

## Curriculum Vitae

## IB CHORKENDORFF

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**ResearcherID** [C-7282-2008](https://orcid.org/0000-0003-2738-0325) and [Orcid.org/0000-0003-2738-0325](https://orcid.org/0000-0003-2738-0325)

Author and co-author of 451 scientific papers published in international refereed journals, current rate ~20 publications/year, one book, and 23 patents and patent applications which are cited >66.000 times, H-Index 98 (Currently increasing ~7900 cit./year) [C-7282-2008](https://orcid.org/0000-0003-2738-0325) or Google Scholar [Google Scholar Chorkendorff](https://scholar.google.com/citations?user=ibchork) H-index 114 and >84.000 citations (Currently increasing ~9400 cit./year), please see enclosed publication list. Since 2017 listed as Highly Cited Researcher (ISI) (top 1%). Participated in a large number of international conferences of which more than 200 were invited, of which many Keynote and Plenary. Additionally, >200 of seminars and presentations in organizations, industry, and universities. Co-founder of three spin-out companies.

- 1985** Ph.D. degree in Physics at the Physics Institute, Odense University
- 1986-1987** Post-doc position with Professor John T. Yates Jr., University of Pittsburgh, USA
- 1987-1999** Associate Professor at the Department of Physics, Technical University of Denmark
- 1999-** Professor in Heterogeneous Catalysis & Head of section “Surface Physics and Catalysis”
- 1999-2006** Director of the Interdisciplinary Research Center for Catalysis (ICAT)
- 1999-2008** Member of the Board for the Federation of European Catalysis Societies
- 2000** Awarded the Ulrik and Marie Brinch award
- 2001** Elected Fellow of The Academy for Technical Sciences (ATV)
- 2005-2016** Director of the Danish National Research Foundation “Center for Individual Nanoparticle Functionality” CINP at Department of Physics, DTU
- 2005-2017** Member of the Scientific Advisory Board of KCK at Chalmers University of Technology, Sweden
- 2007** Awarded the Ingeborg and Leo Dannin’s Prize for Natural Sci. Research 250.000 DKK
- 2008-2013** Member of the Strategic Advisory Committee for (NIMIC), University of Delft, The Netherlands
- 2010-2013** Member of the Scientific Advisory Board for SUNCAT at SLAC/Stanford University USA
- 2012-2015** Chalmers Jubilee Distinguished Visiting Professor, Chalmers University of Technology, Sweden
- 2012-2014** Director of the DTU Initiative “Catalysis Initiative for Sustainable Energy” (CASE)
- 2012-2013** Guest Professor at SUNCAT, SLAC, Stanford University, Palo Alto, USA
- 2013-2019** Member of the Advisory Board of “Solar H<sub>2</sub> DFG SPP 1613”, Germany
- 2013-2019** Consulting Professor, SUNCAT, SLAC, Stanford University, Palo Alto, USA
- 2015-** Elected Fellow of Royal Society of Chemistry (FRSC)
- 2015-2023** Member of **SCIENCE MAGAZINE** Board of Reviewing Editors
- 2015-** Co-founder of HPNOW APS and RenCat APS
- 2016-2023** Director of the “The VILLUM Center for the Science of Sustainable Fuels and Chemicals”
- 2016-2023** Member of the Scientific Advisory Board of **Chemical Building Blocks Consortium** in Netherlands
- 2016-** Founder of Chorkendorff Holding APS and Co-founder of SpectroInlets APS
- 2017-2023** ERC-ADV Grantee
- 2018-** Elected member of the Royal Danish Academy of Sciences and Letters
- 2018-2023** Awarded the Chinese Overseas High-level Talents Program, Chinese Academy
- 2019-** Member of the Scientific Advisory Board of E-Conversion TUM, Germany
- 2019-** Member of the Scientific Advisory Board (Fachbeirat) of the FHI of the Max Plack Society in Berlin
- 2019** Awarded the Julius Thomsen Gold Medal, Technical University of Denmark
- 2020-2024** Awarded a Hans Fischer Senior Fellowship at Technical University of Munich, Germany
- 2021** Awarded the Villum Kann Rasmussen Annual Award of 0.7 M€
- 2022** Awarded The Eni Award: Energy Frontiers Prize 100 k€
- 2023-2028** Villum Investigator of V-Sustain II.

### **General description of activities:**

Ib Chorkendorff was in 1987 employed at the Department of Physics, DTU, for establishing an experimental activity within the field of Surface Physics investigating fundamental aspects of surface reactions, especially with emphasis on establishing a fundamental understanding of the technologically important field of catalysis. Here fundamental aspects of important catalytic processes like Steam Reforming, Methanol Synthesis, and Ammonia Synthesis have been in focus both with respect to understanding existing systems, but also to design new and improved catalytic systems. The activities were then broadened to include various aspects of energy technologies related to energy conversion i.e. Power-to-X like water splitting for hydrogen production, energy storage in form of solar fuels, and energy conversions in fuel cells as well as environmental protection. Two spin-out companies have been established in this field.

Ib Chorkendorff has over the years build up a section called SurfCat which applies a broad variety of the most modern surface sensitive methods (STM, HREELS, TPD, LEED, AES, XPS, High-pressure cells in conjunction with UHV and GC's, and Cluster Sources for *in situ* synthesis of and mass-selected nanoparticle materials). Extensive laboratory facilities are also available for material synthesis in connection with heterogeneous catalysis, and electro- and photo-catalysis in general. The laboratory also has test facilities for thermal catalysis as well as for electrochemical CO<sub>2</sub> and N<sub>2</sub> hydrogenation including Fuel Cell type reactor for up-scaling. Several methods for catalysts testing have been developed i.e. the sniffer chip which has been commercialized and led to a third spin-out company.

Courses on the master and PhD level has been developed and Ib Chorkendorff has been Supervisor for M.Sc. students (total 63) and Ph.D. students (total 82) and Post-docs (70) of which many were in collaboration with industry. Chorkendorff has served on many PhD committees, evaluation committees all over the world, and organized several international meetings including being the Chairman of five PhD summer schools and one winter school.

### **Management Experience last 10 years:**

Ib Chorkendorff has taken part in and managed several larger research programs typically involving several different groups coming from both academia and industry.

**2009-2014** One of six PI's taking the initiative to the Catalysis for Sustainable Energy (CASE) at DTU (18,0M€), and Director from 2012-2014

**2013-2017** Heading NACORR a Energy and Environmental Research council programme of (2.0 M€) in collaboration with Stanford University/SLAC, Chalmers, IRD A/S and Danish Power Systems

**2013-2017** Heading HYDECAT (1.5 M€) with Århus University and Haldor Topsøe

**2016-2024** Director of the "The VILLUM Center for the Science of Sustainable Fuels and Chemicals". A consortium consisting of The Technical University of Denmark, Stanford University, Copenhagen University and Southern Denmark University. The total funding is 20 M€ for 8 years

**2017-2023** ERC-ADV Grant 2.5 M€ over five years

**2019-2022** E-Ammonia: A DTU and SpectroInlet initiative for up-scaling of electrochemical ammonia synthesis. 2.5 M€ over 3 years.

**2023-2028** Extension grant of V-Sustain for I. Chorkendorff only. 3 M€ for 5 years.

### **Member of International Editorial/Advisory Board of:**

Energy and Environmental Science, Chemical Society Reviews, ACS Energy Letters, CHEMCATCHEM, CHEMELECTROCHEM, Energy and Environmental Catalysis.

