Women in Electron Microscopy

- Breaking Barriers and Building Networks –

08. – 10. October 2025

Forschungszentrum Jülich

Germany

endorsed by

IFSM International Federation of Societies for Microscopy

European Microscopy Society

DGE Deutsche Gesellschaft für Elektronenmikroskopie

MSA Microscopy Australia

RMS Royal Microscopical Society

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ORGANIZERS

Lidia Kibkalo
Dr. Genevieve Wilbs
Dr. Yan Lu
Dr. Irene Vercellino
Dr. Saba Shahzad

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ACKNOWLEDGEMENTS

The organizers gratefully acknowledge support of WeM 2025 by these enterprises and organizations:

Based on the scientific quality, educational merits, international dimension, and student support of the present event, The European Microscopy Society (EMS) has granted a sponsorship for WeM 2025.

Furthermore, the event is endorsed by the International Federation of Societies for Microscopy, as well as the Deutsche Gesellschaft für Elektronenmikroskopie, Microscopy Australia, and the Royal Microscopical Society.

In addition, the event has a media partnership with the Microscopy and Analysis Magazine and is supported by Techniker Insurance through their health partnership with Forschungszentrum Jülich.

PREFACE

The first Women in Electron Microscopy Event will be held from October 8 to 10, 2025, on the campus of Forschungszentrum Jülich (FZJ), Germany. WeM is a landmark initiative, designed to foster a supportive, inclusive, and visible community of women in microscopy.

In many scientific fields — including electron microscopy — women continue to be underrepresented. WeM addresses this imbalance by providing a dedicated space for networking, mentorship, open dialogue, and empowerment. This event offers not only scientific sessions but also targeted discussions, workshops, and a panel on gender equality — all intended to surface strategies, share experiences, and inspire action.

The programme features keynote lectures from leading figures in the field, invited talks, and a broad poster session. In addition, the event includes Young Scientist Pitch presentations, lab and campus tours, and a Career Pathways Workshop aimed at connecting early-stage researchers with mentors, peers, and industry partners.

WeM is supported and endorsed by prominent enterprises and organizations. The organizers gratefully acknowledge their sponsorship and endorsement.

Because WeM seeks to be more than a conference, we hope this gathering will help build lasting professional relationships, strengthen visibility of women in electron microscopy, and catalyse new collaborations. We trust that the environment at Jülich will be intellectually stimulating, supportive, and memorable — a space in which you feel encouraged to share, learn, grow, and connect.

PROGRAM OVERVIEW

Wednesday 08th October		Thursday 9th October		Friday 10th October	
		07:15	Bus transfer from B&B to FZJ	07:15	Bus transfer from B&B to FZJ
		07:45	Bus transfer from Einhorn to FZJ	07:45	Bus transfer from Einhorn to FZJ
		08:30	Keynote: Materials Science **Jin Won (Maria) Seo**	08:30	Keynote: Breaking Barriers **Melina Dederichs**
		09:00	Keynote: Materials Science **Regina Ciancio**	09:00	Keynote: Female Empowerment **Nicole Amberg**
		09:30	Keynote: Life Sciences **Marta Carroni**	09:30	Encourage the next generation **Lidia Kibkalo & Eva Robens**
		10:00	Keynote: Life Sciences **Peijun Zhang**	10:00	Coffee
		10:30	Young Scientist Pitches	10:30	Young Keynote **Irene Vercellino**
		11:00	Coffee	11:00	Young Keynote **Meghna Gupta**
10:45	Bus transfer from B&B to FZJ	11:30	Lab Tour / Campus Tour	11:30	Young Keynote **Thérèse Cibaka**
11:15	Bus transfer from Einhorn to FZJ				
12:00	Registration & Welcome Reception with Fingerfood			12:00	Young Keynote **Yan Lu**
		12:30	Lunch Buffet	12:30	Young Keynote **~~Hoelen~~ Robert Sabrina Berkamp**
13:00	Welcome Speech **Ina Brandes / Kobus Kuipers / Rafal Dunin-Borkowski**			13:00	Closing Speech **Astrid Lambrecht**
13:30	Talk: Statistics & Dynamics **Saba Shahzad**	13:30	Keynote: Industry - TFS MS **Maria Meledina**	13:30	Lunch Buffet
		13:45	Keynote: Industry - TFS LS **Lingbo Yu**		
14:00	International Keynote **Laure Bourgeois**	14:00	Keynote: Industry - Hitachi **Heather Berensmann**		
14:30	International Keynote **Bridget Carragher**	14:30	Keynote: Industry - Quantum Detectors **Nina Dimova**	14:30	Bus transfer to Hotel B&B, Einhorn and Düren main station
15:00	Coffee	15:00	Keynote: Industry - CryoCloud **Ieva Drulyte**		
15:30	International Keynote **Miyoung Kim**	15:30	Keynote: Industry - condenZero **Amelia Estry**		
		15:45	Keynote: Industry - Bruker **Meiken Falke**		
16:00	International Keynote **Grace Burke**	16:00	Workshop Introduction **Genevieve Wilbs**		
16:30	International Keynote **Kerstin Volz**	16:30	Coffee		
17:00	International Keynote **Patricia Kooyman**	17:00	Building Networks: From Academia to Industry and Beyond		
17:30	Panel Discussion Promoting Gender Equality in the EM field				
18:30	Poster Session & Fingerfood	18:30	Dinner & Awards		
20:00	Bus transfer to Hotel B&B and Einhorn	20:00	Bus transfer to Hotel B&B and Einhorn		

Wednesday, October 8th, 2025

10:45

🚌 Bus transfer from hotel B&B to FZJ

11:15

🚌 Bus transfer from hotel Rotes Einhorn to FZJ

12:00

📝 Registration & Welcome Reception with Fingerfood

SESSION 1

Seminar room

13:00

🎙️ Welcome Speech

Speakers: Ina Brandes, Kobus Kuipers, Rafal Dunin-Borkowski

13:30

📊 **Talk**: *Demographics for Women in Electron Microscopy*

Speaker: Saba Shahzad / Forschungszentrum Jülich, Germany

14:00

🌍 **International Keynote**: *Imaging Solid State Transformations in Materials*

Speaker: Laure Bourgeois / Monash University, Australia

14:30

🌍 **International Keynote**: *Tools and Technologies for Cryo-ET*

Speaker: Bridget Carragher / Chan Zuckerberg Imaging Institute, USA

15:00

📸 Group Photo

15:10

☕ Coffee Break

15:30

🌍 **International Keynote**: *Toward a 3D Understanding of Plasmonic Nearfields in a Chiral Nanoparticle via Electron Spectroscopies*

Speaker: Miyoung Kim / Seoul National University, South Korea

16:00

🌍 **International Keynote**: *Advancing our Understanding of Materials Performance in Challenging Environments: The Role of Correlative Characterization*

Speaker: Grace Burke / Idaho National Laboratory, USA & University of Manchester, UK

16:30

🌍 **International Keynote**: *4D-STEM for the Understanding of Energy Materials*

Speaker: Kerstin Volz / Philipps-University Marburg, Germany

17:00

🌍 **International Keynote**: *Bridging the Pressure Gap in TEM*

Speaker: Patricia Kooyman / University of Cape Town, South Africa

PANEL DISCUSSION

Seminar room

17:30

🗣️ Panel Discussion: Promoting Gender Equality in the EM Field

Catherine Venien-Bryan / Sorbonne Université, France
Laure Bourgeois / Monash University, Australia
Katharina Hipp / Max Planck Institute for Biology, Germany
Grace Burke / / Idaho National Laboratory, USA & University of Manchester, UK
Treva Brown / Microscopy Society of America, USA
Patricia Kooyman / University of Cape Town, South Africa
Marta Carroni / Stockholm University, Sweden

POSTER SESSION

please note that poster sessions M and L will run in parallel

POSTER SESSION M: Foyer

18:30

🗞️ Poster Session & Fingerfood – see poster program

POSTER SESSION L: Corridor

18:30

🗞️ Poster Session & Fingerfood – see poster program

20:00

🚌 Bus transfer to hotel B&B and Rotes Einhorn

Thursday, October 9th, 2025

07:15

🚌 Bus transfer from hotel B&B to FZJ

07:45

🚌 Bus transfer from hotel Rotes Einhorn to FZJ

SESSION 2

Seminar room

08:30

🔬 **Materials Science Keynote**: *Complex Oxide Thin Films: A Playground for Electron Microscopy*
Speaker: Jin Won (Maria) Seo / KU Leuven, Belgium

09:00

🔬 **Materials Science Keynote**: *Mapping the Missing: Correlating Atomic-Scale Imaging and Spectroscopy of Oxygen Vacancies in Oxide Films*
Speaker: Regina Ciancio / Area Science Park, Italy

09:30

🧬 **Life Sciences Keynote**: *Structural Basis for Bacterial Protein Disaggregation and Proteolysis*
Speaker: Marta Carroni / Stockholm University, Sweden

10:00

🧬 **Life Sciences Keynote**: *The Journey of the HIV-1 Capsid: From Assembly to Nuclear Entry*
Speaker: Peijun Zhang / University of Oxford & Diamond Light Source, UK

10:30

👨‍🔬 **Young Scientist Pitches**
Speaker: Shani Tcherner Elad / Anat Akiva / Sophie Kopetschke / Hannah Cole / Mattea Mačkić Jovanović

11:00

☕ Coffee Break

LAB / CAMPUS TOUR

please note that all tours will run in parallel

Meeting point: Foyer

11:30 – 12:30

🔬 Lab Tour Materials Science

11:30 – 12:30

🧬 Lab Tour Life Sciences

11:30 – 12:30

🏛️ Campus Tour

12:30

🍽️ Lunch Buffet

SESSION 3

Seminar room

13:30

🔧 **Industry Keynote:** *How to Leverage Your Workhorse Talos TEM for Analysis of Sophisticated Modern Materials?*
Speaker: Maria Meledina / Thermo Fisher Scientific

13:45

🔧 **Industry Keynote:** *Direct Electron Detector Development to Enhance Image Contrast for Cryo-Electron Microscopy*
Speaker: Lingbo Yu / Thermo Fisher Scientific

14:00

🔧 **Industry Keynote:** *Thinking Outside the Box in Making Cryo-EM More Accessible for Everyone*
Speaker: Heather Berensmann / Hitachi High-Tech

14:30

🔧 **Industry Keynote:** *Imaging Resolution of the Timepix4 for Transmission Electron Microscopy*
Speaker: Nina Dimova / Quantum Detectors

15:00

🔧 **Industry Keynote:** *Accelerating Cryo-EM Data Analysis with CryoCloud*
Speaker: Ieva Drulyte / CryoCloud

15:30

🔧 **Industry Keynote:** *Liquid Helium TEM Sample Holder: Swift Cooldown and Long Holding Time*
Speaker: Amelia Estry / condenZero

15:45

🔧 **Industry Keynote:** *Element Identification on the Atomic Scale and How to Get There*
Speaker: Meiken Falke / Bruker

WORKSHOP

WORKSHOP INTRODUCTION: Seminar room

16:00

💬 **Workshop Introduction**: *From Academia to Industry and Beyond*
Speaker: Genevieve Wilbs / Forschungszentrum Jülich, Germany

16:30

☕ Coffee Break

please note that workshop sessions M and L will run in parallel

WORKSHOP SESSION M: Foyer

17:00

📓 Workshop Session – see workshop program

WORKSHOP SESSION L: Corridor

17:00

📓 Workshop Session – see workshop program

DINNER & AWARDS

Seminar room

18:30

🏆 **Best Poster Award**

Host: Joachim Mayer / Forschungszentrum Jülich, Germany

18:40

🏆 **TFS Prize Handover**

Host: Lingbo Yu / Thermo Fisher Scientific

18:45

🍽️ Dinner

20:00

🚌 Bus transfer to hotel B&B and Rotes Einhorn

Friday, October 10th, 2025

07:15

🚌 Bus transfer from hotel B&B to FZJ

07:45

🚌 Bus transfer from hotel Rotes Einhorn to FZJ

SESSION 4

Seminar room

08:30

🚀 **Keynote**: *In But Not Up: Understanding and Addressing Structural Barriers for Women in Science*
Speaker: Melina Dederichs / The Yellow Project & University of Applied Sciences Düsseldorf, Germany

09:00

🚀 **Keynote**: *The Many Routes of the STEM fatale Initiative to Promote Gender Equality in STEM*
Speaker: Nicole Amberg / Medical University of Vienna, Austria

09:30

🌱 **Talk**: *Inspiring the Next Generation: Engaging Girls in Electron Microscopy at ER-C*
Speakers: Lidia Kibkalo & Eva Robens / Forschungszentrum Jülich, Germany

10:00

☕ Coffee Break

SESSION 5

Seminar room

10:30

🌱 **Young Keynote**: *How Structure Enables Function in Mitochondria*
Speaker: Irene Vercellino / Forschungszentrum Jülich, Germany

11:00

🌱 **Young Keynote**: *Substrate Transport Across Peroxisomal ABC Transporters*
Speaker: Meghna Gupta / Oregon Health & Science University & UCSF, USA

11:30

🌱 **Young Keynote**: *Consistent CO_2 Reduction Performance of Ag Nanoparticle Gas Diffusion Electrode Under Realistic Dynamic PV-Powered Conditions*
Speaker: Thérèse Cibaka / Forschungszentrum Jülich & TU Berlin, Germany

12:00

🌱 **Young Keynote**: *Electrostatic Potential of Latex Sphere Using Off-Axis Electron Holography*
Speaker: Yan Lu / Forschungszentrum Jülich, Germany

12:30

🌱 **Young Keynote**: *In Situ Structural Organization of the p62 Autophagy Cargo Receptor Studied with CLEM*
Speaker: Sabrina Berkamp / Forschungszentrum Jülich, Germany

CLOSING

Seminar room

13:00

🎙️ Closing Speech

Speaker: Astrid Lambrecht, / Forschungszentrum Jülich, Germany

12:30

🍽️ Lunch Buffet

14:30

🚌 Bus transfer to hotel B&B, Rotes Einhorn, and Düren Main Station

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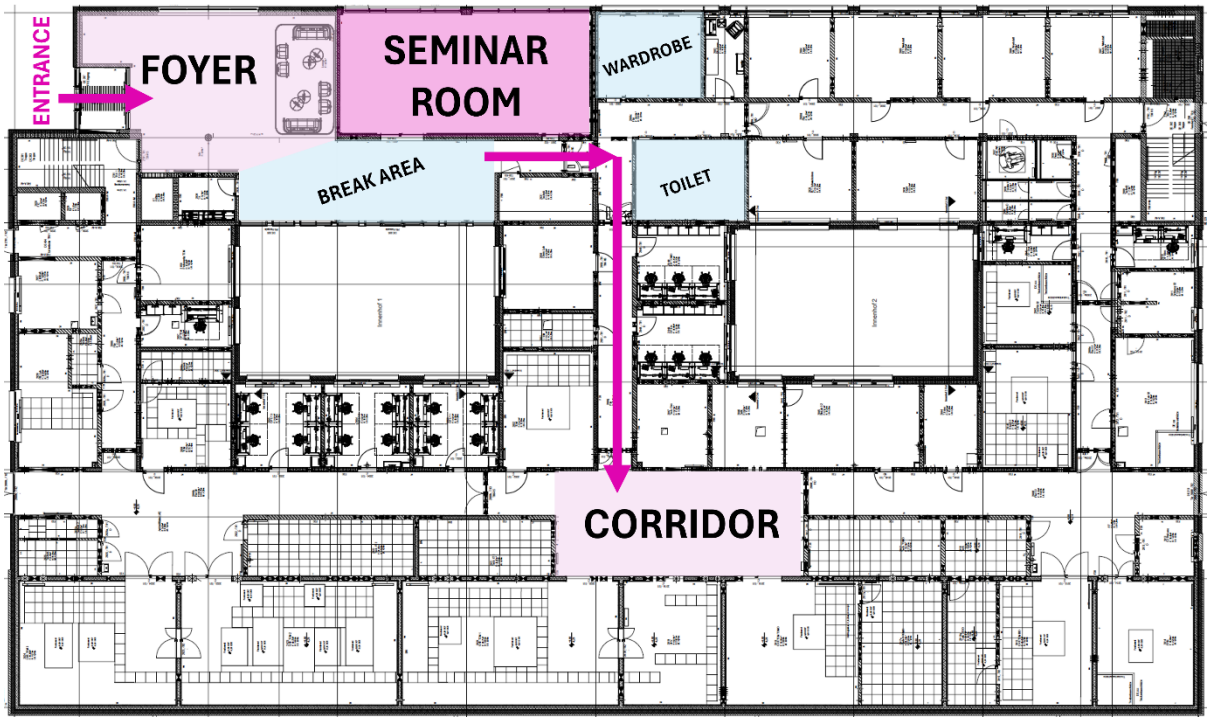
POSTER PROGRAM

October 8th, 2025 / 18:30

please note that poster sessions M and L will run in parallel

POSTER SESSION M: Foyer

POSTER SESSION L: Corridor



FOYER: POSTER SESSION M

MA: Electron Microscopy for Functional Materials: Photocatalysis, Energy Conversion, and Environmental Remediation

MA1

Title: Low-Temperature Plasma-Enhanced Atomic Layer Deposition of ZnO Thin Films for Photocatalytic Degradation of Microplastics
Presenter: Daria Jardas Babić / University of Rijeka, Croatia

MA2

Title: Towards Operando Electron Pair Distribution Function Analysis of Nanoparticle-Based Catalysts
Presenter: Diana Piankova / ETH Zurich, Switzerland

MA3

Title: The Role of Electron Microscopy in Analyzing the Photocatalytic Performance of TiO_2-Cu Nanocomposite ALD Films
Presenter: Ivana Jelovica Badovinac / University of Rijeka, Croatia

MA4

Title: Structural Analysis of CNTs Used as LIB Anodes
Presenter: Shriya Agarwal / RWTH Aachen University, Germany

MA5

Title: CANCELLED

MA6

Title: Technological Advances for Temperature Dependent Liquid and Electrochemical Studies Using In Situ TEM
Presenter: Nynke Krans / Protochips, USA

MA7

Title: Optimizing ALD-Grown SnO_2 Thin Films for Photocatalytic Applications
Presenter: Mattea Mačkić Jovanović / University of Rijeka, Croatia

MA8

Title: Tracking the Crystalline-Amorphous Transition During Lithiation of Silicon Microparticles
Presenter: Helen Valencia / Forschungszentrum Jülich & RWTH Aachen, Germany

MA9

Title: Structural and Photocatalytic Properties of Cu-Doped TiO_2 Films Synthesized by ALD
Presenter: Ivna Kavre Piltaver / University of Rijeka, Croatia

MB: Correlative and In Situ Electron and Scanning Probe Microscopy of Magnetic, Structural, and Mechanical Phenomena

MB1

Title: In Situ-Laser Beam Micro Welding of Aluminum Alloys 5083 and 6060 Inside Large Chamber SEM
Presenter: Shohreh Khatami / RWTH Aachen University, Germany

MB2

Title: Magnetic Characterisation of Mechanically Exfoliated Fe_5GeTe_2 Flakes
Presenter: Renu Rani / Forschungszentrum Jülich, Germany

MB3

Title: Exploring Magnetic Properties and Corrosion Resistance in Recycled and Cryogenically Treated Nd-Fe-B Permanent Magnets
Presenter: Melissa Röhrig / Max Planck Institute for Sustainable Materials, Germany

MB4

Title: Temperature-Induced Magneto-Structural Evolution in CoFeNiMn Alloy
Presenter: Tatiana Smoliarova / University of Duisburg-Essen, Germany

MB5

Title: In-Situ TEM Study of the Effect of Hydrogen on Crack Propagation in Steel
Presenter: Lin Tian / University of Göttingen, Germany

MB6

Title: Correlative TEM and APT Study of Microstructural Origins of Coercivity in Sm–Co–Cu Magnets
Presenter: Mythri Vathuppan / TU Darmstadt, Germany

MB7

Title: Atom Force Microscopy – A Glimpse Beyond Surface
Presenter: Patricia Jovičević-Klug / Max Planck Institute for Sustainable Materials, Germany

MC: Frontiers in Advanced Electron Imaging: 4D-STEM, Holography, and Ptychography for Complex Materials

MC1

Title: Structural Analysis of Au–Pd–Pt–Ru Compositionally Complex Solid Solution Thin Films Using 4D-STEM
Presenter: Miran Joo / Max Planck Institute for Sustainable Materials, Germany

MC2

Title: The Magnetic Microstructure in FeCo Alloys and Its Interaction with Non-Magnetic Inclusions
Presenter: Hannah Cole / University of Cambridge, UK

MC3

Title: Surface Fermi Level Pinning Effect on Phase Contrast in GaN by Electron Holography
Presenter: Qianqian Lan / Forschungszentrum Jülich, Germany

MC4

Title: Unveiling Chemical Ordering Mediated Superstructure in Copper Sulfide Using Correlative 4D-STEM and STEM-EDS
Presenter: Natalie Wende / Forschungszentrum Jülich, Germany & ETH Zürich, Switzerland

MC5

Title: Enabling Atomic-Scale Imaging of Fragile Materials Through Dose-Efficient Ptychography
Presenter: Tamazouzt Chennit / University of Antwerp, Belgium

MS: Sponsors

MS1

Title: Correlative Multimodal Analytical Workflow with STEM-CL and EDS for Functional Nanomaterials
Presenter: Maria Meledina / Thermo Fisher Scientific

MS2

Title: Development of an FIB-TEM Compatible MEMS Heating Holder for In-Situ TEM Observation of Specific Areas
Presenter: Toshie Yaguchi / Hitachi High-Tech

MS3

Title: Advancing TEM Resolution with Merlin T4 and Timepix4
Presenter: Nina Dimova / Quantum Detectors

MS4

Title: Liquid Helium TEM Sample Holder with Rapid Cool-Down and Extended Hold Time
Presenter: Amelia Estry / condenZero

MF: Miscellaneous

MF1

Title: The yDGE Supports Early-Career Microscopists to Build Their Network
Presenter: yDGE Team / Deutsche Gesellschaft für Elektronenmikroskopie e.V, Germany

MF2

Title: Microscopy Australia: Open Access Instruments and Experts
Presenter: Lisa Yen / Microscopy Australia, Australia

CORRIDOR: POSTER SESSION L

LA: Advances in Cryo-Electron Microscopy and Correlative Imaging for 3D Tissue and Cellular Ultrastructure

LA1

Title: A 3D Live-to-Cryo Correlative Workflow Reveals Nanoscale Structural and Biochemical Organization in Zebrafish Scale ECM
Presenter: Anat Akiva / Electron Microscopy Center, Radboud University Medical Center, The Netherlands

LA2

Title: Investigating Aberrant Keratin Structures in Epidermolysis Bullosa Simplex Using Cryo-CLEM
Presenter: Lisa Jungbluth / RWTH Aachen University, Germany

LA3

Title: Structural Investigation of Amyloid Fibril Formation in Medical Insulin by Cryo-EM
Presenter: Simon Sommerhage / Forschungszentrum Jülich, Germany

LA4

Title: CANCELLED

LA5

Title: An Engineered Platform to Study the Influence of Extracellular Matrix Nanotopography on Cell Ultrastructure
Presenter: Shani Tcherner Elad / Technion – Israel Institute of Technology, Israel

LA6

Title: Enhancing Precision and Throughput in Cryo-FIB Milling via an Optimized Correlative Imaging Workflow
Presenter: Marit Smeets / Delmic, The Netherlands

LB: Cryo-Electron Tomography and Correlative Cryo-EM of Macromolecular Machines in Native Contexts

LB1

Title: Translation in a Thermophilic Eukaryote Visualized In Situ Using Cryo-Electron Tomography
Presenter: Sophie Kopetschke / University of Heidelberg, Germany

LB2

Title: Visualizing the (Ultra-)Structural Architecture of the Golgi-Associated Cytoskeletal Filaments by Cryo-Electron Tomography
Presenter: Delnia Nazari / IGBMC & Université de Strasbourg & Inserm & CNRS, France

LB3

Title: Cryo-STEM of Biological Macromolecules: Visualization by Integrated Differential Phase Contrast
Presenter: Aikaterini Filopoulou / Forschungszentrum Jülich, Germany

LB4

Title: Blueprint of Precision: Determining the Structure and Role of the Elongator Complex in Protein Synthesis
Presenter: Paulina Indyka / Jagiellonian University, Poland

LC: Ultrastructural Imaging of Disease Mechanisms and Therapeutic Interventions

LC1

Title: Monosodium Glutamate-Induced Cardiac Tissue Damage and the Potential Ameliorative Effect of Apocynin
Presenter: Sezin Çevik / Acıbadem University, Turkey

LC2

Title: SEM Analysis of Acanthamoeba Alterations Induced by *Garcinia brasiliensis* Extract
Presenter: Diana Mendonça / University of Aveiro, Portugal

LC3

Title: Immunohistochemical and Ultrastructural Evaluation of a Scaffold-Based Therapeutic Approach in Liver Fibrosis
Presenter: Gökçen Özgün / Acibadem Mehmet Ali Aydinlar University, Turkey

LC4

Title: Tale of Two Viruses: Insights into the Synergy Between Novel Archaeal Viruses
Presenter: Lauren Queiss / Max Planck Institute for Marine Microbiology, Germany

LC5

Title: Liquid Phase Electron Microscopy (LP-EM) of Biocrystallization Processes
Presenter: Avital Wagner / Radboudumc, The Netherlands

LS: Sponsors

LS1

Title: Pixel Design to Enhance Signal-to-Noise Ratio in Direct Electron Detector for Cryo-Electron Microscopy
Presenter: Lingbo Yu / Thermo Fisher Scientific

LS2

Title: Automating Cryo-EM Data Analysis by Leveraging AI, Novel Algorithms & Large Scale Analysis
Presenter: Robert Englmeier / CryoCloud

LS3

Title: Quantitative EDS Supporting AlGaN-Based LEDs for Skin-Tolerant Disinfection and More Life Science?
Presenter: Meiken Falke / Bruker

LF: Miscellaneous

LF1

Title: Cryo-EM Instrumentation at the Ernst RuskaCentre: Enhanced Platforms for Cryo-STEM Workflows and CryoCLEM
Presenter: Thomas Heidler / Forschungszentrum Jülich, Germany

WORKSHOP PROGRAM

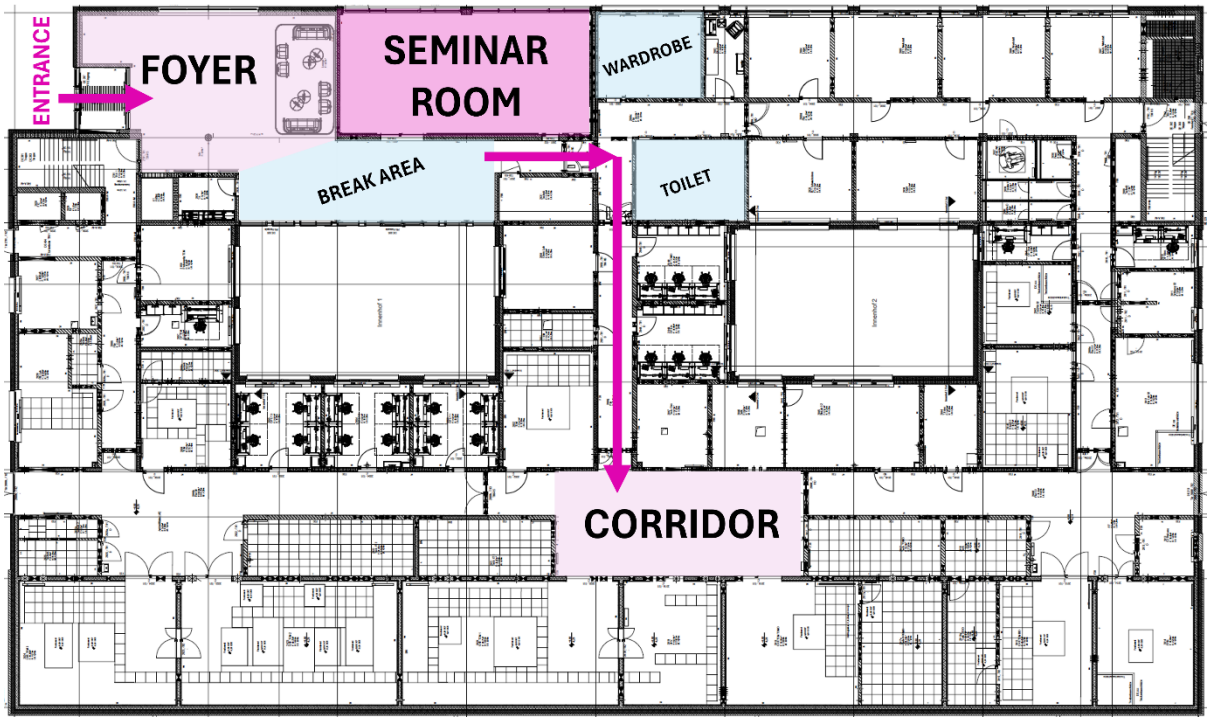
October 9th, 2025 / 17:00

During the workshop session, tables will be set up in the foyer and corridor. Each table will be hosted by either one of our mentors, an industry representative, or a career support advisor. You are warmly invited to approach any of them directly to discuss what matters most to you—whether it's a scientific question, career development advice, or any other topic you would like to explore.

please note that workshop sessions M and L will run in parallel

WORKSHOP SESSION M: Foyer

WORKSHOP SESSION L: Corridor



FOYER: WORKSHOP SESSION M

MENTORS

Laure Bourgeois

Laure has been in the field of electron microscopy for over 30 years. After a PhD at the University of Melbourne and research fellowships at the National Institute for Materials Science (NIMS) in Japan, she moved to Monash University. She then joined the nascent Monash Centre for Electron Microscopy (MCEM) as a microscope scientist and research academic. She is currently a Professor and the Interim Academic Director of MCEM. She is also affiliated with the Department of Materials Science and Engineering. Her main research interest is the application of high-resolution transmission electron microscopy techniques for the characterisation of inorganic materials, with emphasis on nanoscale, aperiodic and defective structures. Her current work focuses on solid-solid phase transformations in light metals and in particular solid-state nucleation mechanisms. As an academic, Laure has supervised and mentored 15(1) PhD (Masters) students and 5 postdoctoral fellows. She is presently co-supervising 6 PhD students. She has developed and delivered several undergraduate lecture courses on the characterisation of materials, working closely with postgraduate student demonstrators to optimise laboratory courses. In her role as a microscope scientist, Laure has provided expert advice to and supported the research of over one hundred postgraduate students and research fellows from a wide range of backgrounds. She has organised several workshops on electron microscopy and crystallography aimed primarily at postgraduate students and early-career researchers. In her current position, she advises her MCEM colleagues on academic matters. Laure is a member of the Australian Microscopy and Microanalysis Society and has been promoting electron microscopy via the Education Committee of Microscopy Australia and the International Union of Crystallography's Commission on Electron Crystallography.

