

INSIDE E-MRS WORLD



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EDITORIAL

Message from E-MRS President Giuseppina Padeletti



Giuseppina
PADELETTI
President

The **2026 E-MRS Spring Meeting** was held in Strasbourg from May 24 to 29. It was a successful edition, confirming a positive trend (5% more attendees than in 2025) that shows continued recovery after the pandemic. Participation encompassed not only European countries but also those from Asia, the Americas, Canada, Australia, and the African continent, demonstrating the truly international character of EMRS.

Special thanks for this success is owed to the conference co-chairs, the symposium organizers, and the E-MRS organizing committee, who are the pillars of this event and ensure its smooth running.

It should be added that several memoranda of understanding (MoUs) are active internationally with other societies, with whom we have jointly established synergistic actions to promote research and respond to challenges in the most strategic sectors on the global scene. This year, during the E-MRS Spring Meeting, an MoU with MRS-Japan was signed.

Another very important aspect of this edition, and one that should be emphasized, is that 43% of registrations were from students. This is undoubtedly a very significant figure, demonstrating the broad participation of young people — the younger generations representing the future of research, science, and of the world.

E-MRS cares deeply for those young generations because we believe strongly that, in addition to representing the above, they also embody the hope for a more cultured and just world. In concrete terms, for years, E-MRS has implemented initiatives to motivate and promote young researchers.

We do this through the E-MRS Young Researcher Awards, intended to recognise and honour graduate students whose academic achievements and current materials research display a high level of excellence, showing promising and significant aptitude in materials science research.

This year, 2026, the Spring Meeting's plenary session was opened with another important prize, acknowledging leading researchers under 40. Formerly the EU40 Prize, beginning with 2026, it will be referred to as the Paul Siffert Award, in honour of our longtime General Secretary Paul Siffert. He founded E-MRS in 1983. This Award honours young researchers under 40 whose work has made a major impact on European Materials Science. It is important to note that this award is not restricted to European citizens, but requires that the research to be honoured was conducted at European institutions, universities, and industries.

The *Inside E-MRS World* newsletter will contain further details on the various initiatives undertaken, and I would therefore like to conclude this message with an optimistic vision for the future of the EMRS as a place where brilliant minds can meet and constructively contribute to shaping our world and our future with the open-mindedness, respect for the thoughts of the others, and creativity that characterize the world of science. 

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The Future of Converting Nuclear Fusion Energy into Electricity via Photovoltaics

Eicke R. Weber, European Solar Manufacturing Council (ESMC)



Eicke R.
WEBER

Every day, the Sun supplies the

Earth with an enormous stream of photons generated by nuclear fusion processes within the Sun in which hydrogen is essentially converted into helium, resulting in a mass loss of 0.7% in the form of γ -radiation, i.e., photons. Nuclear reactors on Earth are based either on nuclear fission processes of heavy elements or on the

nuclear fusion of light elements and use the heat generated by these processes to heat water. The resulting steam drives steam engines and turbines to generate electricity. For the photons from the Sun, we can use a much more elegant process: the photoelectric effect, first discovered by Becquerel in 1837 and later correctly described by Einstein. For this discovery, he received the Nobel Prize in Physics in 1922: A photon can use its energy directly to excite an electron! Within a semiconductor junction, we generate an electron-hole pair, a voltage, and ultimately electrical energy, and we call this process photovoltaics.

The first practical solar cells were manufactured at Bell Labs in 1954 and were used primarily to power satellites in the decades that followed, as they proved to be much easier to handle than power sources based on nuclear processes. In the 1960s and 1970s, the use of solar modules on land was mainly limited to powering remote facilities where connecting to the electrical grid was too difficult and costly. In the 1990s, it was primarily solar enthusiasts who installed solar modules on the ground, as the electricity generated was much more expensive than electricity from the outlet. In certain cases involving remote facilities, connecting to the grid was more expensive than installing a photovoltaic (PV) system; the Sun provides photons generated by nuclear fusion everywhere on Earth, making electricity available everywhere!

Legislation and PV economics

Around the year 2000, German politicians Hermann Scheer and Hans-Josef Fell, together with their staff, drafted an ingenious legislative package—the Renewable Energy Sources Act—which offered anyone who installed a solar or wind power system an attractive payment for every kilowatt-hour of electricity supplied—far above the price of electricity from the grid, and high enough to make such a system economically viable. They succeeded

in passing this law without an upper limit on the amount of electricity generated, as it did not incur any costs for the public budget. The initially very low costs for the small amounts of PV or wind power fed into the grid were simply passed on to the electricity bills of all consumers, resulting in only a very moderate increase in electricity costs for everyone. This law created the first economically viable market for PV, and soon the PV manufacturers flourished in Germany. In China, the political leadership quickly recognized the fantastic opportunities presented by this new technology and, around 2005/2006, included provisions in its 11th Five-Year Plan that emphasized the strategic importance of PV for the future of the People's Republic of China.

It was recognized that the decisive factor was the availability of investment capital for building a strong PV industry, and reportedly around \$50 billion was made available in China in the form of loan guarantees to anyone who submitted a serious proposal to establish PV manufacturing in China. Various regions in China competed to attract this new high-tech industry. The equipment for this new industry had to be purchased in Germany and Europe. Therefore, a very advantageous cycle emerged. Germany offered a viable market for the sale of PV modules, China offered investment guarantees for the establishment of large-scale solar production, yet the majority of these investment funds flowed to Germany and Europe to purchase the necessary equipment. The remarkable ease with which Germany weathered the economic crisis following the bankruptcy of Goldman Sachs in 2008 may have been aided by the influx of these orders just as the global economy was collapsing! In Germany and Europe, however, there was no industrial policy comparable to that in China. Around 2010–2012, European PV manufacturers faced increasing price pressure from the rapidly growing Chinese PV industry, and even global leaders such as Solar World and Q-Cells in Germany were forced to file for bankruptcy protection from their creditors, because they had to sell their products at a loss in order to compete with lower-cost imports from China. In the meantime, the PV market in Germany had accelerated beyond all expectations thanks to the attractive investment model offered by feed-in legislation.

In Germany, Peter Altmaier, as parliamentary leader (and later Federal Minister for Economic Affairs and Energy)

was part of a government that, along with figures such as Katharina Reiche, then Parliamentary State Secretary at the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety, supported amendments between 2010 and 2012 aimed at curbing the rapid growth of photovoltaics. Thanks to innovations in PV technology and rapidly increasing production volumes, the cost of manufacturing PV modules had fallen so rapidly that after 2010, the expansion of PV power generation became attractive worldwide—initially supported by government subsidy mechanisms similar to German legislation, but later solely because solar power quickly became the most cost-effective source of electricity available. A few years ago, the first announcements of PV systems in sunny countries were published, based on costs of around one cent per kilowatt-hour—an incredibly low figure!

Projections

In 2016, we invited leading global scientists in the field of photovoltaics to a workshop in Freiburg that focused on photovoltaics entering the “Terawatt era”. The results of this workshop were published in the journal *Science*. Fig. 1 shows projections for the future growth of photovoltaics in the global market. Today we know that the most optimistic of these curves accurately predicted what we have since experienced. In March 2022, we actually reached the first terawatt of globally installed PV capacity! It took about 70 years, from the 1950s to 2022, to reach this first milestone, but only a little over two years—by 2024—to reach the second terawatt of globally installed PV capacity! Fig. 1 shows that these two data points align well with the most optimistic growth curve, which had already been predicted in 2016!

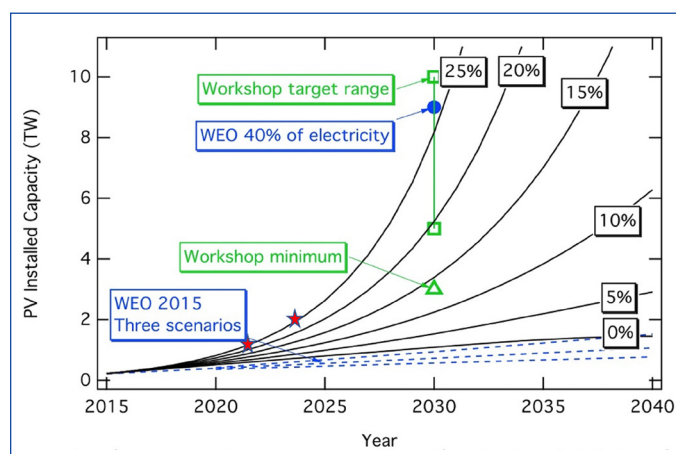


Figure 1: Forecasts for global installed PV capacity through 2040, prepared as part of the first workshop on “PV on the Path to the Terawatt Range” held in Freiburg in 2016. Two red stars have been added to the original graph, to mark the actual achievement of the first terawatt of global installed PV capacity in 2022 and the second terawatt in 2024.

In 2022, the fourth Terawatt Workshop was held in Freiburg, leading to the projection that we will reach approximately 75 TW of PV installations by mid-century (Fig. 2) and achieve an annual production volume of three TW/year or more, which corresponds to an annual market volume of over one trillion US dollars for PV alone—roughly as much as, or even more than the market volume of the global automotive market! Such growth in global PV installations will be able to support the urgently needed rapid expansion of an electricity supply based almost 100% on renewable energy in an electrified world.

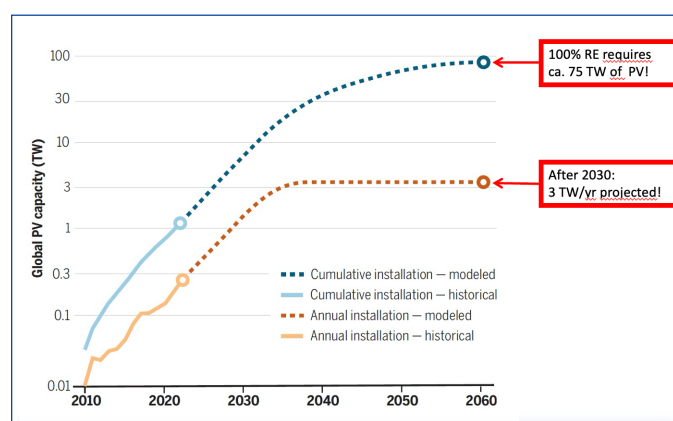


Figure 2: Forecasts from the Fourth Terawatt Workshop in Freiburg 2022 regarding the overall growth of global PV installations and the annual growth rate. Two red boxes have been added to the original diagram, indicating the expected final installation level of 75 Terawatts of PV and the expected annual production volume of 3 Terawatts/yr after 2030. [Graphic: D. An-Pham/Science. Nancy M. Haegel et al., *Photovoltaics at multi-terawatt scale: Waiting is not an option*. *Science* 380, 39-42 (2023). DOI:10.1126/science.adf6957. Modified with permission from AAAS.]

The technology and innovation

Over these 70 years of rapid global growth in photovoltaics, PV technologies have also undergone a dramatic transformation: It all began with a very simple technology based on p-type silicon wafers with a diffused front-side junction, the “emitter,” and a rear-side contact layer made of aluminium, which created a back-side field repelling minority charge carriers. This simple Al-BSF technology enabled the production of solar cells with an efficiency of up to about 20%. To achieve higher efficiencies, the aerial rear contact layer posed the greatest obstacle, as every metal-semiconductor contact also causes charge carrier recombination, which limits efficiency. This was improved by passivating the rear side using an amorphous SiO₂ or Al₂O₃ (sapphire) layer. However, an electrical contact is still required on the back side, and in PERC (Passivated Emitter and Rear Contact) technology, this was achieved by creating thousands of contact points

that were ablated through the passivation layer using a laser, and subsequently coated with a metal contact layer. Now, 99% of the rear surface is well passivated, and the metal-semiconductor contact is limited to the small contact points created by the laser.

PERC technology enables an increase in the efficiency of solar cells by about 20%, to approximately 24% at virtually the same production costs. Since converting an Al-BSF PV production line to a PERC line is relatively straightforward, this transition took place quite rapidly, roughly between 2015 and 2020.

