

## SYMPOSIUM

# Research and Innovation in Energy Efficient and Energy Storage Technologies in an Era of the Fourth Industrial Revolution

14–15 October 2019

Venue: Dalian Institute of Chemical Physics, CAS, China

### Programme

#### DAY 1 | 14 October 2019

08:00–08:30	Arrival and Registration
<b>SESSION 1   Welcoming and Opening Address</b>	
<b>Moderation: Prof Dr LI Xianfeng</b> · Dalian Institute of Chemical Physics, CAS, China	
<b>08:30–09:00</b>	<b>WELCOME REMARKS</b> Prof Dr CAI Rui · Deputy Director General, Dalian Institute of Chemical Physics, CAS, China Dr Jan NISSEN · on behalf of Leopoldina President Prof Dr Jörg HACKER Dr Siyavuya BULANI · on behalf of ASSAf
	<b>KEYNOTE ADDRESSES</b>
<b>09:00–09:30</b>	<i>Energy Efficiency Landscape in South Africa</i> <b>Dr Peter Mukoma</b> · Council for Scientific and Industrial Research, South Africa
<b>09:30–10:00</b>	<i>The State of Research, Development and Innovation of Energy Efficiency Technologies in South Africa</i> <b>Prof Dr XIA Xiaohua</b> · Group Head: Energy Systems, University of Pretoria, South Africa
<b>10:00–10:30</b>	<i>China's Energy Revolution: Challenges and Opportunities</i> <b>Prof Dr CAI Rui</b> · Deputy Director General, Dalian Institute of Chemical Physics, CAS, China
<b>10:30–11:00</b>	<b>PANEL DISCUSSION</b> · all speakers
<b>11:00–11:30</b>	Coffee Break

## SESSION 2 | Energy Efficiency in the Building Sector

**Moderation: Dr Peter MUKOMA** · Council for Scientific and Industrial Research, South Africa

11:30–11:50	<b><i>A New Emerging Energy Storage Technology</i></b> <b>Prof Dr HU Yongsheng</b> · Institute of Physics, CAS, China
11:50–12:10	<b><i>Pathway to Smart City Platforms for Energy Efficiency and Renewable Energy Transitions for African Cities</i></b> <b>Prof Dr Daniel IRURAH</b> · School of Architecture and Planning, University of the Witwatersrand, South Africa
12:10–12:30	<b><i>Development of Energy Efficiency in the Building Sector in Germany and its Contribution towards a Carbon Neutral Building Stock</i></b> <b>Prof Dr Gunnar GRÜN</b> · Deputy Head of Institute & Head of Department, Department Energy Efficiency and Indoor Climate (EER), Fraunhofer Institute for Building Physics IBP, Valley, Germany
12:30–13:00	<b>PANEL DISCUSSION</b> · all speakers
13:00–14:00	Lunch Break

## SESSION 3 | Energy Efficiency in the Industrial Sector

**Moderation: Prof Dr YU Yan** · University of Science and Technology China, China

14:00–14:20	<b><i>Efficiency and Effectiveness of Renewable Energy in a New Energy System of a Low Carbon Economy</i></b> <b>Dr Ludger ELTROP</b> · Visiting Professor at the University of Johannesburg (South Africa); Department Head at the Department System Analysis and Renewable Energies (SEE), University of Stuttgart, Stuttgart, Germany
14:20–14:40	<b><i>Research Progress of Spray-Type Packed Bed Thermal Energy Technology</i></b> <b>Prof Dr WANG Liang</b> · Institute of Engineering Thermophysics, CAS, China
14:40–15:00	<b><i>Energy Efficiency and Energy Flexibility in the Industrial Sector</i></b> <b>Prof Dr Natasha SACKS</b> · Head, Department of Industrial Engineering, Stellenbosch University, South Africa
15:00–15:30	<b>PANEL DISCUSSION</b> · all speakers
15:30–16:00	<b>WRAP-UP OF DAY 1</b> <b>Dr Peter Mukoma</b> · Council for Scientific and Industrial Research, South Africa <b>Prof Dr LI Xianfeng</b> · Dalian Institute of Chemical Physics, CAS, China <b>Prof Dr Anke WEIDLICH</b> · Chair for Control and Integration of Grids, Department of Sustainable Systems Engineering - INATECH, University of Freiburg, Freiburg, Germany

