasassarakich <sup>8</sup> ; <sup>1</sup> Pennsylvania State University, University Park, Pennsylvania/USA; <sup>2</sup> Dalian University of Technology, Dalian/CN; <sup>3</sup> Chulalongkorn University, Bangkok/TH	09:20	Fe <sub>3</sub> Ni <sub>4</sub> S <sub>8</sub> Electrocatalysts: A Promising Material for the Hydrogen Evolution and CO <sub>2</sub> Reduction Reactions S. Piontek <sup>1</sup> ; M. Smlalkowski <sup>1</sup> ; K. Junge Puring <sup>2</sup> ; D. Tetzlaff <sup>2</sup> ; D. Siegmund <sup>2</sup> ; U. Apfel <sup>1</sup> ; <sup>1</sup> Ruhr-Universität Bochum, D; <sup>2</sup> Fraunhofer UMSICHT, Oberhausen/D
09:40	Utilization of captured industrial carbon dioxide for chemicals N. Heikkinen <sup>1</sup> ; N. Kaisalo <sup>2</sup> ; P. Eskelinen <sup>1</sup> ; M. Reinikainen <sup>1</sup> ; <sup>1</sup> VTT Technical Research Centre of Finland Ltd, Espoo/FIN	09:40	Study of copper/copper sulfide composites as electrochemical reduction of carbon dioxide S. Stoiljković <sup>1</sup> ; M. Najdoski <sup>2</sup> ; V. Koleva <sup>3</sup> ; M. Mayer <sup>4</sup> ; <sup>1</sup> Helmholtz Zentrum Berlin für Materialien und Energie, Berlin/D; <sup>2</sup> Institute of Chemistry, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje/MK; <sup>3</sup> Institute of General and Inorganic Chemistry, Bulgarian Academy of Sciences, Sofia/BG
10:00	Roadmap for improving zeolite-based catalysts properties for their application in CO <sub>2</sub> methanation M. C. Barcariza <sup>1</sup> ; S. Amjad <sup>1</sup> ; J. M. Lopes <sup>1</sup> ; C. Henriques <sup>1</sup> ; <sup>1</sup> Instituto Superior Técnico, Lisboa/P; <sup>2</sup> Centro de Química Estrutural, Instituto Superior Técnico, Lisboa/P	10:00	Preparation and Evaluation of Copper Gas Diffusion Electrodes for Electrochemical CO <sub>2</sub> Reduction K. Junge Puring <sup>1</sup> ; P. Derks <sup>2</sup> ; U. Apfel <sup>1</sup> ; <sup>1</sup> Fraunhofer UMSICHT/Ruhr University Bochum, Oberhausen/Bochum/D; <sup>2</sup> Fraunhofer UMSICHT, Oberhausen/D
Coffee break			
CO <sub>2</sub> TO POLYMERS		CO <sub>2</sub> TO CHEMICALS CO <sub>2</sub> for organic synthesis	
Chair: C. Gürtler, Covestro, Leverkusen/D		Chair: A. Park, Columbia University, New York/USA	
11:00	Turning CO <sub>2</sub> -containing industrial waste gases into valuable polyurethanes M. Machat <sup>1</sup> ; <sup>1</sup> Covestro Deutschland AG, Leverkusen/D	11:00	New Catalytic Approaches for CO <sub>2</sub> Valorization into Heterocycles A. Kleij <sup>1</sup> ; <sup>1</sup> The Institute of Chemical Research of Catalonia (IQIQ), Tarragona/E
11:20	Carbon dioxide: A valuable raw material for textile industry L. Norwig <sup>1</sup> ; <sup>1</sup> Covestro Deutschland AG, Leverkusen/D	11:20	Hydrogenation of CO <sub>2</sub> Catalyzed by Iridium Complexes with Proton-Responsive Ligands Y. Himeda <sup>1</sup> ; <sup>1</sup> National Institute of Advanced Industrial Science and Technology, Tsukuba/J
11:40	Fossil free polycarbonate polyols from captured carbon dioxide J. Lehtonen <sup>1</sup> ; K. Mallat <sup>2</sup> ; <sup>1</sup> VTT Technical Research Centre of Finland Ltd, Espoo/FIN; <sup>2</sup> VTT Technical Research Centre of Finland, Espoo/FIN	11:40	Reaction of CO <sub>2</sub> with aziridines M. North <sup>1</sup> ; <sup>1</sup> University of York, Green Chemistry Center of Excellence, York/UK