The theoretical limit for the efficiency of a solar cell was predicted as early as the 1950s by Shockley and Queisser to be approximately 29% for a single-junction silicon PV cell. Two technologies are available for the next step in improving efficiency: tunnel oxide-passivated contact technology (TOPcon) and heterojunction technology (HjT). TOPcon technology is a direct advancement of PERC technology: if the passivation layer on the back is thin enough that charge carriers can tunnel through it, no metal contact

“PERC technology enables an increase in the efficiency of solar cells by about 20%, to approximately 24% at virtually the same production costs.”

points are required. The technological challenge lies in uniformly depositing the passivation layer across the entire wafer size in the sub-nm range, with a thickness of about 1–1.5 atomic layers, using a cost-effective, high-throughput deposition process. An interesting alternative to TOPcon is heterojunction technology: Both sides of an n- or p-type wafer are covered with n+- and p+-doped amorphous silicon, respectively, which ensures perfect passivation and contacting, similar to TOPcon. Although HjT technology is expected to achieve slightly higher efficiencies—the current world record of 27.6% was set by an HjT cell—this technology is not yet as widespread as PERC and TOPcon technologies, meaning that production facilities are not yet available on the same scale and are therefore more expensive than those for TOPcon. In addition, it is relatively easy to convert existing PERC production lines to TOPcon, whereas a HjT line must be built from scratch, as it differs significantly from a PERC line. A further improvement in both TOPcon and HjT cell technology is achieved through the introduction of back-contact (BC) technology, which allows contact lines to be removed from the front of the cell.

However, to exceed the Shockley–Queisser limit for solar energy conversion efficiency, we must use tandem structures—solar cells composed of two or more different materials with different band gaps that can effectively convert photons of different energies into electrical voltage and current. If cost is not a primary concern, we can achieve this with various materials, such as different III-V semiconductor compounds, using a Si or even a Ge wafer as the substrate. In 2016, Fraunhofer ISE set a world record efficiency of 46.7% using this approach, employing a four-material structure under concentrated light (approximately 500 times normal solar intensity). A cost-effective tandem technology does not require concentrated light and uses only two layers, such as perovskite on Si. Efficiency levels exceeding 33% have already been demonstrated with this technology. However, it is not yet certain that such tandem structures can actually achieve lifespans similar to those of simple Si-PV structures, as the perovskite layer does not yet exhibit the same stability as Si.

Energy storage and generation alternatives

A major obstacle to the further development of PV technology is the availability of energy storage solutions, since, as we know, the sun does not shine at night and wind speeds vary between day and night. In this regard, we are benefiting from the rapid development of e-mobility, as electric cars require batteries, and the demand for batteries in the automotive industry still far exceeds the demand for storing PV and wind energy. Therefore, we are benefiting from the sharp decline in battery costs, similar to the cost reductions seen in the PV industry. Today, batteries are available for about \$50/kWh, and that might not be the end of it, especially once second-life batteries from automobiles become widely available: Batteries whose capacity has dropped to 80% of their original capacity are no longer of interest to the automotive sector, as this means only 80% of the original driving range, but they are still perfectly suited for stationary storage—you simply need to add another battery pack to achieve the original storage capacity.

A final technology is needed to fill the gaps in a reliable power supply around the clock, all year round. Since solar and wind energy are increasingly able to cover 100% of electricity demand during the day, there is no longer a need for so-called baseload power plants—plants that run 24 hours a day and cannot be shut down economically during the day when the sun is shining. Flexible gas-fired power plants are the most promising solution for this, and one type of gas-fired power plant is of particular interest: plants that run on biogas derived from the conversion of plant residues and specially cultivated biomass crops such as corn. In Germany, about eight GW of such power

plants are currently in operation, but since they receive a flat-rate feed-in tariff, they run around the clock, typically about 4,000 hours per year! If the subsidy model for biogas power plants were modified so that significantly higher prices are paid for feeding electricity into the grid when it is most urgently needed, annual operating hours could, for example, be reduced to 1,000 hours, while electricity generation could be quadrupled using the same amount of biomass as before the transition to a flexible power plant. In this model, electricity could effectively be stored as biogas, as in other gas-fired plants, or—prior to the conversion—in the form of biomass, depending on which option makes the most economic sense!

Europe's role and future challenges

Even if there are likely no further major technological hurdles to transitioning to an energy system based almost entirely on solar and wind power as well as storage capacity, one question remains of great interest: Where will all these PV modules—in the multi-terawatt range—be manufactured? Can we continue to trust that we will have a secure supply in the coming decades, even with a further increase in production capacity to a level of about three to five TW/year, in order to have a chance of reaching the target of 50–70 TW by 2040–2050?

I would say: No, the experiences of the last decade in particular show that we can no longer rely entirely on imports of strategically important components in the energy sector; it is highly advisable to ensure a certain level of domestic production along the entire value chain.

While more than 90% of all solar cells are currently manufactured in China, we should ensure that we rebuild domestic production capacity in Europe in this and other

similarly important technological sectors. This must begin with the creation of niche markets that are protected for locally produced solar cells and modules; once production volumes have expanded, it may be possible to introduce domestically manufactured solar modules into growing and more competitive market segments. Building a domestic production portfolio that takes into account criteria such as the absence of forced labour, the carbon footprint, and other environmental production characteristics could help support the revitalization of a domestic solar cell value chain in Europe.

The development described above is being driven by the low-cost, ubiquitous availability of energy derived from the Sun's nuclear fusion processes, as well as by growing awareness of the need for a rapid transformation of the global energy system away from climate-damaging emissions such as CO₂. It remains to be seen in the coming years whether we will succeed in bringing about this transformation quickly enough, or whether we will be too slow, so that by 2050 we will indeed have an energy system based almost 100% on renewable energy, but due to our slow implementation, we will be confronted with catastrophic climate events resulting from a drastically altered global climate system! 

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**Beatrice
FRABONI**

Professor Beatrice Fraboni is Full Professor of Physics of Matter in the Department of Physics and Astronomy, University of Bologna (Italy) whose activity spans over thirty years of research in semiconductor physics. Her research focuses on advanced semiconductor materials (organic, inorganic, perovskite) and nanostructured devices with special attention to charge transport, radiation–matter interactions, wearable sensors and bio-electronic interfaces. Key lines of work include: Radiation–matter interactions in semiconductor materials (inorganic, organic, hybrid); Ion implantation, deep level spectroscopy, and defect characterization in semiconductors; Development of flexible, large-area radiation detectors based on organic and perovskite materials; Organic bioelectronic devices and sensors for biomedical applications (including smart textiles); and Integration of nanostructured materials and soft electronics for sustainable and wearable device architectures.

Professor Fraboni is Editor-in-Chief, European Physics Journal – EPJ Plus (Springer). She was awarded the prestigious IEEE-RTSD Scientist Award in 2021 and has presented over 80 invited talks and keynote lectures at various academic and research institutions. Professor Fraboni has been a co-chairperson of the E-MRS Spring and Fall Meetings and is a member of the E-MRS Scientific Council.

E-MRS: Thank you for agreeing to participate in our *Inside E-MRS World* ‘Profile’ program. Would you please give us a brief overview of what you do in your work and how long you have been in your current position?

BF: I am Full Professor of Physics of Matter at the University of Bologna, a position I have held since 2018, following a long academic path from Bologna, to Cambridge (UK) to Madrid (Spain) to Padova and eventually back to Bologna. My research activity spans more than three decades and focuses on semiconductor physics, with particular emphasis on advanced functional materials—organic, inorganic, and hybrid systems—and their integration into functional devices.

I lead a research group working at the intersection of materials science, condensed matter physics, and device engineering, addressing topics such as radiation–matter interactions, charge transport, and the development of flexible and wearable electronic systems. My work combines fundamental investigations with applied research, often targeting applications in healthcare, space, and environmental monitoring.

E-MRS: What are the near and long-term goals you want most to accomplish in your work? On which subfields do you focus most? How would you describe your activities in terms of disciplines such as physics, materials science, etc.?

BF: In the near term, my goal is to further advance the development of flexible, lightweight, and large-area semiconductor devices—particularly radiation detectors and bioelectronic systems—by improving their performance, stability, and scalability. In the longer term, I aim to contribute to a paradigm shift toward sustainable

and human-centered electronics, where materials and devices are not only high-performing but also adaptable, environmentally friendly, and seamlessly integrated into daily life.

My research is inherently interdisciplinary, combining physics, materials science, nanotechnology, and engineering. I see this convergence as essential to addressing complex challenges, from medical diagnostics to space exploration and environmental sensing.

E-MRS: What is your perspective on the technology innovation process, that is, how the product of research eventually supports development of useful products? What is your opinion of the current state of innovation in your fields in Europe and worldwide?

BF: Innovation is a complex and often non-linear process that requires continuous interaction between fundamental research, technological development, and industrial implementation. In my experience, the most impactful innovations arise when curiosity-driven research is coupled with a clear vision of potential applications. Europe has a strong foundation in excellent scientific research, but there is still room to strengthen the translation of knowledge into market-ready technologies. This requires more effective collaboration between academia and industry, as well as support for technology transfer and entrepreneurial initiatives.

Globally, we are witnessing rapid progress in fields such as advanced functional materials and flexible printed electronics, and maintaining competitiveness will depend on our ability to foster interdisciplinary collaboration and long-term investment in research infrastructures.

E-MRS: Were you always interested in science and technology from an early age? Who were the mentors and role models, if any, who influenced your educational and career choices?

BF: Yes, I have been fascinated by science since a young age, particularly by understanding how things work at a fundamental level. Physics, for me, represented both a challenge and an opportunity to explore the underlying principles of nature.

Throughout my education and career, I have been fortunate to encounter inspiring mentors and colleagues who encouraged curiosity, critical thinking, and perseverance. Their guidance played a key role in shaping my scientific path and reinforcing my commitment to research. I am also deeply committed to encouraging more women to pursue careers in STEM, as I believe

“I am also deeply committed to encouraging more women to pursue careers in STEM, as I believe that diversity in perspectives is essential for scientific progress.”

that diversity in perspectives is essential for scientific progress. In particular, I strongly believe that male and female approaches to problem-solving are complementary, and that integrating different ways of thinking leads to more creative, balanced, and ultimately more successful outcomes within research teams.

E-MRS: What was it that led you to your specific technical fields today and do you see your interests evolving toward different and/or broader fields?

BF: My interest in semiconductor physics emerged during my academic training and early research experiences, particularly through exposure to microelectronics and materials science. Over time, I became increasingly interested in how atomic and molecular properties at the microscopic level influence macroscopic materials and device performance.

This naturally led me toward emerging fields such as organic electronics, hybrid materials, and bioelectronics. I see my research evolving continuously, with growing emphasis on applications that bridge physics with life sciences, sustainability, and advanced technologies.

E-MRS: How would you describe the rewards and challenges associated with your R&D work? What has been your experience with research supporting agencies in Italy and the EU?

BF: Research is both intellectually rewarding and inherently challenging. One of the most satisfying aspects is the possibility of discovering new phenomena or developing technologies that can have real societal impact. At the same time, research requires resilience, as progress is often incremental and accompanied by uncertainties. Securing funding and managing complex projects can also be demanding, particularly in highly competitive environments.

My experience with Italian and European funding agencies has been generally positive, especially within collaborative frameworks that encourage international partnerships and interdisciplinary approaches.

E-MRS: How would you describe the rewards and challenges associated with educating the next generation of researchers? E-MRS confers Young Researcher Awards at each Fall and Spring Meeting. What advice would you give to early career researchers who are just starting out?

BF: Training young researchers is one of the most rewarding aspects of my career. It is inspiring to see students develop their own scientific identity and contribute new ideas to the field. The main challenge lies in providing them not only with technical skills but also with the ability to think critically, adapt to change, and navigate an increasingly complex research landscape. I also see mentoring as an opportunity to promote inclusivity in science, encouraging young women to pursue and persist in STEM careers, and fostering environments where diversity is recognized as a strength.

My advice to early-career researchers is to remain curious, embrace interdisciplinarity, and not be afraid to explore unconventional paths. Building strong collaborations and maintaining scientific integrity are also essential for long-term success.

E-MRS: Beyond your current job, would you tell us about your roles as advisor and volunteer for European and international organizations, including E-MRS?