### **Professional memberships:**

- The Electrochemical Society
- The Royal Society of Chemistry
- The International Society of Electrochemistry
- The American Vacuum Society
- The American Chemical Society
- The American Physical Society
- The North American Catalysis Society
- The Material Research Society

**List of Publications in  
International and Refereed Journals for  
IB CHORKENDORFF**

- 460) Mangini, J. B. V. Mygind, S. G. Ballesteros, M. Armandi, **I. Chorkendorff**, F. Bella “Multivariate Approaches Boosting Lithium-Mediated Ammonia Electrosynthesis in Different Electrolytes”, Submitted (2024)
- 459) X. Fu, **I. Chorkendorff**, “Electrochemical Reactor Designs for Redox-Mediated Ammonia Synthesis”, Submitted (2024)
- 458) F. Romeggio, R. Bischoff, C. B. Møller, V. L. Jensen, E. G. Gioria, R. E. Tankard, R. S. Nielsen, O. Hansen, **I. Chorkendorff**, J. Kibsgaard, C. D. Damsgaard, “Room-temperature deposition of  $\delta$ -Ni<sub>5</sub>Ga<sub>3</sub> thin-films and nanoparticles via magnetron sputtering”, Submitted (2024)
- 457) V.A. Niemann, M. Doucet, P. Benedek, N.H. Deissler, J.B.V. Mygind, S.W. Lee, **I. Chorkendorff**, A.C. Nielander, W.A. Tarpeh, and T.F. Jaramillo, “In situ neutron reflectometer reveals the interfacial microenvironment driving electrochemical ammonia synthesis” Submitted (2024)
- 456) E. L. Clark, D. Hochfilzer, B. Seger, and **I. Chorkendorff**, “Deactivation Mechanism and Reactivation Protocol for Electrochemical CO Reduction over Copper in Alkaline Media” In Preparation 2024.
- 455) J. B. V. Mygind, N. H. Deissler, S. Li, X. Fu, J. Kibsgaard, and **I. Chorkendorff**, “Understanding Hydrogen Oxidation in Non-Aqueous Systems”, In Preparation (2024)
- 454) B. Ó. Joensen, Q. Xu, K. Enemark-Rasmussen, V. Frankland, A.P. Periasamy, J. Varcoe, **I. Chorkendorff**, B. Seger, “Advancing the Synthesis for Perdeuterated Small Organic Chemicals via Electrochemical CO<sub>2</sub> Reduction”, In preparation 2024
- 453) Cao, K. Zhang, J. Vernieres, L. H. Wandall, R. Plougmann, J. Kibsgaard, **I. Chorkendorff**, J. K. Nørskov, “The Co/NbN interphase as an effective ammonia synthesis catalyst”, Submitted (2024)
- 452) Y. Zhou, X. Fu, **I. Chorkendorff**, J. K. Nørskov, “Electrochemical Ammonia Synthesis – the Energy Efficiency Challenge”, Submitted (2024).
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- 451) K. Naumann, T. Tichter, R. Nielsen, B. Seger, O. Hansen, **I. Chorkendorff** and P. C. K. Vesborg, “Protection Materials on 111-V Semiconductors for Photo-electrochemical CO-Reduction”, Accepted J. Chem. Phys. C (2024). DOI: 10.1021/acs.jpcc.4c04782.
- 450) Gunnarson, A. Cao, O. F. Sloth, M. Varón, R. B. Villoro, T. Veile, C. D. Damsgaard, C. Frandsen, J. K. Nørskov and **I. Chorkendorff**, “Theory-Guided Development of a Barium-Doped Cobalt Catalyst for Ammonia Decomposition”, Energy & Environmental Science (2024). DOI: 10.1039/d4ee02874k .
- 449) X. Fu, **I. Chorkendorff**, “Prospects and Challenges in Electrochemical Nitrogen Activation for Ammonia Synthesis” Science China (2024), DOI:10.1007/s11426-024-2129-6.
- 448) T. Yilmaz, **I. Chorkendorff**, and B. Seger, “Direct Electrocatalytic Propylene Epoxidation on PdOx and PtOx”, J. Chem. Phys. (2024). DOI: 10.1021/acs.jpcc.4c05592
- 447) F. Romeggio, J. F. Schouenborg, P. C. K. Vesborg, O. Hansen, J. Kibsgaard, **I. Chorkendorff**, C. D. Damsgaard, “Magnetron Sputtering of Pure  $\delta$ -Ni<sub>5</sub>Ga<sub>3</sub> Thin-Films for CO<sub>2</sub> Hydrogenation“, ACS Catal. 14 (2024) 12592–12601. DOI:10.1021/acscatal.4c03345

- 446) S. Li, X. Fu, J. K. Nørskov, **I. Chorkendorff**, “Towards sustainable ammonia electrosynthesis” *Nature Energy* (2024). DOI: 10.1038/s41560-024-01622-7.
- 445) X. Fu, S. Li, N. H. Deissler, J. B.V. Mygind, J. Kibsgaard, **I. Chorkendorff**, “Effect of Lithium Salt on Lithium-mediated Ammonia Synthesis,” *ACS Energy Letters*, (2024) DOI 10.1021/acseenergylett.4c01655
- 444) E. V. Sedano R. Tankard, J.L. Needham, E. Gioria, F. Romeggio, **I. Chorkendorff**, C.D. Damsgaard, J. Kibsgaard, “An Experimental Perspective on Nanoparticle Electrochemistry” *PCCP* 26 (2024) 17456-17466. DOI:10.1039/d4cp00889h
- 443) R. Nielsen, M. Schleuning, O. Karalis, T. H. Hemmingsen, O. Hansen, **I Chorkendorff**, T. Unold, P. C. K. Vesborg, “Increasing the Collection Efficiency in Selenium Thin-Film Solar Cells Using a Closed-Space Annealing Strategy”, *ACS Applied Energy Materials* 7 (2024) 5209-5215. DOI:10.1021/acsaem.4c00636
- 442) E. Plaza-Mayoral, V. Okatenko, K. N. Dalby, H. Falsig, **I. Chorkendorff**, P. Sebastián-Pascual, M. Escudero-Escribano, ”Composition effects of electrodeposited CuAg nanostructured electrocatalysts for CO2 reduction”, *IScience* (2024), DOI:10.1016/j.isci.2024.109933
- 441) M. P. Salinas-Quezada, J. K. Pedersen, P. Sebastián-Pascual, **I. Chorkendorff**, K Biswas, J. Rossmeisl and M. Escudero-Escribano, ”Toward Understanding CO Oxidation on High-Entropy Alloy Electrocatalysts” *EES Catalysis* (2024), DOI: 10.1039/D4EY00023D
- 440) N. H. Deissler, J. B. V. Mygind, K. Li, V. A. Niemann, P. Benedek, V. Vinci, S. Li, X. Fu, P. Vesborg, T. F. Jaramillo, J. Kibsgaard, J. Drnecc, **I. Chorkendorff** ” In operando Investigations of the Solid Electrolyte Interphase in the Lithium Mediated Ammonia Synthesis”, *Energy & Environmental Science*, 17 (2024) 3482 - 3492, DOI: 10.1039/D3EE04235A
- 439) E. Plaza-Mayoral, K. Dalby, H. Falsig, **I. Chorkendorff**, P. Sebastián-Pascual, M. Escudero-Escribano, "Preparation of tunable Cu-Ag nanostructures by Electrodeposition in a deep eutectic solvent" *ChemElectroChem* (2024). DOI: 10.1002/celec.202400094
- 438) S. Li, Y. Zhou, X. Fu, J. B. Pedersen, M. Saccoccio, S. Z. Andersen, K. Enemark-Rasmussen, A. Xu, R. Sažinas, J. B. V. Mygind, N. H. Deissler, J. Kibsgaard, P. C. K. Vesborg, J. K. Nørskov, and **I. Chorkendorff**, “Long-term continuous ammonia electrosynthesis”, *Nature* (2024). DOI:10.1038/s41586-024-07276-5
- 437) R. E. Tankard, F. Romeggio, S. K. Akazawa, A. Krabbe, O. F. Sloth, N. M. Secher, S. Colding-Fagerholt, S. Helveg, R. Palmer, C. D. Damsgaard, J. Kibsgaard, **I. Chorkendorff**, “Stable mass-selected AuTiOx nanoparticles for CO oxidation”, *PCCP* (2023) DOI: 10.1039/D4CP00211C.
- 336) T. Smitshuysen, M. Lützen, A. Zimina, T. L. Sheppard, H. H. Jakobsen; **I. Chorkendorff**; C. D. Damsgaard, “Using CoCu2Ga/SiO2 to identify stability-issues in ethanol-selective Co-Cu alloyed catalysts in carbon monoxide hydrogenation” *Applied Catalysis A: General* 675 (2024) 119636. DOI: 10.1016/j.apcata.2024.119636.
- 435) B. Ó. Joensen, J. A. Z. Zeledón, L. Trotochaud, A. Sartori, M. Mirolo, A. B. Moss, S.I Garg, **I. Chorkendorff**, J. Drnec, B. Seger, Q. Xu, “Unveiling Transport Mechanisms of Cesium and Water in Operando Zero-Gap CO2 Electrolyzers”, *Joule* (2024) DOI: 10.1016/j.joule.2024.02.027.
- 434) K. Fu, A. Xu, J. B. Pedersen, S. Li, R. Sažinas, Y. Zhou, S. Z. Andersen, M. Saccoccio, N. H. Deissler, J. B. V. Mygind, J. Kibsgaard, P. C. K. Vesborg, J. K. Nørskov, **I. Chorkendorff**, “Phenol as Proton Shuttle and Buffer for Lithium-mediated Ammonia Electrosynthesis”, *Nature Communication* 15 (2024) 2417. DOI: 10.1038/s41467-024-46803-w.