## DAY 2 | 15 October 2019

08:30–09:00	Arrival and Registration
<b>SESSION 4   Energy Efficiency in the Transport Sector</b> <b>Moderation: Dr Ludger ELTROP</b> · Visiting Professor at the University of Johannesburg (South Africa); Department Head at the Department System Analysis and Renewable Energies (SEE), University of Stuttgart, Stuttgart, Germany	
09:00–09:20	<b><i>Sustainable Technology for Lithium-Ion Batteries</i></b> <b>Prof Dr CHENG Yajun</b> · Ningbo Institute of Materials Technology & Engineering, CAS, China
09:20–09:40	<b><i>Energy Efficiency in the Transport Sector, an Overview of Scenarios and Exemplary Technologies</i></b> <b>Dr Frank RINDERKNECHT</b> · Head of Research Field Alternative Energy Converters, Institute of Vehicle Concepts, German Aerospace Center (DLR), Stuttgart, Germany
09:40–10:00	<b><i>Energy Efficient Hybrid Battery Energy Storage Systems for the Transport Sector</i></b> <b>Prof Dr Daniel CHOWDHURY</b> · Electrical Engineering Department, Tshwane University of Technology, South Africa
10:00–10:30	<b>PANEL DISCUSSION</b> · all speakers
10:30–10:50	Coffee Break
<b>SESSION 5   Distributed Energy Resources (DERs)</b> <b>Moderation: Prof Dr CHENG Yajun</b> · Ningbo Institute of Materials Technology & Engineering, CAS, China	
10:50–11:10	<b><i>Na(K)-ion Battery Anode Materials Operating through the Alloying–Dealloying Reaction Mechanism</i></b> <b>Prof Dr YU Yan</b> · University of Science and Technology of China, China
11:10–11:30	<b><i>Flow battery for stationary energy storage</i></b> <b>Prof Dr LI Xianfeng</b> · Dalian Institute of Chemical Physics, CAS, China
11:30–11:50	<b><i>Energy Storage Landscape in South Africa and the Rest of Africa</i></b> <b>Prof Dr Kenneth OZOEMENA</b> · Professor of Materials for Energy & Electrochemistry, School of Chemistry, University of the Witwatersrand, South Africa
11:50–12:10	<b><i>Evaluating Operational Flexibility within Cells in Cellular Energy Systems for Optimized Demand and Supply Matching for High Shares of Renewable Generation</i></b> <b>Prof Dr Anke WEIDLICH</b> · Chair for Control and Integration of Grids, Department of Sustainable Systems Engineering - INATECH, University of Freiburg, Freiburg, Germany
12:10–12:40	<b>PANEL DISCUSSION</b> · all speakers
12:40–13:10	<b>WRAP-UP OF DAY 2</b> <b>Dr Peter Mukoma</b> · Council for Scientific and Industrial Research, South Africa <b>Prof Dr LI Xianfeng</b> · Dalian Institute of Chemical Physics, CAS, China <b>Prof Dr Anke WEIDLICH</b> · Chair for Control and Integration of Grids, Department of Sustainable Systems Engineering - INATECH, University of Freiburg, Freiburg, Germany
13:10–14:00	Lunch Break



DALIAN INSTITUTE OF CHEMICAL PHYSICS,  
CHINESE ACADEMY OF SCIENCES



Leopoldina  
Nationale Akademie  
der Wissenschaften

END OF PUBLIC SYMPOSIUM
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#### ACADEMY CONTACT & REGISTRATION:

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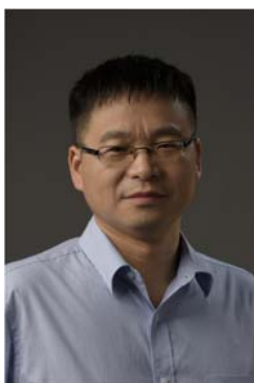
## BIOGRAPHIES (in alphabetical order)



**Dr Siyavuya BULANI** is the Senior Liaison Officer at ASSAf and oversees the Academy's Overseas Collaborations sub-programme. He is responsible for the academy's bilateral agreements with other overseas academies of science and builds new and maintains existing overseas partnerships. Siyavuya previously worked at the CSIR and the Agricultural Research Council (ARC) as a researcher. He holds a PhD in Biotechnology from the University of the Free State.



**Prof Dr CAI Rui** is the Deputy Director of Dalian Institute of Chemical Physics (DICP) & Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences(CAS) since 2017 with the administrative duties on Intellectual property, technology transfer and commercialization, International cooperation and communication, etc. He previously held position as director of science and technology department and assistant director of DICP. He is engaged in a number of national, regional or industrial research, strategic planning and consulting programs in Energy and Chemical Industry, and was awarded the First Prize of Outstanding Achievement in Soft Sciences Research by National Energy Administration of China.



**Prof Dr CHENG Yajun** is a professor at Ningbo Institute of Materials Technology & Engineering, Chinese Academy of Sciences. He received the bachelor degree from Peking University, the master from Siegen University, Germany, and the Ph.D. from the Max-Planck Institute for Polymer Research/Johannes-Gutenberg University am Mainz, Germany. He spent three years as a guest researcher in the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, USA, after Ph.D. He joined the Ningbo Institute of Materials Technology & Engineering, CAS, as an associate professor in 2010. From 2015 to 2017, he worked as a Marie Skłodowska-Curie Fellow at the department of Materials at the University of Oxford, UK, sponsored by the EU. His research interests focus on polymer/inorganic nanohybrid for energy applications. So far he has published more than sixty peer-reviewed papers in top journals including Adv. Mater., Adv. Funct. Mater., Angew. Chemie. Int. Ed., JACS, ACS Nano, Nano Energy, and Chem. Soc. Rev.



**Prof Dr SP Daniel CHOWDHURY** (M'02-SM'11, PhD (Eng), CEng, FIET, FIE, FIETE, SMIEEE, FSAIEE) is presently with the Electrical Engineering Department, Tshwane University of Technology. He has been

in the profession of electrical engineering for more than three decades. He has graduated 10 Doctoral, 45 Masters, 57 Graduate students from Jadavpur University, Calcutta, University of Cape Town, Cape Town and Tshwane University of Technology, Pretoria with more than 10 current PG students. Prof SP Daniel Chowdhury has over 30 years of academic experience in teaching and research in Electrical Engineering. He is an NRF C1-rated scientist in South Africa and published more than 385 research papers in peer reviewed international journals and conferences. He has also co-authored the research book "Microgrids and Active Distribution Networks", which is published by The IET(UK) in 2009 and currently

enjoys a citation count of 902. In addition, he has co-authored two textbooks in software applications in electrical engineering, and microprocessors respectively. In terms of research publications, he has a citation count of more than four thousand and seven hundred, h-index of 27 and i10-index of 85 in Google Citations. He has successfully conducted and completed research projects in the area of energy research worth more than 2.5M Rupees in India, more than 14M ZAR in South Africa. He is presently directing his research and project works to alleviate energy poverty in Africa through smart microgrids.