Grace Burke

Grace Burke received her BS in Metallurgical Engineering from the University of Pittsburgh, and her PhD in Metallurgy from Imperial College of Science and Technology. Her research has focused on the role of microstructure in materials performance – particularly the environment-sensitive behavior of materials. She recognized for her expertise in advanced microstructural characterization, irradiation damage/embrittlement, SCC and structural materials for nuclear power applications. Her career has included ~30 years in industry, including US Steel Research Laboratory, Westinghouse Science & Technology Center, and the Bettis Atomic Power Laboratory, followed by 10 years in academia as Professor and Director of the Materials Performance Centre (and Director of the Electron Microscopy Centre from 2012 through 2016) at the University of Manchester, where she is now Professor Emeritus. Grace joined Idaho National Laboratory in 2023 as INL Laboratory Fellow and Scientific Lead for Reactor Structural Materials at the Materials and Fuels Complex, and was previously a Corporate Fellow at ORNL. Grace was the 2019-2023 President of the Royal Microscopical Society and the 2005 President of the Microscopy Society of America. Fellow of TMS, ASM International, IOM3 (UK), the Microscopy Society of America and the MicroAnalysis Society, and is an Honorary Fellow of the Royal Microscopical Society. Awards include IMS/ASM Sorby Award, ASM Charles S. Barrett Silver Medal, the Coriou Medal of the European Federation of Corrosion, ANS Mishima Award, and was the 2025 Hume-Rothery Lecturer at the University of Oxford. Grace has authored or co-authored over 200 publications.

Patricia Kooyman

Drawing on personal experiences of hardship and gender discrimination, Patricia mentors mainly by asking questions and helping people analyse their own feelings about and reactions to life circumstances. Mentees learn a way of thinking and approaching issues that will serve them throughout the rest of their life and is applicable to any situation in life, whether in a work setting or outside of work. Having bridged multiple cultures through her parents heritage, travelling extensively, and emigrating to another continent, Patricia has developed a flexibility and an open mind that she tries to use to help people get unstuck, grow, and flourish – both in their professional and personal life. Having worked both at an international company and in different academic settings, Patricia is well versed in all kinds of different work cultures.

Jin Won (Maria) Seo

Prof. Jin Won (Maria) Seo earned her Master's and PhD degree in physics from RWTH Aachen University in Germany and completed her PhD under the supervision of Prof. Urban and Dr. Kabius at the Research Centre Jülich. Her postdoctoral experience includes positions at the Electron Microscopy for Materials Science (EMAT) group at the University of Antwerp with Prof. Nick Schryvers, and at the IBM Zurich Research Laboratory in Switzerland, where she was responsible for managing the TEM laboratory. Prof. Seo joined KU Leuven in 2007 after her tenure at EPFL in Switzerland, where she worked as a postdoctoral researcher and later as a scientific staff member at the Institute of Physics of Complex Matter (IPMC), with access to the CIME microscopy center. Currently, she is a full professor in the Department of Materials Engineering (MTM) at KU Leuven, Belgium, and co-leads the Functional Oxide Coating Centre, a collaborative initiative between the Department of Materials Engineering and the Department of Solid State Physics and Astronomy at KU Leuven. Additionally, she serves as the scientific head of KU Leuven's Electron Microscopy Core Facility, overseeing a wide range of instrumentation including SEM, SEM-FIB, ESEM, EPMA, and TEM with more than 100 users. She has been instrumental in establishing and expanding the university's TEM capabilities. Her research focuses on the synthesis and characterization of low-dimensional materials. She has authored over 190 peer-reviewed publications and is co-inventor on five patents.

INDUSTRY

Thermo Fisher Scientific – Materials Science

Dr. Maria Meledina is a product manager in High End TEM for materials science. She joined the Thermo Fisher R&D team in 2021, working on application-driven development of TEM. Prior to her role at Thermo Fisher, Maria focused on characterisation and development of energy materials through advanced TEM while working at RWTH Aachen University and Research Center Julich. Holding the PhD in Physics earned at EMAT, the University of Antwerp and previous degrees in materials science and chemistry Maria has an extensive experience in applying a broad range of advanced TEM techniques for materials development.

Thermo Fisher Scientific are proud of our Mission: To enable our customers to make the world healthier, cleaner and safer. Through our electron microscopy solutions and expertise, we help customers accelerate innovation and enhance productivity across the life sciences, materials science, and semiconductor industries. We offer a broad range of products covering all imaging scales from atomic resolution to defect characterization at the millimeter scale. Analytical solutions span an equally wide range from single atom spectroscopy in the TEM to large area coatings characterization with XPS. At Thermo Fisher Scientific, Diversity & Inclusion is vital to the future success of our mission. Our Women's Employee Resource Group specifically is committed to making Thermo Fisher Scientific one of the world's most admired companies by fostering the advancement of women and building a corporate culture in which women employees are recruited, valued, developed, retained, and promoted globally.

Quantum Detectors

Dr. Akhila Bettadapur is a life science and microscopy specialist, with expertise in molecular biology and advanced imaging technologies. As a Technical Sales Engineer at Quantum Detectors, she works at the interface of research and instrumentation, supporting scientists in deploying cutting-edge detector solutions for electron microscopy. Prior to this, Akhila led field applications and technical sales efforts at Refeyn, where she played a key role in the adoption of novel single-particle analysis platforms across academic and industry sectors. Her cross-functional experience spans scientific research, product development, and customer success – bridging the gap between innovative technologies and the researchers who use them. Akhila earned her Ph.D. in Biochemistry, Molecular, Cellular, and Developmental Biology with a Designated Emphasis in Biotechnology from the University of California, Davis. Her doctoral work focused on the medially relevant human parasite Entamoeba histolytica, where she developed new approaches to study the molecular basis of the host-cell interaction trogocytosis.

At **Quantum Detectors**, we design and deliver world-class detector solutions that enable researchers to push the boundaries of what's possible in electron microscopy. Our advanced direct electron detectors (DEDs) and high-speed readout systems are used globally to support applications in 4D STEM, fast diffraction, in situ studies, and beam-sensitive materials.
Founded in 2007 as a spin-out from the UK's Science and Technology Facilities Council and Diamond Light Source, we've grown to become a trusted technology partner to leading microscopy labs and synchrotron facilities worldwide. Our detectors are fully compatible with major TEM platforms, including Thermo Fisher, JEOL, and Hitachi — with the largest global installed base of hybrid pixel detectors in TEM.
We are proud to collaborate with research leaders across academia and industry, including the University of Glasgow and ESRF, to ensure our technology continues to meet the evolving needs of the scientific community.

Hitachi High-Tech

Toshie Yaguchi is a TEM Applications Engineer at Hitachi High-Tech Corporation, specializing in TEM, STEM, and FIB technologies. She joined Hitachi in 1986 and has focused on advancing materials analysis using transmission electron microscopy. In 1996, she helped develop a focused ion beam (FIB) device for TEM sample preparation, enabling low-damage techniques for semiconductors, metals, and polymers. She earned her Ph.D. in engineering in 2001 with a dissertation on FIB sample preparation technology. She contributed to the development of a semiconductor evaluation system combining a 40 kV FIB with a 200 kV STEM/SEM and designed a 360-degree rotatable sample holder for FIB-processed samples. From 2005, she worked on environmental TEM (ETEM) with enhanced differential pumping and developed specialized holders for in-situ observation under various gas environments. Since 2015, she has been involved in developing a 40-120 kV analytical electron microscope for beam-sensitive nanomaterials and continues to enhance in-situ TEM technologies. In 2022, she received the Japan Society of Microscopy Award (Seto Prize) for her contributions to environmental TEM development. She also served as Executive Director of the Japanese Society of Microscopy (2011–2014) and Treasurer of the Second East-Asia Microscopy Conference (2015). Currently, her primary focus is on advancing in-situ TEM technologies using transmission electron microscopes.

Justyna Grzonka is the SEM and Ion Beam Milling Applications Specialist at Hitachi High-Tech Europe, where she provides expert support through customer consultations, training sessions, and system demonstrations focused on ion and electron beam technologies. She earned her degree from the AGH University of Science and Technology in Kraków, Poland, followed by a Ph.D. in Materials Science from the Institute of Metallurgy and Materials Science at the Polish Academy of Sciences. Her academic and professional journey has taken her across Europe, with research and technical roles in Poland, Portugal, and Spain. Justyna completed a postdoctoral fellowship at the International Iberian Nanotechnology Laboratory (INL), where she specialized in atomic-scale characterization of defects in 2D materials. She later joined the University of Cádiz, focusing on the integration of Energy Dispersive X-ray Spectroscopy (EDX), Scanning Transmission Electron Tomography (STEM), and deep learning-based denoising techniques to advanced nanomaterials imaging and analysis. Since joining Hitachi High-Tech in 2022, Justyna has been actively involved in bridging microscopy technologies with practical applications, helping researchers and engineers unlock new insights at the micro- and nanoscale.

Hitachi High-Tech develops global business around the three segments of Nanotechnology Solutions, Analytical Solutions and Industrial Solutions. It aims to be a successful enterprise trusted by all its stakeholders and contributing to social progress through business activities that emphasize value creation through high tech solutions. Hitachi High-Tech Europe GmbH operates since 2002 from Krefeld with offices for more than 110 employees, a clean room and demo rooms for scanning and transmission electron microscopes as well as focused and broad ion beam systems and for sample preparation and failure analysis. Classic fields in life science and material Sciences are equally covered as new developing fields in battery research and new composite materials for example in the energy or automotive sectors. Our team of experience experts supports you from your first request way until the operation of your instrument.

condenZero

Amelia Estry started in physics as a bachelor student at the Florida State University in Tallahassee, Florida while working as a research assistant at the National High Magnetic Field Laboratory (NHMFL). After graduation, she worked for one year at the Max Planck Institute Center for Chemical Physics of Solids (MPI CPfS) in Dresden, Germany. Amelia did her PhD at the Swiss Federal Institute of Technology in Lausanne (EPFL) on focused ion beam (FIB) fabrication of resonating cantilevers to explore symmetry breaking in quantum materials. She now works in research and development on cryogenic transmission electron microscopy at the Swiss start-up, condenZero.

condenZero was founded in 2019 as a spin-off from the physics department of the University of Zurich. Founders Denys Sutter and Dominik Biscette started the company to solve major technological challenges within the field of cryogenic transmission electron microscopy (cryo-TEM). Emergent phenomena in quantum materials, such as superconductivity and charge or spin ordering, often require the ultra-low temperatures of the liquid-helium range for their study. Unfortunately, the tight spatial constraints of side-entry sample holders make accessing these temperatures technically arduous. The conventional approach to cryo-TEM for side-entry holders — which involves mounting a small dewar on the end of the holder, coupled to the sample with a long thermal link — suffers from slow cool-down time, limited hold time at base temperature, poor thermal stability, poor imaging resolution, and a large thermal drift. The condenZero team specializes in ultra-high vacuum and cryogenic temperatures for high-precision measurements. condenZero's lightweight cryo-TEM holders utilize a continuous flow cryostat, which enables a cool-down time from room temperature to base sample temperature of 5.2 K within one minute. This temperature can be maintained with a stability of +/- 2.5 mK for days.

Ferrovac

Marc Maier is the co-CEO of Ferrovac and a Swiss-certified mechanical design technician. Growing up in a family business specializing in UHV equipment, he gained hands-on experience from an early age and has held various roles at Ferrovac since 2017. Since 2022, Marc has been assisting scientists and facility managers in establishing controlled environment workflow sample transfer systems while coordinating with instrument manufacturers.

Founded in 1996 as a spin-off from ETH Zurich, **Ferrovac** has been at the forefront of ultra-high vacuum (UHV) sample manipulation and transportation for nearly 30 years. Our journey began with the invention of the magnetically-coupled wobblestick—an innovation that addressed a fundamental challenge in scanning tunneling microscopes (STMs). At the time, conventional wobblesticks relied on pressure differences in the bellows, which inadvertently pushed the manipulator into the instrument, limiting precision. By introducing magnetic coupling, we revolutionized sample handling, allowing users to transfer their delicate skills directly into the chamber with unprecedented control. Building on this foundation, we have expanded our capabilities to facilitate seamless sample transportation across instruments, institutions, and even international borders—all while maintaining UHV and cryogenic conditions. At Ferrovac, we are dedicated to empowering researchers to push the boundaries of their fields. Our commitment to excellence is reflected in our high-quality equipment, meticulously designed to deliver precision and durability for decades. We thrive on addressing complex scientific challenges with novel ideas and cutting-edge engineering solutions. To foster the next generation of innovators, we actively participate in the physics lab technician apprentice exchange program at ETH Zurich. This initiative helps bright young minds transition into the industry while strengthening our ties with academia. Our strong customer relationships keep us attuned to evolving technological needs, ensuring we remain at the forefront of innovation in UHV technology.

Protochips

Nynke Krans started her PhD project at the Inorganic Chemistry and Catalysis group in 2015 at Utrecht University under the supervision of Prof. Dr. Ir. Krijn de Jong and Dr. Jovana Zečević. During this PhD project, she investigated the attachment of colloidal iron oxide nanoparticles to various support materials for the Fischer-Tropsch reaction, with a focus on the use of electron microscopy. After finishing her PhD in 2020, she worked for the National Institute for Public Health and the Environment (RIVM) on nanomaterial safety policies. In 2021 she joined Protochips as an applications scientist specializing in specializing in in-situ liquid phase (S)TEM. Most of her time is spent educating, helping and discussing experiments with new and experiences users for in situ microscopy.

Protochips is a pioneering technology company specializing in in situ electron microscopy solutions. By integrating innovative hardware and software, Protochips enables scientists and researchers to observe structure – function relationships at the nanoscale. With a focus on scaling bulk experiments to the nanoscale, accelerating productivity, and fostering collaboration and discovery by providing complete workflow solutions, Protochips systems are used in leading research institutions to drive breakthroughs in materials science, chemistry, engineering, and more.

Miscellaneous

Ernst Ruska-Centre

Dr. Marta Lipińska-Chwałek is a scientist and User Officer at the Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons (ER-C) at Forschungszentrum Jülich (FZJ), Germany. She earned her PhD (2005–2009) through a joint program between the Faculty of Metals Engineering and Industrial Computer Science at the AGH University of Science and Technology in Kraków, Poland, and the Institute of Solid-State Research at FZJ. Following her doctoral studies, she conducted postdoctoral research at the Institute of Energy and Climate Research (IEK-2) at FZJ. She subsequently held a position as Associate Professor of Electron Microscopy at the Faculty of Metals Engineering and Industrial Computer Science and the International Centre of Electron Microscopy for Materials Science (IC-EM) at AGH University. From 2014 to 2021, she continued her research in advanced electron microscopy at both FZJ and the Central Facility for Electron Microscopy (GFE) at RWTH Aachen University, Germany. Her research focuses on the high-resolution characterization of deformation and degradation mechanisms in metals, alloys, and ceramics, using advanced transmission electron microscopy (TEM) techniques. Since 2022, she has led the User Office at the ER-C User Facility, where she supports external users and coordinates access to world-leading microscopy infrastructure.

The **Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons (ER-C)** is a leading center of excellence and user facility, hosting some of the world's most advanced electron microscopes for applications in materials science, condensed matter physics, and life science cryo-EM. ER-C offers access to state-of-the-art electron microscopy, including sub-ångström imaging and spectroscopy, in situ TEM, single-particle cryo-EM, and cryo-tomography. Users benefit from top-tier instrumentation and expert scientific support. Access is open to universities, research institutes, and industry through proposal-based selection, reviewed by an external panel. Additional access opportunities are available through Horizon Europe projects like ReMade@ARI and RIANA, which provide integrated access to complementary techniques such as synchrotrons, neutron sources, and ion beams. ER-C is also expanding through the ER-C 2.0 initiative, delivering five next-generation electron microscopes by 2025–2026, and contributing to hardware development via the IMPRESS project. Visit our table to learn more about the ER-C infrastructure and access opportunities for external users.

Career Planning

Viola Middendorf accompanies researchers and early career scientists in reflecting and deciding on career options, plan next steps and master challenges. An analytical approach, professional empathy and solution orientation are the guidelines of her approach. As a trained psychologist with a focus on occupational psychology she has gained experience as a scientist in academic research as well as in different roles in Human Resources (personnel development and personnel selection) in different industries (agriculture industry, chemistry and pharma, consulting). She loves to combine her academic background with her experience and strong connections in industry.

Which career path suits me? How can I make a good decision about my next career move in industry or academia? What and who can support me on my way? How can I benefit from a good professional network and build it up and keep it running? These and similar questions are part of the **career planning** offer. With the help of DIY Career planning tools and in discussion with career consultant Viola Middendorf, you can get impulses to set up your career more consciously and in a targeted way.

Application Portfolio Check

Anna Mindermann is a recruiter at Forschungszentrum Jülich, where she supports various institutes throughout their recruitment processes. Her responsibilities include the publication of appealing job advertisements, identifying suitable external media channels, managing applicant communications, and coordinating and supporting job interviews. Additionally, she conducts internal training sessions focused on best practices for job advertisements and interview techniques. Anna is passionate about connecting with applicants from around the world and discovering innovative ways to attract top talents in science.

Get feedback and answers to your questions about **applications and application documents**: Bring your CV or cover letter and receive individual feedback on how to improve your documents and get updated information on recruiting trends in industry and academia. Your questions are the focus, e.g. How do I highlight particular skills and competences? What counts when applying for leadership positions? (How) do I address the topic of family / children?

CORRIDOR: WORKSHOP SESSION L

MENTORS

Nicole Amberg

I have a long-lasting passion for patient-relevant research. I am particularly curios on how stem cells interact with their cellular environment and how this interaction shapes stem cell identity and fate in health and disease. During my PhD in the lab of Maria Sibilia at the Medical University Vienna, I was investigating the complex interaction between tumors, the immune system and stem cells in the skin. Due to my interest in cancer-microenvironment interactions, I have contributed to several influential papers of the Sibilia lab, assessing tumor-immune cell interactions in the liver and intestine. During all of these studies, I realized that one of the great limitations of cancer research is to mimic a patient-relevant somatic cell mosaicism by inducing and investigating a targeted gene mutation in single stem cells within a healthy tissue. One of the very few genetic models allowing such manipulation is Mosaic Analysis with Double Markers (MADM). In order to gain expertise in the application of MADM I thus decided to join the lab of Simon Hippenmeyer at the Institute of Science and Technology Austria for my Postdoc. At the same time, I took the chance to broaden my scientific knowledge by changing fields to developmental neuroscience. In my postdoctoral FWF-funded project, I set out to investigate the function of the epigenetic repressor Polycomb Repressive Complex (PRC)2 in neocortical development. Due to its cell-intrinsic mode of action, PRC2 activity has generally been thought to be a cell-autonomous one. Yet, stem cells are embedded within a complex cellular environment and it was unknown, whether global tissue-wide mechanisms shape PRC2 function in individual progenitors. To this end, I have contrasted a single-cell mutant with a whole-tissue ablation paradigm and genetically dissected the interplay of PRC2 cell-autonomous and global tissue requirement. I discovered that PRC2 is not cell-autonomously required for neural progenitor state determination and neuron production. Overall, my work made the novel discovery that PRC2-dependent transcriptional control regulating progenitor cell lineage progression strongly depends on the genetic tissue-wide landscape and cellular environment. In September 2022, I joined the Department of Neurology at the Medical University Vienna as a young PI. Being positioned in a clinical setting grants me direct access to precious patient material in our neurobiobank and provides me with excellent state-of-the-art expertise of the medical staff. My lab is interested how a brain of correct size and cell composition forms during development and how pediatric brain tumors arise. In particularly, we are focusing on:

(1) PRC2 function in human brain development.
(2) patient-derived iPSCs and cerebral organoids to understand the cell-autonomous and non-cell-autonomous mechanisms of pediatric brain tumor development.
(3) Detailed characterizations of human brain malformations.

In addition, I am a strong advocate for women in science and a known science communicator in Austria. I give public speeches, have TV appearances in a popular TV show and have also successfully gained two FWF grants for science communication projects. The latest will develop a narrative audiostory and an NFC-tagged brain figurine and target 8-10 year old kids.

Bridget Carragher

Bridget Carragher received her Ph.D. in Biophysics from the University of Chicago in 1987. She worked in a variety of positions, both in industry and academia before moving to the New York Structural Biology Center in 2015 to lead the Simons Electron Microscopy Center (SEMC), together with Clint Potter. While at SEMC, Bridget and Clint directed the National Resource for Automated Molecular Microscopy (NRAMM), the National Center for CryoEM Access and Training (NCCAT), the National Center for In-situ Tomographic Ultramicroscopy (NCITU), and the Simons Machine Learning Center (SMLC). They also founded the company NanoImaging Services in2007. Bridget moved to her current role as Founding Technical Director of the Chan Zuckerberg Imaging Institute (CZII) in January 2023. The mission of CZII is to enable deep insights into the architecture of complex biological systems, at the molecular level, through the development and application of novel imaging technologies. The initial grand challenge is to develop technologies and methodologies to image the molecular architecture of the cell to near atomic resolution using cryo electron tomography.

Marta Carroni

I am Marta Carroni, I come from Italy, more specifically from a little town in the mountainous part of the island of Sardinia. The Sardinian society I grew up in is a strong matriarchal one and I get a strong feeling of freedom when I think of my grandparents from both sides. Living on an island can be nevertheless quite limiting and I left Sardinia at 19 years old to take the university studies in Pisa, in the mainland. I moved to Madrid for one year Erasmus followed by the master studies. I didn't come back to Italy ever since. I am a convinced European and I think that common means of communication, like science or shared languages, unite people. I moved to London for my PhD and postdoc and there in the UK, where I lived for 10 years, I had great female mentors: my PhD supervisor Silvia Onesti and my postdoc supervisor Helen Saibil. I have been also surrounded by male mentors with open and advanced views about equity, such as Peter Brick and Steve Curry. After London, around 9 years ago, I moved to Stockholm in Sweden to, eventually become the head of the national cryo-EM infrastructure. Here I got a very strong support from a male mentor, Gunnar von Hejine. I never really felt I had to face major gender discriminatory situations. However, as I became older and maybe more mature, I realized that there are deeply embedded cultural bias that make it harder for a woman to affirm herself in the academic environment. Being self-confident is highly prized in the academic environment, even in the scientific one. Somehow, males are still educated differently from females, to be bolder and less caring of other people's opinion. This is of coincidence that eating disorders are more spread among teenage girls than boys. This is of course a rough generalization, but it is also quite common to assume that, if a man and a woman are in the same age and similar positions, the boss is the man. Somehow, to fight these culturally-rooted unconscious bias, it is important to actively bring up discussions whenever unfair situations are detected. I actually noticed that there is another type of discrimination that goes under the radar. I would call it the geographical discrimination, by which people coming from rich countries almost automatically receive better recognition than those coming from poorer countries. Science should become more blind in many aspects.

Katharina Hipp

Katharina Hipp is Head of the Electron Microscopy Facility at the Max Planck Institute for Biology Tübingen, Germany, where research covers a wide range of biological samples from molecular, complex organism down to single cells and purified macromolecular complexes. Originally trained in molecular biology and plant virology, she became fascinated by electron microscopy early on already during her studies. As a PostDoc she joined Bettna Böttcher's group in the Structural and Computational Biology Unit at EMBL Heidelberg, Germany, diving into single particle cryoEM. She continued with cryo-EM at the University of Edinburgh, School of Biological Sciences, UK, as a PostDoc and SULSA cryoEM technologist. After returning to Germany, she started as a group leader in Holger Jeske's lab at the University of Stuttgart studying plant viruses with a focus on structural biology and cellular biology. She completed this work with her habilitation in Molecular Biology at the University of Stuttgart, Germany, in 2020. Currently, she is the President of the German Society for Electron Microscopy that brings together physicists, material scientists and scientists from the life sciences. She is married and has two children.

Catherine Venien-Bryan

Catherine Vénien-Bryan obtained her PhD in Molecular Biophysics at the University Pierre et Marie Curie , Paris (Sorbonne Université). She discovered cryogenic-electron microscopy (cryo-EM) applied to structural Biology during her first post-doc at EMBL Heidelberg Germany (Structural Biology program). This was followed by an ECC Bridge fellowship at the University of Oxford, Biochemistry Department, which enabled her to deepen her knowledge in the field of membrane proteins. In 1993, she was recruited as Assistant Professor at the University of Grenoble, where she focused on the development of biophysical techniques for the study of proteins. She then returned to Oxford University (2000-2012) to take up a University Lecturer position in the Biochemistry Department where she was involved in the Structure and Dynamics of signaling proteins. In 2012, she accepted the position of Professor of Biophysics at Sorbonne Université and Group Leader at IMPMC. Her research focuses on the structure and function of human potassium channels. Many signals in the cell are conveyed by interacting protein molecules. How do protein-protein interactions lead to a response? The most likely explanation is through changes in structure. With her group; she studies protein-protein interactions in the control of signaling processes using cryo-EM and combining the results with information from X-ray diffraction and biophysical studies.

Peijun Zhang

Peijun Zhang is a Professor of Structural Biology in the Nuffield Department of Medicine at the University of Oxford and the founding director of eBIC (the UK National Electron Bio-imaging Centre) at the Diamond Light Source. She obtained B.S. in Electrical Engineering and M.S. in Solid State Physics from Nanjing University, and Ph.D. in Biophysics and Physiology from University Virginia. She was a post-doctoral fellow and subsequently a staff scientist at the National Cancer Institute, NIH, and then an Assistant Professor and tenured Associate Professor at the University of Pittsburgh School of Medicine. She joined Oxford and Diamond Light Source in 2016. Professor Zhang is a leading expert in the fields cryoEM and cryo-electron tomography (cryoET) of macromolecular complexes and assemblies, especially investigating these *in situ* in the native cellular context. Her research is aimed at an integrated and atomistic understanding of molecular mechanisms of viral and bacterial infections by developing and applying novel technologies for high-resolution cryoEM and cryoET. Her current research efforts focus on HIV-1 and SARS-CoV-2 infections using multi-scale correlative structural biology and bacterial chemotaxis signalling pathways using time-resolved cryoEM and cryoET. She has been awarded with prestigious grants such as Wellcome Investigators Award, ERC AdG grant, and Wellcome Discovery Award. She is an elected member of the European Molecular Biology Organization (EMBO) and has received many Honors and Awards, including The Senior Vice Chancellor's Award, Carnegie Science Emerging Female Scientist Award and Distinguished Research Career Award.