- 433) C.A.G. Rodriguez, A. B. Moss, S. Garg, W. Deng, J. R. Varcoe, **I Chorkendorff**, and Brian Seger, “Insights into zero-gap CO<sub>2</sub> electrolysis at elevated temperatures”, *Energy & Environment Catalysis* (2024). DOI: 10.1039/d3ey00224a.
- 432) R. Nielsen, A. Crovetto, A. Assar, O. Hansen, **I. Chorkendorff**, and P. C. K. Vesborg, Submitted 2023. “Monolithic Selenium/Silicon Tandem Solar Cells”, *PRX Energy* (2024). DOI: 10.1103/PRXEnergy.3.013013
- 431) Y. Qiao, D. Hochfilzer, **I. Chorkendorff**, B. Seger, “Operando Detection of Acetaldehyde Behavior in Electrochemical CO<sub>2</sub> Reduction”, *ACS Energy Lett.* 9 (2024) 880-887. DOI: 10.1021/acsenerylett.3c02549.
- 430) K. Zhang, A. Cao, L.W. Wandall, J. Vernieres, J. Kibsgaard, J. K. Nørskov, **I. Chorkendorff**, “Spin-mediated promotion of Co catalysts for ammonia synthesis”, *SCIENCE* (2024) DOI: 10.1126/science.adn0558.
- 429) E. S. Varo, R. E. Tankard, J. Kryger-Baggesen, J. Jinschek, S. Helveg, **I. Chorkendorff**, C. D. Damsgaard, J. Kibsgaard, “Gold nanoparticles for CO<sub>2</sub> electroreduction: a hidden optimum defined by size and shape”, *J. A. Chem. Soc.* 146 (2024) 2015-2023 DOI: 10.1021/jacs.3c10610.
- 428) W. Deng, Y. Qiao, G. Kastlunger, N. Govindarajan, A. Xu, P. Zhang, **I. Chorkendorff**, B. Seger, J. Gong, “Unraveling the rate-determine step of C<sub>2</sub><sup>+</sup> products during electrochemical CO reduction”, *Nature Comm.* 15 (2024) 892. DOI: 10.1038/s41467-024-45230-1
- 427) P. M. Couce, T. Madsen, E. Plaza-Mayoral, H. Kristoffersen, **I. Chorkendorff**, K. Dalby, W. van der Stam, J. Rossmeisl, M. Escudero-Escribano and P. Sebastián-Pascual, “Tailoring the facet distribution on copper with chloride”, *Chemical Science*, 2024, DOI: 10.1039/D3SC05988J.
- 426) E. Clark D. Hochfilzer, B. Seger, **I. Chorkendorff**, "Preventing Alloy Electrocatalyst Segregation in Air using Sacrificial Passivating Overlayers" *J. Phys. Chem.* (2024) DOI: 10.1021/acs.jpcc.3c05493.
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- 425) K. Zhang, L. H. Wandall, J. Vernieres, J. Kibsgaard and **I. Chorkendorff**, “UHV compatible reactor for model catalyst study of ammonia synthesis at ambient pressure”, *Rev. Sci. Instrum.* 94, 114102 (2023) DOI: [10.1063/5.0160459](https://doi.org/10.1063/5.0160459).
- 424) C. Wei, Z. Wang, K. Otani, D. Hochfilzer, K. Zhan1, R. Nielsen, J. K. Nørskov, J. Kibsgaard, **I. Chorkendorff**, “Benchmarking the Stability of Electrocatalysts for Acidic Oxygen Evolution Reaction: Importance of Dissolved Ion Concentration”, *ACS Catal.*, 13, 21, (2023) 14058–14069. DOI: 10.1021/acscatal.3c03257.
- 423) E. L. Clark, R. Nielsen, J. E. Sørensen, J. L. Needham, B. Seger, **I. Chorkendorff**, “Independent and Systematic Tuning of Surface Reactivity and Electric Field Strength via Intermetallic Bonding: A Platform for the Development of Superior Electrocatalytic Materials”, *ACS Energy Lett.* 8 (2023) 4414-4420 10.1021/acsenerylett.3c01639.
- 422) D. Hochfilzer, C. Aletsee, K. Krempl, T. Pedersen, A. Krabbe, M. Tschur, O. Hansen, P.C.K. Viborg, J. Kibsgaard, U. Heiz, and **I. Chorkendorff**, “Enabling real-time detection of photocatalytic reactions by a re-useable  $\mu$ -reactor”, *Measurement Science and Technology* 35 (2024) 015903. DOI: 10.1021/jacs.3c10610
- 421) X. Fu, V. A. Niemann, S. Li, Y. Zhou, K. Zhang, J. B. Pedersen, M. Saccoccio, S. Z. Andersen, K. Enemark-Rasmussen, P. Benedek, A. Xu, N. H. Deissler, J. B. V. Mygind, A. C. Nielander, J. Kibsgaard, P. C. K. Vesborg, J. K. Nørskov, T. F. Jaramillo, **I. Chorkendorff**, “Calcium-Mediated Nitrogen Reduction for Electrochemical Ammonia Synthesis”, *Nature Materials* 23 (2024) 101-107 DOI: 10.1038/s41563-023-01702-1.

- 420) Q. Xu, S. Liu, F. Longhin, G. Kastlunger, **I. Chorkendorff**, and B. Seger “Impact of Anodic Oxidation Reactions in the Performance Evaluation of High-Rate CO<sub>2</sub>/CO Electrolysis”, *Advanced Materials* (2023) [10.1002/adma.202306741](https://doi.org/10.1002/adma.202306741).
- 419) E. J. McShane, V. Niemann, P. Benedek, X. Fu, A. C. Nielander, **I. Chorkendorff**, T. F. Jaramillo, M. Cargnello., “Lithium Alkoxide Deposition in the Solid-Electrolyte Inter-phase Dictates Selectivity in Lithium-Mediated Electrochemical Ammonia Synthesis”, *ACS Energy Lett.* 8 (2023) 4024-4032 [10.1021/acseenergylett.3c01534](https://doi.org/10.1021/acseenergylett.3c01534).
- 418) R. Nielsen, T. Hemmingsen, T. G. Bonczyk, O. Hansen, **I. Chorkendorff**, and P. C. K. Vesborg, “Laser-Annealing and Solid-Phase Epitaxy of Selenium Thin-Film Solar Cells”, *Accepted ACS Applied Energy Materials* (2023) [10.1021/acsaem.3c01464](https://doi.org/10.1021/acsaem.3c01464).
- 417) J. B. V. Mygind, J. B. Pedersen, K. Li, N. H. Deissler, M. Saccoccio, X. Fu, S. Li, R. Sažinas, S. Z. Andersen, P. C. K. Vesborg, J. Doganli-Kibsgaard and **I. Chorkendorff**, “Is Ethanol Essential for the Lithium-Mediated Nitrogen Reduction Reaction?” *ChemSusChem* (2023) [10.1002/cssc.202301011](https://doi.org/10.1002/cssc.202301011).
- 416) Q. Xu, S. Garg, A. B. Moss, M. Mirolo, **I. Chorkendorff**, J. Drnec, B. Seger, “Identifying and alleviating the durability challenges in membrane-electrode-assembly devices for high-rate CO electrolysis”, *Nature Catalysis* (2023) [10.1038/s41929-023-01034](https://doi.org/10.1038/s41929-023-01034).
- 415) Y. Qiao, G. Kastlunger, R. C. Davis, C. A. G. Rodriguez, A. L. Vishart, W. Deng, P. Benedek, D. Q. Xu, S. Li, P. Benedek, J. Cheng, J. Schröder, J. Perryman, D. U. Lee, T. F. Jaramillo, **I. Chorkendorff**, B. Seger, “Mechanistic Insights into Aldehyde Production from Electrochemical CO<sub>2</sub> Reduction on CuAg Alloy via Operando X-Ray Measurements” *ACS Catalysis* Accepted (2023). DOI:[10.1021/acscatal.3c01009](https://doi.org/10.1021/acscatal.3c01009)
- 414) M. R. Almind, J. S. Engbæk, S. B. Vendelbo, P. M. Mortensen, M. F. Hansen, C. D. Damsgaard, T. Veile, **I. Chorkendorff**, C. Frandsen, “Retrofittable plug-flow reactor for in situ high-temperature vibrating sample magnetometry with well-controlled gas atmospheres”, *Rev Sci Instrum* 94 (2023) 063907, DOI: [10.1063/5.0113493](https://doi.org/10.1063/5.0113493).
- 413) S. Garg, Q. Xu, A. B. Moss, M. Mirolo, **I. Chorkendorff**, J. Drnec, B. Seger, “How alkali cations affect salt precipitation and CO<sub>2</sub> electrolysis performance in membrane electrode assembly electrolyzers”, *Energy and Environmental Science* (2023) DOI: [10.1039/D2EE03725D](https://doi.org/10.1039/D2EE03725D).
- 412) Moss, J. Hätingen, P. Kúš, S. Garg, M. Mirolo, **I. Chorkendorff**, B. Seger, “Versatile high energy X-ray transparent electrolysis cell for operando measurements”, *Journal of Power Sources* (2023). DOI: [10.1016/j.jpowsour.2023.232754](https://doi.org/10.1016/j.jpowsour.2023.232754)
- 411) X. Fu, J. B. Pedersen, Y. Zhou, M. Saccoccio, S. Li, R. Salinas, K. Li, S. Z. Andersen, A. Xu, N. H. Deissler, J. J. V. Mygin, C. Wei, J. Kibsgaard, P. C. K. Vesborg, J. K. Nørskov, and **I. Chorkendorff**, “Electrosynthesis of ammonia from nitrogen reduction coupled with hydrogen oxidation in a continuous-flow reactor”, *SCIENCE* 379 (2023) 707-712. DOI: [10.1126/science.adf4403](https://doi.org/10.1126/science.adf4403)
- 410) D. Hochfilzer, **I. Chorkendorff** and J. Kibsgaard, “Catalyst stability considerations for electrochemical energy conversion: Do we measure on what we synthesized?”, *ACS Energy Letters* (2023). DOI: [10.1021/acsenergylett.3c00021](https://doi.org/10.1021/acsenergylett.3c00021)
- 409) C. C. Aletsee, D. Hochfilzer, A. Kwiatkowski, M. Becherer, J. Kibsgaard, **I. Chorkendorff**, M. Tschur and U. Heiz, “A re-usable  $\mu$ -reactor for dynamic and sensitive photocatalytic measurements: Exemplified by the photoconversion of ethanol on Pt-loaded titania P25”, *Rev. Sci. Instrum.* 94, (2023) 033909. DOI: [10.1063/5.0134287](https://doi.org/10.1063/5.0134287)