BF: I have been actively involved in several European and international scientific organizations. Within E-MRS, I serve as a member of the Executive Committee and have contributed as chair and co-chair and as Symposium Organizer of both Spring and Fall E-MRS meetings.

These roles are important to me because they allow me to support the scientific community, promote collaboration, and contribute to shaping research directions at a broader level. I am also engaged in editorial activities, including my role as Editor-in-Chief of EPJ Plus, which provides a valuable perspective on emerging trends across physics and materials science.

E-MRS: Can you tell us a little about your personal goals and avocations outside of your work? What do you enjoy doing outside of the office?

BF: Outside of my professional activity, I value time spent with family and enjoy activities that allow me to disconnect and recharge. I am particularly interested in cultural and outdoor activities, which provide inspiration and balance. At the moment my favourite activities outside of work are yoga, hiking and gardening. Maintaining this balance is essential, as it fosters creativity and helps sustain long-term engagement in research.

E-MRS: Thank you again for agreeing to provide our readers with this 'Profile' conversation. Before we close, would you like to add more about your views on education, researcher mobility, national and EU policies, or other factors that affect your fields of interest?

BF: I believe that education and researcher mobility are fundamental pillars of scientific progress. International exchanges and collaborative networks not only enhance scientific excellence but also foster cultural understanding and innovation.

At the European level, continued investment in research and education is crucial, as is the creation of frameworks that support young researchers and facilitate knowledge transfer. Policies that encourage openness, inclusivity, and interdisciplinarity will be key to addressing the global challenges we face. [Ω](#)

E-MRS FALL MEETING 2026

September 14–17, 2026 | Warsaw University of Technology

The 2026 Fall Meeting & Exhibit of the European Materials Research Society (E-MRS) will take place from September 14 to 17, 2026 at the main campus of the University of Technology in Warsaw (Poland) and will consist of parallel symposia with invited speakers, oral and poster presentations, and including one plenary session to provide an international forum for discussing recent advances in the field of materials science.

The conference will be augmented by an exhibition of products and services of interest to the conference participants.

The high quality scientific program will address different topics organized into 5 symposia arranged in

6 clusters covering the fields of Materials for Electronics, Optoelectronics and Sensing; Functional Materials; Bioinspired and Biomaterials; Nano and Smart Materials; Modelling and Characterisation; and Energy and Environmental Applications.

The latest scientific results will be presented and authors are invited to submit papers in the selected journals that fit the scope of each symposium.

The focus of the scientific program will be both on fundamental investigations and technological applications, providing an international forum for discussing recent advances related to the different aspects to be considered to promote innovation.

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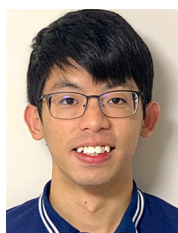
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From Canberra to Europe: Collaborations Advancing Semiconductor Nanotechnology

Wei Wen Wong, Hark Hoe Tan, and Chennupati Jagadish, Australian Research Council Centre of Excellence for Transformative Meta-Optical Systems, Department of Electronic Materials Engineering, Research School of Physics, The Australian National University.



**Wei Wen
WONG**

Collaborations lie at the heart of modern science. As scientific challenges continue to grow in complexity – including theory, experimentation, and real-world applications – cutting-edge research has become increasingly multidisciplinary. In this landscape, collaboration is not merely beneficial, but essential for driving meaningful progress and breakthrough discoveries. The research conducted within our group at the Australian National University (ANU) reflects this reality. While we bring deep expertise and decades of experience in semiconductor materials and fabrication, we actively engage with collaborators across the globe to expand both the depth and breadth of our work. In this article, we highlight a selection of these collaborations, with particular emphasis on our partnerships with European institutions.



**Hark Hoe
TAN**



**Chennupati
JAGADISH**

Our group is part of the Meta-Active International Research Training Group, a collaborative initiative between the Friedrich Schiller University (FSU) in Jena, Germany and the ANU in Canberra, Australia. The program brings together complementary expertise from both institutions to advance cutting-edge research in the field of optics. In the past few years, we have hosted multiple PhD students from FSU, who undertake research at the ANU for a cumulative period of one year as part of their dual PhD program. Our group mainly offers expertise in the materials aspect of these collaborative projects, particularly in semiconductor nanostructure fabrication. For example, during his stay with our group, a PhD student from FSU designed and fabricated vertically-standing III-V nanowire lasers using our nanofabrication and epitaxy facilities, followed by optical characterisation at the FSU.^[1] In another project, a different student fabricated metasurface arrays for chiral molecule detection

on III-V thin films grown at the ANU, and similarly did the optical measurements in Jena.^[2] With over a dozen highly collaborative projects like these being driven at the moment by more than 60 researchers from both institutions, the Meta-Active program stands as a strong example of productive and mutually beneficial scientific collaboration between geographically separated partners.

Beyond our involvement in large collaborative frameworks such as Meta-Active, our group also maintains active partnerships with individual European research groups. One of our long-standing collaborators of more than two decades is Prof. Michael Johnston's group at the University of Oxford. Our collaboration with Prof. Johnston's group spans three closely related research directions. First, we work on the fabrication and demonstration of next-generation terahertz (THz) detectors based on III-V semiconductor nanostructures. By leveraging the unique optoelectronic properties of III-V nanowires grown by our group, including their intrinsic geometrical anisotropy and high carrier mobility, the Oxford team has, for the first time, demonstrated a THz detector capable of reconstructing the full polarisation state of THz pulses.^[3] Building on this success, we are currently extending the concept to III-V nanosheets, which offer improved fabrication scalability and the potential for enhanced signal-to-noise ratios. Second, our collaborators at Oxford have developed a non-contact THz spectroscopy technique to characterise our III-V nanostructures,^[4] providing quantitative measurements of carrier concentration, mobility, and ultrafast carrier dynamics beyond the reach of conventional electrical methods. Finally, using a combination of ion beam irradiation to reduce the carrier lifetimes of III-V materials in combination with epitaxial lift-off process developed at ANU, we work with the Oxford group to demonstrate all-optical active THz metasurfaces that are capable of ultrafast polarisation control.

Researchers in the groups of Profs. Martin Dawson and Michael Strain at the University of Strathclyde in Glasgow have developed a fast and highly precise transferprinting technique that allows our nanowire lasers to be printed onto a wide range of substrates, including polymers, silica, and metals.^[5] Importantly, this process preserves the structural



Hybrid group photo of the Meta-Active cohort, taken during the 2025 Meta-Active annual meeting held in Canberra.

integrity of the nanowires and does not increase the lasing threshold.^[6] The method also enables accurate alignment of the nanowire lasers with underlying waveguides,^[7,8] providing a promising route toward integrating semiconductor lasers directly onto photonic circuits.

We also collaborate closely with Prof. Hannah Joyce's group at the University of Cambridge on topics such as photocurrent spectroscopy of III–V nanowires and the development of nanowirebased transistor devices. In one project, we use pairs of InAs nanowires to fabricate NMOS inverters for ultralowpower applications.^[9] This approach avoids the need for traditional CMOS architectures, which require precise balancing of ntype and ptype transistors to suppress static current.

In addition to these efforts, we collaborate closely with Dr. Patrick Parkinson's group at the University of Manchester. Over the past two decades, our group has developed a wide range of optoelectronic devices based on epitaxially grown III–V semiconductor nanostructures. However, these devices can still suffer from limitations in fabrication yield and repeatability. To address these challenges, Dr. Parkinson's group employs computer vision–assisted spectroscopy for high-throughput optical characterisation of the nanostructures we fabricate. By building large training datasets from these measurements, their team then applies machine learning algorithms to optimise fabrication parameters, with the goal of maximising yield and minimising lot-to-lot variation. In one collaborative project, leveraging high-throughput

characterisation combined with Bayesian optimisation, we demonstrated an accelerated design approach for III–V micro-ring lasers. This resulted in a 1.6-fold reduction in lasing threshold and a lasing yield exceeding 80% across thousands of devices, significantly outperforming prior human-optimised designs.^[10] Currently, we are continuing our efforts in developing advanced data-driven optimisation algorithms to improve the reliability and scalability of nanostructure fabrication.

Our group also maintains ongoing collaborations with Profs. Antonio Polimeni and Marta de Luca's groups at Sapienza University of Rome, which specialises in micro- and nanospectroscopy. Their magneto-optical characterisation of III–V nanowires fabricated by our group has been instrumental in developing a robust understanding of the underlying physical properties of these nanostructures, including their bandgap energies, effective carrier masses, and carrier mobility.^[11,12] Such measurements are particularly critical for non-conventional materials, such as wurtzite-phase InP, which are stable only in nanostructured form. The key material parameters extracted from these studies have enabled accurate optical gain modelling, which in turn has played a central role in the design and optimisation of many of our nanolaser demonstrations over the years.

The article highlights how science operates beyond national borders and political differences. Meaningful progress in research rarely happens in isolation; it depends on collaboration. Whether scientists are separated by countries or entire continents, the most significant

breakthroughs come from working together and sharing knowledge across the globe. 

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European Materials Research Society
Strasbourg Convention Centre

2027 SPRING MEETING

MAY 17 TO 21, 2027

The 2027 Spring Meeting of the European Materials Research Society (E-MRS) will take place from May 17 to 21, 2027 at the Convention & Exhibition Centre in Strasbourg (France).

**Palais de la Musique et des Congrès
Place de Bordeaux
F-67082 Strasbourg
<http://www.strasbourg-events.com/en>**

The scientific programme will highlight the latest advances in materials research at an international level, with a strong emphasis on interdisciplinary research in both fundamental and applied areas.

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UNESCO Chair “Science, Culture and Engineering of Materials for the Future”

Contributed by Giuseppina Padeletti, E-MRS President



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Chaire

Science, Culture and Engineering
of Materials for the Future

Since 2014, E-MRS is co-chairing the UNESCO Chair on “Science, Culture and Engineering of Materials for the Future”. It was founded at the University of Strasbourg, in collaboration with the European Materials Research Society (EMRS) and the International Union of Materials Research Societies (IUMRS). This chair has recently been renewed until June 30, 2030. The Chair holders are: Giuseppina Padeletti, E-MRS (France)/CNR-ISMN (Italy) and Paolo SAMORI, Directeur Laboratoire ISIS, University of Strasbourg (France).

A UNESCO Chair is an international project and team at a higher education or research institution that partners with UNESCO in order to advance knowledge and practice in an area that is a priority for both the institution(s) and UNESCO. The “Science, Culture and Engineering of Materials for the Future” UNESCO Chair’s main missions are to:

- Facilitate the dissemination of information to scientists, engineers, and students in the field of materials, particularly regarding the materials of tomorrow, key sectors being energy, environment, climate change, cultural heritage, and health;
- Enhance the longer term role of materials and their applications to meet global challenges such as the diffusion of scientific and technical information in the field of advanced materials to the European and wider International community;
- Address the new ethical problems related to the use of nanomaterials and artificial intelligence with professionals working in the field and the general public;
- Contribute to the education of young researchers and engineers during conferences by organising and hosting tutorials and workshops and organising and supporting summer schools as well.

Committed to UNESCO’s mission, this Chair contributes to UNESCO’s Strategic Objectives:

- SO1–To ensure equitable and inclusive quality education and lifelong learning opportunities for all, in order to, among other things, reduce inequalities and promote learning and creative societies, particularly in the digital age.

- SO2–To work towards building sustainable societies and protecting the environment by promoting science, technology, innovation, and natural heritage.
- SO3–To build inclusive, just, and peaceful societies by promoting freedom of expression, cultural diversity, global citizenship education, and protecting heritage.
- SO4–To foster a technological environment that serves humanity through the development and dissemination of knowledge and skills, as well as the development of ethical standards.

It contributes as well to specific UN Sustainable Development Goals (SDGs):

- 3. Good Health and Well-being: Ensure healthy lives and promote well-being for all;
- 4. Quality Education: Ensure inclusive and equitable quality education;
- 11. Sustainable Cities and Communities: Make cities inclusive, safe, and resilient;
- 12. Responsible Consumption and Production: Ensure sustainable consumption and production patterns; and
- 13. Climate Action: Take urgent action to combat climate change and its impacts, as well (2030 Agenda).