INDUSTRY

Thermo Fisher Scientific – Life Sciences

Dr. Lingbo Yu has been working in electron microscopy for 20 years. She started as a Ph.D. student under the supervision of Prof. Michael Radermacher. Her research focuses on alignment and classification algorithms for subtomogram averaging. After graduation, she joined FEI-NIH living lab project, and worked on automated data collection. Upon finishing of the project, she took the product management role for various products, including Falcon direct electron detector, micro electron diffraction, Krios and Tundra cryo-TEMs. She is now a Sr. product marketing manager, mainly responsible for Glacios 200kV cryo-TEM.

Thermo Fisher Scientific are proud of our Mission: To enable our customers to make the world healthier, cleaner and safer. Through our electron microscopy solutions and expertise, we help customers accelerate innovation and enhance productivity across the life sciences. We offer a broad range of products covering all imaging scales from near-atomic resolution molecular data to tissue and whole cell ultrastructure. By revealing molecular detail at biologically relevant resolutions, we enable scientific discoveries and breakthrough drug discovery. At Thermo Fisher Scientific, Diversity & Inclusion is vital to the future success of our mission. Our Women's Employee Resource Group specifically is committed to making Thermo Fisher Scientific one of the world's most admired companies by fostering the advancement of women and building a corporate culture in which women employees are recruited, valued, developed, retained, and promoted globally.

Bruker

Meiken Falke, Global Product Manager at the Bruker Nano GmbH Berlin, is engaged in improving instrumentation for structure analysis on the nanoscale in materials and life science. She has over 30 years of experience in electron microscopy. Meiken joined Bruker in 2008 to focus on the development and application of detector systems for energy dispersive X-ray spectroscopy and the respective business development. Before that she worked as lecturer researching how materials macroscopic behavior depends on their nanoscale properties. Between 2002 and 2005, Meiken was one of the first postdocs at the SuperSTEM Laboratory in Daresbury UK supporting the application of aberration correction in transmission electron microscopy and the setup of this international user facility.

The **Bruker Nano GmbH**, part of Bruker Corporation, develops, manufactures, and markets systems for elemental and structural analysis on the micro and nano scale. Our unique range of analytical tools include EDS, WDS, EBSD and micro-XRF instruments for the electron microscope and offer the most comprehensive compositional and structural analysis of materials available today. The full integration of all these techniques into the ESPRIT software allows you to easily combine data obtained by these complementary methods for best results. On top we offer a variety of benchtop micro-X-ray fluorescence (micro-XRF) spectrometers for spatially resolved composition analysis and total reflection X-ray fluorescence (TXRF) instruments for trace element analysis for a multitude of applications. Our handheld XRF analyzers as well as the mobile/portable countertop XRF analyzer, enabling non-destructive and on-site element analysis complete the portfolio. The Bruker Nano GmbH portfolio covers a variety of applications such as material science, life science, geo science, other as well as many industrial applications.

CryoCloud

Dr. Ieva Drulyte is a structural biologist with over a decade of experience in cryo-EM, spanning both academic and industry settings. She holds a PhD in structural enzymology from the University of Leeds and has worked at the interface of science and technology throughout her career. While at Thermo Fisher Scientific, she collaborated with leading pharmaceutical and biotech companies on structure-based drug discovery projects across a range of modalities – including small molecules, peptides, degraders, DARPins, and antibodies – contributing to 17 publications, 25 PDB entries, and 47 EMDB depositions. In her current role as Commercial Director at CryoCloud, Ieva leads sales, customer success, and strategic collaborations. She works closely with structural biologists to help them make the most of the CryoCloud platform for cryo-EM data processing and management. Passionate about bridging scientific innovation with real-world application, Ieva is committed to supporting researchers and advancing structural biology through more efficient, data-driven workflows.

Robert Englmeier, PhD is the Co-Founder & CEO of CryoCloud, a cloud-based platform for cryo-EM data analysis. Originally from Munich, he moved to the Netherlands in 2016 to pursue a PhD in cryo-electron microscopy at Utrecht University, where he focused on mitochondrial protein synthesis using cryo-ET. In mid-2021, while finishing his doctoral work, Robert joined the BCF BioBusiness Summer School. Inspired by the entrepreneurial talks, he pitched the concept of CryoCloud and entered the UtrechtInc Incubator program where he co-founded CryoCloud with two other co-founders. After graduating in June 2022, they launched a working cloud application and accumulated hundreds of active analysis hours by early 2023. Under his leadership, CryoCloud has raised over €2.8 million in funding, enabling the development of proprietary ML-based and classical algorithms, cryo-ET workflows, and highest security standards including ISO-27001 compliance. The platform now supports users in more than 25 countries and serves academia, biotech and pharma clients. A structural biologist and technologist at heart with over ten years of cryo-EM experience, Robert is committed to enabling and democratizing automated, high-throughput cryo-EM via the cloud and the development of cutting-edge algorithms.

CryoCloud develops cloud-native software solutions for cryo-EM data analysis, storage and management. CryoCloud's web-app enables scientists to analyze data on dozens of GPUs in minutes, while automation and collaborative features as well as proprietary algorithms improve the efficiency and quality of results. The CryoCloud web-app eliminates the need for hardware setup and maintenance, and provides the highest information security standards verified by external parties. CryoCloud's mission is to automate cryo-EM data analysis and provide scientists with the simplest and fastest way to determine protein structures at the highest quality.

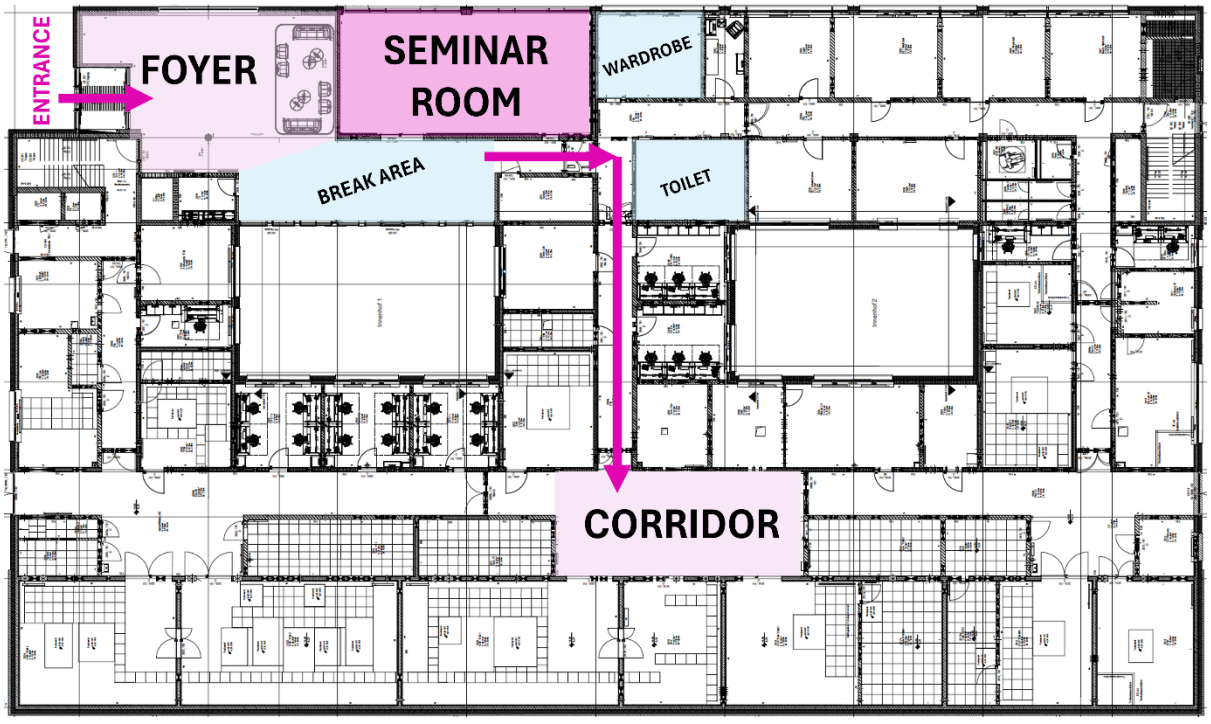
ABSTRACTS

1. Abstracts Oral Presentations

-> Seminar Room

2. Abstracts Poster Presentations

-> Foyer & Corridor



Day 1
13:30

DEMOGRAPHICS FOR WOMEN IN ELECTRON MICROSCOPY

Saba Shahzad*, Irene Vercellino, Yan Lu, Genevieve Wilbs and Lidia Kibkalo

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Gender inequity in science is not new. As early as the 17th century, Lister's daughters contributed scientific illustrations without recognition [1], and women were excluded from the British Microscopy Society until the 20th century [2]. Today, gaps persist: women make up only 32.8% of STEM graduates in the EU and 28% of global STEM researchers. In ICT, only 16.7% of professionals in the EU are women [3,4].

In microscopy and electron microscopy, gender disparities are also evident. Women account for just 30–32% of senior participants at major conferences like ECM. An analysis of 98 scientific meetings showed only 30.1% of speakers were women, with 36% of sessions featuring all-male panels [5]. Under representation also reaches the top: only 25 women have received Nobel Prizes in Physics, Chemistry, or Physiology/Medicine, compared to over 600 men [6].

To drive change, we must first understand where we stand. In this pilot study we aimed to Map gender distribution globally in electron microscopy, analyze ratios across career stages (PhD to PI) and identify regional trends and equity factors.

We also highlight data gaps and propose future focus areas, including conference participation, scientific committees and institutional leadership.

By understanding where we are, we can push for change—through mentorship, inclusive leadership and flexible work policies. This isn't just about raising awareness—it's about building a more balanced future for the next generation in electron microscopy.

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Day 1
14:00

IMAGING SOLID STATE TRANSFORMATIONS IN MATERIALS

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A key question in condensed matter science is how to transform one crystal structure into another, given a similar number and type of atoms. This question is relevant to a wide variety of phenomena, such as earthquakes, shape memory alloys, phase change materials and biomineralization. Such transformations, or solid-to-solid phase transformations, are particularly critical to the microstructural development of high-strength light alloys; this will be the main topic of this presentation.
High-strength aluminium and magnesium alloys are strengthened by solid-state precipitates that are often deeply buried inside the alloy matrix due to having at least one dimension at the nanoscale or even sub-nanoscale [1]. These precipitates are also, in most cases, metastable phases that do not exist in a monolithic state, thus constituting difficult objects to characterise at the atomic scale. Here we present our work on the structural determination of key precipitate phases in aluminium alloy systems. Using a combination of *in situ* heating in the transmission electron microscope (TEM) and atomistic simulations, we reveal not only the existence of new interfacial structures and precipitate phases, but also their mechanisms of transformation [2]. This includes new pathways to the formation of desired strengthening precipitates. These insights are used as a starting point for predicting the precipitation behaviour of other, largely unexplored, alloy systems.

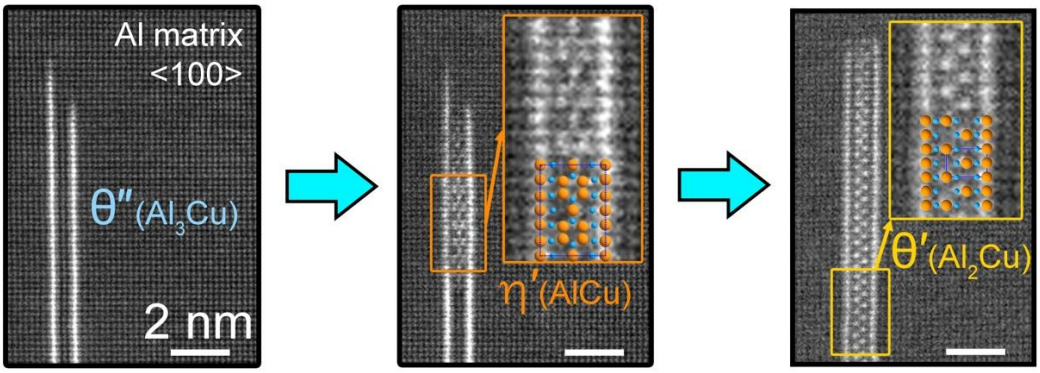

Fig. 1: Transformation of solid-state precipitate phase θ″ in aluminium during quasi *in situ* heating in a scanning transmission electron microscope.

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Day 1
14:30

TOOLS AND TECHNOLOGIES FOR CRYO-ET

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Cryo-electron microscopy (cryoEM) and cryo-electron tomography (cryoET) have emerged as powerful techniques for visualizing biological structures in vitro and in situ. Over the past decade, advances in specimen preparation, instrumentation, and data processing have made it possible to readily obtain high-resolution structures of isolated biological molecules and have opened up the potential for understanding the full molecular architecture of the cell. I will discuss the automation and streamlining of cryoET, combined with the use of machine learning approaches, which are crucial for unlocking the full potential of these methods and driving future progress in structural cell biology.

Day 1
15:30

TOWARD A 3D UNDERSTANDING OF PLASMONIC NEAR-FIELDS IN A CHIRAL NANOPARTICLE *VIA* ELECTRON SPECTROSCOPIES

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Plasmonic near-fields in metal nanoparticles enable nanoscale control of light–matter interactions by confining and enhancing light near the particle surface. Their properties are highly sensitive to particle morphology, and when mirror symmetry is broken—as in chiral nanoparticles—they exhibit complex behaviors such as circular dichroism and handedness-dependent optical activity. These chiral near-fields are of growing interest for applications in enantioselective sensing, biosensing, chiral photocatalysis, and nano-optics [1]. The plasmonic near-fields in chiral nanoparticles remain less explored, as their experimental investigation requires nanoscale spatial and energy resolution, sensitivity to handedness, and three-dimensional (3D) analysis—since chirality cannot exist in purely planar geometries.

Here, we present our approach leveraging electron spectroscopies to investigate plasmonic near-fields in an individual chiral nanoparticle. We implemented autoencoder-embedded low-loss EELS tomography to visualize the 3D spatial distribution of plasmonic fields in a single chiral gold nanoparticle known as a helicoid [2]. This allowed us to identify the plasmonic mode responsible for far-field circular dichroism and reconstruct its near-field distribution in 3D, revealing strong field confinement along the particle's characteristic swirling edges. To further address the handedness-dependent response, we employed photon-induced near-field electron microscopy (PINEM). PINEM images were acquired under left- and right-handed circularly polarized light (CPL) excitation to extract local circular dichroic (CD) features of the near-fields [3]. The resulting CD response observed in the helicoid was distinguishable from that of an achiral gold nanocube reference, both in signal strength and in the spatial pattern of the local CD map, particularly in terms of radial symmetry. A tilt-series of these handedness-resolved PINEM images was obtained, providing access to volumetric insight into the chiral plasmonic behavior. These approaches demonstrate the power of electron spectroscopies in comprehending plasmonic near-fields in chiral systems, providing a significant step forward to understanding optical chirality and enantioselective light–matter interactions at the nanoscale.

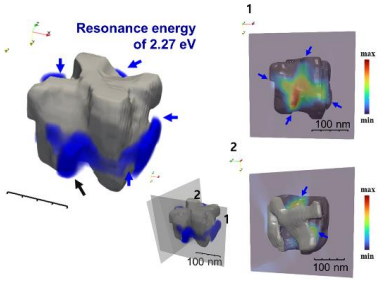

Fig. 1: 3D visualization of the plasmonic near-fields responsible for far-field circular dichroism in a helicoid.

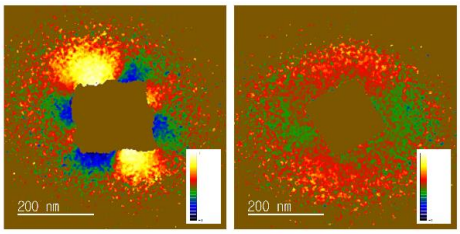

Fig. 2: Local CD maps extracted from PINEM images in a helicoid (left) and an achiral gold nanocube (right)

References:
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Day 1
16:00

ADVANCING OUR UNDERSTANDING OF MATERIALS PERFORMANCE IN CHALLENGING ENVIRONMENTS: THE ROLE OF CORRELATIVE CHARACTERIZATION

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Materials used in power generation systems can limit the operational service “life” of a component due to the local environment. Such operational environments are termed “challenging environments” and are associated with significant financial penalties when unexpected failures occur. Thus, the environment-sensitive behavior of materials remains an important area for materials R&D in numerous power generation industries. As energy demands increase, it is of growing importance to understand the mechanisms of degradation, including the “precursor” reactions so that modelers can incorporate such information into experimentally-informed, mechanistically-based models to predict future performance. Microstructural characterization using correlative techniques ranging from meso-scale to the nm-scale are thus essential. In addition, accelerated tests in relevant environments can be helpful in such endeavours, particularly with respect to investigating the “precursor” stage in environmentally-assisted cracking research. The critical roles of both “conventional” techniques (TEM, SEM, EDXS) and “advanced” techniques (atomic resolution TEM / STEM-EDX spectroscopy and spectrum imaging, *in situ* microscopy, and atom probe field-ion microscopy/atom probe tomography) have made significant contributions to our understanding of irradiation damage and environmentally-assisted cracking in steels and Ni-base alloys. This presentation will demonstrate how independent complementary techniques have provided new insights and have enhanced our mechanistic understanding of these degradation phenomena. Furthermore, the advances in instrumentation, aberration correction, etc. are now “blurring” the boundaries between atom probe and STEM-EDX spectrum imaging techniques, with impressive results.

Day 1
16:30

4D-STEM FOR THE UNDERSTANDING OF ENERGY MATERIALS

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The quest for materials innovation in energy holds the potential to revolutionize the way we generate, store, and utilize energy. By pushing the boundaries of materials science, we could unlock breakthrough technologies such as high-performance batteries, materials for direct photoelectrochemical water-splitting or advanced photovoltaic materials, all of which can significantly enhance renewable energy integration in our society. Many of these novel materials are polycrystalline in nature as well as air-sensitive. Often, the exact correlation of interface structures with their functionality is not yet established.
We use different electron microscopy-based techniques to unravel not only the structure and composition, but also electric fields and potential drops in materials used for energy applications.

In this presentation, I will – with the selected examples of materials for solid state-batteries as well as for photoelectrochemical water-splitting and solar cells – show, how one is able to establish a sample preparation as well as investigation routine, which works at cryogenic temperature and under inert conditions. This enables investigation under conditions as close as possible to reality.

For the investigation of interface´s atomic as well as electronic structure, we use aberration corrected STEM (Scanning Transmission Electron Microscopy), where a fast, pixelated detector allows to record an image of the full reciprocal space at each scanpoint. This gives unprecedented possibilities for evaluation. When compared to image simulations, the information on the sample´s structure derived from this so-called 4-dimensional STEM data can be quantitative. With the help of this technique, when evaluating different regions of the reciprocal space, one is able to track Lithium in battery materials as well as to image potential drops in devices.

BRIDGING THE PRESSURE GAP IN TEM

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TEM is traditionally a high vacuum (10^{-6} Torr) technique. However, many materials have a different (surface) structure in vacuum as opposed to gaseous environment. The specific gas present can even influence the structure of a material. This means that traditional TEM images are mostly obtained of materials that are NOT in the state in which they are used in practice. One important area of application is catalysis research. The development of differentially pumped ETEM was a significant step in the direction of real in situ TEM, allowing gas pressures of up to 50 mbar and heating up to about 1000 °C [1]. We have developed a micro-electro-mechanical system (MEMS) nanoreactor to bridge the pressure gap [2]. It confines a thin layer of gas (several microns) in a windowed cell, thus retaining atomic resolution at pressures exceeding 1 bar by limiting the path length of gas the electrons have to traverse. The catalyst under study (or its precursor) can be loaded into the nanoreactor prior to the experiments. Small electron-transparent windows provide both good transmission of the electron beam and stability against the pressure difference. Heating is possible up to about 600 °C, and the exit gas composition can be determined using mass spectrometry. This means the gas composition can be monitored while simultaneously imaging dynamic changes in, e.g., catalyst nanoparticles.

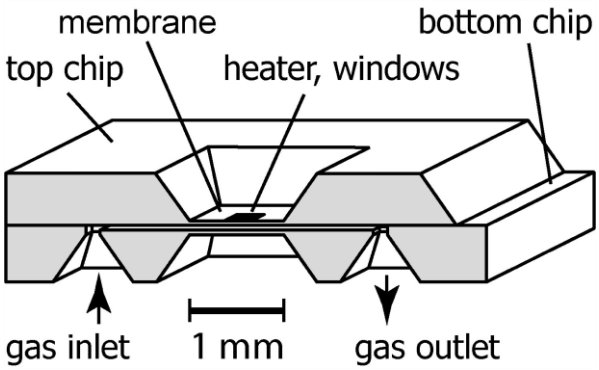

Fig. 1: Schematic of nanoreactor

Fig. 2: Nanoreactor in dedicated TEM holder

References:
[1] E.D. Boyes, P.L. Gai, Ultramicroscopy **67** 219 (1997).
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[3] Funding from the NIMIC SMARTMIX consortium is gratefully acknowledged.

Day 2
08:30

COMPLEX OXIDE THIN FILMS: A PLAYGROUND FOR ELECTRON MICROSCOPY

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Complex oxide thin films offer a rich platform for exploring emergent phenomena driven by lattice, charge, orbital, and spin interactions. In this talk, I will present recent advances in the synthesis and characterization of vanadium- and chromium-based oxide thin films, with a particular focus on the role of electron microscopy in unraveling their structural complexity. We begin with vanadium oxide thin films grown on Al_2O_3 substrates, highlighting how substrate-induced strain and epitaxial relationship influence phase formation and defect structures [1-4]. Using advanced TEM techniques, we investigate defect structures in V_2O_3 and Cr_2O_3, revealing dislocation networks and twin boundaries that critically affect their optical and electronic properties. Building on these insights, we explore V_2O_3/Cr_2O_3 multilayers, where interfacial coupling and strain engineering give rise to novel structural configurations. Finally, I will discuss our recent efforts in sub-unit cell engineering, culminating in the fabrication of an artificial $CrVO_3$ structure [5]. This work demonstrates how atomic-scale control over stacking and composition can be leveraged to design new oxide phases with tailored functionalities. Throughout the talk, I will showcase how electron microscopy — including high-resolution STEM, EDS, EELS, and in-situ techniques — serves not only as a diagnostic tool but also as a guide for materials design in complex oxide systems.

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Day 2
09:00

MAPPING THE MISSING: CORRELATING ATOMIC-SCALE IMAGING AND SPECTROSCOPY OF OXYGEN VACANCIES IN OXIDE FILMS

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Correlative approaches are redefining how we study complex oxides by integrating atomic-scale imaging, spectroscopy, and simulation. By combining atomic-resolution electron microscopy with spectroscopic probes, they reveal buried defects and local chemistries that govern macroscopic behavior, offering insights beyond the reach of single techniques.We report a correlative study combining aberration-corrected Scanning Transmission Electron Microscopy (STEM), site-selective Electron Energy Loss Spectroscopy (EELS), and synchrotron-based spectroscopies, namely X-ray Absorption Spectroscopy (XAS) and X-ray Photoelectron Spectroscopy (XPS), to access structure–property relationships governing oxygen vacancy behavior in two different TiO_2 anatase and $LaNiO_3$ (LNO) thin film heterostructures.

In TiO_2 anatase, oxygen vacancies form ordered superstructures that significantly alter the local electronic structure. STEM-EELS reveals a Ti^{3+}/Ti^{4+} mixed-valence configuration associated with periodic vacancies, contradicting the classical Magnèli-type shear-plane defect model. Atomistic and multislice simulations support a new structural model where vacancy ordering modulates the TiO_6 network without forming long-range Magnèli phases [1]. These results, confirmed by XPS, provide a revised view of TiO_2 defect chemistry, relevant to catalysis, memristive devices, and solar energy systems.

In $LaNiO_3$ (LNO), a correlated perovskite, compressive strain stabilizes an insulating $LaNiO_{2.5}$ phase. High-Angle Annular Dark-Field (HAADF) and Integrated Differential Phase Contrast STEM (IDPC-STEM) reveal periodic oxygen-deficient layers along the growth direction. These rearrangements, confirmed by Density Functional Theory (DFT), reflect a transformation from NiO_6 to NiO_4 units, disrupting Ni–O–Ni connectivity. Geometric Phase Analysis (GPA) strain mapping shows this phase forms due to interfacial strain gradients. IDPC-STEM allows direct imaging of the oxygen sublattice, enabling quantification of local deficiency and symmetry breaking. XAS confirms changes in Ni valence and orbital occupancy, supporting a vacancy-driven metal-insulator transition [2].

Together, these case studies demonstrate the power of correlative electron microscopy and spectroscopy—enhanced by theory—to reveal the microscopic origin of defect-driven transitions.

This aligns with the IMPRESS project [3], which promotes interoperable platforms for advanced characterization. Our work supports this by showcasing integrated pipelines across infrastructures that accelerate defect-aware materials discovery.

References

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[2] Unpublished 2025
[3] https://e-impress.eu/

Day 2
09:30

STRUCTURAL BASIS FOR BACTERIAL PROTEIN DISAGGREGATION AND PROTEOLYSIS

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Protein homeostasis is meticulously maintained across all cells, spanning from archaea to humans. Any deviation from the equilibrium of the proteome, induced by stress or cellular aging, leads to the accumulation of misfolded proteins, contributing to cellular toxicity. A complex proteostasis network actively manages misfolded proteins through processes such as refolding, degradation, or sequestration into intracellular inclusions. Integral to this protein quality control system are ATPases from the AAA+ superfamily (ATPases Associated to a variety of cellular Activities).
These AAA+ proteins, universally present in organisms, share a common structural fold for ATP hydrolysis, but each possesses distinct function-specific domains, enabling specialization in particular cellular activities and interactions with regulatory protein partners.
Our work focuses on the structural investigation of bacterial Hsp100 AAA+ chaperones involved in protein quality control. We aim at understanding their fine-tuned regulation, which is absolutely required by the bacterium to survive harsh environment conditions and useful for us in the effort of killing pathogenic bacterial strains. Using cryo-EM in combination with biochemical functional assays, we can describe the molecular tuning mechanisms used by bacteria to assure the disaggregation or proteolysis of toxic protein species only, while leaving intact functional protein molecules.

Day 2
10:00

THE JOURNEY OF THE HIV-1 CAPSID: FROM ASSEMBLY TO NUCLEAR ENTRY

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Retroviruses such as human immunodeficiency virus type 1 (HIV-1) possess a capsid that encloses the viral RNA genome along with essential enzymes and accessory proteins. The processes of capsid assembly, maturation, and intracellular transport are critical for successful viral replication. Moreover, the capsid surface serves as a dynamic interface for interactions with host cellular components, engaging both antiviral restriction factors and viral dependency factors. As a result, the capsid has emerged a promising target for antiviral therapy, exemplified by the recent development of the long-acting drug lenacapavir. In this presentation, I will discuss the mechanisms of HIV-1 capsid assembly and maturation, as well as its interactions with key host factors, including IP6 and cyclophilin A, highlighting novel interactions that are essential for the stabilization of the HIV-1 capsid. Additionally, I will present our recent in situ structural studies on the nuclear import of HIV-1 cores and the architecture of native chromatin fibres in T cells during HIV-1 nuclear transp ort, utilizing correlative light and electron microscopy.

Day 2
13:30

HOW TO LEVERAGE YOUR WORKHORSE TALOS TEM FOR ANALYSIS OF THE SOPHISTICATED MODERN MATERIALS?

Maria Meledina*, Kristýna Bukvišová, Chloe Minnai, Minda Chen, Ricardo Egoavil, Carman Yip, Stefano Vespucci, Sháněl, Ondřej

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Transmission electron microscopy is applied on the daily basis to analyze a broad range of materials by the scientists from various fields and with broad range of backgrounds.
With the increasing complexity of modern sophisticated materials the TEM techniques for the reliable and trustful investigations require an accurate approach to the most efficient data collection. Interlinking the hardware units by the software the workflows for the daily analysis of the most complex materials using a workhorse TEM are created. Leveraging the one software ecosystem the workflows are enabling scientists coming from the different fields to use the top TEM techniques.
In this talk we will present the workflows allowing the users collecting the reliable information from the most sophisticated materials classes.