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- 407) B. Moss, S. Garg, M. Mirolo, C. A. G. Rodriguez, R. Ilvonen, **I. Chorkendorff**, J. Drnec, B. Seger "In Operando investigations of oscillatory water and carbonate effects in MEA-based CO<sub>2</sub> electrolysis devices", Joule (2023) DOI: 10.1016/J.JOULE.2023.01.013
- Published 2022 -----
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## BOOK:

"Concepts of Modern Catalysis and Kinetics" by **Ib Chorkendorff** and Hans Niemantsverdriet, Wiley-VCH, Weinheim, First Edition (2003) ISBN 3-527-30574-2, Second Edition (2007) ISBN 3-527-31672-4, and Third edition ISBN 978-3-527-33268-7 (505 pages).

## Chapter in BOOK:

"Catalysis of Hydrogen Dissociation and Recombination" by **Ib Chorkendorff** in "Hydrogen as a Future Energy Carrier" Editors: Andreas Züttel and Louis Schlapbach, Wiley-VCH, Weinheim, **ISBN-13: 9783527308170** 2007.

## Invited Talks at International Conferences and Named Lectures by IB CHORKENDORFF

1. Second Nordic Conference on Surface Science, Linköping, Sweden, June 15-17, 1987, "**Scanning kinetic spectroscopy for determination of major reaction pathways on single crystals**"
2. Reactions of Hydrocarbons with Metal Atoms, Clusters, and Solids, Oslo, Norway, April 24-25 1990, "**Dissociative Sticking of Methane on Ni(100)**"
3. Surface and Interface Chemistry, CERC-3 Workshop, Rolduc Abbey, Kerkrade, The Netherlands, April 17-21, 1993, "**Fundamental studies and microkinetic modelling of catalytic processes**"
4. Thirteenth North American Meeting of Catalysis Society, Pittsburg, USA, May 1993, "**Micro-Kinetic Modelling of the Methanol Synthesis Based on Cu Single Crystal Studies**"
5. Annual Meeting of the Danish Physical Society, Nyborg Strand, Denmark, 23-24 May, 1996, "**Design and reactivity of surface alloys**"
6. The 3rd European Conference on Gas-Surface Dynamics, Rolduc Abbey, Kerkrade, The Netherlands, 3-6 September 1996, "**Molecular beam investigations of methane dissociation on Au/Ni(111) surface alloys**"
7. Oji Seminar: Chemical Processes of Surfaces based on Atomic Scale Structure and Dynamics, Saitama, Japan, 27-31 October, 1996, "**Design and Reactivity of Alloys**"
8. The Fourth Nordic Conference on Surface Science, Ålesund, Norway, 29. May - 1. June 1997, "**Design and Reactivity of Surface Alloys**"
9. Gordon Research Conference on Dynamics at Surfaces, Proctor Academy, New Hampshire, USA. 10. – 14. August 1997, "**Molecular Beam Studies of Methane on Surface Alloys**"
10. Fourth European Summer School on Surface Science: "Surface Reactivity", 16. – 22. August 1997, Humlebæk, Denmark, "**Design and Reactivity of Surface Alloys**"
11. Fourth European Summer School on Surface Science: "Surface Reactivity", 16. – 22. August 1997, Humlebæk, Denmark, "**Microkinetic Modelling of Catalysts**"
12. Dynamics and Kinetics of Surface Reactions on Elemental and Bimetallic Surfaces in the European TMR Programme 24 - 27 August, 1997, Dublin, Ireland, "**Surface Reactivity of Epitaxial Metal Overlayers and Alloys: A Combined Experimental/Theoretical Approach**"
13. International Ph.D. Summer School in Solid Films and Surfaces, June 28 - July 5, 1998, Kolloid Conference Center, Denmark, "**A Surface Science Approach to Heterogeneous Catalysis**"
14. Workshop on "Catalysis from first principles", European Science Foundation, Magleås Conference Center, Høsterkøb, Denmark 17-19 May, 1999, "**Significance of steps on real catalytic reactions**"
15. Annual Meeting of the Danish Physical Society, Nyborg Strand, Denmark, 2.-3. June, 1999, "**Interdisciplinary Research in Catalysis**"
16. Fifth European Summer School on Surface Science: "Understanding Catalysis". Drontheim, Holland, 28. August – 3. September 1999, "**Rates of reactions on single crystals**"



17. Euro-conference: "Elementary steps in fast catalytic oxidation reactions". Lelystadt, The Netherlands, 2-6 October 1999, "**Elementary steps in methane activation**"
18. 46<sup>th</sup> International Symposium of the American Vacuum Society, Seattle, USA, 25-29 October 1999, "**Linking surface science and catalysis**"
19. JRP Gas-surface Interaction, Aggsbach-Dorf, Austria, 22-25 October 2000, "**Surface Reaction on Pure, Defective and Alloyed Metal Surfaces**"
20. Gordon Research Conference on Chemical Reaction at Surfaces, Ventura, California, USA. 18 – 23 February 2001, "**Can Minority Sites Dominate the Overall Reactivity of Surfaces**"
21. American Chemical Society Meeting, San Diego, California, USA. 1-5 April 2001, "**Influence on strongly activated processes by clean, defect, and modified surfaces**"
22. Workshop on "Catalysis from first principles" Vienna, Austria, 21-23 February 2002, "**Reactivity of Pseudomorphic Metal Overlayers and Alloys**"
23. First Network Meeting "Predicting Catalysis" Haldor Topsøe A/S Lyngby, Denmark, 11-14 January 2003, "**Can Minority Sites dominate Catalysis?**"
24. American Chemical Society Meeting, New Orleans, Louisiana, USA, 23-27 March 2003, "**Controlling reactivity by blocking minority sites**"
25. Workshop on Theory and Surface Measurements of Fuel Cell Catalysis, Magleås Conference Center, Høsterkøb, Denmark June 16-18 2003, "**CO Exchange Rate on Pt Fuel Cell Catalysts**"
26. 9<sup>th</sup> International Fischer Symposium, Munich, Germany, 21-25 July 2003, "**Reactivity of CO and CH<sub>4</sub> on Nickel and Platinum**"
27. Workshop on "Our Future Light Source" Maxlab, Lund, Sweden, 27-29 September 2004; "**Surface science and catalysis, outstanding problems**"
28. Frontiers in Electronic Structure Theory, Magleås Denmark, 5-6 October 2004, "**Reactivity in Relation to Hydrogen Production and Conversion**"
29. Workshop on Novel Layer Structures for Fuel Cells, German Research Foundation Schloss Pommersfelden 8-11 May 2005; "**From fundamental investigations of conventional fuel cells catalyst to new catalyst for hydrogen evolution**"
30. ECS 207 Quebec, Canada 16-20 May 2005, "**Conversion of Hydrogen on Alloys and inorganic Compounds**"
31. 52<sup>th</sup> International Symposium of the American Vacuum Society, Boston USA, 25-29 October 2005, "**Production and Conversion of Hydrogen**"
32. Danish Physical Society Annual Meeting, Nyborg Strand, Denmark, 1-2 June 2006, "**Why is structure so important in surface reactivity and how can CEN-DTU provide solutions here?**"
33. INANO Summerschool, Fuglsø, Denmark, 11-16 June, 2006, "**Basic Concepts of Catalysis**"
34. 10<sup>th</sup> Fischer Symposium Benediktbeuren, Germany 24-28 July 2006, "**Correlation of Structure and Reactivity in Catalysis and Electrochemistry**"