**Prof Dr Ludger ELTROP** is an environmental and systems engineer with a Diploma and PhD in natural science. He is head of the department "Systems Analysis and Renewable Energy" at the Institute of Energy Economics and Rational Energy Use at the University of Stuttgart and a Visiting Professor at the University of Johannesburg (South Africa). He is teaching and carrying out research in energy technology and energy economics with a special focus on renewable energy. His specific field of expertise lies in the systemic and integrated analysis of renewable energy, with a focus in bioenergy and solar energy. For many years, his research interest also lies in the integration of renewable energy in the city environment. Since 1994, he is engaged in a large number of consulting and research projects in Germany, Europe and developing and transition countries worldwide. Among others, he was project manager of the EnerKey project in South Africa on Sustainable energy systems in the

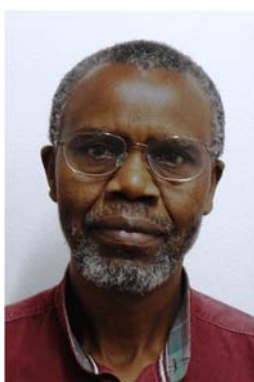
Megacity region of Gauteng and the SolarMining project in Chile on the options of using renewable energy for copper and lithium mining.



**Prof Dr Gunnar GRÜN** graduated in civil engineering (Dipl.-Ing.) at University of Stuttgart, Germany, where he also performed his PhD (Dr.-Ing.) in cooperation with the Fraunhofer Institute for Building Physics IBP. He joined Fraunhofer IBP in 2005 as researcher and established a research group on indoor climate systems in 2009. In 2011, he became head of the department for indoor climate. During 2015–2019, he was professor for system integration of energy efficient buildings at the Technische Hochschule Nürnberg Georg Simon Ohm, Germany. He currently is deputy director of Fraunhofer IBP, head of the department of energy efficiency and indoor climate at Fraunhofer IBP and professor for building physics at University of Stuttgart. His research area spreads from system integration of energy efficient buildings to comfortable indoor environments with a speciality on indoor comfort.



**Prof Dr HU Yong-Sheng** is a full professor at the Institute of Physics, Chinese Academy of Sciences. He is working on advanced materials for long-life stationary batteries and their energy storage mechanism, particularly focusing on Na based batteries. He has published over 200 internationally refereed SCI publications including Nature Mater., Nature Energy, Joule, Nature Commun., Science Adv., Adv. Mater., etc, which have been cited over 20000 times according to ISI web of science with an H-index of 70. He was selected as a Thomson Reuters Highly Cited Researchers in the field of Materials Science from 2014 to 2018. He became the senior Editor of ACS Energy Letters from October of 2018. He also received several awards and honors, such as The National Science Fund for Distinguished Young Scholars, The 14th China Youth Science and Technology Award, Tajima Prize, Fellow of The Institute of Physics (UK), Fellow of The Royal Society of Chemistry, etc.



**Prof Dr Daniel IRURAH** serves as an Associate Professor in Smart-Sustainable Architecture & Cities, School of Architecture & Planning at The University of the Witwatersrand, where he supervises masters and PhD studies in Sustainable Architecture & Cities. He holds a BArch (with Hons, University of Nairobi, 1985), MArch and MUP (University of Oregon, 1991) and PhD (University of Pretoria, 1997). His PhD study focused on application of the input-output model in analysis of embodied energy of construction materials and buildings in South Africa. His MArch study focused on climatic response, energy conservation and renewable energy for buildings within inter-tropical regions. His MUP study focused on energy and environmental policy analysis/planning for cities. He is a registered Architect in Kenya and South Africa and previously served as a Member of the Board of Directors of the Green Building Council of South Africa (GBCSA) where he chaired the Education Sub-Committee of the Board. In 2017, Daniel was nominated as a Mind & Life Fellow of the Mind & Life Institute in USA.



**Prof Dr LI Xianfeng** is Assistant Director General of the Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China. LI Xianfeng received a doctoral degree from Jilin University in 2006, after 3 years' postdoc in K. U. Leuven University, he was appointed as associated professor in Dalian Institute of Chemical Physics (DICP), Chinese Academy of Science. In 2012, he was promoted as full professor. He currently serves as the head of Energy Storage Division at DICP. His research interest mainly focused on electrochemical energy storage, eg. Flow battery, lithium ion battery etc. Up to now, Dr. Li has authored more than 200 peer-reviewed papers with more than 7000 citations. Additionally, he has applied for over 200 patents, and more than 60 patents have been granted. At present, he serves as the editorial board member of "Science Bulletin", "Sustainable Energy & Fuels" (RSC), "Journal of Energy Chemistry" (Elsevier), "Scientific Reports" (Nature publishing Group) and "Sustainability".