12:00	Upgrading CO <sub>2</sub> into novel families of regioregular and functional polymers B. Grižnarič <sup>1</sup> ; <sup>1</sup> University of Liege, Liege/B	12:00	CO <sub>2</sub> Utilization in Organic Synthesis D. Yu <sup>1</sup> ; <sup>1</sup> Sichuan University, Chengdu/CN
12:20	Copolymerization of CO <sub>2</sub> and α,ω-diols using CeO <sub>2</sub> and γ-furonitrile Y. Gu <sup>1</sup> ; <sup>1</sup> Graduate School of Engineering, Tohoku University, Sendai/J	12:20	Ag(I) catalyzed carbonylative cyclisation of propargyl alcohols to exo-vinylene carbonates C. Johnson <sup>1</sup> ; S. Dabral <sup>2</sup> ; B. Bayamagana <sup>3</sup> ; M. Hemsden <sup>4</sup> ; Y. Schiedel <sup>5</sup> ; V. Mormu <sup>6</sup> ; A. Hashmi <sup>7</sup> ; T. Schaub <sup>8</sup> ; <sup>1</sup> Catalysis Research Laboratory (CARLA), Heidelberg/D; <sup>2</sup> BASF SE, Ludwigshafen/D; <sup>3</sup> Institute of Organic Chemistry, Heidelberg University, Heidelberg/D
12:40	Metal-Free Copolymerization of CO <sub>2</sub> and Epoxides: From Super High Molar Mass Polycarbonates to Low Molar Mass Polyols X. Feng <sup>1</sup> ; <sup>1</sup> King Abdullah University of Science and Technology (KAUST), Thuwal/SAR	12:40	Selective Anti-Markovnikov Hydrocarboxylation of Olefins: Formation of all-carbon quaternary centres B. Buckley <sup>1</sup> ; <sup>1</sup> Loughborough University, Loughborough/UK
Lunch break			
CO <sub>2</sub> TO CHEMICALS CO <sub>2</sub> for organic synthesis		CO <sub>2</sub> REFORMING	
Chair: S. Müller, DEHEMA e.V., Frankfurt am Main/D		Chair: P. Sanderson, University of Sheffield, Sheffield/UK	
14:00	Carboxylation of terminal alkynes with CO <sub>2</sub> over Ag loaded ZIF-8 N. Sun <sup>1</sup> ; J. Shi <sup>1</sup> ; L. Zhang <sup>1</sup> ; Q. Shen <sup>1</sup> ; Q. Gao <sup>1</sup> ; W. Wei <sup>1</sup> ; <sup>1</sup> Shanghai Advanced Research Institute, Chinese Academy of Sciences, Shanghai/CN	14:00	Bi-reforming of methane with steam and carbon dioxide: effect of operating conditions M. Damachera <sup>1</sup> ; S. G. R. M. Badhe <sup>2</sup> ; A. Sharma <sup>3</sup> ; K. Dr. G. S <sup>4</sup> ; <sup>1</sup> Indian Oil Corporation Ltd., R&D Centre, Faridabad/IND; <sup>2</sup> IOCL R&D Centre, Faridabad/IND
14:20	Direct methyl N-phenylcarbamate synthesis from CO <sub>2</sub> , aniline and methanol using a combination catalyst of CeO <sub>2</sub> and γ-cyanopyridine M. Tamura <sup>1</sup> ; <sup>1</sup> Tohoku University, Aramaki, Aoba-ku, Sendai, Miyagi/J	14:20	Ce-enhanced Fe <sub>3</sub> O <sub>4</sub> /Al <sub>2</sub> O <sub>3</sub> for CO <sub>2</sub> utilization in chemical looping partial oxidation of methane D. Kang <sup>1</sup> ; M. Lee <sup>2</sup> ; H. Lim <sup>3</sup> ; J. Lee <sup>4</sup> ; <sup>1</sup> Korea Advanced Institute of Science and Technology (KAIST), Daejeon/ROK
14:40	Sodium Acrylate from CO <sub>2</sub> and Ethylene T. Schaub <sup>1</sup> ; <sup>1</sup> BASF SE, Ludwigshafen am Rhein/D	14:40	Advances on CO <sub>2</sub> sorption and subsequent catalytic conversion to added value products, using alkaline ceramics H. Pfeiffer <sup>1</sup> ; <sup>1</sup> Universidad Nacional Autónoma de México, Mexico City/MEX