Day 2
13:45

DIRECT ELECTRON DETECTOR DEVELOPMENT TO ENHANCE IMAGE CONTRAST FOR CRYO-ELECTRON MICROSCOPY

Lingbo Yu[1*], Maarten Kuijper[1], Bart Janssen[1], Gerald van Hoften[1], Martin Obr[1], Bart van Haeringen[1]

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Cryo-electron microscopy (cryo-EM) has become an essential tool for studying biological samples at high resolution while preserving their native state. The main challenge is radiation damage to biological samples. Under low dose imaging conditions, direct electron detectors (DEDs) are crucial, as the DEDs significantly improved the quality of cryo-EM images by enhancing the detective quantum efficiency (DQE) and reducing noise. This talk discusses the advancements in Thermo Scientific's Falcon series of DEDs, highlighting their superior performance in low-dose imaging conditions, which is crucial for minimizing radiation damage to sensitive biological specimens. The Falcon detectors has gone through multiple generations [1] and multiple improvements to reduce various noise in the imaging system, such as backthinning [2], electron counting [3], etc. These technological improvements have led to significant contributions in structural biology, allowing researchers to achieve resolutions in the range of 3-4Å and solve critical biological questions more efficiently.

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Day 2
14:00

THINKING OUTSIDE THE BOX IN MAKING CRYO-EM MORE ACCESSIBLE FOR EVERYONE

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The screening process for single particle analysis (SPA) often requires extensive trial-and-error to achieve the perfect grid suitable for high-resolution image acquisition. This iterative nature of grid screening requires a specialized microscope that is easy to learn, provides minimal operational downtime, and supports maximum efficiency. However, the financial ramifications associated with such a system can pose significant accessibility barriers for many laboratories, such as core facilities and universities, and can be limited to selective applications. By improving the versatility of a thermionic (tungsten, LaB_6 source) TEM, while preserving the full functionality of all room temperature capabilities, cryo-EM entry becomes more attainable for a wider demographic. However, the process of screening vitrified proteins using a low-kV thermionic TEM can present inherent challenges; one of which can be maintaining a stable, low temperature environment within the microscope column. To comprehensively evaluate the efficacy of Hitachi's HT7800 thermionic TEM for cryo-screening, two separate samples were investigated, each targeting different aspects of the system's performance. The first experiment aimed to assess the TEM's ability to maintain appropriate conditions over an extended amount of time by screening apoferritin for over 9 hours. The second experiment tested the instrument's ability to sustain optimal conditions in untraditional, non-laboratory environments by screening vitrified virus-like particles (VLPs) at The Microscopy & Microanalysis Conference (M&M 2024) in Cleveland, Ohio, USA. Through the experimental evaluations of Hitachi's innovative retractable cold finger design, coupled with Simple Origin's transfer holder and SerialEM [1], Hitachi's HT7800 TEM demonstrated to be an effective screening tool in multiple environments. Thereby expanding the HT7800's versatility for a wider array of applications and providing greater accessibility to cryo-EM technology for everyone.

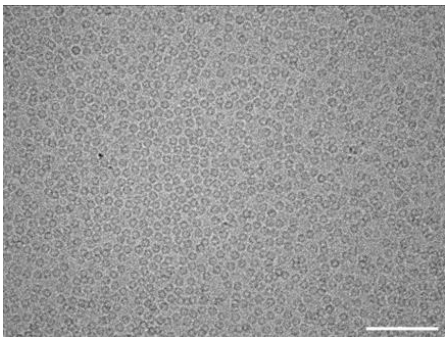

Fig. 1: Vitrified Apoferritin particles imaged approximately nine hours after the Simple Origin transfer holder was loaded into the microscope column. Images were taken with AMT's Nanosprint15-MarkII sCMOS camera. Image is digitally enlarged to show detail. Scale bar equivalent to 100 nm.

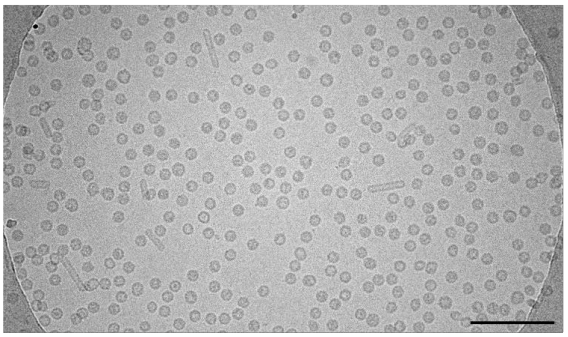

Fig. 2: Vitrified Virus-like particles (VLPs) imaged during the M&M 2024 conference in Cleveland, Ohio, USA. Images were taken with AMT's Nanosprint15-MarkII sCMOS camera at x70,000 magnification. Scale bar equivalent to 200 nm.

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Day 2
14:30

IMAGING RESOLUTION OF THE TIMEPIX4 FOR TRANSMISSION ELECTRON MICROSCOPY

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Imaging and diffraction capabilities in electron microscopy have been revolutionised by the introduction of direct electron detectors (DEDs), owing to their sensitivity to single electron events, noiseless background, high modulation transfer functions (MTFs), high detective quantum efficiencies (DQEs), radiation tolerance and speed. These superior properties over conventional cameras enable novel experimental protocols while enhancing existing methodologies. Most notably, the current generation of hybrid pixel DEDs from the Medipix3 family (Timepix3 and Medipix3 architectures) have served to collect high-quality four-dimensional scanning transmission electron microscopy (4D STEM) data from a wide range of challenging material systems under diverse experimental conditions, together with accessing unique time resolution for ultrafast transmission electron microscopy (UTEM) and unparalleled advantages for spatially resolved electron energy loss spectroscopy (EELS).

The Merlin T4 is the next-generation hybrid pixel DED, built on the Timepix4 [1] application specific integrated circuit (ASIC) from CERN, designed to push the boundaries of electron microscopy performance. Merlin T4 combines the frame and event mode capabilities of its predecessors into one platform. Here, we focus on the advantages of event mode. Merlin T4 provides pixel coordinates, time of arrival (ToA) and time over threshold (ToT) information per detected event when operating in event mode.

We present an evaluation of the imaging capabilities of a Merlin T4 using the Timepix4.2 ASIC bump-bonded to a 300 µm planar silicon sensor. Using the knife-edge method [2], we have measured the MTF and DQE for 100 and 200 keV electrons. To elaborate, knife-edge and flatfield images are generated by binning all events in time. Initial results from these knife-edges show a decrease with increasing particle energy of the MTF and DQE response at Nyquist (spatial) frequency. However, by exploiting the temporal structure of the detected events, and after performing per-pixel timewalk correction and energy-calibration, we enhanced the spatial discrimination of particle arrival. The blurring effects caused by extended electron trajectories and charge-sharing within the sensing layer were corrected in the image data. This approach improved the MTF at Nyquist by factors of 2.6 to 3.7 for different energies.

References:
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Day 2
15:00

ACCELERATING CRYO-EM DATA ANALYSIS WITH CRYOCLOUD

Ieva Drulyte[1*], Gydo van Zundert[1], Tadej Satler[1], Oleg Mikhailovskii[1], Anna Boronina[1], Boy Persoon[1], Ilja Gubins[1], Robert Englmeier[1]

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Advances in cryo-electron microscopy (cryo-EM) instrumentation, automation, and imaging protocols now allow acquisition of data for multiple high-resolution structures in a single day of cryo-TEM time [1-2]. However, as data collection has become faster and more efficient, the bottleneck has shifted downstream to data processing and management.
This talk will introduce CryoCloud, a cloud-based platform for scalable and automated cryo-EM data analysis. The underlying infrastructure has been purpose-built to optimise job execution for speed and stability. Recent developments include a machine learning-based particle picker, a map anisotropy quantification tool, and additional features that enable a fully automated workflow from raw movies to 3D reconstruction without user input.
This workflow has been applied successfully to a range of protein classes, including GPCRs (Fig. 1) and antigen-Fab complexes. By automating previously manual steps, CryoCloud reduces researcher workload and supports high-throughput applications such as screening or validating dozens of molecules in structure-based and computational drug discovery pipelines. These developments improve efficiency and consistency in cryo-EM, enhancing accessibility for both expert and non-expert users alike.

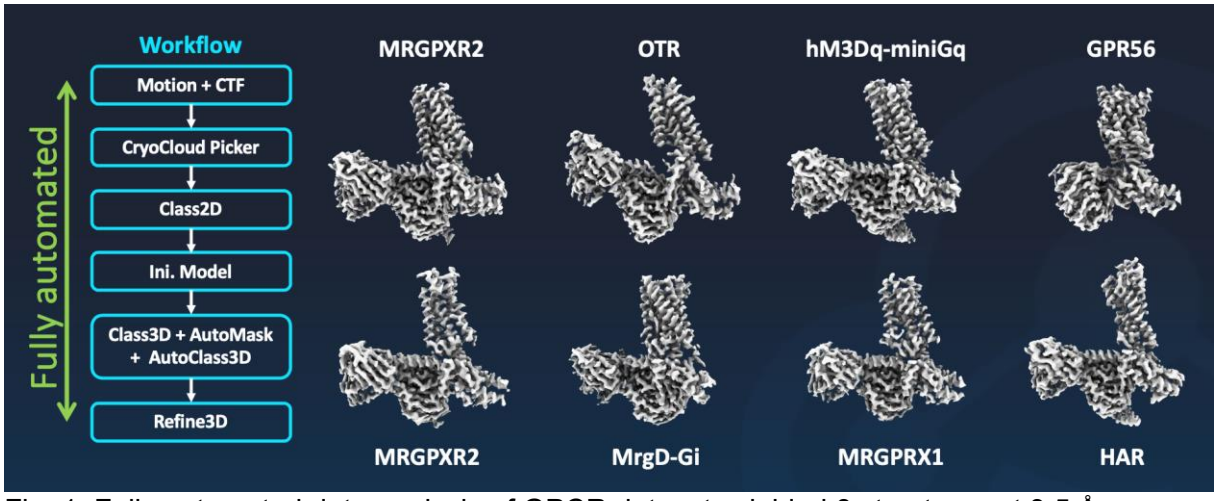

Fig. 1: Fully automated data analysis of GPCR datasets yielded 8 structures at 3.5 Å average resolution.

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Day 2
15:30

LIQUID HELIUM TEM SAMPLE HOLDER: SWIFT COOL-DOWN AND LONG HOLDING TIME

Amelia Estry[1*], Peng-han Lu[2], András Kovács[2], Yan Lu[2], Joseph V. Vas[2], Michael Faley[2], Thibaud Denneulin[2], Damian Bucher[1], Johan Chang[1], Dominik Biscette[1], Denys Sutter[1], Rafal E. Dunin-Borkowski[2]

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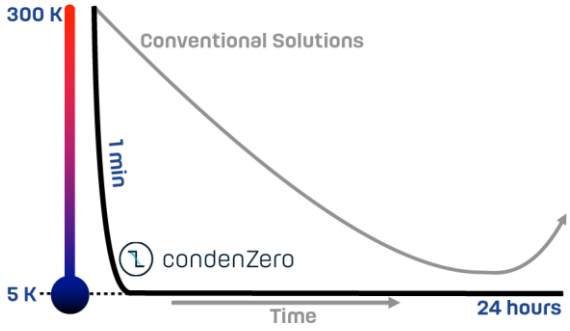
Quantum materials host unique electronic and magnetic properties—including superconductivity, charge and spin ordering—predominantly observed at cryogenic temperatures [1,2]. While progress in cryogenic transmission electron microscopy (cryo-TEM) methodologies have led to the development of liquid nitrogen (LN_2) cooled side-entry sample holders and cartridge-integrated microscopes tailored to suit the demands of life sciences, the exploration of such phase transitions within quantum materials typically necessitates adjustable temperatures with a base in the liquid helium (LHe) range [3].

LHe solutions for high-resolution imaging in electron microscopes have been developed with base temperatures as low as 1.5 K maintainable over a continuous five-hour timespan [4]. Unfortunately, such solutions, constructed in a cryo-stage setup, which combine superfluid helium alongside LN_2-cooled shields, cannot be easily adapted to the tight spatial constraints of the much more technically versatile side-entry holders. Until recently, commercially available LHe side-entry holders have been limited by considerable mechanical and thermal instability, as well as short base-temperature holding times due to the limited cryogen storage capacity of the dewar attached to the holder.

We present recent innovations of a lightweight, ultra-low-temperature LHe TEM sample holder. From room temperature, a base temperature of 5.2 K (as measured adjacent to the sample) can be attained within one minute and sustained with a stability of +/- 2.5 mK for days. Here, we demonstrate our recent achievements in the latest LH_2 cryo-TEM setup, developed thanks to collaborative efforts with the ER-C-1 at the Research Center Juelich.



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ELEMENT IDENTIFICATION ON THE ATOMIC SCALE AND HOW TO GET THERE

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The realization of aberration correction in scanning transmission electron microscopy combined with the recent technology leaps for various detection systems dramatically changed our possibilities in material and life science. Exciting opportunities in instrumentation development have opened and many new companies are taking on the challenge.
Our contribution focusses on EDS detector development, its technical intricacies and the conditions for success. The collection angle must be optimized without sacrificing space for other experiments, energy resolution, acquisition speed in combination with other simultaneous fast analysis techniques and affordability. Annular multi-segment detectors are most promising, however also complex and costly. Furthermore, EDS performance depends considerably on the specifics of the microscope. As single detector in a high-end dedicated STEM is suitable for atom column resolution [1] and to identify individual atoms in seconds [2]. A personal account of reaching such goals within reasonable development time navigating the academic and industrial landscape will be given as well as an outlook on what could be next.

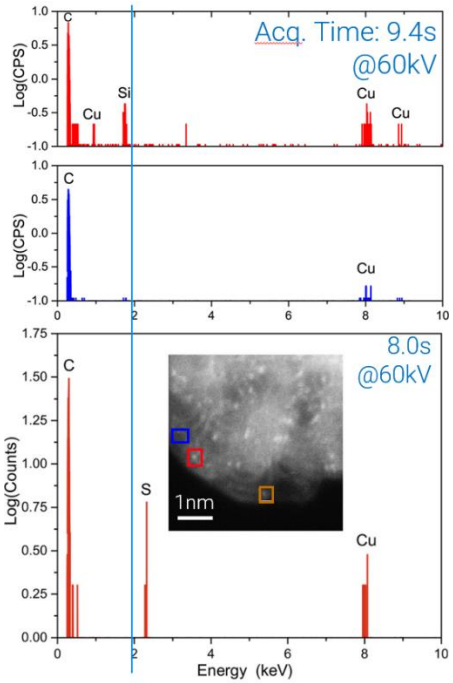

Fig. 1: Individual heteroatom identification within seconds in turbostratic carbon from space.
Specimen courtesy: Rhonda Stroud, School of Earth and Space Exploration Tempe, USA.

Fig. 2: Typical front part of a 100mm^2 active area EDS detector reaching a solid collection angle of up to 1 sr, depending on microscope pole piece geometry.

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Day 3
08:30

IN BUT NOT UP: UNDERSTANDING AND ADDRESSING STRUCTURAL BARRIERS FOR WOMEN IN SCIENCE

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Women remain underrepresented at senior levels of science and research worldwide [1–3], with a persistent decline in representation from doctoral completion to leadership positions evident across disciplines [4,2]. Structural disparities in authorship credit and evaluation outcomes [5–7] are associated with reduced career progression and visibility. Moreover, academic climates marked by gender discrimination and sexual harassment have been shown to foster attrition and are consistently associated with adverse mental health outcomes [8-11]. Additional barriers include higher service loads, which exacerbate workload imbalances and reduce time for research [12], as well as caregiving demands, which women continue to bear disproportionately and may lead to slower advancement or career discontinuity [13]. Psychological factors such as the impostor phenomenon further exacerbate strain, even in the context of strong performance [14]. This talk synthesizes evidence on structural and cultural barriers for female scientists in academia and highlights interventions with demonstrated effectiveness. The aim is to outline strategies that advance equity, promote mental health, and sustain inclusive career trajectories.

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Day 3
09:00

THE MANY ROUTES OF THE STEM FATALE INITIATIVE TO PROMOTE GENDER EQUALITY IN STEM

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Even today, women are underrepresented in STEM. Women often account for only 1/8 of professorship applications at academic institutions. In order to understand the underpinnings of the low participation rate of women in STEM leadership positions, a group of scientists enthusiastic to promoter gender equality in STEM had founded the STEM fatale Initiative in 2020. The initiative provides us with a structure to be stronger together, to advocate for women in STEM, to support women to aspire leadership positions and to raise public awareness.

As such, the initiative has been highly active in following different paths to increase the participation of women in STEM, particularly in leadership positions:
One scientifically inspired path was a data-driven approach through the creation of a survey, allowing us to assess factors – both, negative and positive ones - that have a significant impact on women's career choices in STEM. The survey results will serve as evidence-based steppingstones for the implementation of measures fostering women's career progression in STEM.
Furthermore, we are not only focusing on those women who have already decided to enter a STEM profession, but also on children and young adolescents who have an interest and a talent in the STEM disciplines. The initiative has thus organized 'Women in STEM' creativity contests in Austria, with more than 1,000 children (boys and girls) participating and deepening their knowledge on important scientific / technological advances made by women.

Lastly, each of the STEM fatale members represent action towards a more inclusive academic environment by serving as individual advocates for STEM and for women in STEM in particular. One fantastic opportunity to do so is science communication, for example at public outreach events. Such occasions not only allow us to share our work with the interested public, but also provides a platform to increase our communication skills in general, which is highly beneficial for our professional life.

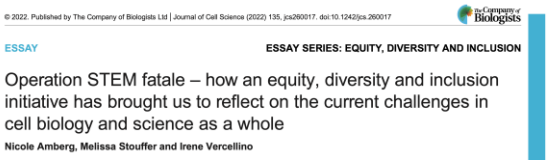

Fig. 1: Essay published by the STEM fatale Initiative in 2022 (Journal of Cell Science).

Fig. 2: Award ceremony of the 'Women in Tech' creativity contest for school students in 2023.

Day 3
09:30

INSPIRING THE NEXT GENERATION: ENGAGING GIRLS IN ELEKTRON MICROSKOPY AT ER-C

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Encouraging young talents - especially girls - to explore electron microscopy is crucial for fostering diversity and innovation in science. At the Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons (ER-C), we actively promote curiosity for this field through various initiatives. These include the Girls' Day, organized by JuLab, where small groups of middle school students (grades 7–9) experience hands-on microscopy; the Physics Project Days, a collaboration with RWTH Aachen and JuLab, bringing 30 high school students to our institute; and the Women in Science Initiative, offering guided tours for female students and scientists.

A key initiative is our internship program for female students in grades 9–12, a fully in-house project at ER-C. From concept to execution, we design and implement all experiments and activities, ensuring a hands-on and tailored learning experience. Additionally, we offer voluntary internships for high school seniors and bachelor students, as well as the JuLab MINT for Girls project, a fall break program introducing middle schoolers to microscopy and analytics.

In this talk we will present these activities, highlight their impact, and discuss strategies to further engage the next generation of female scientists in electron microscopy.

Fig. 1: Explaining FIB system for TEM sample preparation to high school students during "Physics Project Days 2024"

Day 3
10:30

How structure enables function in mitochondria

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My research is focused on the function of mitochondrial membrane proteins using structural biology as a tool[1]. Mitochondria are the organelles producing most of the energy used by our cells and harbor membrane-embedded complexes that are crucial for their function. In fact, mitochondrial proteins dysfunction is associated with diseases affecting highly energy-demanding organs, like brain and muscles, leading to neurodegeneration and myopathies. My method of choice for structure determination is cryogenic electron microscopy (cryo-EM).
I had the opportunity to become an expert of cryo-EM of mitochondrial complexes from my postdoc at the Institute of Science and Technology Austria. There, I studied how the energy-producing machinery of mitochondria assembles and how the resulting assemblies, called supercomplexes, can tune metabolism in mammals depending on the needs of the cell[2–4].
As I started my group at the Forschungszentrum Jülich in April 2023, I decided to focus on how the structure of the mitochondrial membrane supports the energy-producing function of the organelle, as it is known that structural perturbations of the membrane lead to functional impairment, ultimately linked to disease. These objectives are being investigated using cryo-EM as the main method, based on my expertise in structural biology of membrane protein complexes and enabled by the state-of-the-art facility present at Forschungszentrum Jülich.

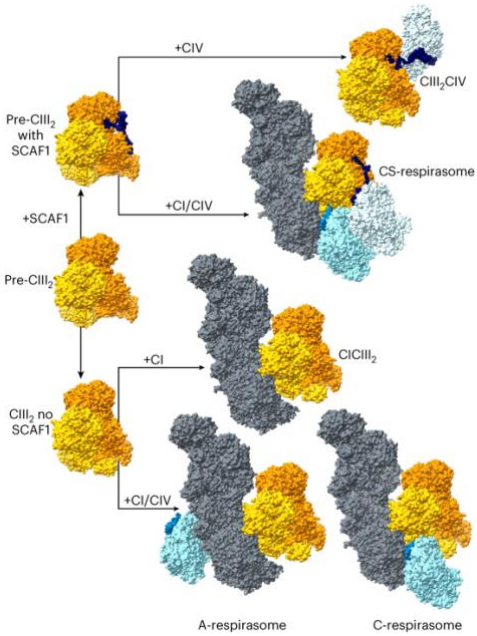

Fig 1. Overview of the conformational and compositional landscape of mammalian respirasomes, from REF[4].

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Day 3
11:00

SUBSTRATE TRANSPORT ACROSS PEROXISOMAL ABC TRANSPORTERS

Meghna Gupta[1,2*], Nitesh Kumar Khandelwal[1,2], Devin J. Seka[1], Sree Ganesh Balasubramani[3], Miles Sasha Dickinson[2], Alexander Myasnikov[2], Ignacia Echeverria[3,4], Robert M. Stroud[2*]

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Peroxisomes are dynamic organelles critical for lipid metabolism and cellular detoxification, including roles in fatty acid oxidation and bile acid synthesis. Transport of fatty acyl-CoA esters across the peroxisomal membrane is mediated by ATP-binding cassette (ABC) transporters of the D subfamily, with ABCD3 being the most prevalent. ABCD3 facilitates the import of diverse substrates, including branched-chain and very long-chain fatty acids, bile acid intermediates, and dicarboxylic acids. Mutations in ABCD3 are linked to metabolic disorders such as congenital bile acid synthesis defects. We determined cryo-electron microscopy structures of human ABCD3 in both apo and phytanoyl-CoA-bound states at near-atomic resolution. Biochemical analyses demonstrate that substrate binding enhances ATPase activity of the transporter, indicating a conformational coupling between substrate recognition and catalytic function. Structural comparisons reveal substrate-induced closure of nucleotide-binding domains, shedding light on the transport mechanism. These insights advance our understanding role of ABCD3 in peroxisomal metabolite trafficking and associated diseases.

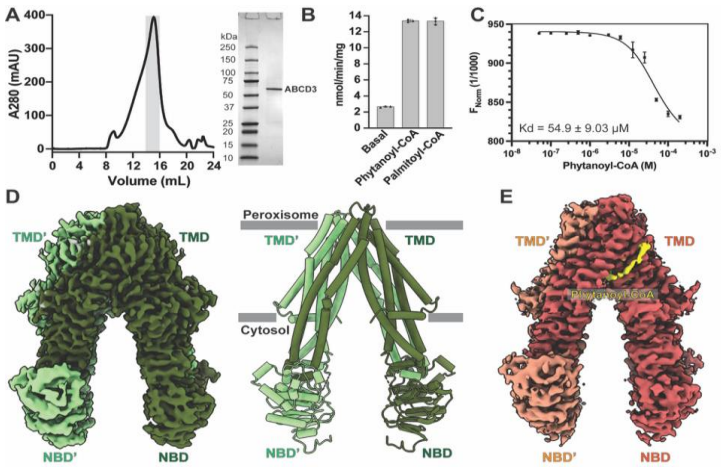

Fig. 1: Gupta lab's ongoing efforts on biochemically and structurally characterizing peroxisomal ABC transporters (A) ABCD3 purification, (B) Substrate-induced ATPase activity (C) Binding constant determination for the substrate (D) ABCD3 cryo-EM structures-Apo and with substrate [1].

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Day 3
11:30

CONSISTENT CO_2 REDUCTION PERFORMANCE OF AG NANOPARTICLE GAS DIFFUSION ELECTRODE UNDER REALISTIC DYNAMIC PV-POWERED CONDITIONS

Thérèse Cibaka[1,4], Tsvetelina Merdzhanova[1*], Oleksandr Astakhov[1], Viktor Schlichting[1], Sergey Shcherbachenko[1,3], Robert Zandonella[2], Marc Heggen[2], Uwe Rau[1,3], Peter Strasser[4]

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Advances in CO_2 reduction catalyst development have led to more stable and selective solutions for solar fuel production. Typically, these catalysts are evaluated under steady-state conditions. However, for CO_2 electroreduction to serve as a reliable long-term storage solution for renewable energy, especially from photovoltaics (PV), it must withstand fluctuations in power supply. Directly connecting CO_2 electrolyzers to PV systems supports carbon utilization and efficient energy storage but demands catalysts that deliver stable performance under variable power input. In this work, we employ a silver nanoparticle gas diffusion cathode that consistently produces CO over a broad current density range. When directly linked to a hardware-emulated silicon PV module operating under a realistic sunny-day profile, the system achieved 96% energy matching and an accumulated solar-to-chemical (CO) efficiency of 8.8% as seen in Fig. 1. This study highlights the promise of Ag-based cathodes for stable operation in PV-powered fluctuating conditions and introduces a novel testing approach that better mirrors real-world PV-electrolyzer integration, moving closer to practical solar-driven CO_2 reduction.

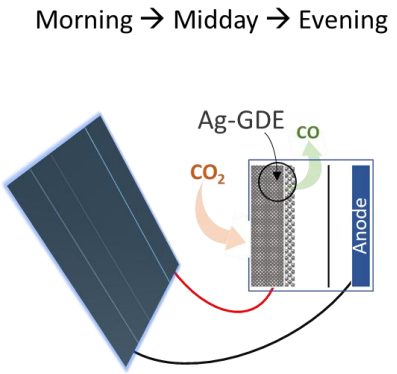

Fig. 1: Graphic content of the PV-EC under realistic dynamic conditions.

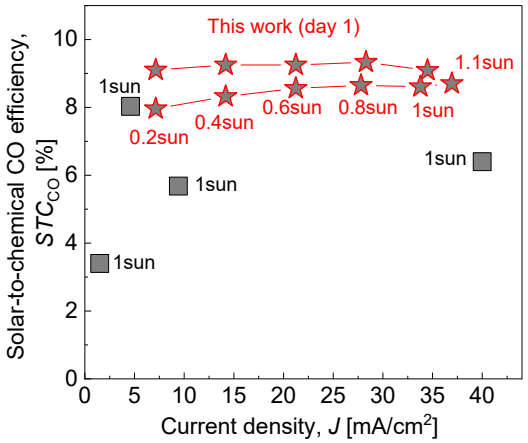

Fig. 2: Solar-to-CO Efficiency vs. Current Density for Si-PV Coupled EC [1-4]

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ELECTROSTATIC POTENTIAL OF LATEX SPHERE USING OFF-AXIS ELECTRON HOLOGRAPHY

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Electrostatic potential, including both that contributed by electron-beam-induced specimen charging and intrinsic material-related mean inner potential (MIP), is crucial because it is influence the reaction between charged particles, chemical reactivity, and dielectric properties. Off-axis electron holography is a powerful TEM technique that can be used to map local variations in electron optical phase shift, which are in turn sensitive to electrostatic potentials and magnetic fields. In the absence of magnetic contributions to the phase shift, the recorded phase is proportional to the projected electrostatic potential within and outside the specimen. Insulating nanoparticles with simple geometries are ideal objects for the study of specimen charging in the TEM.

Polystyrene latex beads were examined temperature-dependent behavior of the MIP and electron-beam-induced charge from room temperature down to 5.3 K in a FEI Titan G2 TEM at 300 kV. The diameter of latex spheres is in the range of 230 nm to 600 nm. By using a model-independent approach for the quantification of the spatially-dependent projected charge density from a recorded phase image [1, 2], the amount of positive charge on the sphere at each temperature was determined. Isolating the electrostatic potential contributed by the electron-beam-induced charge, the MIP was obtained at high precision, revealing a significant increase of 16.8%±4.2% as temperature decreases from RT to 5 K.