35. VTU Summerschool on SOFC Fuel Cells 2006, Sandbjerg Gods, Sønderborg, Denmark, 20-24 August 2006, **“Structure and Reactivity of Surfaces”**
36. ASEVA Workshops 2006, WS-19 Physical, Chemical and Mechanical Properties of Nanoclusters, Ávila, Spain. September 25-27, 2006 **“Reactivity of Nanostructures and Clusters”**
37. 1<sup>st</sup> SURMAT Workshop, Dusseldorf, Germany 6-8 December 2006, **“Correlation of Structure and Reactivity for Design of New Materials for Hydrogen Production”**
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39. CAMd Lundbæk Symposium, February 26-27, 2007, Kgs Lyngby, **“Structure sensitivity in surface processes“**
40. 233<sup>rd</sup> American Chemical Society Meeting, Chicago, USA, 22-30 March 2007 **“Role of Mono-atomic Steps in the Catalytic Reactions”**
41. 1<sup>st</sup> Symposium of the EU Network on Hydrogen, 16 and 17 April 2007 in Amsterdam, The Netherlands **“Correlation of Structure and Reactivity for New Electrode Materials”**
42. WS-21 ASEVA Workshop on Hydrogen as a future energy carrier 2-5 September 2007, Avila, Spain, **“Conventional Hydrogen production”**
43. EU High Level Conference on Nanotechnologies 20-21 November 2007, Braga, Portugal **“Electrocatalysts and the multidisciplinary approach combining theoretical design combinatorial methods and development of MEAs”**
44. Zing Conference on Trends in Surface Chemistry, 7-11 January 2008 Antigua, **“Identification of Active Edge Sites for Electrochemical H<sub>2</sub> Evolution from MoS<sub>2</sub>”**
45. Denmark-California Workshop on Rational Design of Catalytic Materials, 14-15 January 2008, Berkeley, USA, **“Design of new Catalyst for Hydrogen Production”**
46. 2<sup>nd</sup> Symposium Hydrogen & Energy 21.-25. January 2008 Braunwald, Switzerland, **“Identification of Reactive Site for Design of New Materials for Hydrogen Production”**
47. Materials for Cleaner Technologies 20- 21 May, 2008 Stockholm, Sweden **“New inorganic materials for hydrogen evolution in PEMFC”**
48. European Science Foundation (ESF) Conference on Nanotechnology for Sustainable Energy, 14-19 June, 2008 Obergurgl, Austria, **“Identifying the Site and New Materials for Hydrogen Production”**
49. 14<sup>th</sup> International Conference on Solid Films and Surfaces, 29<sup>th</sup> June-4<sup>th</sup> July, 2008 Trinity College Dublin, **“Identification of the Active Site in Nano-Catalytic Systems”**.
50. Faraday Discussion 140: Electrocatalysis – Theory and Experiment at the Interface, Southampton, UK, 7-9 July, 2008, **“Hydrogen Evolution on Nano-Particulate Transition Metal Sulphides”**
51. ICC 14 Pre-Symposium: 50<sup>th</sup> Anniversary of the Catalysis Society of Japan, International Symposium on creation and Control of Advanced Selective Catalysis, Kyoto, Japan 8-12 July 2008 **“The Influence of Step Sites on Surface Hydrogenation/Dehydrogenation Reactions”**

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55. Netherlands Catalysis and Chemistry Conference X, The Netherlands, 2-4 March 2009, “**Identifying the rate limiting step and its reaction site**”
56. 237<sup>th</sup> American Chemical Society Meeting, Salt Lake City, USA, 22-27 March 2009, “**Identifying the rate limiting step and its reaction site: The key to new and improved catalysts**”
57. Horiba-ISSP International Symposium (ISSP-11) Japan 12-16 October 2009, “**New Electro-Catalysts for Hydrogen Production**”
58. 1<sup>st</sup> Meeting in European Graduate school for Sustainable Energy “**New Catalysts and Electro-Catalysts for Hydrogen Production and Conversion**” Heeze, The Netherlands, 2-4 November 2009.
59. The 4<sup>th</sup> IDECAT Conference on Catalysis, Porquerolles, France 12-16 May 2010, “**Design of new catalysts based on molecular level insight**”
60. CASE-Helios workshop: Co-catalysts in photochemical fuel production” 17-18 May 2010, DTU, Denmark, “**Photochemical hydrogen evolution**”
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63. Summer School on ‘Materials for the hydrogen economy’, 17-21 August, 2010, Reykjavik, Iceland. “**Intro to Hydrogen Production**”
64. Summer School on ‘Materials for the hydrogen economy’, 17-21 August, 2010, Reykjavik, Iceland. “**New Catalysts for producing Solar Fuels**”
65. 61<sup>st</sup> International Society of Electrochemistry (ISE) Meeting, 26 of September - 1 October, 2010, Nice, France. “**New electrode materials for the oxygen reduction reaction**”
66. Paul Scherrer Institute (PSI) Switzerland, 2<sup>nd</sup> October 2010, “**Heterogeneous Catalysis: A Part of the Solution for Future Energy Production**”
67. 57<sup>th</sup> American Vacuum Society (AVS), Albuquerque, 17-22 October, 2010. “**Catalytic reactivity of mass selected nanoparticles**”
68. Workshop on High pressure x-ray photoelectron spectroscopy (HP-XPS) and other in situ techniques” 9-10 November 2010, Lund, Sweden. “**The need for identifying the reactive site in heterogeneous - and electro-catalysis**”

69. Nano and Surface Science Approaches to Production and Storage of Hydrogen, 14-19 November 2010, Noordwijkerhout, The Netherlands, **“New Catalyst for Hydrogen Evolution and oxygen Reduction”**
70. GDCh (Society of German Chemists) Technical University of Munich, Germany 18<sup>th</sup> January 2011, **“Heterogeneous Catalysis: A Part of the Solution for Future Energy Production”**
71. 5<sup>th</sup> Hydrogen & Energy Symposium, Stoos, Switzerland 23-28 January 2011, **“New Catalyst for Hydrogen Evolution and Oxygen reduction“**
72. 2<sup>nd</sup> Workshop of the International Max Planck Research School Complex Surfaces in Material Sciences, Schloss Ringberg, Tegernsee, Germany, 21-25 February 2011, **“Heterogeneous Catalysis: A Part of the Solution for Future Energy Production”**
73. 44. Jahrestreffen Deutsche Chemiker – Reaktionstechnik, 16-18 March 2011, Weimar, Germany, **“Design of new catalysts based on molecular level insight – A surface science approach”**
74. Summer School: Energy and Materials from the Sun, Rolduc Abbey, The Netherlands, 20-23 June 2011. **“Heterogeneous Catalysis: A Part of the Solution for Future Energy Production”**
75. Gordon Research Conference on Clusters, Nanostructures & Nanocrystals, Mount Holyoke College, MA, USA, 24-29 July 2011. **“Mass selected nanoparticles used for modeling catalytic reactions”**
76. SPIE Photonics and Optic Conference San Diego, CA, USA, 21-25 August 2011, **“Bio-inspired co-catalysts bonded to a silicon photocathode for hydrogen evolution”**
77. Japan-EU Workshop “Substitution of Critical Raw materials”, Tokyo Japan, 21-22 November 2011. **“Catalysis for sustainable energy: The challenge of harvesting and converting energy”**
78. MRS fall meeting, Boston, MA, USA, 27 November – 2 December 2011, **“New catalysts for Production of Solar Fuels”**
79. 243<sup>rd</sup> ACS Spring Meeting in San Diego 25-29 March 2012 **“Activity of mass-selected nanoparticles: Correlation of structure and reactivity”**
80. CIMTEC 2012 - 4th International Conference on Smart Materials, Structures and Systems, Montecatini Terme, Italy 10-14 June 2012 **“New catalysts for Production of Solar Fuels”** Keynote lecture at IPS-19 at Caltech, Pasadena, USA, 29 July-3 August, (2012), **“New catalysts for Production of Solar Fuels”**
82. Summer school on Reactivity of nanoparticles for more efficient and sustainable energy conversion -II at Kobæk Strand, Denmark, 5-10 August 2012, **“Energy - do we have a problem?”**
83. Symposium on “The Future of Catalysis” SLAC National Accelerator Laboratory, Stanford, USA, September 26-28, 2012, **“Catalysis for Sustainable Energy”**.
84. The 17th International Conference on Semiconductor Photocatalysis and Solar Energy Conversion (SPASEC-17), Jacksonville, USA 11-15 November 2012, **“New catalyst for HER and CO<sub>2</sub> Hydrogenation in relation to PEC and Solar Fuel Production”**
85. Elementary Reactive Processes at Surfaces, The Lorentz Center, Leiden, Holland, December 3-7, 2012, **“How doing both surface science and electrochemistry helps us forward?”**
86. Deutsche Physikalische Gesellschaft DPG-Frühjahrstagung, Regensburg, Germany, 10 -15 March 2013. **“The origin of the high oxygen reduction activity on PtX (X= Sc, Y, La, Sm, Gd and ..) alloys and their activation mechanism”**.