15:00	Stereo/Regio-Divergent Synthesis with CO <sub>2</sub> C. Macquillon <sup>1</sup> ; <sup>1</sup> IQIQ, Tarragona/E	15:00	
Coffee break			
START-UP WORKSHOP, DISCUSSION		PLASMA TECHNOLOGIES FOR CO <sub>2</sub> CONVERSION	
Chair: V. Slick, University of Michigan, Michigan/USA		Chair: R. Rothman, University of Sheffield, Sheffield/UK	
15:50	V. Slick, University of Michigan, Ann Arbor/USA G. W. Quance, Solid Carbon Products, Salt Lake City/USA M. Kember, Eonic Technologies Ltd., Macclesfield/UK	15:50	Plasma and Fluidic Oscillation Assisted Electrolysis of CO <sub>2</sub> Using a Solid Oxide Cell A. Call <sup>1</sup> ; T. Holmes <sup>2</sup> ; P. Desai <sup>3</sup> ; W. Zimmerman <sup>4</sup> ; R. Rothman <sup>5</sup> ; <sup>1</sup> The University of Sheffield, Sheffield/UK; <sup>2</sup> Perlemax, Sheffield/UK
		16:10	Low-Temperature CO <sub>2</sub> Methanation: Understanding the role of Ni in plasma – catalyst synergism F. Ahmad <sup>1</sup> ; E. Lovell <sup>1</sup> ; J. Scott <sup>1</sup> ; R. Amal <sup>1</sup> ; <sup>1</sup> Particle and Catalysis Research Group, University of New South Wales, Sydney/AUS
		16:30	Integrated Membrane Separation and Non-thermal Plasma (NTP) Assisted Catalysis Process for Upgrading Biogas Y. Mu <sup>1</sup> ; H. Chen <sup>2</sup> ; X. Fan <sup>3</sup> ; C. Hardacre <sup>4</sup> ; <sup>1</sup> University of Manchester, The Mill, Manchester/UK
		16:50	Core-Shell SiO <sub>2</sub> @TiO <sub>2</sub> beads for Plasma Catalytic CO <sub>2</sub> Dissociation in a Packed bed DBD reactor P. Kaliyappan <sup>1</sup> ; K. Leyssens <sup>2</sup> ; P. Samyn <sup>3</sup> ; V. Meynen <sup>4</sup> ; A. Hardy <sup>5</sup> ; M. K. Van Bael <sup>1</sup> ; <sup>1</sup> Universiteit Hasselt/B; <sup>2</sup> University of Antwerp/B
		17:10	CO <sub>2</sub> activation by Cu/γ-Al <sub>2</sub> O <sub>3</sub> promoted DBD plasma D. Ray <sup>1</sup> ; S. Ch <sup>2</sup> ; <sup>1</sup> Indian Institute of Technology Hyderabad, Sangareddy/IND
CONFERENCE DINNER (19:30 – 23:00) Saal Europa			

Room: Brüssel		Room: K 4	
Chair: W. Leitner, RWTH Aachen/D; MPI for Chemical Energy Conversion, Mülheim/D			
08:30	PLENARY LECTURE Sustainable polymers based on CO <sub>2</sub> H. Bach <sup>1</sup> ; <sup>1</sup> Covestro Deutschland AG, Leverkusen/D	08:30	PLENARY LECTURE Sustainable polymers based on CO <sub>2</sub> H. Bach <sup>1</sup> ; <sup>1</sup> Covestro Deutschland AG, Leverkusen/D
Room: K 3		Room: K 4	
ELECTROCATALYSIS		LCA/TEA	
Chair: E. Gyenge, Agora Energy Technologies Ltd., Vancouver/CDN		Chair: K. Armstrong, The University of Sheffield, Sheffield/UK	
09:20	Fe <sub>3</sub> Ni <sub>4</sub> S <sub>8</sub> Electrocatalysts: A Promising Material for the Hydrogen Evolution and CO <sub>2</sub> Reduction Reactions S. Piontek <sup>1</sup> ; M. Smlalkowski <sup>1</sup> ; K. Junge Puring <sup>2</sup> ; D. Tetzlaff <sup>2</sup> ; D. Siegmund <sup>2</sup> ; U. Apfel <sup>1</sup> ; <sup>1</sup> Ruhr-Universität Bochum, D; <sup>2</sup> Fraunhofer UMSICHT, Oberhausen/D	09:20	Carbon Chem® Co-simulation framework as a tool for CCU technology assessments T. Wich <sup>1</sup> ; H. Wagner <sup>2</sup> ; M. Oles <sup>3</sup> ; A. Diekmann <sup>4</sup> ; J. Grundler <sup>5</sup> ; G. Deenberg <sup>6</sup> ; <sup>1</sup> thyssenkrupp AG/Ruhr-Universität Bochum, Essen/D; <sup>2</sup> thyssenkrupp AG TCCT, München/D; <sup>3</sup> thyssenkrupp AG, Essen/D; <sup>4</sup> Fraunhofer UMSICHT/Ruhr-Universität Bochum, Oberhausen/D