Particularly, the challenge posed by cultural heritage is a highly topical issue (SO2 and SO3), closely aligned with UNESCO’s priorities, i.e., implications for populations, nations, environment, and sustainability. The Chair strongly considers the contribution of materials science for the safeguarding of cultural heritage in both its components, tangible and intangible, both being strictly interconnected. At E-MRS, symposia relating materials science to cultural heritage have been organized since 2003 with participants from around the world. There, scientists, students, and young researchers have been able to discuss, exchange ideas, and enhance their knowledge and expertise. 

Joint Session at Spring Meeting 2026 – Two UNESCO Chairs Represented



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Chair
Science, Culture and Engineering
of Materials for the Future



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Chair
Aid4GEA - Technologies and Materials for
Green and Energy Applications

At the E-MRS 2026 Spring Meeting, as a first action after the renewal of the UNESCO Chair, “Science, Culture and Engineering of Materials for the Future”, a Joint Special Session was organised between two symposia running in parallel during the conference week. The two symposia were Symposium F, “*Engineered Nanomaterials for Energy and Environment from Synthesis to Application*”, and Symposium X, “*Cultural Heritage Materials, Methods, Practice and Innovation*”.

What do these two symposia have in common? First, both are linked to two UNESCO Chairs: Symposium F to the UNESCO Chair Aid4GEA-Technologies and Materials for Green and Energy Applications” and Symposium X to the UNESCO Chair on “Science, Culture and Engineering of Materials for the Future”. Second, both are related to the sustainability topic.

The UNESCO Aid4GEA Chair is held by Professor Elisa Moretti at Ca’ Foscari University of Venice (Italy), in partnership with Professor Alberto Vomiero at Luleå University of Technology (Sweden). The UNESCO Chair “Science, Culture and Engineering of Materials for the Future” holders are: Giuseppina Padeletti, EMRS (France)/CNR-ISMN (Italy) and Paolo Samori, Directeur Laboratoire ISIS, University of Strasbourg (France).

The two UNESCO Chairs organised this joint initiative, because UNESCO recognises Culture & Science as interconnected foundational drivers for global sustainability, aiming to achieve the UN’s Sustainable Development Goals. This holistic approach ensures that preserving our heritage and fostering innovation directly supports environmental resilience, economic growth and social cohesion.

The joint session consisted in two invited presentations, one from each symposium, with the aim to show how these two different disciplines can both contribute to sustainability. The contribution from Symposium X was provided by Prof. Isabelle Pallot-Frossard and Dr. Ann Bourges. Their

talk, “*New challenges for cultural heritage preservation facing the climate crisis*”, dealt with climate change, a major challenge facing our societies, necessitating far-reaching transformations. The construction industry is the largest emitter of carbon. Cultural heritage, which is becoming increasingly vulnerable, must find its place within the recent Réglementation Environnementale 2020 (RE 2020) law, which came into force in January 2022 and requires an energy assessment of all new buildings and their plots of land over the next fifty years. In this context, which adaptation strategies from the past could contribute to the resilience of our societies? What impact might the (re)use of cultural heritage have on the environment? Adaptation strategies to protect cultural heritage were examined in the context of climate change and limiting the environmental impact of conservation techniques and materials for museum collections, historical sites, and built heritage.

Cultural heritage is part of the problem but also can be part of the solution, because it also offers a whole range of resources for green development, whether through the reuse of historic buildings, the revival of environmentally sound traditional skills, or the insights it provides into past climates. In this respect, heritage sciences, which are actively developing new tools for diagnosis, monitoring,

“Cultural heritage is part of the problem but also can be part of the solution, because it also offers a whole range of resources for green development...”

and durability assessment of preservation methods, have a vital role to play in the implementation of the European Green Deal. New opportunities to develop research in this field are offered by the launch of the European partnership on Resilient Cultural Heritage, gathering 30 countries and 70 institutions, with a budget of about 200M€ for 10 years. Furthermore, the Cultural Heritage Cloud, which is under construction (100M€), will offer a solid place for sharing knowledge and experience across disciplines as a key vector for providing new and accurate solutions for the future.

The contribution from Symposium F was provided by Prof. Federico Rosei. Its title was “*Energy challenges from a*

materials perspective". The quest for sustainable development dictates an urgent transition from fossil fuels to renewables. This presentation focused on next generation (solar) energy technologies from a materials perspective. Structure-property relationships in advanced materials are studied, emphasizing multifunctional systems that exhibit several functionalities. Such systems are then used as building blocks for the fabrication of various emerging technologies. In particular, nanostructured materials synthesized via the bottom-up approach present an opportunity for future-generation low cost and low energy intensive manufacturing of devices. Recent developments in solar technologies were presented including third generation photovoltaics, solar hydrogen production, luminescent solar concentrators, and other optoelectronic devices, highlighting the role and importance of critical raw materials.

The joint session was most appreciated by the audience and represented a good example of cross-fertilization among different disciplines, representing a deliberate exchange of ideas, methodologies, and frameworks from diverse fields to enrich knowledge, spark innovation, and solve complex problems. It combined distinct perspectives that transcend traditional academic or professional boundaries, thus inviting discussion. By merging ideas from different domains, teams can create hybrid concepts, foster breakthrough products, and develop a more holistic understanding of complex realities.

Speakers of the Joint Session



Isabelle Pallot-Frossard is art historian and general curator of Cultural Heritage. She was Inspector of Historical Monuments (1980-1992), Director of the National Research Laboratory for Historical Monuments (1992-2014), and Director of the

Centre for Research and Restoration of the Museums of France (2015-2021). She is currently Chair of the Foundation for Heritage Science. During her career, she has been involved in many European research projects; she has also been a member of the ICCROM Council and vice-president of the Council, Director and President of the International Scientific Committee for the Conservation of Stained Glass (ICOMOS-Corpus Vitrearum). She gives lessons and conferences on the conservation of Cultural Heritage in France and abroad. She has published many papers in national and international journals on the conservation of tangible cultural heritage, with a special focus on stained glass windows. She is an Officer of the Légion d'honneur, a Chevalier des Arts et Lettres and an associate member of the Académie royale de Belgique.



Dr Ann Bourguès is a conservation scientist at the Centre for Research and Restoration of Museums of France (C2RMF), earning her HDR in materials science in 2017. In 2006 she obtained her PhD in mineralogy at the University of Geosciences at the Ludwig-Maximilians-Universität in Munich. She worked as a conservation scientist specialising in stone and clay conservation at the Laboratoire de recherche des monuments historiques (LRMH) for 13 years and now holds the same position at the C2RMF. Ann Bourguès is Secretary-General of ICOMOS France and leads the Climate and Heritage Working Group as well as the WP6 Climate and Interface of the national research project Equipex+ Espadon. She also leads the AFNOR group on the standardisation of cultural goods, in particular of inorganic porous materials constituting cultural heritage.



Federico Rosei received MSc and PhD degrees from the University of Rome "La Sapienza" in 1996 and 2001, respectively. He joined the University of Trieste (Italy) as a Professor of Industrial Chemistry in March 2023. Previously he was a Professor and Former

Director of Institut National de la Recherche Scientifique, Énergie, Matériaux et Télécommunications, Varennes (QC) Canada. He has held the Junior Canada Research Chair in Nanostructured Organic and Inorganic Materials (2003-2013) and the Senior Canada Research Chair in Nanostructured Materials (2016-2023). He also held the UNESCO Chair in Materials and Technologies for Energy Conversion, Saving and Storage (2013-2023). [Ω](#)

Relations with MRS-Japan

Contributed by Franck Tessier, E-MRS Vice President

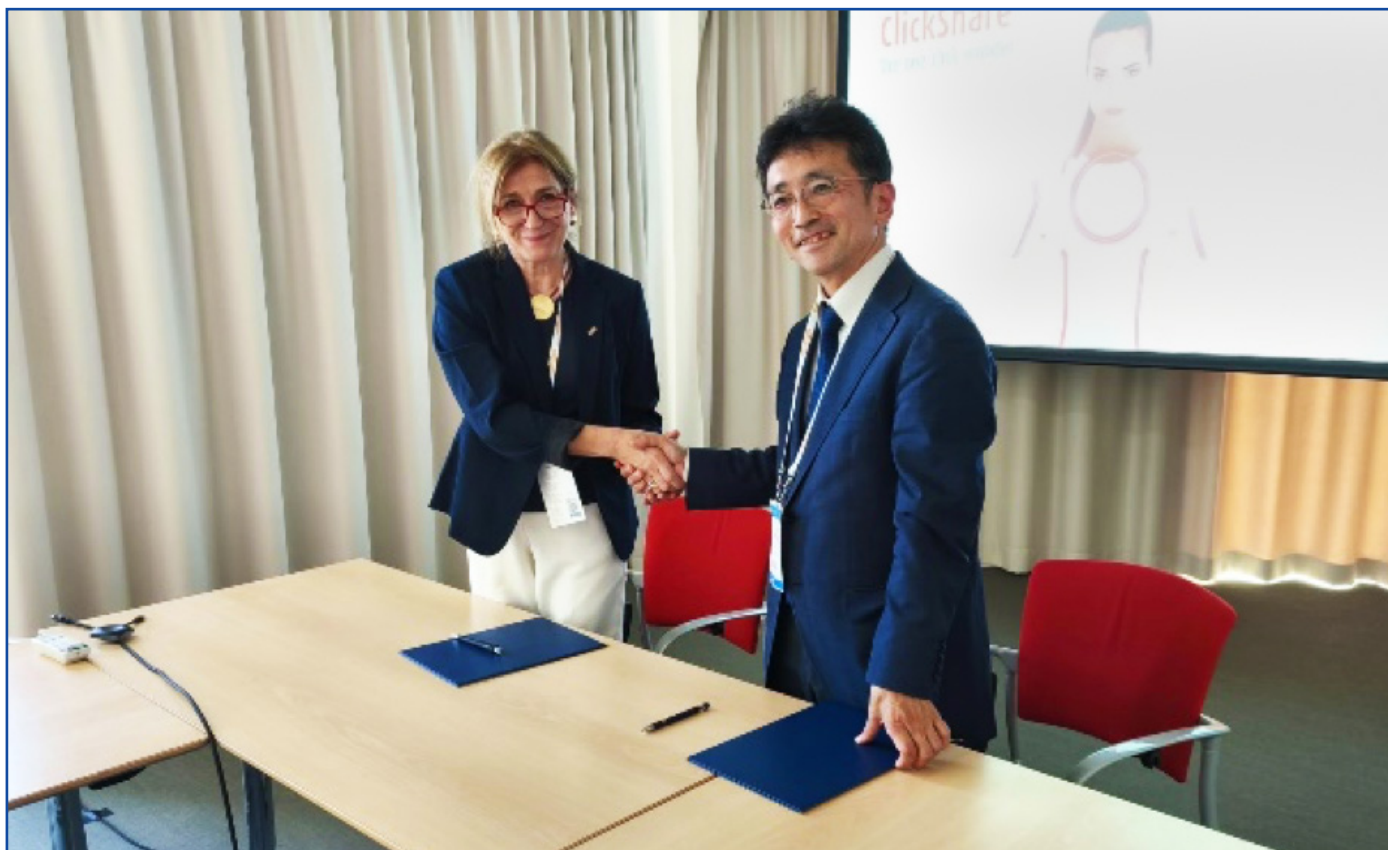
E-MRS was pleased to welcome

a Japanese delegation led by MRS-Japan Vice President Nobuhiro Matsushita. This year, we celebrated the 10th E-MRS–MRS-J Bilateral Symposium on “Synthesis, Processing and Characterization of Nanoscale Multifunctional Oxide Films X.”

The occasion also provided an opportunity, on May 26, 2026, to renew the Memorandum of Understanding (MoU) between E-MRS and MRS-J under the presidency of Dr. Shunichi Arisawa. The renewed agreement reaffirms our shared commitment to strengthening the excellent relationship between our societies through the development of additional joint symposia and the expansion of collaborative activities. 