87. 245<sup>th</sup> ACS Spring Meeting in New Orleans, USA 7-11 April 2013. **“Oxygen Reduction Catalysts and their Activation Mechanism -Understanding the New Class of Pt<sub>3</sub>X, and Pt<sub>5</sub>X (X= Sc, Y, La, Gd and ..)”**
88. Gordon Research Conference on Chemical Reaction at Surfaces, Les Diablerets, Schweiz. 28<sup>th</sup> April – 2 May 2013, **“Correlation of reactivity and activity for single crystals and mass selected nanoparticles”**
89. 223<sup>th</sup> ECS meeting Toronto, Canada, 12-16 May 2013 **“New catalyst for HER and CO<sub>2</sub> Hydrogenation in relation to PEC and Solar Fuel Production”**
90. Conference on Artificial Photosynthesis, Seoul, South Korea, May 26-28, 2013. **“New catalyst for HER and CO<sub>2</sub> Hydrogenation in relation to Solar Fuel Production”**.
91. Summer School: Catalysis for Sustainability, Rolduc, The Netherlands, 23-26<sup>th</sup> June 2013. **“What is the nature of the reactive site for the steam reforming and the methanation reaction?”**
92. Summer school: “Solar Fuel”, Reykjavik, Iceland 25-28<sup>th</sup> June 2013. A) **“Electrochemical reduction of CO<sub>2</sub>; Catalysis at the anode and the Cathode”** and B) **“New catalyst for HER in relation to PEC and Solar Fuel Production”**
93. The SUNCAT Summer Institute, SLAC Stanford University, Menlo Park, CA USA, 25-30 August 2013. **“Electro-catalytic Oxygen Reduction”**
94. ISACS12: Challenges in Chemical Renewable Energy, Cambridge, UK, 3-6 September 2013. **“Understanding the New Class of Pt<sub>3</sub>X, and Pt<sub>5</sub>X Alloys for improving the Oxygen Reduction Catalysts in PEMFC”**
95. Swiss Chemical Society Fall Meeting, Lausanne, 6 September 2013, **“New electro-catalyst alloys for the Oxygen Reduction Reaction (ORR) and Hydrogenperoxide production”**
96. 2<sup>nd</sup> Annual SFB FOXSI Symposium, 18-20 September 2013, Conference Center Burg Schlaining, Stadtschlaining, Austria, **“Rational Design of Oxygen Reduction Reaction and Hydrogen Peroxide Catalysts: From Surface Science to Nanoparticles”**
97. NanoEnergy 2014, 19-21 February (2014) London, UK. **New catalyst for HER and CO<sub>2</sub> Hydrogenation in relation to Solar Fuel Production”**
98. ACS-247<sup>th</sup> Spring Meeting 16-20 March 2014, Dallas, USA **“New catalyst and protection layers for the tandem design for solar water splitting”**
99. **“4<sup>th</sup> International Symposium of Intermetallic Compounds in Catalysis”**, Plenary, 5-9, April, 2014, Santa Margherita Ligure, Italy. **“Intermetallic Compounds and Mass-selected Nanoparticle Alloys for Methanol Synthesis and Oxygen Reduction Reactions”**
100. Discussion meeting NRSC-Catalysis “Solar Fuels”, Eindhoven, The Netherlands, 16 April 2014, **“Issues with respect to electrochemistry and catalytic materials”**
101. MRS Spring Meeting San Francisco, USA 21-25 April 2014, **“Elements of Tandem Devices: New catalyst and protection layers for solar water splitting”**
102. Heraeus Seminar - From Sunlight to Fuels, Bad Honnef, Germany, 11-16 May 2014 **“Coupling of catalysts and protection layers to tandem design for solar water splitting”**

103. E-MRS Lille France, 24-30 May 2014, **“Designing and testing HER and OER catalyst for tandem designs for photo catalysis “**
104. CSI 2014: Cluster Surface Interaction, Lake Varese, Italy 1-4 June 2014 **“Mass-selected Nanoparticle for Heterogeneous and Electro-Catalysis”**
105. NanoGe: New Advances in Materials Research for Solar Fuels Production, Montreal, Canada 24-26 June 2014 **“The challenge of interfacing protection layers and catalysts to tandem design for solar water splitting”**
106. IPS-20, Berlin, Germany, 27 July-1. August 2014 **“Elements of a Tandem Design for Water Splitting: Combining Electrocatalysts with Semiconductors”**
107. LightChEC Program Summer School and Symposium, Les Diablerets, Schweiz. 9-12 September 2014, **“Harvesting solar light with a tandem design: The challenge of integration protection layers and catalyst for solar fuel production”**
108. International Symposium on Electrocatalysis 2014, Whistler, Canada, 26-29 October 2014, **“New Electrocatalysts Alloys for the Oxygen Reduction Reaction and Hydrogenperoxide Synthesis ”**
109. 7th International Symposium on Surface Science (ISSS-7), Matsue, Japan, 2-6 November 2014 **“From surface science to nanoparticles: In search of new electrocatalysts”**
110. 3<sup>rd</sup> International Symposium on Chemistry for Energy Conversion and Storage, Berlin, Germany 18<sup>th</sup> to 21<sup>th</sup> of January 2015, **“The challenge of integrating catalysts to the tandem design for water splitting producing H<sub>2</sub> or possibly CO<sub>2</sub> hydrogenation”**
111. EPFL - EuroTech PhD winter school - Integrated Approaches to Energy Systems, EPFL, Lausanne, Switzerland, 2<sup>nd</sup> -6<sup>th</sup> February, 2015 **“Challenges of designing a Tandem Device for Water splitting I & II”**
112. 2<sup>nd</sup> Solar Fuels Workshop Dead Sea, Israel, 14<sup>th</sup> -19<sup>th</sup> February, 2015, **“The challenge of coupling of catalysts and protection layers to tandem design for solar water splitting”**
113. NANO GE 15, La Palma, Mallorca, Spain, 10<sup>th</sup> -13<sup>th</sup> March 2015. **“The Challenge of Interfacing Protections layers and Catalysts on a Tandem Device for Water Splitting”**
114. ASC 249<sup>th</sup> Meeting, Denver, USA, 22<sup>nd</sup> -26<sup>th</sup> March 2015, **“The Challenge of Interfacing the Tandem Design for Water Splitting”**
115. MRS 2015 Spring Meeting, San Francisco, USA, 6<sup>th</sup> - 10<sup>th</sup> April, 2015 **“Catalysts, Protection layers, and Semiconductors: The Challenge of Interfacing in the Tandem Design”.**
116. Manufacturing of Green Fuels from Renewable Energy, April 14-16, 2015, Risoe Denmark, **“Overview of Electrochemical CO<sub>2</sub> Hydrogenation”**
117. International FOXSI Workshop, May 11-13, 2015 Vienna, Austria, **“Mass-selected Nanoparticles for Investigating Fundamental Aspects of Catalysis”**
118. International Conference on Photocatalysis ICP2015, Jeju Island Korea, 28<sup>th</sup> June - 3<sup>rd</sup> July 2015, **“The Challenge of Protecting and Interfacing Catalysts to a Tandem Device for Solar Water Splitting”**
119. Solar Fuels: Moving from Materials to Devices London, UK 6<sup>th</sup>-8<sup>th</sup> of July, 2015 **“Catalysts, Protection layers, and Semiconductors: The Challenge of designing an efficient device for solar water splitting”**