09:40	Study of copper/copper sulfide composites as electrochemical reduction of carbon dioxide S. Stoiljković <sup>1</sup> ; M. Najdoski <sup>2</sup> ; V. Koleva <sup>3</sup> ; M. Mayer <sup>4</sup> ; <sup>1</sup> Helmholtz Zentrum Berlin für Materialien und Energie, Berlin/D; <sup>2</sup> Institute of Chemistry, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje/MK; <sup>3</sup> Institute of General and Inorganic Chemistry, Bulgarian Academy of Sciences, Sofia/BG	09:40	Environmentally optimal conversion pathways for gaseous carbon waste streams from steel mills L. Kleinekorte <sup>1</sup> ; A. Kaloudian <sup>2</sup> ; A. Bardow <sup>3</sup> ; <sup>1</sup> Institute of Technical Thermodynamics, RWTH Aachen University, Aachen/D; <sup>2</sup> Institute of Technical Thermodynamics, RWTH Aachen University & Institute of Energy and Climate Research – Energy Systems Engineering (IEK-10), Forschungszentrum Jülich GmbH, Aachen/ Jülich/D
10:00	Preparation and Evaluation of Copper Gas Diffusion Electrodes for Electrochemical CO <sub>2</sub> Reduction K. Junge Puring <sup>1</sup> ; P. Derks <sup>2</sup> ; U. Apfel <sup>1</sup> ; <sup>1</sup> Fraunhofer UMSICHT/Ruhr University Bochum, Oberhausen/Bochum/D; <sup>2</sup> Fraunhofer UMSICHT, Oberhausen/D	10:00	Environmental impacts analysis of typical methanol production routes by life cycle analysis Q. Shen <sup>1</sup> ; <sup>1</sup> Shanghai/CN
Coffee break			
CATALYSIS		LCA/TEA	
Chair: R. Heyn, Sintef Industry, Oslo/N		Chair: A. Bardow, RWTH Aachen/D	
11:00	Manganese(II) Hydroxycarbonyl Catalysts for Homogeneous CO <sub>2</sub> Reduction to Formate and Methanol Under Mild Conditions J. Gonsabli <sup>1</sup> ; E. Bertini <sup>1</sup> ; M. Peruzzini <sup>1</sup> ; M. Glatz <sup>2</sup> ; N. Gorgas <sup>3</sup> ; B. Stoeger <sup>4</sup> ; K. Kirchner <sup>5</sup> ; L. Veins <sup>6</sup> ; <sup>1</sup> Consiglio Nazionale delle Ricerche - Istituto di Chimica dei Composti Organometallici (ICCOM-CNR), Sesto Fiorentino/I; <sup>2</sup> TU Wien/A; <sup>3</sup> IST-University of Lisbon/P	11:00	The cost of OME <sub>n</sub> e-fuels from CO <sub>2</sub> and electricity, a comparative TEA A. Zimmermann <sup>1</sup> ; E. Genzer <sup>2</sup> ; F. O'Sullivan <sup>3</sup> ; R. Schomäcker <sup>4</sup> ; <sup>1</sup> TU Berlin, Berlin/D; <sup>2</sup> MIT, Cambridge/USA
11:20	Hydrogenation of CO <sub>2</sub> Catalyzed by Iridium Complexes with Proton-Responsive Ligands Y. Himeda <sup>1</sup> ; <sup>1</sup> National Institute of Advanced Industrial Science and Technology, Tsukuba/J	11:20	Techno-economic analysis of renewable jet fuel through co-valorisation of CO <sub>2</sub> and wood pellets B. Kolosz <sup>1</sup> ; B. Xu <sup>1</sup> ; S. Ahmad <sup>2</sup> ; M. Maroto-Valer <sup>3</sup> ; J. Andresen <sup>4</sup> ; <sup>1</sup> Heriot-Watt University, Edinburgh/UK