Signature of an MOU with MRS-Japan in Strasbourg during the 2026 Spring meeting. (left: E-MRS President Giuseppina Padeletti, right MRS-J Vice President Nobuhiro Matsushita)



E-MRS 2026 Spring Meeting

Symposium A – Thin-Film Chalcogenide Materials for PV and Solar Energy Conversion

Chalcogenide semiconductors continue to play a central role in the transition toward sustainable, large-scale solar energy production. Their direct bandgaps, high absorption coefficients, tuneable optoelectronic properties, and compatibility with low-cost, large-area deposition make them uniquely suited for thin-film photovoltaics (PV), tandem solar cells, and emerging solar-to-molecules technologies. Symposium A brought together leading researchers from academia and industry to discuss advances across the full spectrum of chalcogenide materials research, spanning fundamental semiconductor physics, materials science, device engineering, process optimization, and solar fuel generation.

The symposium covered both established material systems - CdTe and Cu(In,Ga)Se₂ (CIGSe), which have reached laboratory efficiencies above 22% and commercial module efficiencies exceeding 20% – as well as emerging absorbers including kesterites, antimony chalcogenides, and chalcogenide perovskites. Topics ranged from theory and simulations, sustainable and scalable processing, thin-film growth, defects and interfaces, heterostructures and transport layers, and advanced characterization, to building-integrated photovoltaics (BIPV), industrialization, tandem architectures, flexible devices, light management, and photoelectrochemical (PEC) energy conversion.

The program featured 12 invited presentations covering the full topical range, one special invited lecture on the history and future of chalcogenide photovoltaics, 73 contributed oral presentations across 15 sessions, and approximately 50 posters presented in two dedicated poster sessions. Attendance remained strong throughout the week, with audiences reaching up to 150 participants. The lively discussions during the sessions and poster events reflected the strong momentum of the field and provided valuable opportunities for interaction between established researchers, industry representatives, and early-career scientists.

A major scientific theme was the continued progress toward bifacial CIGSe solar cells. Several groups reported advances in transparent back contacts and optical management strategies for bifacial operation. A notable highlight was the presentation by EMPA of a 19.9% efficient bifacial CIGS solar cell, demonstrating the growing technological maturity of this architecture and its potential for future high-yield photovoltaic applications.

Antimony-chalcogenide solar cells also attracted considerable attention, reflecting the rapid development of these earth-abundant absorber materials. Several groups reported efficiencies approaching 10%, alongside important advances in device architecture and interface engineering. These results underline the growing maturity of the field and the increasing competitiveness of antimony-chalcogenides for future thin-film photovoltaic applications.

Important contributions were also presented on novel buffer layers and electron transport materials for a variety of chalcogenide absorbers, addressing critical interfacial bottlenecks that currently limit device performance. A dedicated session on photoelectrochemical energy conversion and chalcogenide perovskites highlighted the expanding role of chalcogenide semiconductors beyond conventional photovoltaics, bridging toward solar fuel generation through water splitting, CO₂ reduction, and PV-driven electrolysis. In parallel, a session on advanced characterization showcased the power of nanoscale, optical, electrical, and electron-beam techniques for understanding structure-property relationships in these complex polycrystalline materials.

The symposium recognized several outstanding contributions. Young Researcher Awards were presented to Saeed Bayat (University of Luxembourg) and Yue Hu (University of Science and Technology of China). Poster prizes were awarded to Annabel Saar (Tallinn University of Technology), Philippa Cox (University of Birmingham), Xavier Leitão Pinheiro (International Iberian Nanotechnology Laboratory), and Oliver Wolf (Martin-Luther University Halle-Wittenberg).

Overall, Symposium A confirmed that chalcogenide thin-film solar energy research continues to advance on multiple fronts simultaneously – from pushing efficiency limits and developing bifacial and tandem architectures to exploring novel absorber materials and expanding into solar fuel production. The strong participation of early-career researchers, combined with the high scientific quality of the contributions, demonstrated a vibrant and internationally connected community that is well positioned to address the remaining scientific and technological challenges on the path toward large-scale deployment of sustainable solar energy technologies. [Ω](#)

SYMPOSIUM ORGANIZERS

Bart VERMANG, University of Hasselt / imec, Belgium

Martina SCHMID, University of Duisburg-Essen, Germany

Sascha SADEWASSER, International Iberian Nanotechnology Laboratory, Portugal

Xiaoqing HAO, University of New South Wales, Australia

Yukiko KAMIKAWA, National Institute of Advanced Industrial Science and Technology, Japan



E-MRS 2026 Spring Meeting

Symposium B: Nano-engineered Coatings and Thin Films: From Design to Applications

The Symposium is one of the oldest symposia within the E-MRS Spring Meeting, organized biannually since 1993 (originally under the name “Protective Coatings and Thin Films”). In the 2026 edition, the Symposium attracted a record-high number of abstracts (333) which were arranged in 80 oral presentations (including 11 invited presentations) and 230 poster contributions. The oral presentations were distributed in 17 sessions over four and a half days, while posters were presented in three sessions. The topics presented covered the following key aspects of thin-film science and technology:

- Fundamental principles of thin-film processing, including synthesis methods, *in-situ* and real-time diagnostics, atomistic mechanisms, and modelling;
- Design of thin films and coatings and novel fabrication techniques;
- Advances in *in-situ/in-operando* and *ex-situ* characterization methods;
- Coatings and thin films for energy conversion and storage, surface protection, photonics, plasmonics, and catalysis;
- Environmental impact and sustainability aspects pertaining to synthesis of thin films and coatings.

The oral sessions were characterized by high attendance numbers (typically more than 150 attendees), strict adherence to the schedule (including no no-shows), and fruitful exchanges between the presenters and the audience. The poster sessions were also very well attended.

A highlight of the symposium was the Young Researcher Awards (YRA). A total of 21 applications were received, out of which the symposium organizers shortlisted five applicants for face-to-face interviews that took place during the conference. The two winners were Susmita Chowdhury from Uppsala University and Hendrik Jansen from Empa. All shortlisted applicants had their conference fees waived by the symposium.

As a satellite event to the symposium, the tutorial “Vapor-Phase Thin-Film Synthesis: fundamentals, design, and applications” was also organized, which gave the opportunity to about 120 PhD students and early-career researchers to familiarize themselves with: (i) thin-film vapor-based synthesis techniques; (ii) fundamental atomic-scale processes and phenomena encountered during vapor-based film deposition; (iii) theoretical and computational tools used for thin-film design; and (iv) applications of nanoengineered thin films and coatings with a focus on nanomechanical characterization and stress evolution.

In addition to the support by E-MRS, the symposium was sponsored by Labex Interactifs, Nova, Park Systems, PREVAC, Rigaku, and Swiss Cluster.

We feel that the symposium was a great success with respect to the breadth and depth of topics that were presented, the participants’ engagement, and the overall scientific and collegial atmosphere. We would like to wholeheartedly thank all those who contributed to the success, including the contributors, attendees, session chairs, members of the scientific committee, and tutorial instructors. [Ω](#)

SYMPOSIUM ORGANIZERS:

Barbara PUTZ, Empa Thun, Switzerland.

Gregory ABADIAS (Main organizer), L’Institut Pprime, Université de Poitiers / CNRS, France.

Kostas SARAkinos, University of Helsinki, Finland.



Gregory Abadias, Barbara Putz, and Kostas Sarakinos

E-MRS 2026 Spring Meeting

Symposium D: Hybrid Integration and Multiphysics Nanomaterials for Photonic Devices and Circuits

The 2026 E-MRS Spring Meeting in Strasbourg provided an excellent platform for discussing emerging materials and technologies that will shape the future of photonics. Within this framework, Symposium D was organized by the Horizon Europe EIC Pathfinder project CIRCULIGHT (Circulating Light on Any Photonic Platform), with support from the Graduate School "Engineering and Systems Science" at Université Paris-Saclay (France), and sponsorship from the society LinkZill.

The symposium brought together more than 60 researchers from academia and research institutes across Europe and beyond. The scientific program featured seven invited talks, 32 oral presentations, and numerous posters covering hybrid integration, multiphysics materials, magneto-optics, nonlinear photonics, quantum photonics, and emerging device architectures for next-generation photonic systems.



Prof. Yuya Shoji's presentation on "Magneto-optical non-reciprocal devices in Si photonics"

A central highlight was the dedicated session on "Magneto-optical Materials and Devices," which showcased recent advances in magneto-optical materials, integrated optical isolators and circulators, and non-reciprocal photonic devices. More broadly, the symposium reflected the scientific vision surrounding the CIRCULIGHT project by highlighting how advances in functional materials, their integration into photonic or multiphysics platforms, as well as plasmonics, nonlinear optics, and quantum technologies are converging to enable increasingly versatile and efficient photonic circuits.

The symposium also showcased the strength of the international photonics community through invited contributions from leading researchers including Ivo Tanghe (Ghent University, Belgium), Yuya Shoji (Tokyo Institute of Technology, Japan), Zahara Moussadjy (Sorbonne Université, France), Bert Koopmans (Eindhoven University of Technology, The Netherlands), Laurent Vivien (Université Paris-Saclay, France), Nadia Belabas (Université Paris-Saclay, France), and Alexey Krasavin (King's College London, United Kingdom). Their presentations provided participants with a broad overview of current challenges and emerging opportunities across integrated photonics and advanced functional materials.



Hai Hoang Thi Thanh (Université Jean Monnet, Saint-Étienne, France) receiving Symposium D's Young Researcher Award

The symposium concluded with the presentation of the Young Researcher Award to Hai Hoang Thi Thanh (Université Jean Monnet, Saint-Étienne, France) in recognition of outstanding work demonstrating an innovative application of cobalt-ferrite nanoparticle composite materials for photonic technologies. The award highlighted the excellent contributions of early-career researchers and the promising future of the field.

The organizers would like to express their sincere gratitude to all colleagues who contributed to the success of Symposium D. Special thanks are extended to the co-organizers, Béatrice Dagens (Centre de Nanosciences et de Nanotechnologies – C2N, France), Yuliya Dadoenkova (Université Jean Monnet Saint-Étienne, France), and Lukáš Halagačka (VSB – Technical University of Ostrava, Czech Republic), whose dedication and efforts were essential throughout the preparation and execution of the symposium. The organizers are equally grateful to the members of the scientific committee: François Royer, Giovanna Calò, Giovanni Magno, Bilal Gökce, Navy Yam, Yuqing Jiao, Dalibor Javůrek, and Mike Wale for their valuable contributions to shaping a high-quality scientific program. Appreciation is also extended to the session chairs: Damien Jamon, Nadia Belabas, Giovanni Magno, Laurent Vivien, and Tsz Wing Lo, as well as to the symposium assistants Vinh-Phuoc Truong and Oliver Jan Hejtman, whose support ensured the smooth running of the event.

The organizers furthermore wish to acknowledge the outstanding support provided by the European Materials Research Society (E-MRS) and the local organizing team. Their responsiveness, professionalism, and exceptional management of the meeting logistics created a welcoming and highly productive environment that was greatly appreciated by speakers and participants alike. The quality of the organization contributed significantly to the success of the symposium and to the vibrant scientific exchanges that took place throughout the week in Strasbourg.

The organizers warmly thank all speakers, authors, participants, reviewers, and session chairs for their contributions. The success of Symposium D highlighted the importance of interdisciplinary exchanges in advancing photonics research and fostering new collaborations. Readers interested in learning more about the CIRCULIGHT project, its latest results, publications, and upcoming activities are invited to visit the project website (<https://www.circulight.eu>) and subscribe to the CIRCULIGHT newsletter.

The consortium looks forward to continuing the discussions initiated in Strasbourg and developing new collaborations across the photonics community. 

SYMPOSIUM ORGANISERS

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Lukáš HALAGAČKA, VSB – Technical University Ostrava, Czech Republic.

Yuliya DADOENKOVA, Jean Monnet University, France.

E-MRS 2026 Spring Meeting

Symposium H: Interdisciplinary Approaches in Materials Science for Addressing Energy and Environmental Challenges

Symposium H was held from May 25 to 27, 2026, in Strasbourg, France. The research topics of the symposium covered a wide range of fields, including hydrogen science, functional materials, and computational and mathematical methodologies. The event attracted 173 abstracts from 37 countries and regions, featuring 26 invited presentations, 16 general oral presentations, and 131 poster presentations. Over three-days, the symposium attracted a large audience of international researchers, particularly vibrant early-career scientists.