120. ACS 250<sup>th</sup> Meeting Boston, USA 16<sup>th</sup> - 20<sup>th</sup> August 2015, **“Rational Design of Oxygen Reduction Reaction and Hydrogen Peroxide Catalysts: From Surface Science to Nanoparticles.”**
121. SUNCAT Summer Institute (2015), Stanford University, USA, 24-28 August 2015, **“Catalysis of Model Systems”**
122. CATSENSE Summer School, Brugge, Belgium, 7-11 September, 2015, **“Catalysis for Solar Fuels”**
123. KCK- Chalmers Symposium Frontiers in Environmental Catalysis, 24 September, 2015, **“From Fundamental Surface Science to New Electro-Catalysts for Fuel Cells”**
124. 228<sup>th</sup> ECS Meeting Phoenix, USA, 11-15 October 2015, **“Catalysts, Protection layers, and Semiconductors: The Challenge of Interfacing”**
125. Manfred Eigen Nachwuchswissenschaftler Gespräche, Max Planck Muhlheim, Germany, 6 - 8 April 2016, **“Photo-electro-chemical water splitting and the making of new chemicals”**
126. Symposium on Fundamental X-ray Science and its Application to Catalysis and Water Research: Future Directions Stockholm University, May 12-14, 2016 , **“From Surface Science to Catalysts for Energy conversion”**
127. Summer School Solvation Science, Bochum, Germany, 17-20 May 2016, **“Electrocatalysis for Energy Conversion”**
128. CRC Graduate Academy, Burghausen , Germany, 5-8<sup>th</sup> June, 2016, **“Photo-electrochemical water splitting and the making of renewable chemicals”**
129. EuCheMS-6, Seville, Spain, 11<sup>th</sup>-15<sup>th</sup> September 2016, **“From Surface Science to Nanoparticles: A rational design of new ORR catalysts for Fuel Cells”**
130. DFG SPP 1613 Summer School, Berlin, September 25<sup>th</sup> – 28<sup>th</sup> 2016, **“Water splitting and the making of renewable chemicals”**
131. ECS Pprime Honolulu, Hawaii 2<sup>nd</sup> -7<sup>th</sup> October 2016, **“Water splitting and the making of renewable chemicals”**
132. The Meloche lectures, University of Wisconsin-Madison, Madison, USA, 7-8<sup>th</sup> November 2016, **“Water splitting and the making of renewable chemicals” and “From Surface Science to Nanoparticles: A rational design of Heterogeneous and Electro-Catalysts”**
133. 63<sup>th</sup> AVS Nashville, USA, 6<sup>th</sup> -11<sup>th</sup> November 2016, **“From Surface Science to Nanoparticles: A rational design of Heterogeneous and Electro-Catalysts”**
134. MRS 2016 fall meeting Boston USA, 28<sup>th</sup> November 2<sup>nd</sup> December, **“Water splitting and the making of renewable chemicals”**
135. 2nd International Workshop on Graphene and C3N4-Based Photocatalysts, March 24-27, 2017, Wuhan, China, **“Photo-electro-chemical water splitting and the making of renewable chemicals”**
136. Gastekniske dage, 23-24 May 2017, Billund, Denmark.”**The Villum Center for the Science of Sustainable Fuels and Chemicals”**
137. ElectroCatalysis at the Atomic Scale Summer school 23-26 June 2017, San Sebastian, Spain, **“Photo-electro-chemical water splitting and the making of renewable chemicals”**

138. 2<sup>nd</sup> Symposium of Advanced Lectures on Fundamentals for Solar Energy Conversion: Theory and Experiments. 25<sup>th</sup>-28<sup>th</sup> July 2017, Dalian, China, **“The design and use of tandem devices for capturing solar light for water splitting”**
139. SUNCAT Summer Institute 2017: Fundamentals and Applications of Heterogeneous Catalysis, 14-18 August, 2017, Stanford University, Palo Alto, USA; **“Challenging reactions towards sustainable fuels”**
140. 254<sup>th</sup> ACS Meeting, Washington, USA, 20-25<sup>th</sup> of August 2017; **”Water splitting and the making of renewable chemicals”**
141. NanoGe SolarFuel17 Barcelona Spain 4-7 September 2017; **”Water splitting and the making of renewable chemicals”**
142. Catsense Summer School Leuven, Belgium 11-14<sup>th</sup> September 2017, **“Mass selected cluster for oxygen reduction, oxygen evolution (water splitting) Hydrogen evolution and for CO2 hydrogenation”**
143. 6<sup>th</sup> De Nora R&D Symposium, 27-28<sup>th</sup> September 2017, Milan, Italy, **“The Catalysis for Sustainable Fuels and Chemicals”**
144. 64<sup>th</sup> AVS Meeting, Tampa, USA, 30<sup>th</sup> Oct. - 3<sup>rd</sup> Nov. 2017, **“A Surface Science Approach for New Heterogeneous Catalyst”**
145. KNAW-MCEC outreach symposium 14<sup>th</sup> of December 2017, Utrecht, The Netherlands, **“Catalysis and Sustainability” and “Mass-selected Nanoparticles for Conversion of Sustainable Energy”**
146. Gordon Conference on Renewable Energy: Solar Fuels; Ventura January 26<sup>th</sup> – February 2<sup>nd</sup> 2018 **“The Need for New Photo-Absorbers: Their Protection and Integration with Electro Catalysts for Solar Fuel Production”**
147. EPFL Winter school: Challenges and Opportunities in Energy Research. Crans-Montana, Switzerland 5<sup>th</sup> -9<sup>th</sup> March 2018 **“The making of renewable fuels and chemicals”**
148. The Davidson Lectures, Massachusetts Institute of Technology (MIT), Boston, USA 13-14<sup>th</sup> of March 2018, **“Water Splitting and the Making of Renewable Chemicals” and “A Surface Science Approach for the Making of New Heterogeneous Catalyst”**
149. International Conference on Catalysis and Surface Chemistry, Krakow Poland, 19-22<sup>nd</sup> March 2018, **“Mass-selected nanoparticles for conversion of sustainable energy”**
150. MRS Spring Meeting Phoenix, USA, 2-6 April 2018, **“Mass-selected Nanoparticles for Conversion of Sustainable Energy “**
151. 233<sup>th</sup> ECS, Seattle USA , 13-17 May 2018, **“Electrochemical Ammonia Synthesis - Facts or Dreams?”**
152. 8<sup>th</sup> Forum on New Materials, CIMTEC, Perugia, Italy June 10-14<sup>th</sup>, 2018, **“Strategies for stable water splitting via protected photoelectrodes”**
153. PSI Catalysis Symposium June 14, 2018 **“Catalysis for Conversion of Sustainable Energy “**
154. Cluster-Surface Interaction Workshop CSI Trondheim Norway 19-21<sup>st</sup> I 2018 **“Mass-selected Nanoparticles for Conversion of Sustainable Energy “**