11:40	RWGS over In <sub>2</sub> O <sub>3</sub> with different crystal phases and the phase transition under reaction conditions J. Wang <sup>1</sup> ; G. Zhang <sup>2</sup> ; C. Song <sup>3</sup> ; X. Guo <sup>4</sup> ; <sup>1</sup> Dalian University of Technology, Dalian/CN; <sup>2</sup> Pennsylvania State University, University Park/USA	11:40	Comparative cross-sectoral life-cycle cost and value chain analysis of production, use and recycling of CO <sub>2</sub> based products S. Turnau <sup>1</sup> ; S. Brinzeu <sup>2</sup> ; <sup>1</sup> University of Kassel/D
12:00	The structural dynamics of supported vanadia catalysts: a comparative study of CO <sub>2</sub> and O <sub>2</sub> during propane ODH by using operando IV Raman spectroscopy S. Rogg <sup>1</sup> ; M. Mathes <sup>2</sup> ; C. Hess <sup>3</sup> ; <sup>1</sup> Eduard-Zintl-Institut, TU Darmstadt, Darmstadt/D	12:00	Integrating LCA and TEA for analysis of CCU processes K. Armstrong <sup>1</sup> ; L. Wunderlich <sup>2</sup> ; P. Styring <sup>3</sup> ; <sup>1</sup> The University of Sheffield/UK; <sup>2</sup> TU Berlin/D
12:20	Low Alkane Oxidation of CO <sub>2</sub> as Soft Oxidant S. Park <sup>1</sup> ; <sup>1</sup> Inha University, Incheon/ROK	12:20	Direct conversion of carbon dioxide to liquid fuels and synthetic natural gas using renewable power: Techno-economic analysis C. Zhang <sup>1</sup> ; K. Jun <sup>2</sup> ; S. Kim <sup>3</sup> ; S. Hwang <sup>4</sup> ; H. Park <sup>5</sup> ; <sup>1</sup> Korea Research Institute of Chemical Technology, Daejeon/ROK
12:40	Interconversion between CO <sub>2</sub> and HCOOH catalyzed by PdAu nanoparticles supported by graphene oxide under high-pressure conditions H. Kawanami <sup>1</sup> ; <sup>1</sup> National Institute of Advanced Industrial Science and Technology, Sendai, Miyagi/J	12:40	Practical use of the Global CO <sub>2</sub> Initiative TEA and LCA Guidelines for CO <sub>2</sub> Utilization: Mineralization of CO <sub>2</sub> Worked Example S. McCord <sup>1</sup> ; A. Villa Zaragoza <sup>2</sup> ; P. Sanderson <sup>3</sup> ; K. Armstrong <sup>4</sup> ; P. Styring <sup>5</sup> ; <sup>1</sup> University of Sheffield/UK
Lunch break			
BIOTECHNOLOGICAL CO <sub>2</sub> -CONVERSION		LCA	
Chair: H. de Wever, Flemish Institute for Technological Research (VITO), Mol/B		Chair: B. Offe-Krüdtlein, Institute for Advanced Sustainability Studies, Potsdam/D	
14:00	Enzymatic CO <sub>2</sub> reduction to formate: towards a biocatalyst for the use of the abundant atmospheric CO <sub>2</sub> L. Maia <sup>1</sup> ; J. Moura <sup>2</sup> ; <sup>1</sup> LAQV REQUIMTE, FCT NOVA, Portugal, Caparica/P	14:00	A world made from CO <sub>2</sub> ? A life-cycle perspective on the potential of carbon capture and utilization A. Bardow <sup>1</sup> ; <sup>1</sup> RWTH Aachen University, Aachen/D
14:20	Continuous Syngas Fermentation at Elevated Pressure L. Stoll <sup>1</sup> ; N. Boukis <sup>2</sup> ; J. Sauer <sup>3</sup> ; <sup>1</sup> Karlsruhe Institute of Technology (KIT), Institute of Catalysis Research and Technology (IKFT), Eggenstein-Leopoldshafen/D	14:20	