On the first day, the symposium commenced with opening remarks delivered by the main organizer, Prof. Shin-ichi Orimo, Director of AIMR, Tohoku University (Figure 1). Following the opening, the symposium featured two prestigious keynote lectures that set a profound academic tone for the event. First, Prof. Andreas Züttel from the Swiss Federal Institute of Technology in Lausanne (EPFL), Switzerland, delivered a keynote lecture on “The role of hydrogen in the global energy transition”. Subsequently, Dr. Michael Hirscher from the Max Planck Institute for Solid State Research (MPI-IS), Germany, gave another keynote talk entitled “25 Years of metal-organic frameworks for cryo-adsorption hydrogen storage”. The opening day then concluded with an active poster session.

The momentum continued into the second day, highlighting advanced material designs for environmental remediation and green hydrogen generation, driven by a keynote talk by Prof. Alexander Kuhn from the Institute of Molecular Sciences (ISM) of the University of Bordeaux, France, on “Multifunctional semiconductor Janus micro- and nano-particles with enhanced photocatalytic efficiency for green hydrogen production and depollution”. On the final day, the symposium highlighted AIMR's strong research capabilities, featuring eight invited talks from AIMR. The symposium concluded with closing remarks delivered by one of the co-organizers, Dr. Andreas Borgschulte (Empa). Overall, the symposium concluded with remarkable success, characterized by dense academic discussions and high audience engagement, providing a highly dynamic platform for scientific exchange and discussion on the latest advances in materials research.

In parallel with the symposium, AIMR also hosted an exhibition booth in collaboration with the JSPS (Japan Society for the Promotion of Science) Strasbourg Office, providing an excellent opportunity to promote AIMR's research activities and strengthen international academic exchange (Figure 2). The integration of these high-level scientific presentations with the AIMR-JSPS joint booth promotion created a seamless workflow, effectively guiding inspired attendees toward future career opportunities and international fellowships in Japan. [🔗](#)

SYMPOSIUM ORGANISERS



Shin-ichi ORIMO
(Main Organizer)
Advanced Institute for Materials Research (AIMR), Tohoku University



Andreas BORGSCHULTE
(Co-organizer)
Swiss Federal Laboratories for Materials Science and Technology (Empa)



Astrid PUNDT
(Co-organizer)
Karlsruher Institut für Technologie (KIT)



Figure 1. Prof. Shin-ichi Orimo gave an opening talk.



Figure 2. Core members at AIMR-JSPS joint booth.

E-MRS 2026 Spring Meeting

Symposium K: Photo and Electrochemical Systems for Value-Added Synthesis

The E-MRS Spring Meeting 2026 successfully hosted Symposium K, bringing together leading researchers from academia and research institutes, to discuss the latest advances in sustainable chemical production and energy storage. The symposium was organized under the framework of the European Horizon Europe project PECATHS, highlighting the project's commitment to accelerating innovative photoelectrochemical and electrochemical technologies for the green transition.

The symposium addressed some of the most pressing scientific and technological challenges associated with achieving the European Union's climate neutrality goals and the CO₂ emissions reduction targets established under the Paris Agreement. Discussions focused on the development of renewable pathways for producing chemicals and fuels while reducing dependence on fossil resources.

Over three days, the symposium featured an outstanding scientific program comprising 12 invited lectures, 38 contributed oral presentations, and 25 poster presentations, reflecting the growing international interest in photoelectrochemical and electrochemical approaches for sustainable synthesis. The presentations covered a broad range of topics, including: biomass conversion into platform chemicals, green hydrogen production and hydrogen storage technologies, advanced materials for (photo)electrosynthesis, state-of-the-art characterization techniques, and computational modelling of (photo)(electro)catalysts.

A central theme throughout the symposium was the development of alternative strategies for storing renewable energy in chemical bonds through liquid and solid hydrogen carriers, as well as the sustainable transformation of biomass into high-value chemicals. These approaches represent key enabling technologies for replacing fossil-derived feedstocks in the chemical industry and advancing the circular economy.

The symposium also highlighted the importance of combining advanced experimental characterization with computational modelling to gain fundamental insights into catalytic materials and reaction mechanisms, ultimately enabling the design of more efficient and durable (photo)electrochemical systems.

Researchers participating in Symposium K emphasized the interdisciplinary nature of the field, fostering collaborations across materials science, chemistry, catalysis, electrochemistry, and engineering. The lively discussions following presentations and during poster sessions created valuable opportunities for knowledge exchange and the establishment of new research partnerships.

The success of the symposium confirms the growing momentum of the international research community working on photo- and electrochemical systems and highlights their potential to transform the production of fuels, chemicals, and energy storage solutions in the coming decades. [Ω](#)

SYMPOSIUM ORGANIZERS:

Alba GARZON MANJON, Catalan Institute of Nanoscience and Nanotechnology (ICN2), Spain.

David TILLEY, University of Zurich, Switzerland.



Elena MAS MARZÁ (main organiser), Institute of Advanced Materials (INAM), Universitat Jaume I, Spain.

E-MRS 2026 Spring Meeting Symposium M: Emergent Ferroelectric Thin Films

Symposium M at the 2026 E-MRS Spring Meeting successfully bridged fundamental science with emerging applications in ferroelectric thin films. The event drew remarkable participation, with 69 submitted abstracts translating into 18 invited talks, 42 contributed oral presentations, and 9 poster session contributions. This strong turnout, paired with a well-balanced mix of theory and experiment, fostered rich discussions and created an interdisciplinary environment focused tightly on recent advances in ferroelectric systems. The talks provided expert insights into pivotal topics, connecting basic research on ferroelectric systems to real-world deployment. Key developments in CMOS-compatible materials were showcased, ranging from wurtzite ferroelectrics (Fichtner, Univ. of Kiel) to hafnia-based thin films (Schroeder, NaMLab; Bégon-Lours, ETH; Fina, ICMAE; Di Wu, Nanjing University; and Nukala, IIS Bangalore) for memory and in-memory computing devices. Emerging trends also took centre stage, including twisted oxide membranes (Santamaría, Univ. Complutense) and complex polar structures (Rivadulla, Univ. of Santiago de Compostela). Cutting-edge experimental and computational techniques were highly visible throughout the program and received dedicated focus (Müller, Univ. of Konstanz; Lenzi, Univ. of Braga; and Cazorla, Univ. Politecnica de

Catalunya). Bringing together speakers from both academia and industry sparked vital dialogues on translating these laboratory breakthroughs into commercial technologies.

Highlighting the event's talent, one PhD student received the Symposium's Young Researcher Award for her outstanding presentation. The energetic involvement of numerous young researchers greatly enriched the overall atmosphere. In closing, the organizers express their sincere gratitude to all participants for their essential role in making Symposium M a success and extend a special thanks to E-MRS and APL Electronic Devices for their sponsorship. The dynamic discussions and interdisciplinary exchanges left attendees feeling inspired and motivated for future work. [Ω](#)

SYMPOSIUM ORGANIZERS

Chen GE, Institute of Physics, Chinese Academy of Sciences, China
Florencio SÁNCHEZ, Institut de Ciència de Materials de Barcelona (ICMAE-CSIC), Spain
José P. B. SILVA (Main organizer), University of Minho, Portugal
Judith DRISCOLL, University of Cambridge, UK
Maximilian LEDERER, Fraunhofer Institute for Photonic Microsystems – IPMS, Germany

E-MRS 2026 Spring Meeting Symposium S: Material-related Problems of Neuromorphic Technologies

The rationale behind the Symposium S was the inevitability of a revolution in the field of electronic technology, driven by the emergence of new paradigms in electronics that cannot be implemented using existing hardware.

The sessions of the Symposium S occupied 3.5 days from Monday, 25 May, to Thursday, 28 May. The symposium program included 18 invited, 58 oral, and 27 poster presentations.

The presenters came from 25 countries: Australia, Belgium, Brazil, Canada, Denmark, France, Germany, Hong Kong, Hungary, India, Israel, Italy, Japan, Korea, Lithuania, The Netherlands, Norway, Poland, Portugal, Spain, Switzerland, Taiwan, UK, USA, and Uzbekistan, located across five continents: Asia, Australia and Oceania, Europe, and North and South America, demonstrating, in this way, the recognition of the importance of the symposium's theme by researchers and engineers around the world.

The participation of several renowned scientists significantly enhanced the event's scientific depth and prestige, fostering stimulating discussions and providing valuable insights for both early-career and established researchers. The symposium greatly benefited from their engagement.

It is striking that there were no speakers from institutions in mainland China – a country that is highly active in the field of neuromorphic technologies – although several speakers of Chinese origin represented overseas institutions where they are studying or working. This prompts us to explore further ways of promoting information about future symposia in China. Another problem is the no-show, opening holes in the oral program. A possible solution may be to remove talks from the program if the presenting author has not completed registration two weeks before the meeting begins.

Overall, Symposium S was a great success, attracting a large number of students and early-career researchers from all over the world. Four prizes were awarded to them: two in the 'Young Researcher Awards' category and two for the best poster. Many symposium participants expressed a strong desire for follow-up symposia to be organized in the near future. [Ω](#)

SYMPOSIUM ORGANIZERS

Nikolai SOBOLEV, Marina SPARVOLI, Hans CHO, and Ronald TETZLAFF

Young Researcher Awards at the Spring 2026 E-MRS Meeting

The **E-MRS Young Researcher Awards** are intended to honour and encourage graduate students whose academic achievements and current materials research display a high level of excellence and distinction. E-MRS seeks to recognize students of exceptional ability who show promise for significant future achievement in materials research. Each award winner receives 450 Euro and a personalised award certificate. The Awards ceremony was held on Thursday, May 28, at the conference venue. The name and affiliation of each winner in their symposia are listed below.* Several individual summaries of their research [edited for length and clarity] are included in the following pages.

Symposium A

Saeed **BAYAT**
University of Luxembourg

Hu **YUE**
University of Science and Technology of China

Symposium B

Hendrik **JANSEN**
Swiss Federal Laboratories for Materials Science and Technology (Empa)

Susmita **CHOWDHURY**
Uppsala University

Symposium C

Laura **SALAMONE**
University of Catania

Olugbenga **AYENI**
Christian-Albrechts-Universität zu Kiel

Symposium D

Hai **HOANG THI THANH**
Hubert Curien Laboratory, Université Jean Monnet Saint-Étienne

Symposium E

Yunyu **ZHANG**
University College London

Symposium F

Sara **PATTARO**
Luleå University of Technology

JuYeon **KIM**
Korea University

Symposium G

Helena **RABELO FREITAS**
Catalan Institute of Nanoscience and Nanotechnology (ICN2)

Symposium H

Alexey **RULEV**
Swiss Federal Laboratories for Materials Science and Technology (Empa)

Symposium I

Seonjeong **LEE**
Korea Advanced Institute of Science and Technology (KAIST)

Fernando **NÚÑEZ GÁLVEZ**
Institute of Materials Science of Seville (ICMS)

Symposium J

Nitika **(नलिका)**
Indian Institute of Technology Roorkee and University of Surrey

Bhanu Jai **SINGH**
Institut Matériaux Microélectronique Nanosciences de Provence (IM2NP)

Symposium K

Marc **ARNAU ROCA**
Universitat Politècnica de Catalunya (UPC)

Symposium L

Alberto **PEINADOR**
Universidade da Coruña

Symposium M

Han **YU**
Tsinghua University

Symposium N

Enzo **ROLANDO**
Aix-Marseille Université

Maël **LAUPRETRE**
Institut Lumière Matière (ILM)

Symposium O

Anjali **JAYACHANDRAN**
University of Strasbourg

Rana **LOMLU**
Cornell University

Symposium P

Mattia **FAUSTI**
Institut de Physique et Chimie des Matériaux de Strasbourg (IPCMS)

Symposium Q

Jingyi **SHAN**
Northwestern Polytechnical University

Giuseppe **PROIETTO SALANITRI**
University of Bologna

Symposium R

Emma **PAPPAS**
University of Illinois Urbana-Champaign

Symposium S

Harshita **RAI**
Kyushu Institute of Technology

Yingxin **LI**
Technical University of Darmstadt

Symposium T

Kan **LIU**
Westlake University

Ángel **LABORDET ÁLVAREZ**
Swiss Federal Laboratories for Materials Science and Technology (Empa)

Symposium U

Sara **PANDOLFI**
University of Bologna

Asmaa **KHALIL**
Université de Lille

Symposium V

Estela **BOCARANDO SALCIDO**
Trinity College Dublin

Symposium W

Bharti **RANA**
Indian Institute of Technology Delhi

Sanjoy **SUR ROY**
Indian Institute of Technology Guwahati

Symposium X

Ayoub **TRAVERSON**
École Normale Supérieure Paris-Saclay 

*See the meeting program at <https://www.european-mrs.com/meetings/2026-spring/symposia-program> to associate the letter with each symposium topic.