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Day 3
12:30

IN SITU STRUCTURAL ORGANIZATION OF THE P62 AUTOPHAGY CARGO RECEPTOR STUDIED WITH CLEM

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When cells have aggregated proteins, excess lipid droplets or malfunctioning organelles, they can be recycled via selective autophagy. This cargo is marked with a poly-ubiquitinated tag and subsequently recognized by cargo receptors that recruit a series of autophagy core machinery complexes, which in turn recruit a double phospholipid bilayer, also called autophagosome. This autophagosome is subsequently directed to the lysosome or vacuole for degradation and component recycling. The most studied cargo receptor is called p62/SQSTM1, and it forms polymers *in vitro* and phase-separates in the cytosol together with the poly-ubiquitinated cargo *in vivo* [1,2]. We aimed to understand the formation of these intracellular structures by comparing the *in vitro* cryo-EM structure of p62 as well as the *in situ* structural organization of p62 with cellular cargo, studied by cryo-ET. We determine the full-length structure of p62 and found a structured double helical filament scaffold, which upon binding to the autophagy mediator LC3 and poly-ubiquitin, mimicking autophagy cargo, underwent filament re-arrangements. In the cellular environment, under stalled autophagy conditions, we found an accumulation of large lipid droplets, which often co-localized with p62. We used a correlative light and electron microscopy [3], super resolution confocal microscopy as well as energy-dispersive X-ray spectroscopy approach to gain further insight into these structures. Surprisingly, we found high-contrast layers consisting of calcium, and phosphorus together with p62 enwrapping these lipid droplets. We hypothesize that these p62 oligomers with high calcium content are a potential early stage of autophagy.

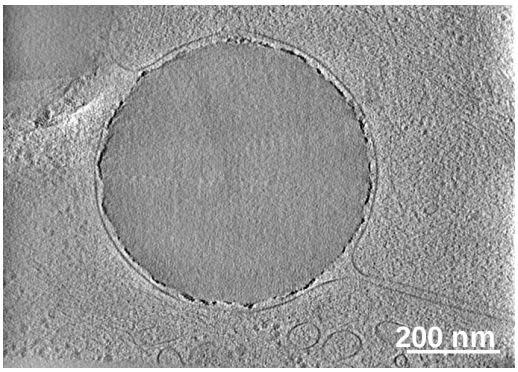

Fig. 1: Slice of tomogram of a p62 enwrapped lipid droplet

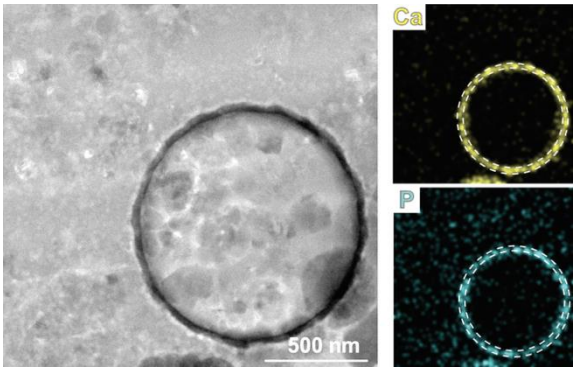

Fig. 2: Elemental analysis on the high contrast layer surrounding the p62 structure

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MA1

LOW-TEMPERATURE PLASMA-ENHANCED ATOMIC LAYER DEPOSITION OF ZnO THIN FILMS FOR PHOTOCATALYTIC DEGRADATION OF MICROPLASTICS

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Microplastics remain a persistent pollutant in the aquatic environment and current strategies for their removal are limited in both efficiency and scalability. In this work, an innovative photocatalytic degradation pathway using zinc oxide (ZnO) thin films deposited on plastic microfibres by plasma-enhanced atomic layer deposition (PEALD) is investigated. This method enables the deposition of several tenths of a nanometer thick conformal films at low temperatures and is therefore ideal for temperature-sensitive materials such as plastics [1].
ZnO films deposited with PEALD exhibit high photocatalytic activity even when grown at room temperature [2] and are therefore well suited for sustainable, energy-saving production methods. When exposed to UV light in water, these films accelerate the degradation of plastic microfibres. Remarkably, measurable degradation was also observed under simulated sunlight, emphasising the potential for environmentally friendly applications powered by natural light. The degradation mechanism involves the photo-creation of electron-hole pairs in ZnO, which subsequently generate reactive oxygen species that attack and oxidise the plastic surface [3].
In this presentation we show the results of the photocatalytic degradation of polyethylene terephthalate (PET) using scanning electron microscopy (eSEM) and Raman spectroscopy. Fig. 1 shows an untreated PET microfibre, while Fig. 2 shows the same after 48 hours of photocatalytic degradation, with a significant reduction in volume and increased surface roughness, indicating substantial material degradation.

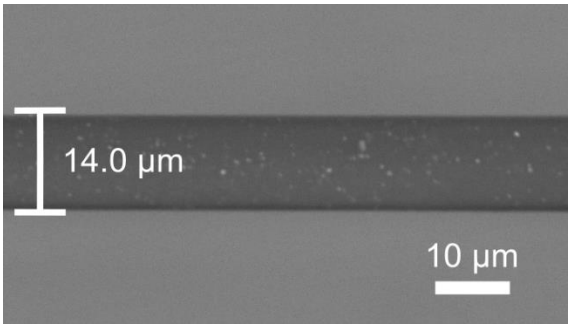

Fig. 1: PET microfibre before degradation.

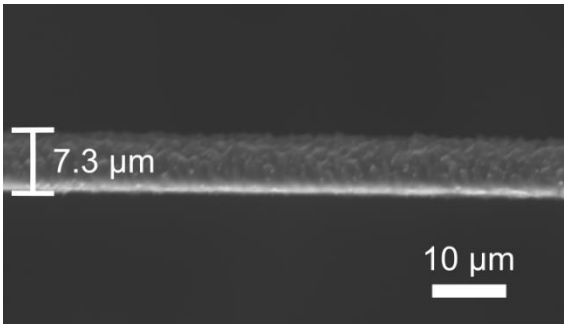

Fig. 2: PET microfibre after 48 hours of degradation.

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TOWARDS OPERANDO ELECTRON PAIR DISTRIBUTION FUNCTION ANALYSIS OF NANOPARTICLE-BASED CATALYSTS

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Pair distribution function (PDF) analysis of total scattering data is a key technique for studying short- to mid-range order in materials that lack translational periodicity and exhibit structural disorder, such as nanoparticles.[1] Nanoparticles often serve as functional materials, notably as heterogeneous catalysts, the structures of which are dynamic under working conditions. Therefore, *in situ* and *operando* PDF analyses are essential for reliably correlating local structural changes with catalytic performance, thereby establishing structure-performance relationships.[2] While *in situ/operando* X-ray PDF analysis, typically performed at synchrotron facilities, provides valuable insights into the local order of catalysts, its limited spatial resolution poses a challenge to the characterization of catalysts exhibiting complex morphologies and structural heterogeneities at the atomic- and nanoscale.

As an alternative, electron PDF (ePDF), obtained from electron total scattering data collected in conventional transmission electron microscopes (TEM), provides spatially resolved local structural information at the atomic scale. [3] Moreover, ePDF can be combined with complementary TEM-based techniques—including imaging, energy-dispersive X-ray spectroscopy (EDX), and electron energy-loss spectroscopy (EELS)—to simultaneously capture morphological, compositional, and electronic structure information. However, performing operando ePDF analysis is challenging due to unwanted elastic and inelastic scattering contributions from the environment components of *in situ* TEM gas cells. These include the SiN_x nanoreactor membranes (~ 80 nm thick, compared to *ex situ* carbon films of 3–30 nm) and gas-phase layers (~ 4 µm at 1 bar, compared to ~10^{-7} bar *ex situ*), both of which obscure the coherent single-scattering signal originating solely from nanoparticle catalysts

Here, we systematically investigate how background electron scattering contributes to the ePDF obtained during the oxidation of Pd nanoparticles into PdO. This reaction was chosen because it displays significant short-range structural changes. We carefully evaluate the validity of different background modeling and subtraction approaches, including a direct subtraction of signals from the empty *in situ* TEM gas cells with *ad hoc* corrections [4], Multivariate Curve Resolution-Alternating Least Squares (MCR-ALS), and Principal Component Analysis (PCA) to establish robust protocols for operando ePDF acquisition and data processing, thereby facilitating its broader application in catalysis research.

We thank the SNSF for financial support (grant TMPFP2_224646).

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MA3

THE ROLE OF ELECTRON MICROSCOPY IN ANALYZING THE PHOTOCATALYTIC PERFORMANCE OF TiO_2-Cu NANOCOMPOSITE ALD FILMS

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To improve solar-driven photocatalysis, we synthesized TiO_2-Cu composites with different copper content in the form of thin polycrystalline films by atomic layer deposition (ALD). The copper nanoparticles were embedded directly into the TiO_2 matrix during the film deposition. To investigate the surface morphology, crystalline and electronic structure, and optical absorption of the Cu-TiO_2 composite films, we applied a series of characterization methods, including X-ray photoelectron spectroscopy (XPS), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), transmission electron microscopy (TEM), X-ray diffraction (XRD), and UV-Vis spectroscopy. The photocatalytic performance of the samples was determined by monitoring the degradation of methylene blue (MB) in aqueous solution under simulated solar irradiation. The ALD-synthesized TiO_2-Cu composites in our study show significantly improved photocatalytic efficiency compared to similar compounds described in the literature. This work presents the role of scanning electron microscopy in analyzing the photocatalytic performance of TiO_2-Cu nanocomposites.

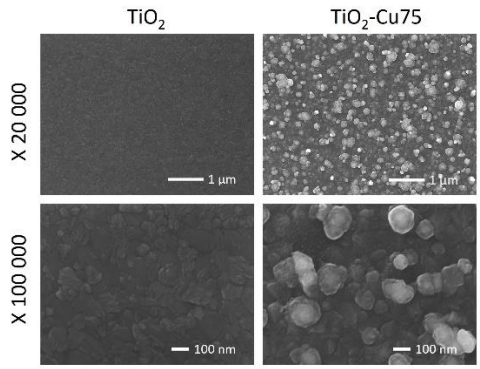

Fig. 1: SEM images of a pure TiO_2 sample and of TiO_2-Cu composite film.

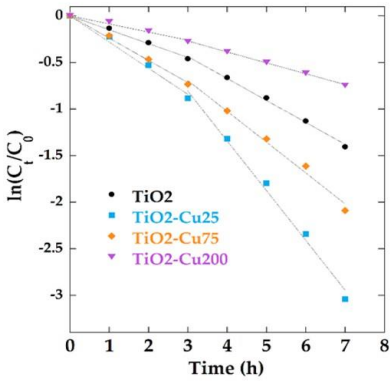

Fig. 2: Plot of $\ln(C_t/C_0)$ as a function of the irradiation time for pure TiO_2 catalyst and TiO_2-Cu composite films.

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MA4

STRUCTURAL ANALYSIS OF CNTs USED AS LIB ANODES

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This work highlights the role of high-resolution electron-microscopy in characterizing nanoscale degradation phenomena in multi-walled carbon nanotubes (MWCNTs) used as anode materials in lithium-ion batteries (LIBs), by structurally analyzing their evolution during electrochemical cycling. The work focuses on pristine (PCNT), lithiated (LCNT) and de-lithiated (DCNT). All samples are prepared via mechanical dispersion in ethanol and drop-cast onto copper TEM grids. The samples are examined using bright-field transmission electron microscopy (TEM BF), high-resolution TEM (HRTEM), and electron energy loss spectroscopy (EELS). Following lithiation, the CNTs exhibit distinct structural transformations characterized by the emergence of an amorphous surface layer; presumed to be the solid electrolyte interphase (SEI) [2]. Furthermore, a pronounced increase in the interlayer spacing is observed, ascending from approximately 0.35 nm in pristine CNTs to 0.39 nm following lithiation, thereby supporting the hypothesis of lithium-ion intercalation between the graphene layers. Additionally, EELS analysis is conducted to corroborate these findings. The LCNTs also exhibit signs of outer wall exfoliation, indicative of lithiation-induced structural degradation [2]. A partial structural recovery is evident post-lithiation, marked by a reduction in interlayer distance to approximately 0.36 nm and a corresponding decrease in wall thickness. However, both parameters remain elevated compared to those of the PCNT, implying the incomplete de-intercalation of li-ions and persistence of irreversible morphological altercations, including SEI layer retention. Finally, the aforementioned dimensional variations are quantitatively assessed and visualized via histogram analysis, clearly illustrating the lithiation-induced increase in CNT wall thickness and its partial reversal following de-lithiation.

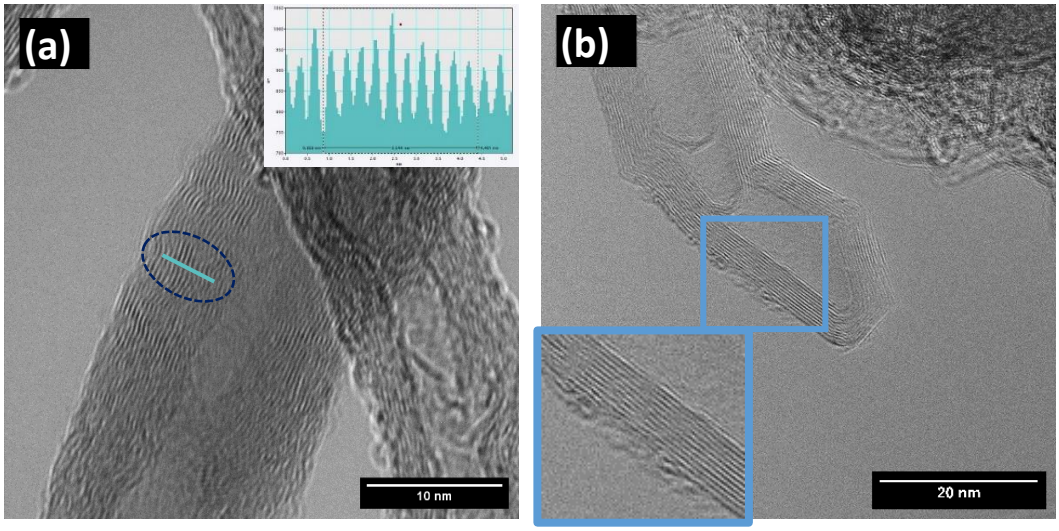

Fig1 : HRTEM images for (a) PCNT with live profile (b) LCNT with visible tube damage

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MA6

TECHNOLOGICAL ADVANCES FOR TEMPERATURE DEPENDENT LIQUID AND ELECTROCHEMICAL STUDIES USING IN SITU TEM

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Transmission electron microscopy (TEM) is a powerful technique used to characterize materials at the nano- and atomic scale. However, because TEM operates in a high-vacuum environment, observing materials in their native state is traditionally impossible. This challenge has been addressed with *in situ* TEM holders, which create a sealed environment within the TEM, isolating samples from vacuum while allowing the controlled introduction of liquids, gases, and external stimuli such as temperature, voltage, and pressure. With this capability, researchers can now directly observe nanoscale phenomena, including electrocatalytic surface area loss[1], corrosion propagation in steel[2], nucleation and growth of nanomaterials[3], and battery shorting[4].

For materials subjected to electrochemical stress during operation, temperature also plays a crucial role in overall performance. However, until now, no *in situ* TEM system has provided the broad temperature range needed for most applications. A breakthrough in temperature-controlled liquid systems for *in situ* TEM now enables experiments from -50°C to 300°C, simultaneous with electrochemical testing. This advancement allows researchers to replicate real-world conditions experienced by fuel cell catalysts and electric vehicle batteries, as well as achieve the high temperatures required for nanomaterial synthesis, such as high-entropy alloys.

In this presentation, examples of how the temperature affects the kinetics of electrochemical reactions as well as the morphological structures of the materials will be showcased (Figure 1). In addition, examples of temperature-dependent phenomena, such as the crystallization of water to ice and the nucleation and growth of gold (Figure 2) will be discussed, with diffraction, energy-dispersive X-ray spectroscopy (EDX), and electron energy loss spectroscopy (EELS) analyses as a complement.

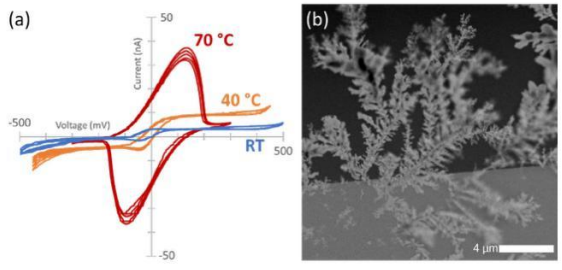

Figure 1. (a) Chemical redox cycling of 50 mM ferric and 50 mM ferrous chloride at room temperature (blue), 40 °C (orange) and 70 °C (red) within a closed-cell TEM system (b) TEM micrograph of silver dendrites formed in real time on the platinum working electrode by chronoamperometry.

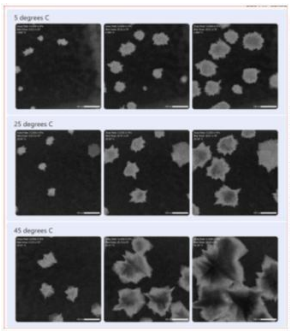

Figure 2. Demonstrating the effect of temperature while holding total dose constant on morphology as gold nucleates and grows in a solution of gold chloride.

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pitch MA7

OPTIMIZING ALD-GROWN SnO_2 THIN FILMS FOR PHOTOCATALYTIC APPLICATIONS

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Water pollution is a critical environmental issue that threatens ecosystems and human health worldwide. Photocatalysis has emerged as an effective and environmentally friendly method for wastewater treatment by harnessing light energy to degrade harmful organic and inorganic contaminants [1], [2]. Tin dioxide (SnO_2) is an n-type semiconductor with a wide bandgap (~3.6 eV), known for its high chemical stability, excellent optical transparency, strong electron mobility, and notable photocatalytic activity. Its biocompatibility, low toxicity, and suitability for low-cost large-scale production make it a promising material for environmental applications, particularly in water purification [3], [4].

In this study, we investigate the influence of deposition temperatures on the properties of SnO_2 thin films prepared by atomic layer deposition (ALD), a technique that enables precise control over film thickness, conformality, and composition at the nanoscale. The films are deposited on silicon substrates using $SnCl_4$ and H_2O as precursors. Surface morphology is characterized by scanning electron microscopy (SEM), while photocatalytic activity is evaluate through the degradation rate of methylene blue in aqueous solution under ultraviolet and simulated solar radiation.

Based on the obtained results, the most efficient SnO_2 will be used as a dopant to modify ZnO and TiO_2 films deposited by ALD with the aim of enhancing their photocatalytic performance.

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MA8

TRACKING THE CRYSTALLINE-AMORPHOUS TRANSITION DURING LITHIATION OF SILICON MICROPARTICLES

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With the aim of the European Commission to archive the first climate-neutral continent by 2025 the development of electrical energy systems is of great importance [1]. Therefore, the improvement of energy storage systems is crucial, making the development of the next generation of Lithium-ion batteries an up-to-date topic.
Graphite-based anodes are nowadays widely used, but silicon-based anodes are of great interest due to their high theoretical capacity of 3579 mAh/g which is approximately ten-fold than that of the commonly used graphite-based anodes [2,3]. The biggest challenge that silicon-based anodes face is the degradation due to volume expansions of ~300 % upon (de)lithiation, resulting in a crystalline-amorphous transition. To overcome this hurdle, one approach is partial lithiation, by only using ~30 % of the silicon anode, meaning the silicon anode is cycled under its capacity limit. The benefit of this approach is a smaller volume expiation of only one-third of the maximal expansion which also helps to ensure that a crystalline silicon phase remains upon (de)lithiation [4].
Transmission electron microscopy (TEM) is the method of choice in order to correlate the microstructure, and chemical composition with the electrochemical performance of the crystalline and amorphous phases within partially lithiated polycrystalline silicon microparticles. Although silicon nanoparticles have been studied extensively and a core-shell model is proposed [2,5]. In the sample we investigated, we found out that additional amorphous veins form throughout the silicon crystal upon lithiation, which is supported by other literature sources [6]. This indicates that there are still unanswered questions regarding bulk silicon anodes. To further understand how the amorphous veins form in the silicon microparticles during lithiation and whether this stage can be investigated, an in-situ biasing TEM experiment was performed to lithiate a pristine sample by applying an electrical current.

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MA9

STRUCTURAL AND PHOTOCATALYTIC PROPERTIES OF Cu-DOPED TiO_2 FILMS SYNTHESIZED BY ALD

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Water pollution caused by organic contaminants has become a global environmental concern, requiring the development of efficient and sustainable treatment methods [1]. Among them, photocatalysis stands out as a promising approach due to its ability to degrade harmful compounds into less toxic or harmless products using light and semiconductor materials [2]. Titanium dioxide (TiO_2) is widely studied as a photocatalyst [3] because of its chemical stability, non-toxicity, and strong oxidative power under UV light.

In this study, TiO_2 and Cu-doped TiO_2 thin films were synthesized via atomic layer deposition (ALD) on flat silicon substrates using $TiCl_4$ and H_2O at 250 °C. Copper(II) acetate was employed as the dopant precursor to enhance visible light absorption. The films were characterized by SEM, TEM, GIXRD, and XPS to analyze their morphology, crystallinity, and chemical composition. Photoluminescence and Hall effect measurements were used to evaluate the optical and electrical properties. Photocatalytic activity was tested through the degradation of methylene blue under UV and simulated solar irradiation.

The results demonstrate that Cu doping modifies the surface morphology, leading to the formation of island-like structures with metallic Cu cores embedded in the TiO_2 matrix (Fig. 1). These structural changes significantly improve light absorption and charge carrier dynamics, resulting in enhanced photocatalytic efficiency compared to undoped TiO_2 films. The findings suggest that Cu-doped TiO_2 films prepared by ALD are a promising material for advanced water purification technologies.

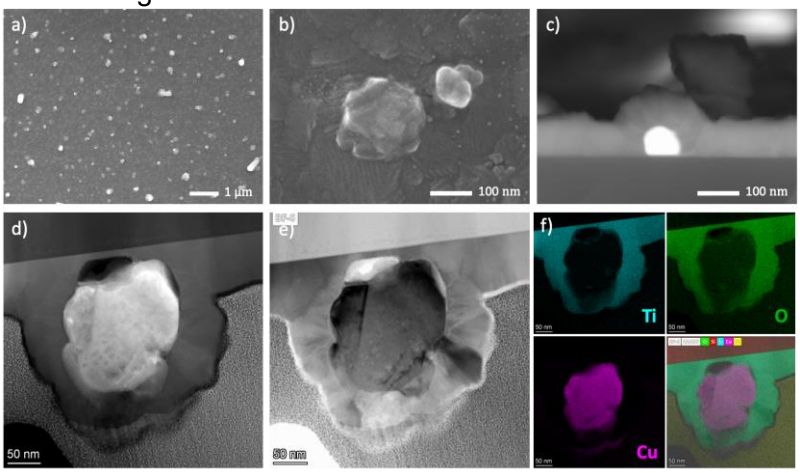

Fig. 1: Top row: SEM images of the Cu-doped TiO_2 film a)-c). Bottom row: TEM images d)-e) and EDS maps of the Cu-doped TiO_2 film f).

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MB1

IN SITU-LASER BEAM MICRO WELDING OF ALUMINUM ALLOYS 5083 AND 6060 INSIDE LARGE CHAMBER SEM

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This work represents the in situ laser beam micro welding of aluminum alloys 5083 and 6060 inside a large chamber scanning electron microscope (LC-SEM). The main goal was to investigate the influence of laser welding parameters including welding mode (Keyhole vs. Heat Conduction) and feed rate (0.5 mm/s and 1 mm/s) on weld geometry, microstructure, and defect formation. The keyhole mode resulted in deeper and wider welds than the heat conduction mode. Lower feed rates significantly increased penetration depth but also introduced more porosity, especially in alloy 5083. SEM and 3D optical microscopy revealed distinct surface morphologies and internal weld geometries. In alloy 5083, grain growth in the weld pool followed a transition from elongated to equiaxed and intergrown structures. TEM analysis revealed Fe-rich precipitates concentrated at the center of the weld, contributing to the formation of unique spherical morphologies.EBSD and EDX mapping confirmed reduced Mg content in the weld seam due to vaporization and elemental redistribution. In both alloys, epitaxial grain growth was observed at the boundary between the heat-affected zone (HAZ) and the former melt pool. Alloy 6060 exhibited a finer grain structure and less complex morphology compared to 5083, along with sub grain formation near the weld center. These results demonstrate the capability of LC-SEM-assisted laser welding to offer precise, high-resolution insight into metallurgical transformations, highlighting the influence of process parameters on weld integrity in aluminum alloys

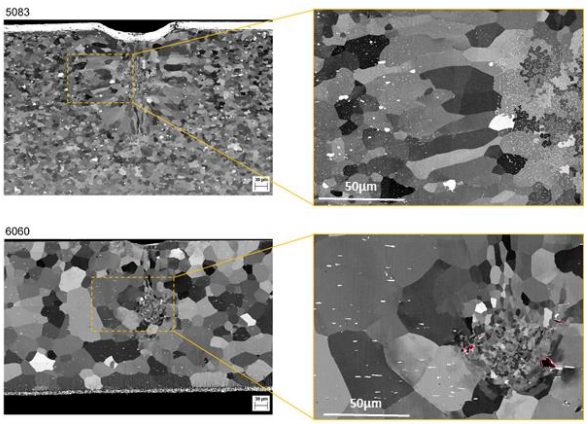

Fig. 1: BSE images of the weld seams welded in keyhole mode at 0.5 mm/s

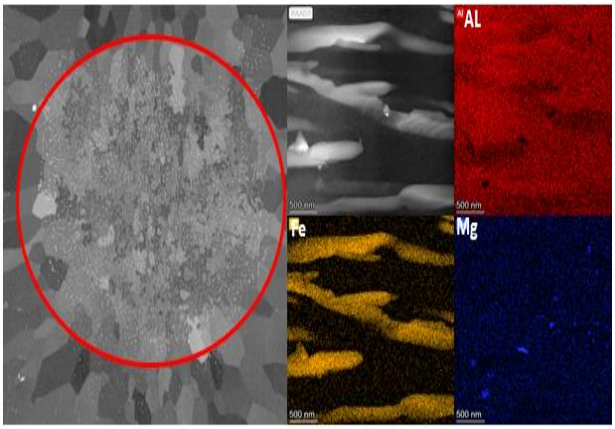

Fig. 2: STEM images of center area of laser welding zone

MB2

MAGNETIC CHARACTERISATION OF MECHANICALLY EXFOLIATED FE_5GETE_2 FLAKES

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Two-dimensional (2D) magnetic materials have significant applications in advanced electronics, quantum computing, and spintronic devices.[1] The Fe_5GeTe_2 (F5GT) family stands out due to its high Curie temperature and strong ferromagnetism at ambient temperatures. [2] Iron content and elemental substitutions like Co, Ni, can be used to change its magnetic properties. [2-4] In our work, we have used Lorentz Transmission Electron Microscopy (LTEM) and Vibrating Sample Magnetometry (VSM) to study how oxidation affects the magnetic characteristics of exfoliated F_5GT flakes. Our findings show that exfoliated F_5GT flakes have different magnetic properties before and after oxidation, which are attributed to specific dominant spin configurations. Our findings show that oxidation has a greater effect on the out-of-plane spin contribution than on the in-plane components. This effect arises because oxidation predominantly progresses along the flake's thickness, which is much smaller than its lateral dimensions. Consequently, the out-of-plane direction, having a higher demagnetisation factor, becomes more vulnerable to oxidation-induced changes. These findings are supported by VSM measurements, which reveal a decrease in the out-of-plane magnetic moment after oxidation. Therefore, changes in magnetic properties caused by oxidation may be a common trait among numerous air-sensitive 2D magnetic materials, making such studies critical for understanding the evolution of magnetic properties under oxidative conditions.