**Dr Peter Mukoma**, Council for Scientific and Industrial Research, South Africa



**Dr Jan NISSEN** is Senior Officer at the International Relations Department of the German National Academy of Sciences Leopoldina. He coordinates bilateral academy projects with partners in Africa, South America and Israel. Jan Nissen studied political science, economic policy and public administration at the University of Muenster and Hertie School of Governance, Germany. He holds a PhD in political sciences as well.



**Prof Dr Kenneth OZOEMENA** is Professor of Materials for Energy & Electrochemistry at the University of the Witwatersrand (Wits University), South Africa. Prior to joining Wits University in 2017, he had worked at the Council for Scientific and Industrial Research (CSIR) as Chief Research Scientist and Research Group Leader of the CSIR Electrochemical Energy Technologies (2009 - 2017). His current research interests are focussed on energy storage and conversion systems (such as lithium-ion batteries, electrochemical capacitors, and fuel cells). He holds a PhD degree (Rhodes University, 2003) in Chemistry. He is a Certified Renewable Energy Professional (CREP, Association of Energy Engineers, USA), member of the Academy of Science of South Africa (MASSAf), Fellow of the African Academy of Science (FAAS), and Fellow of the Royal Society of Chemistry (FRSC). He serves on the editorial Boards of some science journals, including *Electrochemistry Communications* (Elsevier), *Current Opinions in Electrochemistry* (Elsevier) and *Scientific Reports* (Nature Publishing). He is the Chief Editor, *International Journal of Electrochemistry* (open access journal, Hindawi Publishing).



**Dr Frank RINDERKNECHT** studied electrical engineering with the focus on electrical machines at the University of Stuttgart and received his diploma in 2002. He started his career in 2002 at the German Aerospace Center (DLR), Institute of Vehicle Concepts. F. Rinderknecht is a consultant on various projects in the field of electrical drive and storage systems. He led the Energy Converter team from January 2010 onwards and evolved it into the division for Alternative Energy Converter. In 2011, Frank Rinderknecht began to coordinate the drive train activities in the DLR. He also coordinated in a small core team all electromobility activities in the DLR from 2011 to 2013. He was graduated in 2012 (Dr.-Ing.) with a thesis on the topic development of an innovative linear generator for hybrid vehicles. He is the scientific leader of the VDI Conference of Waste Heat Recovery for Vehicles. Since 2017, he is mentor in the DLR Mentoring Program, which is the DLR elite program for scientists who start their leadership career. His main research interests are in the field of energy converters like electrical drives, power electronics, waste heart recovery systems, range extenders, serial hybrids and thermal high power storages.





**Prof Dr Natasha SACKS** recently joined the Department of Industrial Engineering at Stellenbosch University in South Africa where her research focus includes advanced manufacturing. Prior to joining Stellenbosch she was an Associate Professor in Metallurgical and Materials Engineering at the University of the Witwatersrand in South Africa, where she began her academic career as a lecturer in 2004. Prof Sacks is the focus area coordinator of the Carbides and Cermets research group within the DST-NRF Centre of Excellence in Strong Materials, a member of the South African Institute of Mining and Metallurgy, and the South African Institute of Tribology. She serves on the editorial board of the International Journal of Refractory Metals and Hard Materials and has served on the scientific committees of several international materials conferences. Sacks holds a bachelors and masters degree in materials engineering from the University of Cape Town in South Africa and a doctorate in engineering from the Friedrich Alexander University based in Erlangen, Germany.