**Saeed
BAYAT**
Symposium A

Symposium A: Backside Passivation Approaches in Bifacial CIGSe Solar Cells

Saeed Bayat, University of Luxembourg

As a PhD researcher at the University of Luxembourg, my work focuses on bifacial copper indium gallium selenide (CIGSe) solar cells, where transparent conductive oxide replaces the conventional molybdenum back contact to enable light absorption from both sides. Due to inherent physical constraints, the rear-side efficiency of bifacial CIGSe cells consistently lags behind their front-side performance, and closing this gap is the central motivation of my research.

One of the most promising strategies to improve rear-side performance is reducing the absorber thickness. Thinner absorbers not only lower material consumption but also enhance the collection of carriers generated near the back contact. However, thinning the absorber introduces new challenges, as surface recombination at the rear interface becomes harder to control compared to thicker devices.

My work addresses this challenge by developing a gallium oxide (GaO_x) hole transport layer as a passivation strategy for the rear interface of thin bifacial CIGSe solar cells. This approach aims to suppress recombination losses and bring the rear-side efficiency closer to its front-side efficiency.



**Yue
HU**
Symposium A

Symposium A: Nucleation Control for High-Efficiency Cd-Free $\text{Sb}_2(\text{S,Se})_3$ Solar Cells

Yue Hu, University of Science and Technology of China

$\text{Sb}_2(\text{S,Se})_3$ is a promising earth-abundant thin-film photovoltaic absorber with optimal bandgap and strong optical absorption. Replacing the conventional CdS buffer layer with TiO_2 eliminates parasitic absorption and environmental concerns, but introduces a critical limitation: the chemically inert TiO_2 surface imposes high nucleation barriers, leading to sparse film morphology and elevated deep-level defect densities.

To overcome this, two complementary engineering strategies were developed. First, thioacetamide (TA) was introduced during chemical bath deposition as a molecular patching agent, suppressing Sb_2O_3 formation and repairing film discontinuities. A key finding is that S/Se composition tuning enabled by TA suppresses SbS substitutional defects, establishing a direct link between precursor chemistry and defect speciation. Building on this, a dual-functional interfacial modification was developed by grafting sulfate and protonated amine groups onto TiO_2 via sulfur-ethylenediamine treatment. This modification enhances the anion adsorption capability of TiO_2 , which not only increases nucleation density by 40% through an instantaneous nucleation mechanism, but also passivates sulfur vacancy defects at the interface. The resulting compact, pinhole-free films yielded a record Power Conversion Efficiency (PCE) of 9.33% for Cd-free $\text{Sb}_2(\text{S,Se})_3$ solar cells.

Together, these two strategies demonstrate that nucleation control is a powerful approach for simultaneously suppressing defect formation and enhancing film quality, paving the way toward high-efficiency, environmentally sustainable Cd-free $\text{Sb}_2(\text{S,Se})_3$ solar cells and other chalcogenide thin-film photovoltaic technologies.



**Susmita
CHOWDHURY**
Symposium B

Symposium B: Questionable van der Waals Epitaxy of Nonlayered Materials on Fluorophlogopite Mica: The Case of ScN

Susmita Chowdhury, Department of Chemistry, Ångström Laboratory, Uppsala University

My research primarily explores thermoelectric materials that can directly convert waste heat into electricity, a sustainable route of energy harvesting. Traditional use of tellurides and selenides are often limited due to toxicity, scarcity, and hence high cost. I focus on designing nontoxic refractory transition metal

nitrides (TMNs), namely ScN and CrN with group 4-6 nonmagnetic alloying. ScN is of interest due to its high thermal conductivity of $10\text{--}12 \text{ Wm}^{-1}\text{K}^{-1}$, which can be reduced through alloying in the absence of ^{45}Sc isotopes, a key to improve the conversion efficiency. On the other hand, earth-abundant CrN has a thermoelectric power factor of $1.5\text{--}5 \text{ mWm}^{-1}\text{K}^{-2}$ and relatively low thermal conductivity of $2\text{--}4 \text{ Wm}^{-1}\text{K}^{-1}$ due to strong spin-lattice coupling, and is comparable with conventional Bi_2Te_3 and PbTe . Accessing synchrotron sources at MAX IV, Sweden and at INDUS 2, RRCAT, India, through absorption and emission studies around the conduction and valence band, my research experimentally demonstrated with theoretical aid that defects at reduced dimensions influence the electronic structure, and in turn govern thermoelectric performance. Further, my research on ScN explores the field of plasmonics. In the presence of N vacancies with alloying, the plasmonic response in ScN can be tuned from $1800\text{--}2400 \text{ nm}$ to the biological transmission window ($650\text{--}1350 \text{ nm}$). And as a final step of my research, I explored the possibilities of eliminating substrate dependency of these thin films enabling cross-platform heterogeneous integration. Therefore, van der Waals epitaxy (vdWE) is of interest for realizing the free-standing films because vdWE connotes weak out-of-plane vdW forces and a strong in-plane ionic/covalent bonding. My research on thickness dependent nonlayered ScN thin films deposited on layered fluorophlogopite mica demonstrated conventional epitaxial growth dispelling the prior myth that epitaxy on layered templates means vdWE. Rather my research proposes that conventional epitaxy should be the default assumption for nonlayered materials grown on layered templates below 10 nm layer thickness. Overall, the work highlights the inherent trade-off between strength, stability, and brittleness, providing key guidelines for designing robust interface-engineered thin films.



**Hendrik
JANSEN**
Symposium B

Symposium B: Towards Thermal Stability of Interface-Engineered Crystalline/Amorphous $\text{Al}_{100-z}\text{Ni}_z/\text{AlO}_x\text{H}_y$ Nanolaminates

Hendrik Jansen, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf (Empa)

Hybrid physical vapour deposition (PVD) combined with atomic layer deposition (ALD) without vacuum break enables fabrication of interface-engineered materials with precisely controlled chemistry and nanoscale architecture. By integrating metallic layers (e.g., PVD-AlNi) with ultrathin ceramics (e.g., $\sim 1 \text{ nm}$ ALD- AlO_xH_y) in nanolaminates, these systems offer enhanced strength, thermal stability, and functionality beyond conventional coatings. However, their stability under processing, thermal exposure, mechanical loading, and even characterization remains insufficiently understood.

Here, Al–Ni/AIO_xH_y nanolaminates produced by hybrid PVD/ALD establish novel structure-property-stability relationships. Chemistry, nanoscale layering, and interface structure govern strengthening and thermal degradation that are resolved by advanced techniques including transmission electron microscopy, atom probe tomography, synchrotron X-ray diffraction, and micromechanical testing. Results show that interface engineering significantly increases strength via Ni alloying and confined deformation. Thermal exposure triggers competing processes such as segregation, precipitation, oxide crystallization, interlayer instability, and coarsening, which degrade performance. It is also shown that Ga⁺ focused ion beam (FIB) preparation can induce artefacts, whereas Xe⁺ plasma FIB preserves the true microstructure. Importantly, strengthening through alloying and nanoscale confinement also promotes intrinsic brittleness due to a distinct deformation mechanism.

While the hybrid PVD/ALD strategy enhances strength, competing shearing mechanisms limit ductility and damage tolerance, especially below 10 nm layer thickness. Overall, the work highlights the inherent trade-off between strength, stability, and brittleness, providing key guidelines for designing robust interface-engineered thin films.



**Olugbenga
AYENI**
Symposium C

Symposium C: Defect and Interface Engineering of Ag-Decorated WO₃-TiO₂ Heterostructures for Enhanced Photocatalysis*

Olugbenga Ayeni, Christian-Albrechts-Universität zu Kiel

Micro- and nanoplastics (MNPs) contamination in water systems is a growing global environmental challenge, with millions of tons of plastic waste entering aquatic environments annually and traces now detected in drinking water. My research is motivated by the need to develop efficient photocatalytic materials for addressing

such emerging pollutants and ensuring cleaner water systems. In our recent work at the Chair of Composite Materials, Kiel University, headed by Prof. Dr. Tayebah Ameri, we investigated Ag-decorated WO₃-TiO₂ heterostructured thin films as a model photocatalytic system to gain a fundamental understanding of, and improve, photocatalytic processes relevant to environmental remediation. The WO₃-TiO₂ heterostructures were fabricated via reactive DC sputtering under controlled oxygen flow. The WO₃-TiO₂ heterostructures were further decorated with Ag nanostructures. This approach enables simultaneous tuning of defect states and interfacial properties, which are critical in governing charge separation and recombination processes in oxide-based photocatalysts. The results demonstrate that oxygen flow during film growth strongly influences defect formation in the WO₃-TiO₂ system. Furthermore, decorating the WO₃-TiO₂ heterostructures with Ag further enhances photocatalytic activity by improving interfacial charge extraction and suppressing recombination. These improvements are linked to defect modulation and more efficient separation and utilization of photogenerated charges, as confirmed by X-ray photoelectron spectroscopy (XPS) and ultrafast transient absorption (TA) spectroscopy measurements. The insights gained from this study provided a useful basis for designing more efficient photocatalytic systems for future applications in water purification, including the degradation of micro- and nanoplastics and other emerging contaminants.

***All authors of this work:** Olugbenga Ayeni, Marvin Krupp, Josiah N. Shondo, Tim Tjardts, Thomas Strunskus, Oral C. Aktas, Stefan Lochbrunner, Salih Veziroglu, and Tayebah Ameri.



**Laura
SALAMONE**
Symposium C

Symposium C: A novel MOCVD approach to earth-abundant ferrite thin films for light-driven applications

Laura Salamone, University of Catania

Can solar-driven catalysis become more sustainable, without relying on scarce, expensive noble metals or critical raw materials? This is the question my PhD is trying to address. In particular, my research focuses on calcium and magnesium ferrites (CaFe₂O₄ and MgFe₂O₄), underexplored but promising candidates for light-driven applications due to their chemical

stability, optimal visible-light absorption, and the high abundance of their constituent elements. However, their efficiency is inherently limited by short carrier diffusion lengths and therefore high recombination of the photogenerated carriers in the bulk of these materials.

To counteract these limitations, the core novelty of my work lies in the development of a novel metal-organic chemical vapor deposition (MOCVD) approach using advanced second-generation organometallic precursors. In fact, unlike conventional powder-based methods, this gas phase strategy allows us to grow highly crystalline ferrite thin films at relatively low temperatures, while controlling their nanostructure and thickness with high precision. Our research has already yielded significant and original results, establishing the first ever chemical vapor-phase deposition of calcium ferrite and one of the very few reports on magnesium ferrite, achieved across a range of substrates including planar surfaces for functional testing and complex 3D macroporous nickel foam.

The functional tests carried out on the samples confirm that MOCVD deposited nanostructured thin films possess the ideal properties to drive water splitting and actively generate photocurrent under visible light. Notably, a systematic thickness study on MgFe₂O₄ films showed that thinner films outperform thicker ones, yielding a 5.3 fold enhancement in photocurrent density. This finding demonstrates how the precise thickness control and high crystallinity uniquely enabled by MOCVD can directly unlock the photoelectrochemical performance of these underexplored ferrite materials, establishing this approach as a powerful and scalable route toward noble-metal-free catalysts for light-driven applications.