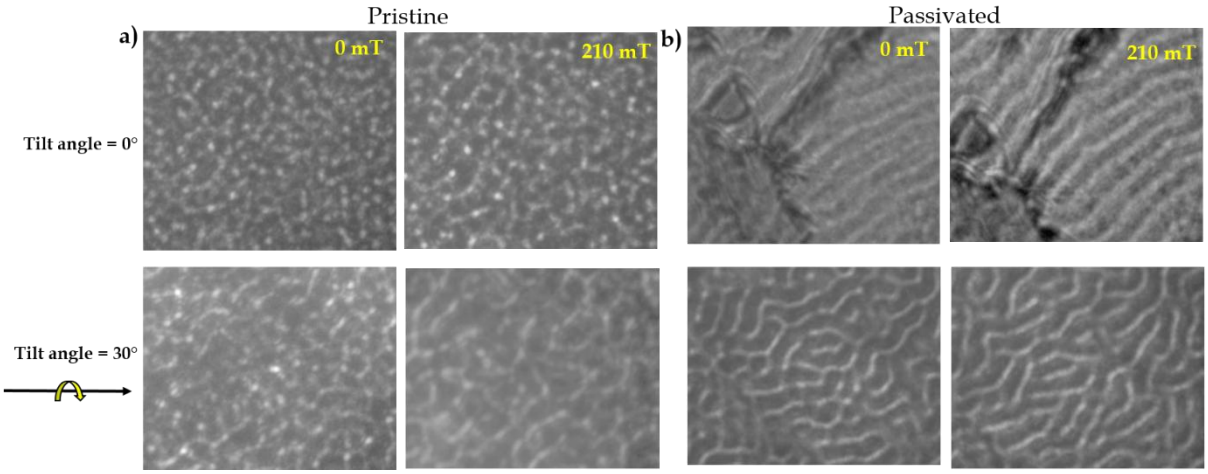

Fig. 1: *a-b) Lorentz transmission electron microscopy (LTEM) images of exfoliated Fe_5GeTe_2 of pristine and oxidised region of same flake at tilt angles 0° and 30° under 0 and 210 mT. The measurements are done at 100 K with defocus -2.5 mm. The exfoliated Fe_5GeTe_2 are oxidised by keeping it in ambient condition for 100 hrs.*

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[1] Ping Liu et al. *Iscience* **26**,9 (2023).
[2] Hongtao Ren, Lan Mu. *Molecules* **28**, 21 (2023): 7244.
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[4] Bochong Wang et al. *Applied Physics Letters* **123**,7 (2023).

MB3

EXPLORING MAGNETIC PROPERTIES AND CORROSION RESISTANCE IN RECYCLED AND CRYOGENICALLY TREATED Nd-Fe-B PERMANENT MAGNETS

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Nd-Fe-B permanent magnets are indispensable functional materials in technologies driving the global energy transition, including electric vehicles and offshore wind turbines[1]. However, due to their poor corrosion resistance, protective coatings are required, which can hinder the recycling process of end-of-life magnets[2]. Cryogenic treatment (CT) has been applied to several ferrous alloys used as structural materials with observed improvements corrosion resistance[3]. This study explores the application of CT as a promising alternative for enhancing the corrosion resistance of sintered and recycled Nd-Fe-B magnets, while also evaluating its influence on their magnetic properties. Advanced electron microscopy techniques — including SEM combined with EDS, EBSD, and AFM-MFM — were employed as key tools to investigate the microstructural modifications induced by CT. These techniques allowed for a detailed correlative analysis of crystallographic, chemical, and magnetic features, enabling a comprehensive understanding of the structural evolution. Results reveal that microstructural changes can potentially improve corrosion resistance, emerging as a promising pathway for the sustainable post-processing of Nd-Fe-B magnets. This study also reinforces the critical role of high-resolution microscopy in uncovering degradation mechanisms and enhancing material performance for a more circular, low-carbon economy.

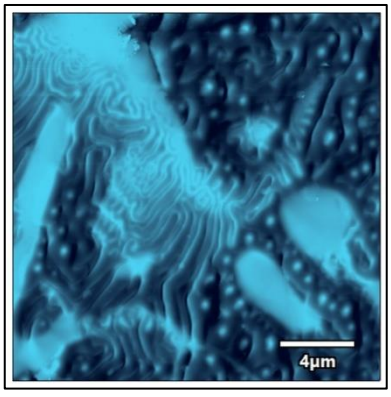

Fig. 1: AFM-MFM magnetic domains of Nd-Fe-B magnet.

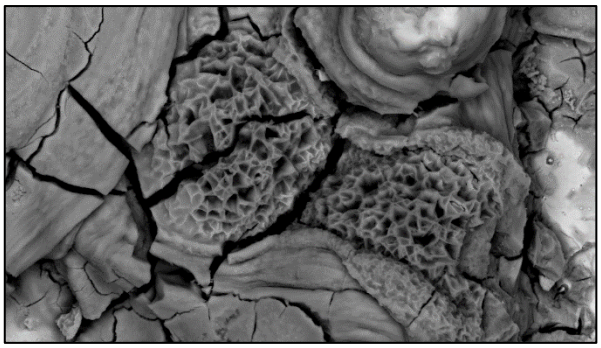

Fig. 2: SEM image of oxide build-up after corrosion testing.

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MB4

TEMPERATURE-INDUCED MAGNETO-STRUCTURAL EVOLUTION IN COFENIMN ALLOY

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Magnetic high entropy alloys (HEAs) are defined as alloys containing five or more principal elements in equal or near-equal atomic concentrations stabilized by high configurational entropy [1] and can be designed to have a range of magnetic properties [2], including both soft and hard magnetic characteristics, depending on their composition and structure. In particular, CoFeMnNi-based HEAs, were used [3] to study the effect of the addition of Al, Ga and Sn on structure and magnetic properties. It was found that upon addition of Al, Ga and Sn saturation magnetization (M_S) increases by 8 times for Al and by 4 times for Ga and Sn due to microstructural changes, which remained unclear.

In this work, we address this knowledge gap by correlating magnetism and microstructure of the CoFeMnNi alloy produced by high-energy ball milling (HEBM). Temperature-dependent magnetization measurements in an external magnetic field of 1 T are combined with measurements of microstructural evolution by transmission electron microscopy (TEM).

The CoFeMnNi alloy is a medium-entropy alloy (MEA), with the configurational entropy of mixing ΔS_{conf} ~ 1.38 R (R = 8.314 J/K mol), providing a starting point for the rational design of magnetic HEAs. As-milled single-FCC solid solution displays soft-magnetic behaviour (M_S = 46 Am²/kg, $\mu_0 H_C$ = 0.5 mT) with uniform elemental distribution matching the nominal concentrations.

Annealing at 800 K induces nanoscale phase separation (Fig. 1) into ferromagnetic FeCo (BCC) and antiferromagnetic NiMn ($L1_0$), promoting exchange coupling across ~ 0.5 nm interfaces and the raise of the room-temperature magnetization and coercivity to M_S = 115 Am²/kg and $\mu_0 H_C$ = 30 mT – representing 2.5-fold and 60-fold increases, respectively. Subsequent annealing to 950 K dissolves FeCo back into the FCC matrix and coarsens NiMn to ~ 50 nm precipitates, restoring a soft state with M_S = 18 Am²/kg and $\mu_0 H_C$ = 0.5 mT. Consequently, temperature driven phase transformations in the FeCoNiMn alloy reversibly modulate M_S and $\mu_0 H_C$, offering a controllable pathway for precise tailoring of magnetic properties. Financial support by DFG, CRC/TRR 270 (project ID 405553726) is acknowledged.

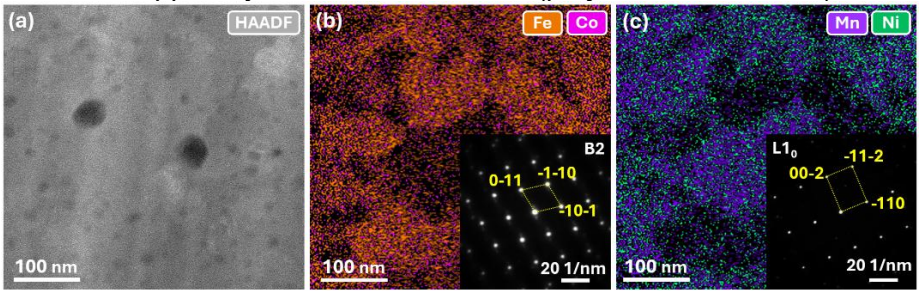

Fig. 1: (a) HAADF STEM image of the FeCoNiMn alloy held at 800 K, accompanied with EDX elemental maps of (b) ferromagnetic FeCo (BCC) and (c) antiferromagnetic NiMn ($L1_0$) phases.

References:
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MB5

IN-SITU TEM STUDY OF THE EFFECT OF HYDROGEN ON CRACK PROPAGATION IN STEEL

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Crack tip propagation within Cr-Mo low alloy steel lamellae was directly observed through in-situ fracture testing conducted in an environmental transmission electron microscope (TEM) to investigate hydrogen embrittlement. The nanomechanical testing reveals that the initial crack propagation stages involve significant plasticity and thinning ahead of the crack tip, regardless of the presence of hydrogen gas in the microscope chamber. However, subsequent stages exhibit notable differences influenced by the presence of hydrogen gas. In the absence of hydrogen gas, crack tip blunting, void nucleation, crack bridging, and necking occur due to continued extensive plasticity [1]. On the contrary, when hydrogen gas is present, the crack tip maintains its sharpness, advancing through the creation and connection of zig-zag micro-cracks featuring projection edges along the <100> direction, associated with minimal plastic deformation [2]. Possible scenarios will be presented, centering on the development of zig-zag cracks facilitated by hydrogen-enhanced local plasticity (HELP) on slip planes within TEM lamellae, as well as hydrogen-enhanced decohesion (HEDE). Potential electron beam effects will be discussed, along with extrapolations of observations and models to the geometries and high triaxiality conditions encountered during the fracture of hydrogen embrittled bulk specimens.

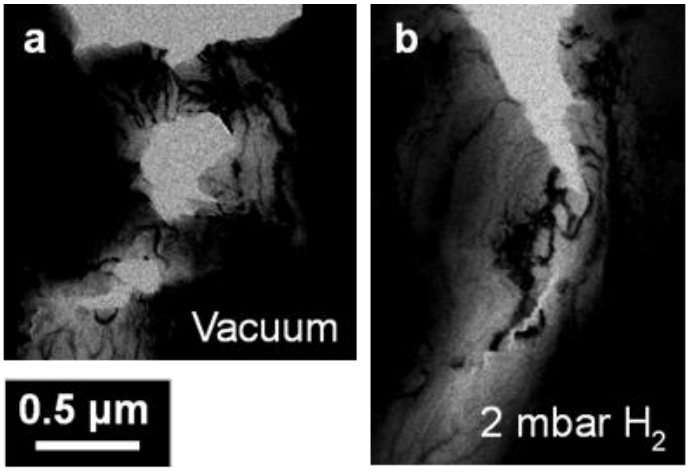

Fig. 1: Snapshots from in-situ TEM videos of crack propagation in a Cr-Mo steel during fracture testing (a) in vacuum [1] and (b) in 2 mbar H2 gas reveal clear evidence of hydrogen embrittlement

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MB6

CORRELATIVE TEM AND APT STUDY OF MICROSTRUCTURAL ORIGINS OF COERCIVITY IN Sm-Co-Cu MAGNETS

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Sm_2Co_{17}-type magnets exhibit high coercivity due to complex multiphase microstructures. To understand the role of the Cu-rich 1:5 phase, we studied textured $Sm_{1.1}(Co_{0.7}Cu_{0.3})z$ alloys (z = 5–7.5) with a fixed Co/Cu ratio. Coercivity showed a strong dependence on composition, reaching 1.6 T for z = 6.5. SEM and XRD revealed a dominant 1:5 phase. Correlative TEM and APT identified nanoscale 2:17-type precipitates within the 1:5 matrix and an inverse Co/Cu distribution, highlighting the microstructural origins of domain wall pinning and magnetic performance. These correlative microscopy techniques were key to understanding the microchemistry and microstructure controlling domain wall pinning and coercivity in this ternary system

Comparison of 1:5 Phase in Low and High Coercivity Samples

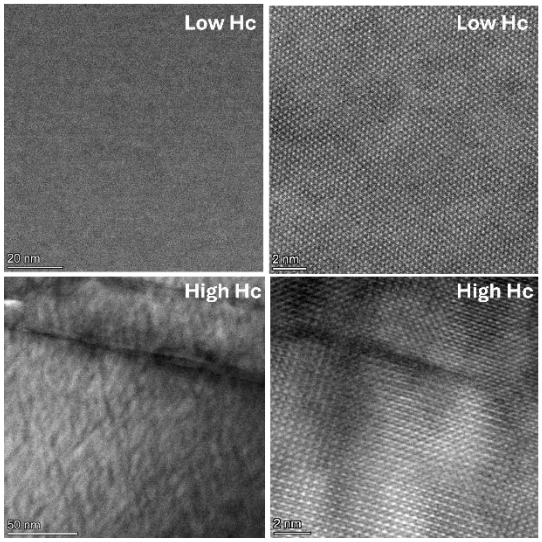

Fig. 1: BF and HRSTEM images of the 1:5 phase in high- and low-coercivity samples. Textured precipitate-like features and local misorientations are visible in the high-coercivity sample, while the low-coercivity sample shows a more uniform 1:5 matrix.

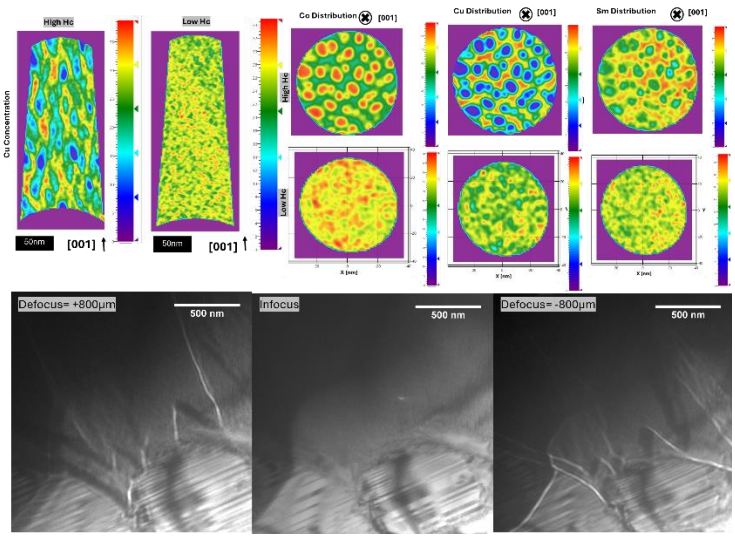

Fig 2: APT analysis of low- and high-coercivity samples.The low-coercivity sample exhibits random microstructure with weak compositional variation, while the high-coercivity sample shows a textured microstructure with strong Co/Cu segregation. Lorentz TEM reveals domain walls confined within the 1:5 phase in the high-coercivity sample, consistent with enhanced internal pinning

References:

1]Gutfleisch, O., 2009. High-temperature samarium cobalt permanent magnets. *Nanoscale magnetic materials and applications*, pp.337-372.

MB7

ATOM FORCE MICROSCOPY – A GLIMPSE BEYOND SURFACE

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Atom force microscopy (AFM) is well known as a crucial tool in imaging and probing surfaces with nanoscopic resolution, particularly when topography, i.e. surface morphologies and roughness, are targeted. However, AFM can offer much more beyond topography, giving insight into materials structure and their functionality, when AFM is used with multi-modal analysis. Here we present how AFM with its various modes can deliver valuable insight and probing capabilities that provide both high spatial and functional resolution, crucial for various applications and characterization of different classes of materials. We will present how magnetic force microscopy (MFM) delivers insight into magnetic coupling and magnetic states and how this can be correlated to bulk magnetic properties and how MFM provides the means to visualize topological magnetic features such as skyrmions. We will show how scanning Kelvin probe AFM allows visualization of surface potential by probing the work function of a material that can be used to evaluate the corrosion/oxidation activity of a material's surface. We will also dive into the field of electrostatics and conductivity where electrostatic force microscopy (EFM) and conductive AFM are used to probe the potential changes and conductivity of materials that can be associated to specific microstructural and chemical features. A particular example will be also given how all these methods can complement each other to asses also multiple functionalities of a material's surface, i.e surface potential and conductivity correlated with specific microstructural features. All of the AFM modes will be presented in the sense of real-life research examples that are used to provide insight into the strengths, the weakness and potential of each AFM mode for current and future materials research and development. The examples will entail materials such as ferrous and non-ferrous alloys, meteorites (Fig 1 & Fig 2) and functional materials.

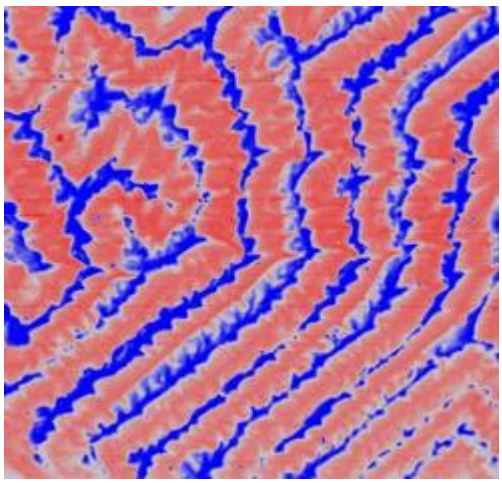

Fig. 1: AFM-MFM image of Aletai meteorite.

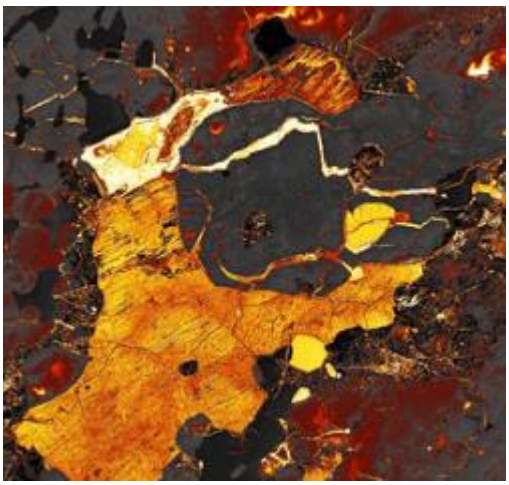

Fig. 2: AFM image of North African meteorite.

MC1

STRUCTURAL ANALYSIS OF Au-Pd-Pt-Ru COMPOSITIONALLY COMPLEX SOLID SOLUTION THIN FILMS USING 4D-STEM

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Compositionally complex solid solutions (CCSS) have emerged as promising candidates for electrocatalysts [1], where their catalytic performance is closely linked to their structural complexity. This complexity arises from the presence of multiple mixed elements with varying compositions and associated crystallographic characteristics. In this study, we utilize four-dimensional scanning transmission electron microscopy (4D-STEM) to investigate phase, orientation and lattice strain in Au-Pd-Pt-Ru CCSS thin films. The films were fabricated via room-temperature magnetron sputtering onto a Ta adhesion layer on sapphire substrates, forming combinatorial thin film materials libraries [2]. The resulting films exhibit columnar nanograins with diameters ranging from 10 to 20 nm, with grain boundaries enriched by specific elements as proven by atom probe tomography (APT). We focus on three representative compositions: $Au_{68}Pd_{13}Pt_{15}Ru_4$ (Ru-poor), $Au_{27}Pd_{24}Pt_{23}Ru_{26}$ (equiatomic), and $Au_8Pd_{21}Pt_{18}Ru_{52}$ (Ru-rich). As Ru content increases, various planar defects are evolved likely due to accumulated lattice strain. X-ray diffraction (XRD) analysis confirms that all three samples predominantly form a face-centered cubic (FCC) solid solution with a strong (111) texture. Averaged lattice parameters were extracted from selected area electron diffraction patterns. The 4D-STEM datasets acquired from the film surfaces provide detailed phase and orientation maps [3]. Quantitative orientation and strain mapping from 4D-STEM offers critical insights into the structural features influencing electrocatalytic behavior in CCSS systems.

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Acknowledgement

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THE MAGNETIC MICROSTRUCTURE IN FECO ALLOYS AND ITS INTERACTION WITH NON-MAGNETIC INCLUSIONS

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Soft magnetic alloys are considered essential for high power density motors in electrified aviation. Equiatomic FeCo alloys are a preferred candidate due to their high saturation magnetisation and low coercivity. Commercial FeCo alloys contain other elements including V and Nb [1] that can also lead to the formation of non-ferromagnetic inclusions (e,g. oxides, carbides) that can interact with magnetic microstructure. To investigate this, a FEI Tecnai F20 was used in field-free mode, to image the magnetic structure. A form of phase contrast imaging (Fresnel imaging) was utilised in order to convert phase information (sensitive to the local B-field) to amplitude information. Then, a 'through-focal' series of images was acquired from regions of interest to enable the application of the Transport of Intensity Equation (TIE) analysis. This was supplemented by Mumax3 simulations [2], which allowed the simulation of the magnetisation and then an Ubermag package [3] was used to calculate the Fresnel micrographs expected from this state. An external field could be applied to the sample by slightly exciting the objective lens and tilting the sample to allow for dynamic interaction of domain walls with the inclusions to be captured.

Fresnel imaging has shown the formation of Néel spikes around non-ferromagnetic inclusions, which is consistent with Néel's inclusion theory [5]. Both the TEM (Fig.1a) and simulation data (Fig.1c) seem to indicate that the most stable spike structure for this sample geometry and material is 4-spike formation instead of the more typical 2-spike [6]. The magnetic B-field maps around these inclusions have been determined using TIE analysis (Fig.1b) and this corresponds well with the magnetisation simulation data (Fig.1c). The simulated Fresnel image (Fig.1d) corresponds strongly to what is seen in the experimental data (Fig.1a). The formation of the spike domains around these inclusions firstly confirms that they are non-ferromagnetic and from EDX analysis it is known that these inclusions are rich in V and Nb, compared to the bulk. Another way these inclusions can interact is by pinning the domain wall. This study recorded a domain wall being unpinned from an inclusion by applying an external field. The pinning of a domain wall increases the coercivity of these soft magnetic alloys; therefore, this work demonstrates the importance of controlling the size and distribution of these non-ferromagnetic inclusions to further decrease the coercivity of these alloys.

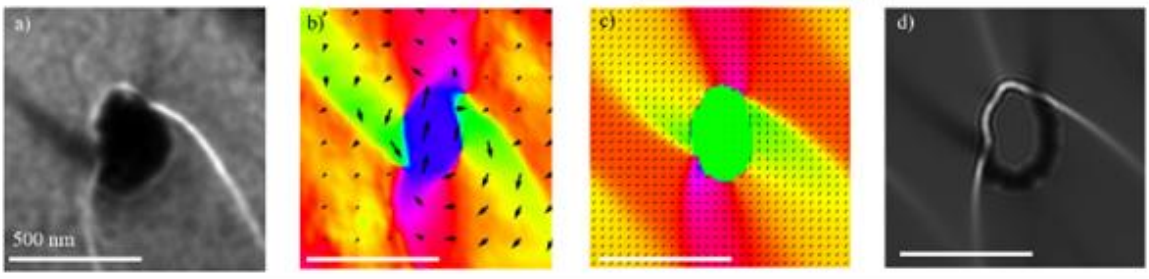

Fig. 1: a) Fresnel image showing magnetic structure around an inclusion. b) In-plane B-field direction determined by TIE analysis. c) Micromagnetic simulation of the central slice of the in-plane magnetisation. d) Simulation of a Fresnel contrast from the structure shown in c).

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SURFACE FERMI LEVEL PINNING EFFECT ON PHASE CONTRAST IN GAN BY ELECTRON HOLOGRAPHY

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Quantifying electrostatic potentials in semiconductors at high spatial resolution is essential for understanding and optimizing the performance of semiconductor devices. Electron holography (EH) has proven particularly effective for demonstrating the interface potential in p-n junctions and heterostructures. However, previous studies have revealed intriguing results. In particularly, the electron optical phase contrast observed across p-n junctions is always smaller than anticipated, whereas the phase contrast across a n-n+ doping step is larger than expected. This work aims to elucidate the physical origin of the phase contrast measured by EH of doping structures, seeking to reconcile these discrepancies. We use an *n*-*n*+ doping step in GaN with Si concentrations of 8×10^{17} and 3.5×10^{18} cm^{-3}. Figure 1 shows a phase map and phase line profiles across GaN doping step measured by EH, revealing a 0.40 ± 0.02 rad phase contrast difference across the doping step. For quantitative interpretation of the measured phase change profiles, self-consistent electrostatic potential calculations are carried out, taking the presence of a surface Fermi-level pinning of the TEM lamellas into consideration. By fitting EH data with the calculations, we revealed a surface Fermi-level pinning of 0.7 eV above the valence band. The calculation indicates the predominant contribution to the phase contrast arises from the doping-dependent screening length of the FIB-induced surface Fermi-level pinning occurring in the defect-rich crystalline inner shell (below the outer amorphous shell). This near surface depletion region remains unchanged for lamellas with different thicknesses, resulting in an almost constant electron optical phase contrast vs. thickness. The contribution of the built-in potential is almost negligible since its value is too small for modulation doping and only relevant for large built-in potentials at e.g. p-n junctions. [1]

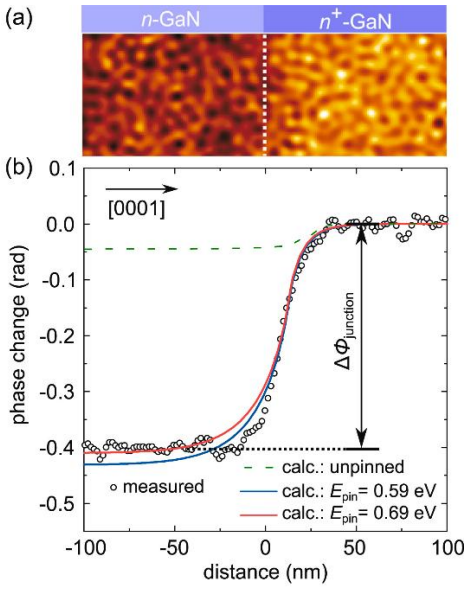

Fig. 1: (a) Phase map across an n-n+ GaN doping step. (b) Phase change profile extracted from the phase map averaged over a width of 500 nm. The n-n+ interface is positioned at 0 nm. The phase contrast across the doping step Δϕ junction is 0.4 rad.

References:

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UNVEILING CHEMICAL ORDERING MEDIATED SUPERSTRUCTURE IN COPPER SULFIDE USING CORRELATIVE 4D-STEM AND STEM-EDS

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Digenite, a specific phase of copper sulfide, $Cu_{1.8}S$, is a low-cost and low-toxicity thermoelectric material that could play an important role in sustainable energy production. Despite of numerous studies, the local ordering in the low temperature phase of digenite still remains elusive. Recently, a checkerboard pattern-like contrast was found in the atomic-resolution HAADF-STEM images of the 6a phase of digenite [1]. This could be very likely due to a chemical modulation within the structure but has not been directly proven so far.
We designed a correlative workflow to first identify the 6a phase areas based on spatially resolved diffraction patterns using precession-assisted 4D-STEM technique and then to measure the elemental distribution on these identified areas using EDS on a probe-corrected STEM instrument.
Since the concentration difference of copper in the neighbouring checkered patterns was expected to be low, the EDS maps were post-processed by combining multi-frame averaging and sub-area alignment-and-averaging to improve their signal-to-noise ratio. Furthermore, in principle, this approach allows to lower the electron dose used for the STEM-EDS measurements and therefore can decrease sample damage.