14:40	Using a thermocatalytic cathodic biofilm to drive waste gas driven polyhydroxyalkanoate production T. Lung <sup>1</sup> ; J. Reiner <sup>2</sup> ; M. Hackbarth <sup>3</sup> ; M. Fink <sup>4</sup> ; C. Lapp <sup>5</sup> ; H. Horn <sup>6</sup> ; S. Kerzenmacher <sup>7</sup> ; J. Gescher <sup>8</sup> ; <sup>1</sup> Department of Applied Biology, Karlsruhe Institute of Technology (KIT), Karlsruhe/D; <sup>2</sup> Engler-Bunte-Institut, Karlsruhe Institute of Technology (KIT), Karlsruhe/D; <sup>3</sup> Center for Environmental Research and Sustainable Technology (UFT), University of Bremen/D	14:40	LCA of CCU-Chain Demonstration in the ALIGN-CCUS project – Poly(oxyethylene) Dimethyl Ethers from H <sub>2</sub> and CO <sub>2</sub> S. Troy <sup>1</sup> ; P. Zapp <sup>2</sup> ; P. Moser <sup>3</sup> ; G. Wiechers <sup>4</sup> ; M. Majid <sup>5</sup> ; A. Heberle <sup>6</sup> ; H. Kakihira <sup>7</sup> ; M. Maruyama <sup>8</sup> ; R. Peters <sup>9</sup> ; S. Weiske <sup>10</sup> ; B. Lechner <sup>11</sup> ; M. Neumann <sup>12</sup> ; T. Schornobus <sup>13</sup> ; E. Gotheer <sup>14</sup> ; <sup>1</sup> Forschungszentrum Jülich/D; <sup>2</sup> RWE Power AG, Essen/D; <sup>3</sup> Mitsubishi Hitachi Power Systems Europe GmbH, Duisburg/D; <sup>4</sup> Asahi Kasei Europe GmbH, Düsseldorf/D; <sup>5</sup> VKA, RWTH Aachen University, Aachen/D; <sup>6</sup> FEV Europe GmbH, Aachen/D; <sup>7</sup> TNO, Delft/NL
15:00	Converting CO <sub>2</sub> to Fuels and Chemicals with Microbial electrosynthesis (MES) E. Yu <sup>1</sup> ; P. Izadi <sup>2</sup> ; <sup>1</sup> Newcastle University, Newcastle upon Tyne/UK	15:00	Life Cycle Assessment of a commercial scale CO <sub>2</sub> – Direct Air Capture Plant A. Lozanovsky <sup>1</sup> ; M. Held <sup>2</sup> ; T. Betten <sup>3</sup> ; <sup>1</sup> University of Stuttgart/D; <sup>2</sup> Fraunhofer Institute for Building Physics, Stuttgart/D
Coffee break			
CO <sub>2</sub> TO CHEMICALS CO <sub>2</sub> to methanol			
Chair: T. E. Müller, Ruhr-Universität Bochum, Bochum/D			
15:50	Mesoporous Indium Oxide as a Superior Catalyst for Methanol Synthesis by CO <sub>2</sub> Hydrogenation J. Wang <sup>1</sup> ; <sup>1</sup> Dalian University of Technology, Dalian/CN	15:50	
16:10	Electron-Mediated Photonic Synergism in Industrial Cu/ZnO/Al <sub>2</sub> O <sub>3</sub> Catalyst for Enhanced Methanol Production B. Xie <sup>1</sup> ; R. Wong <sup>2</sup> ; T. Tan <sup>3</sup> ; J. Scott <sup>4</sup> ; A. Aguey-Zinsou <sup>5</sup> ; R. Amal <sup>6</sup> ; <sup>1</sup> University of New South Wales, Sydney/AUS; <sup>2</sup> Kyushu University, Sinsu/AUS	16:10	
16:30	ZnO/Cu core-shell nanoparticles for CO <sub>2</sub> hydrogenation N. Podrobniková <sup>1</sup> ; A. Oriňák <sup>2</sup> ; R. Oriňáková <sup>3</sup> ; <sup>1</sup> Pavol Jozef Safárik University in Košice/SK	16:30	
16:50	CO <sub>2</sub> plasma-catalytic process for methanol synthesis from CO <sub>2</sub> hydrogenation at room temperature and ambient pressure L. Wang <sup>1</sup> ; Y. Wang <sup>2</sup> ; X. Liu <sup>3</sup> ; <sup>1</sup> University of Liverpool/UK	16:50	
17:10	Recent Advances in CO <sub>2</sub> Hydrogenation to Methanol on In <sub>2</sub> O <sub>3</sub> Supported Catalysts C. Liu <sup>1</sup> ; <sup>1</sup> Tianjin University, Tianjin/CN	17:10	
CONFERENCE DINNER (19:30 – 23:00) Saal Europa			