155. Scandem 2018 Kongens Lyngby, Denmark 25-28<sup>th</sup> June 2018, **“Catalysis: A Key Materials for Converting Power into Chemicals and Fuels”**
156. Netherlands conference on Electrochemical Conversion & Materials (ECCM) , Keynote, Den Haag, the Netherlands June 29<sup>th</sup> 2018. **“Electrochemical energy conversion.”**
157. Summer school Power to X: Fundamentals and Applications of Modern Electrosynthesis, Villars sur Ollon, Switzerland 26-30 August 2018, **“A surface Science approach to electrocatalysis: extended surfaces and nanoparticles”**
158. RACIRI Summer school Island of Rugen Germany 25<sup>th</sup> August to 1<sup>st</sup> September 2018: From Basic Science and application to Technologies inspired by Nature **“Nature inspired solar fuel technology”**
159. NIM: The Future of Nanoscience, Tutzing, Germany September 4 - 6, 2018, **“Mass-selected nanoparticles for conversion of sustainable energy”**
160. INL Workshop Solar Fuels production based on Nanostructured Photoelectrodes and Catalysts 29-30 November 2018, Braga, Portugal. **“Catalysis for Conversion of Sustainable Energy “**
161. 10<sup>th</sup> Singapore International Chemistry Conference SICCC10, 16-19 December 2018, Singapore. **“Catalysis for Conversion of Sustainable Energy“**
162. The Royal Society of Science and Letters, 27 of April 2019, **“Heterogeneous Catalysis: The key for conversion of sustainable Energy”**
163. International Bunsen-Discussion-Meeting -1st April - 5th April 2019: Hotel Villa Diodoro, Taormina, Italy **“Catalysis for Conversion of Sustainable Energy”**
164. Creo Syndicate, Copenhagen 15<sup>th</sup> may, 2019.” **The Next Frontier for Sustainable Fuels and Chemistry”**
165. MARC VIII, Cabourgh, France, 19<sup>th</sup> - 23<sup>rd</sup> May 2019, **“Sulfides for HDS and HER: Various aspects of a multipurpose catalysts.”**
166. Gordon Conference on Cluster and Nanoparticles, Les Diablerets, Switzerland, 16<sup>th</sup> - 21<sup>th</sup> June 2019, 19<sup>th</sup> - 23<sup>rd</sup> May 2019, **“Improving Catalyst Performance Using Clusters and Nanoparticles”**
167. SUNCAT Summer Institute, Stanford University 12-16 August 2019, Palo Alto, USA, **“Catalysis for Conversion of Sustainable Energy”**
168. EuropaCat XII Aachen, Germany, August 19-23<sup>th</sup> 2019, Plenary, **“Catalysis for Conversion of Sustainable Energy”**
169. ACS Fall Meeting 25-29 August, 2019 San Diego, USA, **“Catalytic materials for the making of renewable fuels and chemicals”**
170. E-Conversion Conference Venice Italy, 9-13 September 2019, **“Electrocatalysis for conversion of Sustainable Energy”**
171. E-MRS, Warsaw, Poland, 16<sup>th</sup> - 20<sup>th</sup> September 2019, **“Electrochemical Catalysis for Conversion of Sustainable Energy”**
172. E-MRS, Warsaw, Poland, 16<sup>th</sup> - 20<sup>th</sup> September 2019, **“In situ methods for analysis of the ORR, CORR and other energy conversion reactions”**

173. OIST Workshop, Okinawa, Japan, 18-24 October, 2019, **“Mass-selected Nanoparticles for Conversion of Sustainable Energy”**
174. Danish Electrochemistry Society meeting, Comwell Klarskovgaard, Kosør, Denmark, 31 oct-1 Nov. 2019, **“Electrochemical Conversion of Sustainable Energy”**
175. CHAINS National Chemistry Conference in Veldhoven, Netherlands, 9<sup>th</sup>-11<sup>th</sup> December 2019 **“Electrochemical Conversion of Sustainable Energy”**
176. 14th European Nitrogen Fixation Conference, Plenary August Århus Denmark August 2021 (Virtual) **“New Ammonia Catalysts for a Sustainable Energy Scenario”**
177. SunCat Summer Institute 2021, 17-19 August 2021, (Virtual) Stanford University, USA **“Electrochemical Ammonia Synthesis”**
178. XXIV International Conference on Chemical Reactors ChemReactor-24 Milano (Virtual) Plenary September 12-17, 2021, **“Conversion of Sustainable Energy: Electrified Reactors”**.
179. Catchy kick-off training, Leuven, Belgium (Virtual) 15<sup>th</sup> September 2021 **“Clusters for conversion of sustainable energy”**
180. Recent developments in Gas Phase Synthesis of Nanoparticles and applications Madrid Spain (Virtual) 15 September 2021, **“Mass-Selected Nanoparticles for Water splitting”**.
181. Dansk Kedel og kraftværkselskab, Copenhagen, Denmark, 2<sup>nd</sup> December 2021, **”Hvad er udfordringerne i Power-to-X?”**
182. 758. Wilhelm and Else Heraeus- Seminar , 10-13 January 2022, Bad Honnef, **”Experimental Aspects of Electrochemical Ammonia Synthesis”**
183. ELCAT Winter School 7-11 February 2022, Antwerp Belgium, **“Electrochemical NH<sub>3</sub> Reduction”**
184. ACS Spring Meeting 2022, 20-25 March 2022, San Diego , USA, **“Mass-selected cluster for Conversion of Sustainable Energy ”**
185. 3rd ComBioCat Symposium, Rostock, Germany, 8-9 June, 2022, Plenary **”Electrochemical Ammonia Synthesis”**
186. The SurfCat summer school, Kysthusene, Gilleleje, Denmark, 7-11 August, 2022, **”Electrochemical Ammonia Synthesis”**
187. E-MRS 2022, Warsaw, Poland 19-22 September 2022, Keynote **”Electrochemical Ammonia Synthesis”**
188. Electrochemistry 2022, Berlin, Germany, 27-30 September , 2022, Plenary **” Electrochemical activation of molecular nitrogen to ammonia”**
189. 3<sup>rd</sup> KAIST Emerging materials e-Symposium, December, Kaist Korea 2022, Plenary **”Challenges of Electrochemical Ammonia Production”**
190. DISTINGUISHED LECTURESHIP for NUS Centre for Hydrogen Innovations (CHI) March, 2023, Singapore **”Challenges of Nitrogen Activation”**
191. TUM-IAS General Assembly , 3-4 May 2023, Garching Germany, **“Electrifying Chemical Production: Electrochemical Ammonia Synthesis ”**

192. Fuel Science: From Production to Propulsion 11th International Conference on Fuel Science May 23 - 25, 2023 Eurogress, Aachen, Germany , "**Ammonia in a Sustainable Energy Framework**"
193. 60-year Anniversary of the Journal of Catalysis Symposium, June 18, 2023 Omni Hotel, Providence RI, USA "**Re-Thinking our Chemical Production**"
194. North American Catalysis Society 21, NAM 21, June 19-23, 2023 Omni Hotel, Providence RI, USA Keynote, "**Electrochemical Activation of Molecular Nitrogen to Ammonia: Scaling up**"
195. The 21st National Conference on Catalysis of the Chinese Chemical Society, Kunming, China, July 21-25, 2023, Plenary "**Electrifying Chemical Production**"
196. SUNCAT Summer Institute, Stanford University, Palo Alto, USA, 7-11 August 2023, "**The Challenge of Activating Nitrogen**"
197. NanoG Matsus23, Malaga, Spain, 18-21 Oct, 2023, "**Electrochemical activation of molecular nitrogen to ammonia**"
198. Forum on Green Catalysis Utilizing and Producing Renewable Energies Hefei China 21-23 Oct 2023, "**Electrifying Chemical Production: Electrochemical Ammonia Synthesis**"
199. FUNCAT Symposium, Mulheim, Germany 22-23 November 2023, "**New routes of ammonia synthesis**"
200. Deutsches Physikalische Gesellschaft GPG Conference in Berlin, Germany March 17<sup>th</sup> to 22<sup>nd</sup> 2024 "**A surface science approach to thermal and electrochemical ammonia synthesis**"
201. Cluster-surface Interactions for energy applications, Bernried, Germany 7-10 April 2024, "**Single crystals and mass-selected nanoparticles for ammonia synthesis**"
202. SurfCat summerschool 12<sup>th</sup> - 17<sup>th</sup> August 2024 Kobæk Strand, Denmark, "**Ammonia**"
203. Materials Challenges in Alternative and Renewable Energy (MCARE 2024), Jeju, South Korea, from August 19<sup>th</sup> to 23<sup>rd</sup>, 2024. Keynote "**Progress in thermal and electrochemical ammonia synthesis**"
204. 2<sup>nd</sup> International Workshop: Challenges in Renewable Energy Conversion, at Castle Liblice, Czech Republic, 1<sup>st</sup>-4<sup>th</sup> September , 2024, Keynote "**New Routes of Ammonia Synthesis and Decomposition**"
205. 3<sup>rd</sup> Symposium on Ammonia Energy, 24<sup>th</sup>-26<sup>th</sup> September Shanghai, China. Plenary. "**New Routes of Ammonia Synthesis and Decomposition**"
206. 7<sup>th</sup> International Symposium on Solar Fuels and Solar Cells, 24<sup>th</sup>-27<sup>th</sup> September, Dalian, China. Plenary "**New Routes of Ammonia Synthesis**"

Beyond these invited contributions, a similar number of talks were given at conferences, workshops, and seminars all over the world.