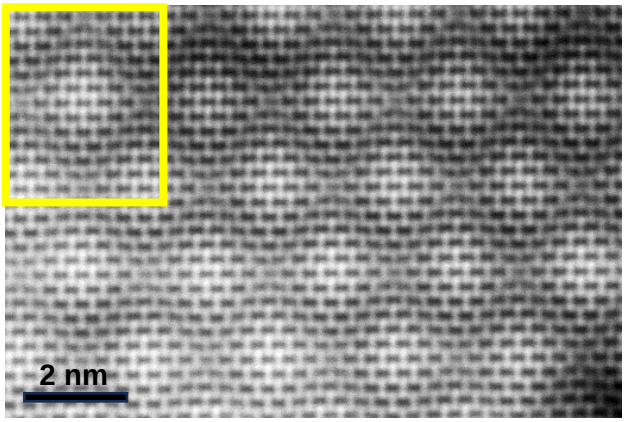

Fig. 1: HAADF-STEM image of the 6a phase of $Cu_{1.8}S$, in yellow one example sub-area used for the image post-processing

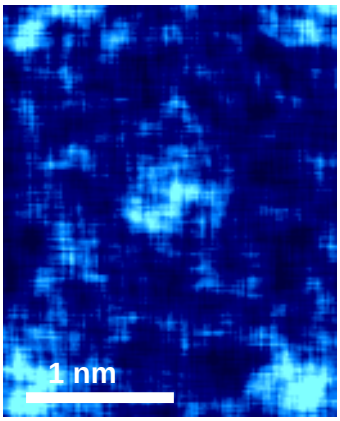

Fig. 2: Copper EDS-STEM map after image processing (brighter areas indicate higher copper concentration)

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MC5

ENABLING ATOMIC-SCALE IMAGING OF FRAGILE MATERIALS THROUGH DOSE-EFFICIENT PTYCHOGRAPHY

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Many nanomaterials, including hybrid perovskites such as $MAPbBr_3$ and $FAPbBr_3$ [1], exhibit exceptional optoelectronic and structural properties but are inherently sensitive to electron beam exposure. This beam sensitivity presents a significant barrier to atomic-scale characterization, especially using high-resolution transmission electron microscopy (TEM).
Given these challenges, dose-efficient imaging techniques have become essential for studying sensitive materials. Among them, scanning transmission electron microscopy (STEM)-based methods particularly electron ptychography have shown great promise. Electron ptychography is a coherent diffractive imaging (CDI) technique that enables reconstruction of a specimen's projected potential by retrieving the phase shifts of the electron beam the phase shift imposed by the elastic and coherent interaction with the specimen. This method provides high sensitivity even at low electron doses. Its practical application has been made possible by advances in direct electron detectors, especially event-driven models based on the Timepix3 chip [2], which play a crucial role in data acquisition for such delicate systems. To explore the suitability of ptychographic imaging for beam-sensitive materials, we investigated thin $FAPbBr_3$ nanocrystals NCs (~10 nm in thickness) under low-dose conditions (~50 $e^-/Å^2$). The study revealed that accurate structural reconstructions could be achieved with carefully optimized external parameters in the ptychographic reconstructions, emphasizing the critical balance between algorithmic stability and reconstruction fidelity, especially under constrained dose budgets. Simulations and experimental reconstructions alike demonstrate that these beam-sensitive materials require not only low-dose imaging conditions, but also data processing strategies tuned to prevent noise amplification and artefactual solutions, resulting from local minima in the optimization problem.

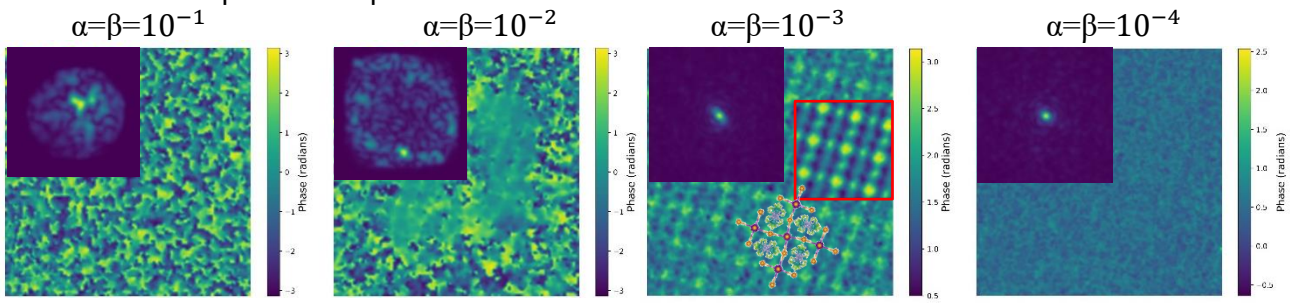

Fig. 1: ptychographic reconstructions of FAPbBr3 nanocrystal (NC) with ePIE at varying update strengths using an experimental dataset acquired with a dose of 50 $e^-/Å^2$, shown with the corresponding reconstructed probe amplitudes. The 4D-STEM data of the NC depicted in the reconstruction for $\alpha=\beta=10^{-3}$ was averaged using template matching and is presented alongside the reconstruction.

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MS1

CORRELATIVE MULTIMODAL ANALYTICAL WORKFLOW WITH STEM-CL AND EDS FOR FUNCTIONAL NANOMATERIALS

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Cathodoluminescence (CL) spectroscopy in a scanning transmission electron microscope (STEM) provides invaluable insights into the optical properties of a wide range of materials at the nanoscale. We present results obtained with Thermo Fisher Scientific transmission electron microscopes (TEMs) equipped with an integrated, retractable CL collection mirror from Attolight. A key advantage of this setup is the decoupling of the CL detector from the sample holder, which enables the investigation of extended areas across the entire sample grid with consistent collection efficiency, boosting the throughput and consistency of results. The ability to collect high resolution Energy Dispersive X-Ray Spectroscopy (EDS) exceptional correlative capabilities.

The capability of this setup was showcased across diverse materials. For core-shell WS_2@ReS_2 and WS_2@$ReSe_2$ nanotubes, high-resolution CL mapping resolved the differences between core and shell emissions, correlating them with EDS compositional data. In photovoltaic CdTe layers, from which Focused Ion Beam (FIB) lamellae were prepared using Thermo Fisher Scientific Plasma FIB (PFIB), a direct, high-resolution correlation was established between the energy of emitted light and low Se concentrations detected by EDS. The optical uniformity of these layers can be advantageously evaluated using STEM-CL .

This work highlights the significant advantages of the STEM-CL solution, providing a versatile method for high-resolution optical characterization of advanced nanomaterials

MS2

Development of an FIB-TEM compatible MEMS heating holder for *in-situ* TEM observation of specific areas

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In the pursuit of advancing the development of nanocomposite materials, it is crucial to investigate their fine structures under diverse conditions. The *in-situ* transmission electron microscopy (TEM) observation technique stands out as one of the most effective methodologies for examining these materials. While numerous studies have concentrated on various nanoparticles, there has recently been a growing demand for *in-situ* observations targeting specific sites on composite bulk specimens.
Consequently, we have designed a specimen heating holder compatible with focused ion beam (FIB) system and transmission electron microscope (TEM), which incorporates a Micro-Electro-Mechanical System (MEMS) heating chip specifically tailored for specimens fabricated via FIB techniques [1]. Figure 1 shows a schematic diagram of a tip of FIB-TEM compatible MEMS heating holder. This design facilitates attachment to the FIB system at a 90° angle relative to the TEM, enabling FIB specimen preparation, further milling and the *in-situ* heating observation of a desired area without removing specimen. Moreover, it is feasible to eliminate the risk of the specimen breakage when removing or replacing the specimen. Figure 2 shows the external view of the heater portion of the MEMS chip (a), and a FIB micro sample (b). The MEMS chip was commercialized based on the Camp-Nano chip developed at Xi'an Jiaotong University [2]. The MEMS chip features a heating component (yellow shaded area) consisting of three pillars for specimen mounting. This heating component is isolated from the base to minimize the temperature gradient in the vicinity of the heater, thereby enhancing the responsiveness of the system.
The technique using the MEMS holder was applied to the *in-situ* heating TEM observation of SiC-MOSFET. As a result, the deterioration process was observed. In addition, the technique was also applied to the simultaneous heating of micro-samples with different thicknesses. By using this technique, it was confirmed that the growth rate of Al crystal grains depends on the specimen thickness.

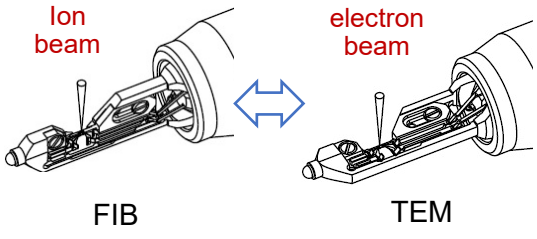

Fig. 1: Schematic diagram of a tip of FIB-TEM compatible MEMS heating holder.

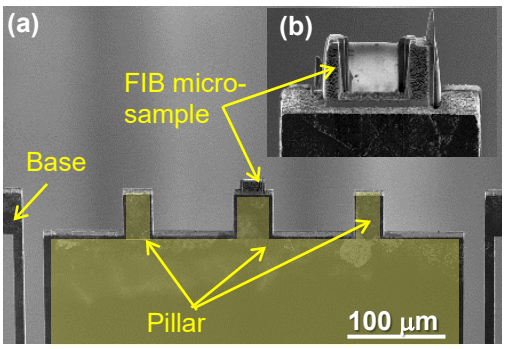

Fig. 2: External view of heater part of MEMES chip (a) with a FIB micro sample (b).

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MS3

ADVANCING TEM RESOLUTION WITH MERLIN T4 AND TIMEPIX4

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The Merlin T4, built on CERN's Timepix4 ASIC, is a next-generation direct electron detector that brings together event-based and frame-based imaging in a single platform — ideal for pushing boundaries in 4D-STEM, ultrafast diffraction, and beam-sensitive materials.

This work presents results using 100 and 200 keV electrons, where MTF at Nyquist improved by up to a factor of 3.7 following per-pixel timewalk correction and energy calibration. By leveraging the timing precision of Timepix4, we correct for charge-sharing effects and enhance spatial resolution beyond the physical pixel size.

These findings highlight Merlin T4's potential for sub-pixel trajectory reconstruction and its transformative impact on high-resolution, high-speed TEM workflows.

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MS4

LIQUID HELIUM TEM SAMPLE HOLDER WITH RAPID COOL-DOWN AND EXTENDED HOLD TIME

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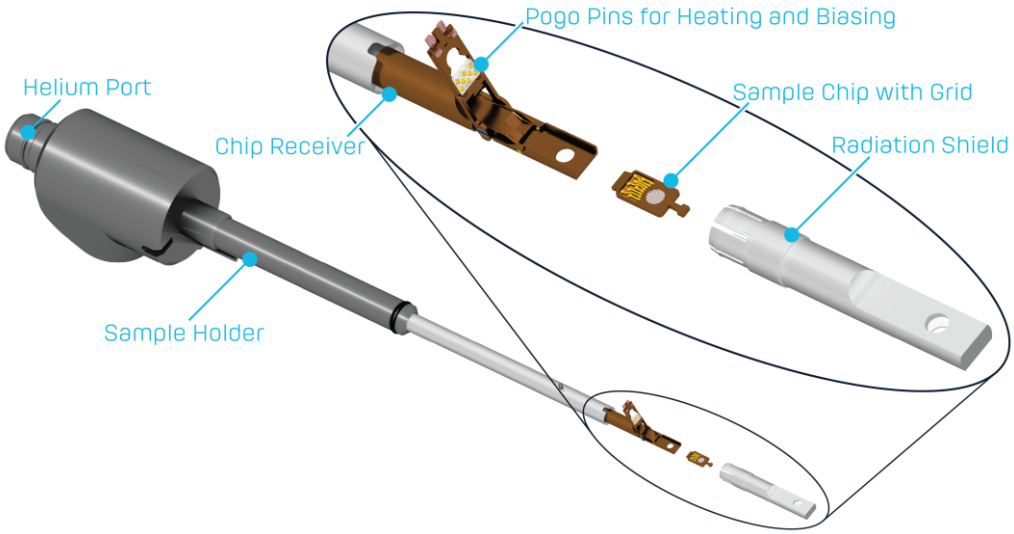
Quantum materials exhibit distinctive electronic and magnetic phenomena—such as superconductivity, and charge and spin ordering—that predominantly emerge at cryogenic temperatures [1,2]. Although advances in cryogenic transmission electron microscopy (cryo-TEM) have yielded liquid nitrogen (LN_2)-cooled side-entry holders and cartridge-based systems optimized for life sciences, investigating phase transitions in quantum materials often requires tunable temperature control extending into the liquid helium (LHe) regime [3].

We present recent advancements in the development of a lightweight, ultra-low-temperature liquid helium (LHe) TEM sample holder employed without requiring modifications to the microscope. Starting from room temperature, the holder achieves a base temperature below 6 K (measured in close proximity to the sample) within a few minutes and maintains exceptional thermal stability better than ±2.5 mK for prolonged measurements.

Our holders make use of a cartridge-based sample exchange in which standard TEM grids or membranes are clipped into an exchangeable chip with 8 electrical leads, thereby enabling experiments with electrical biasing. Furthermore, we are working together with Norcada, a company with extensive expertise in MEMS chips for TEM, to develop MEMS chips with integrated heating and biasing capabilities.



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MF1

THE yDGE SUPPORTS EARLY-CAREER MICROSCOPISTS TO BUILD THEIR NETWORK

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The DGE young microscopists (yDGE) is dedicated to fostering a network among early-career scientists across the disciplines of life, material, and instrumental sciences who are enthusiastic about electron microscopy. yDGE activities are tailored to support students, doctoral candidates, and early postdoctoral researchers in building professional relationships. Online game nights are an all-time favourite that introduce new peers into the community in a welcoming atmosphere. In-person meetings are hosted yearly, for example, at DGE-hosted conferences. Here, the yDGE invites to a 2-hour symposium featuring peer-to-peer science pitches and career-related talks/discussions. These activities are organised by the yDGE board, which is composed of chairs who are responsible for specific purviews, like social events, scientific symposia, or communication, and the executive board that takes over administrative tasks. The yDGE board meets monthly to discuss ongoing activities and how these benefit the community. By collaborating with other early-career groups, most notably the Microscopy Society of America Student Council, the yDGE aims to expand the network's reach. We are always happy to invite new and motivated members. Besides helping to create and expand the network between early-career scientists in electron microscopy, working together with us offers the experience of building a network and trying out new tasks that are usually not found in a traditional scientist's career. If you're interested, you can find us at www.ydge.de or contact us at contact@ydge.de.

MICROSCOPY AUSTRALIA: OPEN ACCESS INSTRUMENTS AND EXPERTS

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Microscopy Australia, established in 2007, is a consortium of university-based microscopy facilities united by values of collaboration, accessibility, excellence and innovation. Each year, over 4,000 researchers from universities and industry use our instruments and expertise in facilities around Australia. Over 50,000 trainee microscopists around the world use our online training tools each year: Myscope.

Microscopy Australia (ROR ID: https://ror.org/042mm0k03) is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS), state governments and participating institutions. We report high-impact science outcomes from this investment in our annual Research Highlights and online news. We also engage the public in science with unique exhibitions and learning resources.

Microscopy Australia enables access to an array of high-end microscopy platforms and associated scientific expertise in strategic locations to efficiently service Australia's microscopy needs. Microscopy Australia provides professional development opportunities for our scientific staff, and has formal connections with a range of other specialised linked laboratories.

Keywords: Network; Collaboration; Australia

pitch LA1

A 3D LIVE-TO-CRYO CORRELATIVE WORKFLOW REVEALS NANOSCALE STRUCTURAL AND BIOCHEMICAL ORGANIZATION IN ZEBRAFISH SCALE ECM

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Correlative light and electron microscopy (CLEM) offers a powerful way to link cellular dynamics with ultrastructure. However, conventional CLEM workflows for tissues rely on chemical fixation, which introduces artifacts. Cryogenic CLEM (cryoCLEM), preserving native hydrated states, is well-established in 2D systems [1,2], but rarely applied to 3D tissue imaging.

We present a novel 3D live-to-cryoCLEM pipeline that connects live-cell fluorescence microscopy to volume cryo-FIB/SEM, cryoTEM, and cryoET. Using high-pressure freezing and a FinderTOP grid system, we achieve accurate overlay between live fluorescence and cryo-imaging modalities.[3] This workflow supports targeted cryo-lamellae lift-out and enables integration with Raman microscopy for localized biochemical analysis.

We apply this approach to zebrafish elasmoid scales to study early extracellular matrix (ECM) formation. Live Airyscan imaging and (cryo)Raman microspectroscopy are correlated with cryoFIB/SEM and cryoET to visualize the 3D organization of collagen layers and mineral phase deposition at nanoscale resolution. We reveal spatial control of collagen density and show that mineralization—initiated with amorphous calcium phosphate—continues via external influx into a porous matrix, eventually forming carbonated hydroxyapatite. Raman analysis confirms a gradient of mineralization linked to structural porosity.

This method enables high-resolution, correlative insight into tissue development and mineralization, offering a blueprint for studying ECM dynamics in native 3D contexts.

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LA2

INVESTIGATING ABERRANT KERATIN STRUCTURES IN EPIDERMOLYSIS BULLOSA SIMPLEX USING CRYO-CLEM

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Epidermolysis bullosa simplex (EBS) is a rare genetic skin disorder marked by severe mechanical fragility of the epidermis. The condition is most often caused by mutations in the keratin 5 (K5) or keratin 14 (K14) genes, which alter intermediate filament assembly and compromise the structural integrity of keratinocytes. One clinically relevant mutation, K14 R125C, is associated with the formation of keratin granules in the cell periphery. To investigate the structural nature of these granules, we used an in vitro model system in which cells were transfected with YFP-tagged wild-type or mutant K14 (R125C). Plastic-section electron microscopy revealed electron-dense puncta in the cell periphery in mutant-expressing cells (Fig. 1) [1]. To gain further insight into the organization and potential filament state of these structures, we now employ correlative cryo-fluorescence and electron microscopy (cryo-CLEM), combined with cryo-focused ion beam (FIB) milling and cryo-electron tomography (cryo-ET). This approach enables targeted preparation and high-resolution imaging of intracellular structures under near-native conditions (Fig. 2). Our ongoing analysis aims to better understand how disease-associated keratin mutations affect filament assembly and spatial organization in cells. This work illustrates the potential of cryo-CLEM and cryo-ET in studying cytoskeletal abnormalities in keratinopathies at the molecular level.

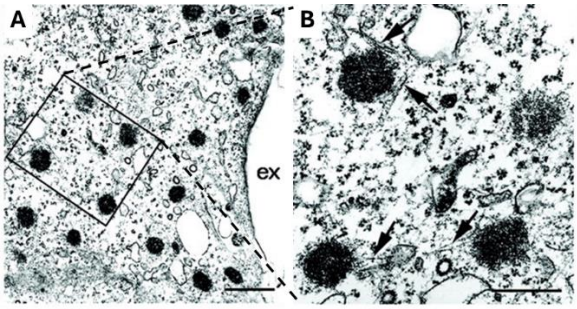

Fig. 1: Representative TEM image showing electron dense structures at the periphery of K14 R125C positive cells. Bars, 1 µm (A), 0.5 µm (B). [1]

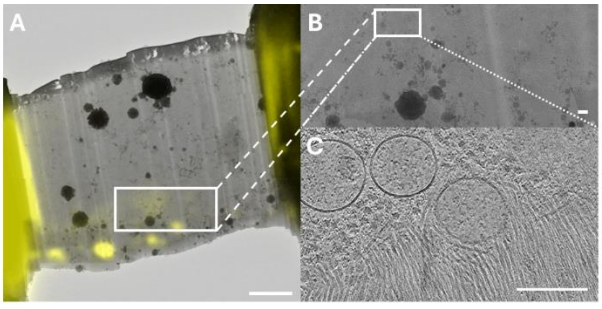

Fig. 2: Representative region-of-interest in K14 R125C cells presented as (A) lamella, (B) search map image, (C) reconstructed and denoised tomogram. Bars, 2 µm (A), 200 nm (B, C).

References:

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LA3

STRUCTURAL INVESTIGATION OF AMYLOID FIBRIL FORMATION IN MEDICAL INSULIN BY CRYO-EM

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Insulin is a critical hormone for blood glucose regulation and diabetes treatment. However, it is prone to forming amyloid fibrils, which compromises its effectiveness. This aggregation poses challenges for insulin storage and stability, particularly in warmer climates and in low- and middle-income countries. Using cryo-electron microscopy (cryo-EM), we investigated insulin fibril formation at a molecular level to provide a foundation for developing strategies to prevent aggregation. This article reports novel cryo-EM structures of fibrils aggregated from recombinant human (RH) insulin and from insulin glargine, one of the most widely used modified insulin formulations in medical practice.

Our analysis revealed that RH insulin produced primarily two fibril types, while glargine exhibited four distinct polymorphs (structural variants). We resolved the structures of two glargine fibrils and one of the two RH insulin fibrils to approximately 3.2 Å resolution (Fourier shell correlation).

Notably, the four glargine polymorphs differed significantly from both RH insulin fibril types in their protofilament structure and arrangement, presumably due to glargine's modified amino acid sequence. Additionally, the morphology of RH insulin fibrils differed substantially from previously reported structures, highlighting the strong influence of specific buffer conditions on the aggregation process. Our work provides valuable structural insights to address the challenge of insulin aggregation, potentially contributing to improved insulin formulations and storage methods. These findings may have significant implications for enhancing the stability and efficacy of insulin-based treatments, particularly in challenging environmental conditions.

pitch LA5

AN ENGINEERED PLATFORM TO STUDY THE INFLUENCE OF EXTRACELLULAR MATRIX NANOTOPOGRAPHY ON CELL ULTRASTRUCTURE

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Nanoscale fabrication techniques have played an essential role in revealing the impact of extracellular matrix (ECM) nanotopography on cellular behavior. However, the mechanisms by which nanotopographical cues from the ECM influence cellular function remain unclear. To approach these questions, we have engineered a novel class of nanopatterned ECM constructs suitable for cryogenic electron tomography (cryo-ET), the highest resolution modality for imaging frozen hydrated cells in 3D. We electrospun aligned and randomly oriented ECM fibers directly onto transmission electron microscopy (TEM) supports to generate fibrous scaffolds that mimic physiological ECM in healthy (organized ECM) and diseased (disorganized ECM) states. We produced fibers from gelatin without toxic additives and cross-linked them to maintain structural stability in aqueous environments. The electrospun fibers had an average fiber diameter of hundreds of nanometers. We confirmed that the nanopatterned TEM supports can serve as viable cell culture substrates that can influence cell organization and demonstrated their compatibility with plunge freezing and cryo-ET. By enabling nanoscale structural analysis inside cells on substrates with programmable topographies, this platform can be used to study the physical cues necessary for healthy endothelial tissue formation and pathologies that are linked to endothelial dysfunction in diseases such as peripheral arterial disease.

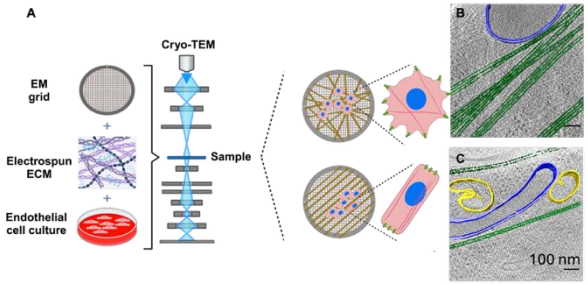

Fig. 1: Graphical abstract. (A) Schematic depicts a platform for high resolution cryo-TEM imaging of cells grown on ECM with different topographical cues. (B-C) Tomographic slices overlaid with segmentation of select features in (B) showing a double-membranes organelle (membranes in blue and violet), microtubules (green), and vesicles (yellow), and in (C) showing a double-membranes organelle (membranes in blue and violet) and microtubules (green).

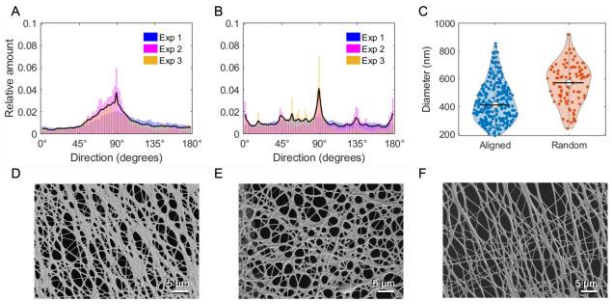

Fig. 2: Fiber characterization. (A and B) Histograms of preferred fiber orientation for three separate experiments for aligned (A) and random (B) fiber orientations; black line represents a weighted average. (C) Violin plot depicts fiber diameter for random (red) and aligned (blue) oriented fibers; black line indicates the median. (D–F) HRSEM images of gelatin fibers electrospun directly onto gold TEM grids. (D) Aligned fibers. (E) Randomly oriented fibers. (F) Aligned oriented fibers after 4 months of storage in a desiccator.

LA6

ENHANCING PRECISION AND THROUGHPUT IN CRYO-FIB MILLING VIA AN OPTIMIZED CORRELATIVE IMAGING WORKFLOW

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Correlative cryo-focused ion beam (cryo-FIB) milling is a powerful sample preparation technique for *in situ* cryo-electron tomography (cryo-ET), enabling the visualization of cellular components in their native state at near-atomic resolution. A key bottleneck in this workflow, however, remains the efficient and precise correlation between fluorescently-labeled regions of interest (ROIs) and the milling position, particularly for high-throughput applications [1-4]. This challenge often limits the feasibility of studying rare or transient biological events.

To address this challenge, we have developed and implemented a streamlined correlative method utilizing an integrated fluorescence microscope with significantly enhanced capabilities. Our approach leverages an expanded field of view, which accelerates initial sample mapping by providing broader cellular context in a single acquisition. Furthermore, optimizations to the optical path increases the SNR with 50%, improving the precision of ROI identification while minimizing potential phototoxicity through shorter exposure times.

We demonstrate the efficacy of this workflow with two challenging applications. For the serial lift-out of a high-pressure frozen C. elegans, precise fluorescence-guided trench milling resulted in a high success rate, with 27 of 29 prepared lamellae containing the targeted ROI. For on-the-grid milling of primary rat neurons, the method enabled rapid, multi-channel mapping of the entire sample grid and reliable ROI verification in the final, thinned lamella.

These methodological advancements significantly improve the speed, precision, and throughput of the cryo-FIB workflow. By making the identification of ROIs more robust and efficient, this approach facilitates the structural investigation of complex biological questions that were previously intractable, paving the way for deeper insights into cellular architecture and function.

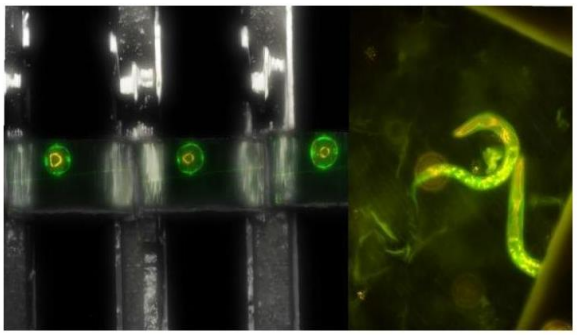

Fig. 1: Correlative serial lift-out workflow of C.elegans

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pitch LB1

TRANSLATION IN A THERMOPHILIC EUKARYOTE VISUALIZED *IN SITU* USING CRYO-ELECTRON TOMOGRAPHY

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As ribosomes mediate the translation of mRNA to amino acid sequences, they iteratively cycle through multiple functional states. This is accompanied by extensive conformational rearrangements, translocation of tRNAs and binding and dissociation of elongation factors. Different states and their relative abundancies within the translation elongation cycle have been analyzed previously using *in vitro* [1] and *in situ* [2-5] structural biology approaches which have provided insights into the translational landscape in mesophilic organisms.
Here, we studied structural and mechanistic adaptations of the translation elongation cycle to life at high temperatures. We used cryo-FIB milling and cryo-electron tomography to visualize the translation machinery in the thermophilic fungus *Chaetomium thermophilum* natively growing at 50 - 55°C. By comparing the overall distribution of translation states in mesophilic and thermophilic eukaryotes, we could show that the translational landscape is deeply conserved across species and a vast range of optimal growth temperatures.
Upon induction of cold stress on different time scales, we observed adaptations of the translational landscape at different rates. This includes enrichment of eEF2-bound hibernating ribosomes upon persistent cold stress and elevated eIF5A binding, indicating an altered translational landscape and reduction of translational activity in response to reduced temperatures. Finally, comparing the distribution of ribosomal states between individual cells revealed a high degree of variability for specific translation states, demonstrating pronounced cell-to-cell variability of the translational landscape in a multicellular organism.
Collectively, this study provides a molecular resolution view on the translational landscape in a thermophilic organism and its remodeling in response to different environmental factors.

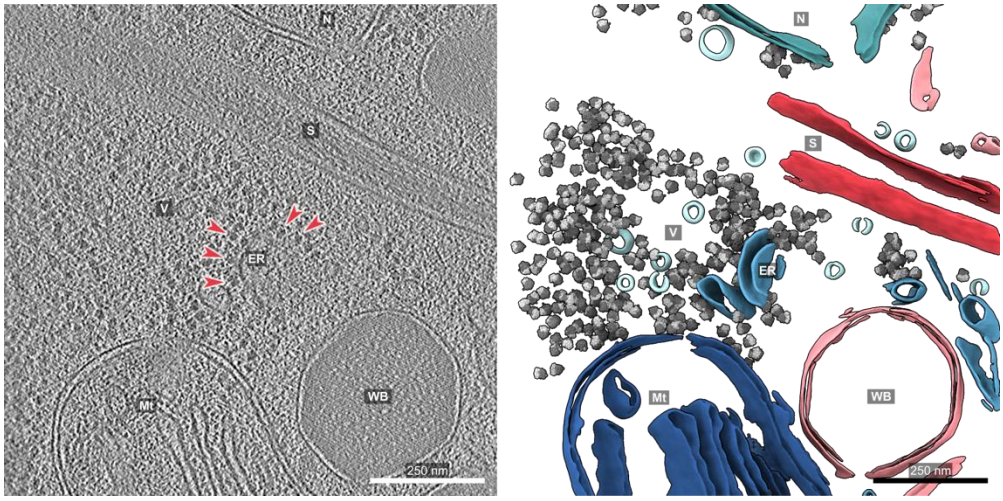

Fig. 1: Annotated tomogram of *C. thermophilum* showing organelles specific to filamentous fungi such as a septum (S) separating two cells with woronin bodies (WB) in close proximity, as well as subtomogram averages of 80S ribosomes.