**Prof Dr WANG Liang**, BEng PhD, is currently a professor with Institute of Engineering Thermophysics (IET) at Chinese Academy of Sciences (CAS), a member of Youth Promotion Association of CAS. He received his Bachelor degree and his Doctor degree from Beihang University in 2002 and 2009. In 2011, he joined IET-CAS, mainly worked on experimental aspects and numerical simulations of the large-scale cold storage/heat storage and heat transfer. He has been involved with over 30 research projects with 10 of which being the principal investigator including the China National Natural Science Foundation, 863 program and 973 program et al. In recent years, the applicant has published more than 50 papers, including nearly 40 SCI journal papers in “Applied Thermal Engineering”, “Energy”, “International Journal of Heat and Mass Transfer” etc., and has obtained more than 40 authorized patents.



**Prof Dr Anke WEIDLICH** is a professor for Control and Integration of Grids at the University of Freiburg, Department of Sustainable Systems Engineering (INATECH). Before, she was a professor for Energy Economics and Energy Systems Technology at the University of Applied Sciences in Offenburg from 2011 until 2017. In parallel during 2011 – 2012, she was a fellow of the Berlin-based think tank stiftung neue verantwortung and, in this position, conducted a multi-stakeholder research project on Smart Grids. Ms. Weidlich gained industry experience as a senior researcher and project leader in the domain of Smart Grids at the large German software company SAP. She studied Industrial Engineering and Business and then pursued advanced studies in Energy Economics and Energy Policy in Paris. Her PhD studies were conducted at the University of Karlsruhe, with research stays in the U.S. and in Mannheim. She was awarded several scholarships for her studies and for a research stay abroad.

In her research, Prof. Weidlich focuses on the evaluation of operational flexibility in highly renewable energy systems, the interplay between electricity grids and electricity markets, and on sustainability assessment of energy systems. In this context, she and her team develop simulation models in the framework of several third-party funded research projects. Her work has been published in journals such as Applied Energy, Energy Economics, or Energy Policy.



**Prof Dr Xiaohua XIA** is a professor in the Electrical, Electronic and Computer Engineering Department, University of Pretoria, director of the Centre of New Energy Systems, and the director of the National Hub for the Postgraduate Programme in Energy Efficiency and Demand-side Management. He obtained his PhD degree at the Beijing University of Aeronautics and Astronautics in 1989. He was academically affiliated with the University of Stuttgart, Germany, the Ecole Centrale de Nantes, France, and the National University of Singapore before joining the University of Pretoria in 1998. He is an IEEE fellow and an NRF A-rated scientist. He was elected a fellow of the South African Academy of Engineering in 2005, and a member of the Academy of Science of South Africa (ASSAf) in 2011. He is a registered professional engineering by the Engineering Council of South Africa, and a certified measurement and verification professional by the American Association of Energy Engineers. He is an elected board member of measurement and verification council of South Africa (MVCSA) since 2014. He is the founding director of Onga Energy Efficiency and Management Pty Ltd - the first SANAS accredited M&V Company against ISO 17020 and he is a technical assessor for the South African National Accreditation Systems (SANAS) for M&V inspection bodies in South Africa. He has been a scientific advisor to two ministers of the South African government – the Department of Energy and the Department of Science and Technology, and he has also been an advisor to Chinese State Council Overseas Office as a member of the Scientific Committee. His current research interests are energy systems modelling, optimisation and standardisation.



**Prof Dr YU Yan** is a Professor of material science in University of Science and Technology of China (USTC). Her current research interests mainly include design of novel nanomaterials for clean energy, especially for batteries and the fundamental science of energy storage system. She has published more than 200 articles in tier 1 journals. As the first author or corresponding authors, her key publications include Adv. Mater. x26, Angew. Chem. Int. Ed. x5, Nano Lett. x7, Energy & Environmental Science x1, J. Am. Chem. Soc. x1, ACS Nano x5, Adv. Funct. Mater. x5, Adv. Energy Mater. x8. These papers have been cited nearly 8000 times, and 30 articles are marked as “ESI Highly Cited Articles”. Her H-index is 58. She won some awards, including Sofja Kovalevskaja Award from Alexander von Humboldt Foundation, Young Scientist award of the Ceramic Society of China, Young Scientist award of The Chemical Industry and Engineering Society of China; Wiley “Outstanding Young Researcher”, Wiley “Small Young Innovators” etc.