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LB2

VISUALIZING THE (ULTRA-)STRUCTURAL ARCHITECTURE OF THE GOLGI-ASSOCIATED CYTOSKELETAL FILAMENTS BY CRYO-ELECTRON TOMOGRAPHY

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The Golgi apparatus plays a vital role in membrane trafficking and intercellular communication. In mammalian cells, individual cisternae stacks of the Golgi are connected laterally to form a prenuclear ribbon, important for proper cell polarity and migration. Studies show cytoskeleton filaments are key in maintaining Golgi architecture and positioning during cell polarization. Golgi-derived microtubules (MT) can induce cell asymmetry, facilitating transport in a specific direction. Their defects have been shown to induce Golgi disassembly and turn it into individual stacks of cisternae. The actin cytoskeleton is also emerging as a key factor in assembling and maintaining the Golgi architecture. In addition, the Golgi apparatus is a hub for a wide array of actin regulatory proteins, localized at the Golgi apparatus and the trans-Golgi network. Depletion of different F-actin nucleators can either lead to its dispersal or compaction. A distinct connection between Golgi membranes, actin filaments, and Golgiderived MTs coordinates dynamics during Golgi ribbon formation. In contrast to MTs and actin, less is known about the association of the Golgi complex with another cytoskeleton element, the intermediate filaments(IF). For instance, Septin-1 knock-down causes a dramatic alteration to the shape of Golgi cisternae. A commonality among these three cytoskeleton types and their assemblies at the Golgi, has not been well described at the structural and ultrastructural levels. A key to understanding how various cytoskeleton components impact the Golgi ribbon lies in examining the spatial organization of the filaments and the directions in which they may exert forces on cisternal membranes or facilitate transport processes. Here, vitreous hRPE1 cells tagged with Golgi markers were thinned by cryo-focused ionbeam milling, and visualized by CLEM and cryo-ET to study cytoskeleton in the context of the Golgi in situ. Quantitative ultrastructural information was derived from tomograms acquired on adherent cells combined with segmentation, vectorization, and geometrical analysis, with a pipeline being established for this aim, which guides to employ subtomogram averaging for detailed characterization of abundant cytoskeletal organizers. The present data highlights our capability to prepare grids with suitable cell counts, the visibility of the marker in cryo-FM and of cells in SEM/FIB-imaging, the potential to mill usable lamellae from the specimen, and the success of correlation using the selected markers, we identified membrane structures with TGN identity surrounded by F-actin, IFs and MT. To further investigate filament tracing, was done to find filament coordinates, so we can reconstruct individual filament subunits, allowing us to do classification and subtomogram averaging. Finally, through the establishment of an optimized pipeline, we visualized the Golgi apparatus and its associated cytoskeletal elements. We aim to combine the acquired ultrastructural information into a model of the Golgi ribbon and the cytoskeleton surrounding it.

LB3

CRYO-STEM OF BIOLOGICAL MACROMOLECULES: VISUALIZATION BY INTEGRATED DIFFERENTIAL PHASE CONTRAST

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Scanning transmission electron microscopy (STEM) is a well-established method for the characterization of materials. However, it is not a widely used method for imaging biological samples in cryogenic conditions. Biological specimens are dose-sensitive, often have poor contrast against ice background and can therefore be challenging to visualize. Recently, we showed that integrated Differential Phase Contrast (iDPC)-STEM can be applied on vitrified biological specimens and near atomic resolution can be determined (1). In STEM the resolution is dependent on the convergence semi-angle (CSA) of the focused beam. Using the iDPC-STEM approach, the maximum contrast of the image can be achieved in focus. In this work, tobacco mosaic virus (TMV) has been used as specimen at different CSAs (2.0, 4.0 mrad). In case of TMV near-atomic resolution results are demonstrated, in both types of data collection, micrographs and dose fractionated data. However, these challenges serve as a springboard for further research on the method in structural biology. Addressing the theoretical and experimental limitations can lead to methodological improvements and an expanded applicability of single-particle analysis to complex biological systems.

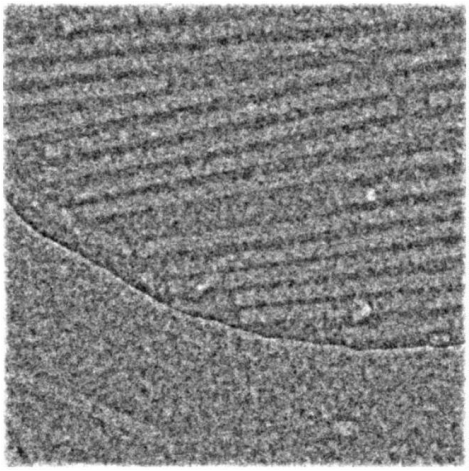

Fig. 1: TMV embedded in vitreous ice.

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LB4

BLUEPRINT OF PRECISION: DETERMINING THE STRUCTURE AND ROLE OF THE ELONGATOR COMPLEX IN PROTEIN SYNTHESIS

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Although all cells in the body share the same genetic material, different cell types produce distinct sets of proteins. The regulation of gene expression – determining which genes are active and when – is a highly controlled process involving numerous molecular elements, structures, and protein complexes. One such complex is the Elongator.

The Elongator complex is a conserved multiprotein assembly found in all eukaryotic organisms, including animals, plants, fungi, and protists. It plays a key role in the chemical modification of transfer RNA (tRNA) molecules, which are essential for translation. During this process, tRNAs deliver specific amino acids to ribosomes, enabling their incorporation into newly synthesized proteins.

Our cryo-electron microscopy (Cryo-EM) studies have enabled us to determine the biochemical activity and mechanism of action of the Elongator complex, as well as to define the roles of its individual subunits [1]. Furthermore, understanding the spatial architecture of this complex allows us to predict how various structural perturbations – such as those caused by mutations – may impair cellular function and affect the entire organism. Notably, mutations in the Elongator complex in humans have been linked to various neurodevelopmental and neurodegenerative disorders, as well as to cancer. These findings highlight the Elongator complex as a promising target for novel therapeutic strategies.

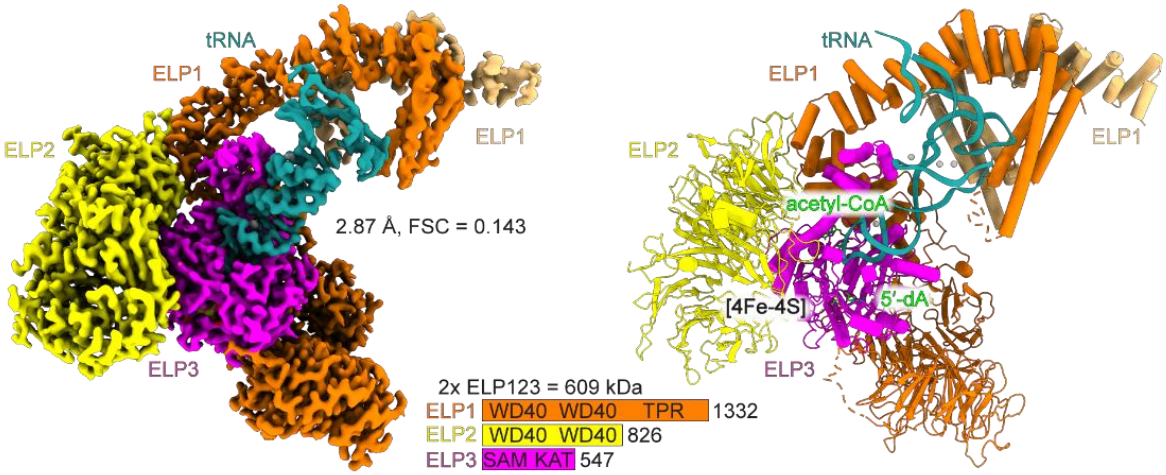

Figure 1. Human ELP123 cryo-EM structure [1].

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LC1

MONOSODIUM GLUTAMATE-INDUCED CARDIAC TISSUE DAMAGE AND THE POTENTIAL AMELIORATIVE EFFECT OF APOCYNIN

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Monosodium glutamate (MSG), a commonly used food additive, has been shown to induce oxidative stress and structural damage in various tissues, including heart tissue. Apocynin, a natural NADPH oxidase inhibitor, is known for its antioxidant properties and may help mitigate such effects. In this study, a neonatal MSG-induced obesity model was used to evaluate the effects of MSG on cardiac tissue and the potential protective role of apocynin. C57BL/6J mice were divided into four groups: control, MSG, MSG+DMSO, and MSG+APO. MSG was administered subcutaneously on specific postnatal days, followed by a 15-week observation period. Then, apocynin or DMSO was given intraperitoneally for 14 days. Cardiac tissue samples were stained with hematoxylin-eosin and Masson's trichrome for histological evaluation, and connexin 43 (Cx43) expression was assessed via immunofluorescence. Ultrastructural changes were examined using transmission electron microscopy. MSG-treated mice showed cardiomyocyte disorganization, cytoplasmic vacuolization, and decreased Cx43 expression, along with myofibrillar and mitochondrial damage. In contrast, apocynin treatment preserved tissue architecture and Cx43 levels, and reduced ultrastructural degeneration. These findings suggest that MSG leads to significant cardiac damage and Cx43 downregulation, while apocynin demonstrates a protective effect, highlighting its potential as a therapeutic antioxidant in MSG-related cardiac injury.This study was supported by TUBITAK (Project number: 224S995) and Acibadem University BAPKO (Project number: THD 2024-2198).

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LC2

SEM ANALYSIS OF ACANTHAMOEBA ALTERATIONS INDUCED BY *GARCINIA BRASILIENSIS* EXTRACT

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Acanthamoeba are parasitic protozoa commonly found in water sources and able of causing *Acanthamoeba* keratitis (AK), a severe eye infection that can lead to blindness. Current treatments rely on pharmaceuticals like chlorhexidine, but natural products offer promising alternatives. *Garcinia brasiliensis*, has shown properties against protozoa like *Leishmania*[1]. This study explored the effect of *G. brasiliensis* leaf extracts on the morphology of *Acanthamoeba* cells using SEM. Trophozoites and cysts of *A. castellanii* and *A. polyphaga* were treated with serial dilutions of the extract to determine the minimum inhibitory concentration (MIC). Results showed that 4 mg/mL inhibited *A. polyphaga* growth, while *A. castellanii* required 1 mg/mL for trophozoites and 32 mg/mL for cysts. Anti-adhesion assays indicated that the extract was as effective as a contact lens cleaner in preventing cell attachment. SEM analysis revealed that the extract caused cell shrinkage, membrane perforations, and loss of acanthopodia (figure 1), crucial for adhesion. Cysts of *A. castellanii* exhibited punctate perforations on an otherwise smooth surface (figure 2), consistent with their known resistance to treatment[2]. These findings suggest that *G. brasiliensis* could serve as a preventive solution. Future research should incorporate TEM approaches to further investigate the mechanism of action of *G. brasiliensis.*

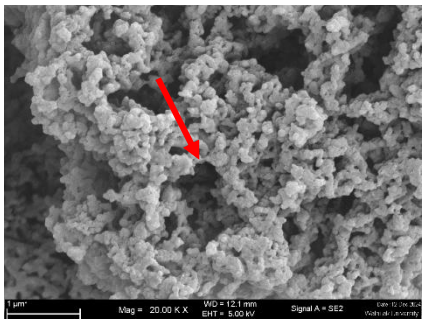

Fig. 1: *A. castellanii* trophozoites treated with plant extract showing membrane perforations. X20.00.

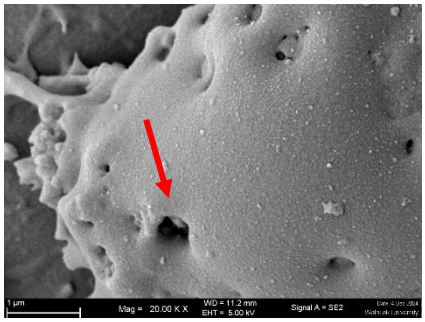

Fig. 2: *A. castellanii* cysts treated with plant extract showing punctual perforations. X20.00

Funded by Walailak University grant No. WU-IRG-63-073, The Center for International Affairs (CIA), Walailak University, The Royal Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn & Project CICECO-Aveiro Institute of Materials UIDB/50011/2020, (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) and LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC).

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LC3

IMMUNOHISTOCHEMICAL AND ULTRASTRUCTURAL EVALUATION OF A SCAFFOLD-BASED THERAPEUTIC APPROACH IN LIVER FIBROSIS

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Liver fibrosis is characterized by excessive collagen deposition and impaired liver function, often resulting from chronic liver diseases. Current treatment options are limited, highlighting the need for new therapeutic approaches. Wharton's Jelly-derived mesenchymal stem cells (WJ-MSCs) and melatonin have shown individual benefits in liver regeneration [1]. However, a combined delivery system using hydrogel, stem cells, melatonin, and a fibrous scaffold has not been previously reported. Galectin-3, a β-galactoside-binding lectin, plays a critical role in hepatic fibrogenesis by modulating inflammatory cell activation and extracellular matrix deposition [2]. Its expression correlates with fibrotic severity, making it a valuable marker for evaluating therapeutic interventions targeting liver fibrosis.

This study aimed to evaluate the therapeutic effects of a WJ-MSC and melatonin-loaded hydrogel implanted with an electrospun poly(lactic-co-glycolic acid) and poly(L-lactide-co-D,L-lactide) (PLGA–PLDLLA) mesh in a thioacetamide (TAA)-induced rat model of liver fibrosis. Rats were divided into control, injury (TAA), and treatment (TAA + implant) groups. After 6 weeks of TAA administration, hydrogel-scaffold combination implanted on the liver surface in treatment group. Following 21 days of recovery, liver and serum samples were collected for histological, immunohistochemical (Galectin-3), ultrastructural, and biochemical analyses. Galectin-3 immunostaining was performed on cryosections and analyzed by confocal microscopy. For ultrastructural evaluation, liver tissue sampless were fixed in 2.5% glutaraldehyde, post-fixed in osmium tetroxide, dehydrated, and embedded in Epon resin. Ultrathin sections were contrasted, then examined using transmission electron microscopy [3]. Sirius Red staining showed reduced collagen accumulation in the implant group. Galectin-3 expression was also decreased, indicating reduced fibrotic activity. TEM revealed preserved hepatocyte nuclei and bile canaliculi structure, with less vacuolization and endoplasmic reticulum dilation. Biochemical markers such as ALT, AST, and bilirubin, elevated in the injury group, were significantly reduced after treatment.

These results suggest that the WJ-MSC and melatonin-loaded hydrogel with electrospun scaffold supports liver regeneration and reduces fibrosis. This novel combinatory approach may offer a promising alternative for liver fibrosis therapy.

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LC4

TALE OF TWO VIRUSES: INSIGHTS INTO THE SYNERGY BETWEEN NOVEL ARCHAEAL VIRUSES

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Spindle-shaped viruses infecting halophilic archaea are among the most abundant viral morphotypes observed in hypersaline environments. Despite their abundance, only two isolates, His1 and LSV-48N, have been described [1,2]. Here, we characterize a novel spindle-shaped virus, Tebenquiche spindle-shaped Virus 1 (Tebi-SV1), isolated from *Halorubrum* strain TLS-6 (*Hrr.* TLS-6), deriving from a hypersaline lagoon in the Salar de Atacama, Chile. Sequencing of purified viral particles revealed the presence of a second virus, Tebenquiche Pleomorphic Virus 1 (Tebi-PV1) that coinfects host cells. We show that Tebi-SV1 and Tebi-PV1 can coinfect across different genera of Haloarchaea but are unable to establish a long-term infection in host organisms other than *Hrr.* TLS-6. Viral preparations from *Hrr.* TLS-6 were dominated by Tebi-PV1 particles. We routinely observed fewer Tebi-SV1 particles and hypothesize that their production is more tightly regulated. However, alternating abundances under different growth conditions suggests a mutual regulation of the two viruses. Insights into the lifecycle, attachment, and egression of both viruses have been obtained through electron microscopy.

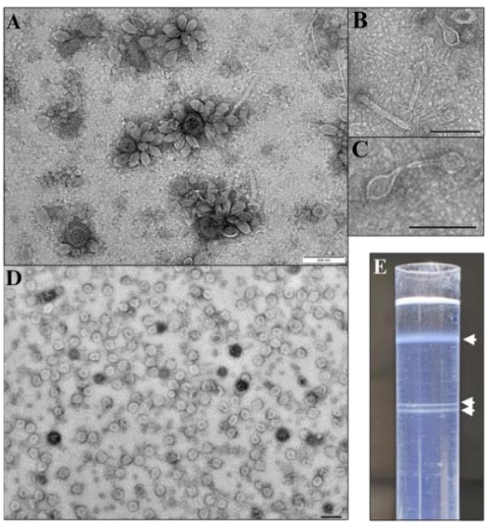

Fig. 1: Gradient purified viral preparation of Tebi-SV1 and Tebi-PV1

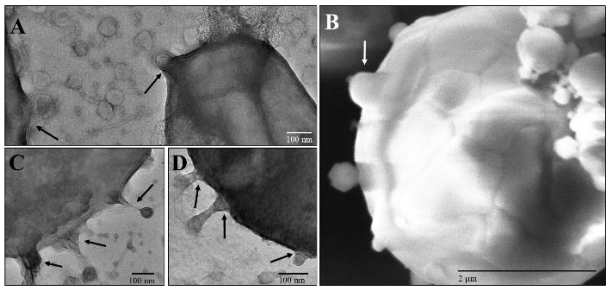

Fig. 2: Virus-like particles budding from host organism, *Hrr.* strain TLS-6

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LC5

LIQUID PHASE ELECTRON MICROSCOPY (LP-EM) OF BIOCRYSTALLIZATION PROCESSES

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Liquid phase electron microscopy (LP-EM) has been established as a high-resolution technique to study dynamic, real-time processes of inorganic and organic materials in aqueous environments [1]. In this technique, active constituents are sealed in their native liquid environment between two electron transparent windows and imaged using a transmission electron microscope (TEM). The technique has provided unique insights in diverse material systems from nanoparticle nucleation and growth, electrochemical reactions, to self-assembly and structures of biomolecules. LP-EM was also used to image gold-labeled membrane proteins and the ultrastructure of whole hydrated cells [2]. However, dynamic nano-scale imaging of biological processes using LP-EM has proved to be challenging [3]. This is due to issues related to low electron contrast, beam sensitivity, and the need to repeatedly expose the sample to monitor a process. We combine two novel strategies to minimize beam-induced damage: (1) use of graphene-based enclosures, as graphene is a scavenger for harmful reactive radicals created during electron-water interactions [4]. (2) Applying AI-based sparse imaging strategies, where a mathematical model is used to reconstruct missing information from sub-sampled images [5]. Our primary focus is on monitoring pathogenic biocrystallization processes. These can be directly harmful to human health through abnormal deposition of calcium minerals or uric acid crystals in various tissues (pathological mineralization) [6], or indirectly, as in malaria, where heme crystallization ensures parasite survival [7]. We aim to advance LP-EM and uncover the dynamics of crystallization in different biological systems, with the intent to inhibit crystal formation and arrest the disease progression.

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LS1

PIXEL DESIGN TO ENHANCE SIGNAL-TO-NOISE RATIO IN DIRECT ELECTRON DETECTOR FOR CRYO-ELECTRON MICROSCOPY

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Cryo-electron microscopy (cryo-EM) has advanced significantly with the development of direct electron detectors (DEDs). These detectors enhance the detective quantum efficiency (DQE) by eliminating the need for scintillators, thus improving signal-to-noise ratios and image resolution. The Falcon detectors utilize CMOS sensors optimized for electron detection, with back-thinned substrate and integrated low atomic mass backscatter reduction plates to minimize noise and improve image clarity [1]. The Falcon series supports dose fractionation readout modes, allowing for the motion correction to compensate for the beam induced motion [2], which is crucial for high resolution imaging in cryo-EM. The Falcon pixel design not only maximizes the separation between signal and noise, which is crucial for electron event detection; but also minimizes the confusion area, which is crucial for electron event localization. This allows for further improving the signal-to-noise ratio (SNR) by electron counting [3]. These technological advancements have enabled resolutions in the range of 3-4Å, facilitating detailed structural analysis of biological specimens and contributing significantly to the field of structural biology.

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AUTOMATING CRYO-EM DATA ANALYSIS BY LEVERAGING AI, NOVEL ALGORITHMS & LARGE SCALE ANALYSIS

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In the last decade, improved hardware and algorithms have facilitated structure determination by cryo-EM routinely yielding ~3 Å resolutions for optimized and well-behaved samples. However, throughputs in cryo-EM still remain low and challenging samples of small, compositionally or conformationally heterogeneous, or preferentially orientated samples often require extensive and complex data analysis protocols and manual optimization.
Here, we present developments within the CryoCloud platform to automate data analysis and overcome challenges of difficult samples, including new ML based particle pickers for fast and accurate particle localization, algorithms for the analysing map anisotropy, and workflows for the automated large scale analysis of membrane proteins. Our picker shows improved precision and faster performance compared to current pickers across a range of datasets, while eliminating the need for parameter optimizations and user input. Our algorithms for the analysis of map anisotropy reliably and objectively quantify map anisotropy, and applied to more than 14,000 maps from the EMDB (Fig. 1) identified cases suffering from anisotropy which can be computationally corrected (Fig. 2). Lastly, the development of new workflows and their application within our scalable platform enabled the automated structure determination of dozens of membrane proteins.
Combined, these developments pave the way for automated and unsupervised data analysis, which will make cryo-EM more scalable, cost-effective, and accessible.

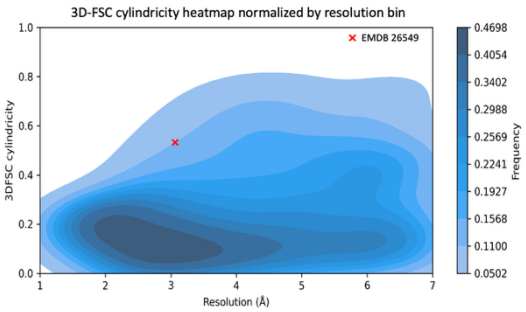

Fig. 1: Systematic anisotropy analysis of 14,000 EMDB maps.

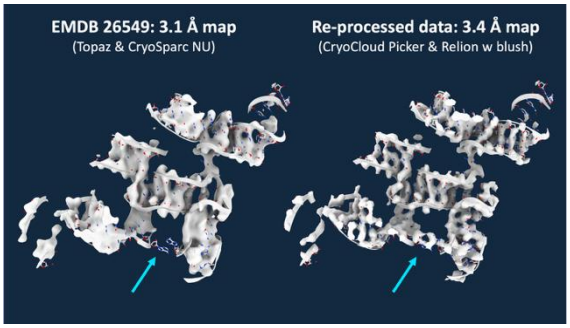

Fig. 2: Reprocessing EMDB 26549 with CryoCloud Picker & Relion with Blush.

QUANTITATIVE EDS SUPPORTING AlGaN-BASED LEDs FOR SKIN-TOLERANT DESINFECTION AND MORE LIFE SCIENCE?

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We explore options to analyze the element distribution in materials and life science using Energy Dispersive X-ray Spectroscopy (EDS). We focus on high spatial resolution in electron transparent specimens investigated in STEM and SEM.
AlGaN layer structures for UV-LEDs, which have been recently tested for skin-tolerant inactivation of SARS-CoV-2 and multi-resistant bacteria were studied. Optimization of such devices often requires structural and compositional analysis involving STEM-EDXS, EELS and high-resolution imaging [1]. We show that this effort can be reduced by carrying out part of the analysis using FIB lamellae in SEM, so-called T-SEM. Specimens from AlGaN based LEDs were prepared in cross-section by standard lift out technique and investigated by annular EDS in SEM. The quantification of the element composition in SEM, including element depletion and segregation triggered by morphological substrate defects, will be shown.
Additionally, we demonstrate how the same EDS equipment and quantification routines can be successfully applied to life science problems, for example, research on malaria.

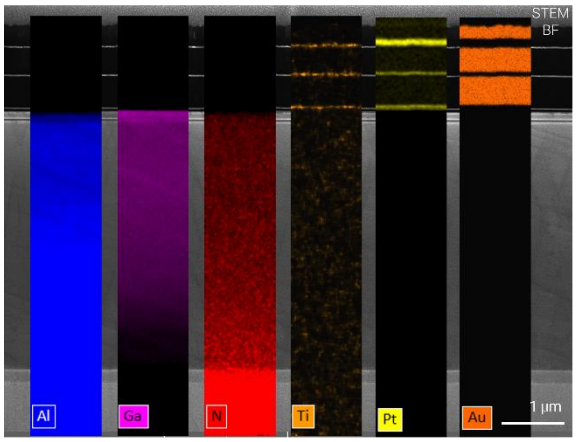

Fig. 1: LED layer system overview. Even a few nm wide thin films can be identified by EDS in SEM.

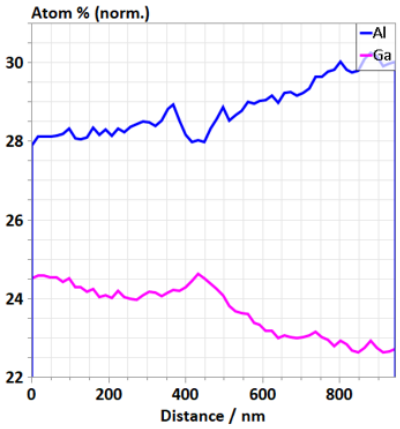

Fig. 2: Quantified element profile across a morphological defect, showing the Ga gradient and depletion and segregation effects.

Specimen courtesy: Anna Mogilatenko, Ferdinand-Braun-Institut gGmbH, Leibniz-Institut für Höchstfrequenztechnik and Humboldt University of Berlin, Germany.

Specimen preparation by FIB: Purvesh Soni, Bruker Nano GmbH, Berlin Germany.

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CRYO-EM INSTRUMENTATION AT THE ERNST RUSKA-CENTRE: ENHANCED PLATFORMS FOR CRYO-STEM WORKFLOWS AND CRYO-CLEM

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The Cryo-EM facility at the Ernst Ruska-Centre (ER-C), Forschungszentrum Jülich, Germany, is a leading national user facility providing global access to cutting-edge cryo-electron microscopy (cryo-EM) infrastructure. Our instrumentation is specifically adapted to support a wide range of structural biology methods, including single particle analysis, tomography, cryo-STEM, and cryo-correlative light and electron microscopy (cryo-CLEM).

Key platforms include a modified Aquilos 2 FIB-SEM, equipped with Meteor and Ceres (Delmic), enabling in situ fluorescence imaging for efficient cryo-CLEM, and a STEM-adapted Krios G4 with Arina and Panther detectors, supporting high-contrast, low-dose cryo-STEM.

A full suite of sample preparation tools, Vitrobot MK4+, Leica EM GP2, VitroJet, Wohlwend HPF, supports the entire pipeline. Since 2022 over 100 external projects have been hosted, with users ranging from experienced researchers to first-time trainees.

In August 2025, the installation phase of a helium-cooled, double aberration-corrected Krios with combined STEM/TEM capabilities started, designed to explore and push the boundaries of resolution, contrast, and dose dependencies in cryo-EM workflows.

Read more : https://er-c.org/index.php/facilities-2/life-science/

Fig. 1: View into the FZJ Krios

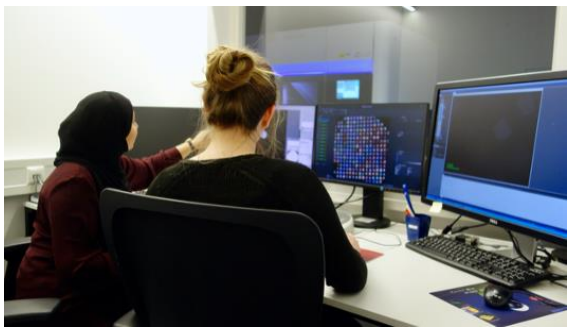

Fig. 2: User training on Arctica

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