**Hai
HOANG THI
THANH**
Symposium D

Symposium D: Magnetic field steering of the optical reflectance of VO₂ film coated on sol-gel processed nanocomposite

Hai Hoang Thi Thanh, Hubert Curien Laboratory, Université Jean Monnet Saint-Étienne

Controlling the optical properties of a surface without any contact is a long-standing goal in photonics and smart materials. This work demonstrates a new approach by using a magnetic field to remotely trigger the thermochromic phase transition of vanadium dioxide (VO₂) and thereby switch the optical reflectance of its functionalized surface. The

strategy relies on solid-state magnetic hyperthermia. A nanocomposite monolith which is CoFe₂O₄ nanoparticles (NPs) dispersed in a silica matrix via sol-gel processing acts as a heat source. A VO₂ thin film deposited on top by pulsed laser deposition serves as a photonic surface with thermochromic behaviour. Under an alternating magnetic field of 800 kHz and 6 mT, the monolith reaches 150°C, crossing the VO₂ metal-insulator transition at 68°C. The result is a sharp, reversible

modulation of infrared reflectance as the film switches between its dielectric and metallic states driven entirely by the magnetic field with no direct thermal contact required. The monoliths were characterized by TEM, SEM, EDS, Raman spectroscopy, and Faraday rotation measurements, confirming the structural integrity, NP dispersion, and magnetic properties of the composite. Regarding heating in the monolith, this study presents, for the first time, the significant heating effect of the hyperthermia monolith. Based on this, our work on magnetic field steering of the optical reflectance of the VO₂ film coated on sol-gel processed nanocomposite opens application pathways in magnetically reconfigurable photonic surfaces, contactless optical switching for telecommunications, smart infrared coatings for energy management, and optical security features.



Yunyu ZHANG
Symposium E

Symposium E: A Multi-Scale Mixture of Experts Model for Structural Prediction of Cu Nanoparticles

Yunyu Zhang, Department of Chemistry, University College London

Understanding and predicting the atomic structure of complex nanomaterials remains one of the central challenges in computational materials science. The enormous configurational space of nanoparticles and the high cost of quantum-mechanical calculations often limit the scale and realism of computational studies.

My research develops machine-learning methodologies that improve both the efficiency and predictive capability of atomistic modelling workflows. One part of this work is REMatch+SOS, a structure-aware unsupervised screening framework that identifies representative configurations from large candidate datasets without requiring energy calculations. Although initially developed for supported metal nanoclusters, the approach is broadly applicable to global optimisation, high-throughput materials screening, molecular dynamics trajectory reduction, and machine-learning dataset construction. By reducing configurational redundancy while preserving structural diversity, it enables substantial savings in computational cost.

A second focus is the development of a multi-scale mixture of experts (MoE) framework for machine-learned interatomic potentials (MLIPs). The key idea is that different physical interactions dominate at different length scales, yet most existing MLIPs rely on a single model to describe all of them simultaneously. By combining specialised experts that learn short-, medium-, and long-range interactions, the framework achieves improved accuracy, transferability, and interpretability across nanoparticle size regimes. While demonstrated for copper nanoparticles, the underlying methodology is general and can be integrated into a wide range of MLIP architectures and material systems.

Together, these approaches aim to establish more scalable, transferable, and physically meaningful machine-learning workflows for materials discovery. By bridging efficient structure exploration with next-generation atomistic modelling, they provide new opportunities for studying realistic catalytic nanomaterials and other complex materials systems at unprecedented scales.



JuYeon KIM
Symposium F

Symposium F: From Binary to Quaternary TMD Alloys: Phase Transition and Defect Engineering for Hydrogen Evolution Catalysis

JuYeon Kim, Dept. of Micro-device Engineering, Korea University

My research focuses on the computational design of transition metal dichalcogenide (TMD) alloy catalysts for the hydrogen evolution reaction (HER). Using first-principles calculations, I have investigated how alloy composition, atomic mixing, phase stability, and defect formation influence catalytic performance, extending from binary to quaternary alloy systems.

In binary TMD alloys, I found that many elemental combinations tend to exhibit phase separation rather than homogeneous atomic mixing. Despite these limitations, vacancy defects create highly active sites for hydrogen adsorption and play a key role in determining HER activity. To overcome phase separation, I extended the study to ternary alloys. The increased configurational entropy promotes homogeneous mixing. In addition, vanadium (V)-rich compositions stabilize the metallic 1T phase and exhibit enhanced HER performance. However, the high V content also leads to surface instability and oxidation, limiting practical applicability.

To address this challenge, I designed a quaternary ruthenium (Ru)-containing alloy that stabilizes the metallic 1T phase at lower V concentrations. This strategy achieves comparable HER performance at lower V concentrations, avoiding surface instability and oxidation.

Overall, my work establishes a compositional design strategy that systematically evolves from binary to quaternary TMD alloys. By controlling atomic mixing, phase stability, and defect formation, this work provides a practical framework for developing efficient and durable HER catalysts.



Sara PATTARO
Symposium F

Symposium F: Freeze-casted ceramic with vertically-aligned pores decorated with photothermal absorbers for solar-driven interfacial evaporation

Sara Pattaro, Department of Engineering Sciences and Mathematics, Luleå University of Technology, Sweden*

I am Sara Pattaro, a PhD student in Experimental Physics at Luleå University of Technology, Sweden. My research focuses on harnessing solar radiation to address environmental challenges.

My scientific journey began with the study of solar energy conversion through photovoltaic devices. During my master's thesis, I developed and optimized Sb₂S₃-based thin film solar cells, with the goal of producing semitransparent devices for photovoltaic integrated windows.

Currently, my PhD research explores a novel application of solar energy for water desalination through solar-driven interfacial evaporation. This thermally driven process relies on the photothermal conversion of sunlight into heat, which is used to evaporate water and generate freshwater from seawater. My work covers the design, fabrication, and optimization of both inorganic photothermal materials (e.g., Co-Bi₂S₃, black titania) and porous ceramic supports (e.g., alumina, silica), as well as their integration into efficient desalination devices.

In particular, I investigate freeze-casting as a method for producing porous ceramic structures with vertically aligned channels that enhance water transport. By carefully balancing the properties of the ceramic support, such as water affinity and water flux, with those of the photothermal material, including light-to-heat conversion efficiency and thermal management, I aim to maximize freshwater production under solar irradiation.

In parallel, I am expanding my research interests to photoelectrocatalysis, exploring electrode materials that combine solar energy and electrical power to produce sustainable fuels and chemicals, such as hydrogen, oxygen, and ammonia.

***Principal supervisor:** Alberto Vomiero



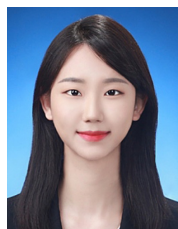
**Helena
RABELO
FREITAS**
Symposium G

Symposium G: Advanced Strain Characterization of Zn_3P_2 Thin Films via 4D STEM

Helena Rabelo Freitas, Catalan Institute of Nanoscience and Nanotechnology (ICN2)

Zn_3P_2 is a promising earth-abundant material with a direct bandgap of 1.5 eV and strong optical absorption, nearly ideal for photovoltaic applications. However, achieving high-performance devices requires careful control of the microstructure during growth and post-growth processing, as strain and crystal quality can strongly influence carrier transport and recombination. In this work, we used 4D STEM to investigate the effect of thermal annealing on epitaxial Zn_3P_2 thin films grown on InP substrates. Unlike conventional strain mapping methods based on high-resolution STEM images, which are normally limited to small regions, 4D STEM enables quantitative strain and orientation analysis across micron-scale fields of view, making it possible to evaluate structural variations over areas that are representative of the entire thin film.

By comparing as-grown samples with films annealed at 300°C and 400°C, we observed a clear evolution of the crystal structure. Annealing at 300°C promoted strain relaxation while preserving the monocrystalline nature of the film, indicating a beneficial effect on material quality. However, annealing at 400°C resulted in significant degradation of the crystal structure, with the film no longer remaining monocrystalline. In addition, stacking faults were observed throughout the film, indicating the formation of extended crystal defects. Such defects can act as non-radiative recombination centres and are consistent with the reduction in device performance observed after high-temperature annealing. The combined structural and electrical results reveal an optimal annealing window for Zn_3P_2 thin films and provide practical guidance for future device fabrication.



**Seonjeong
LEE**
Symposium I

Symposium I: Miniaturized Flexible Ion-Gel Pressure Sensors Based on Gradual Electric Double Layer Formation

Seonjeong Lee, Korea Advanced Institute of Science and Technology (KAIST)

In this study, we develop a miniaturized, flexible capacitive pressure sensor capable of detecting a wide pressure range without the need for additional surface microstructures, which are often used for improvement in sensitivity and response speed but suffer from issues such

as rapid saturation under high pressure and mechanical instability during repetitive pressure cycles. Based on a porous Poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) polymer with optimized ion concentration, the ion-polymer film is fabricated via a simple spin-coating method, featuring an ultrathin structure and mechanical stability. The proposed sensor exhibits a high capacitance density of several $\mu\text{F}/\text{cm}^2$, even with a small surface area, by leveraging the electric double layer (EDL) formed by ions. This design enables the sensor to maintain high performance even when scaled down to tens of micrometres, utilizing a mechanism of gradual EDL modulation under applied pressure.

With the proposed approach, we demonstrate a miniaturized capacitive pressure sensor ($50 \times 50 \mu\text{m}^2$) capable of detecting a wide range from 10 kPa to 1 MPa. The sensor exhibits a capacitance increase exceeding 50 times its initial value in response to applied pressure. It is particularly noteworthy that the sensor can achieve a high capacitance density of over $2 \mu\text{F}/\text{cm}^2$ at a maximum pressure of 1 MPa. This miniaturized, flexible, and near-invisible sensor allows for easy integration. Furthermore, the sensor array turns out to outperform human fingerprints in resolution, opening up new possibilities for robot skin in harsh environments or for detecting details too small for human touch.



**Fernando
NÚÑEZ
GÁLVEZ**
Symposium I

Symposium I: Water-resistant perovskite solar cell-drop energy harvester

Fernando Núñez Gálvez, Science Materials Institute of Seville

This research presents a significant advance in hybrid renewable energy systems by developing a novel device capable of harvesting energy from both sunlight and rainfall. The work addresses a key global challenge: the growing energy demand cannot be sustainably met by relying on single energy sources alone. To overcome this limitation, the study introduces a multifunctional hybrid technology that combines highefficiency perovskite

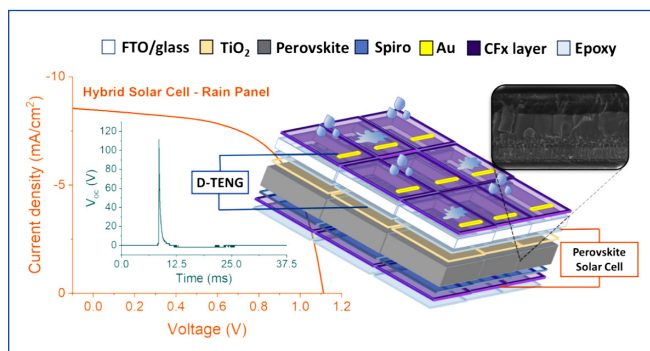
solar cells (PSC) with water-droplet triboelectric nanogenerators (D-TENGs) that convert the kinetic energy of raindrops into electricity. A central innovation of this work lies in the use of ultrathin plasma-deposited fluorinated films with thicknesses on the order of tens to hundreds of nanometres. These layers perform a dual role: they act as protective encapsulation, significantly enhancing the environmental stability of PSCs against moisture, temperature fluctuations, and direct water exposure, while simultaneously functioning as active triboelectric surfaces. This dual functionality allows the device not only to maintain high photovoltaic performance but also to generate electrical signals from rain impacts.

Importantly, the research overcomes longstanding limitations of perovskite technologies, particularly their vulnerability to humidity and water, by introducing a robust, scalable, and sustainable encapsulation approach compatible with industrial processes. The plasmabased fabrication method enables precise control over material composition and microstructure, offering a dry, wastefree alternative to conventional solution-based techniques, enabling



continuous energy production under variable weather conditions. By exploiting the complementarity between solar radiation and rainfall, the device mitigates the intermittency of renewable energy sources and enables autonomous operation 24/7.

In terms of applications, this technology is particularly suited for lowpower, outdoor electronic systems such as Internet of Things (IoT) devices, environmental and structural sensors, smart agriculture, and distributed monitoring infrastructures. Its robustness under harsh environmental conditions also makes it promising for smart cities, remote energy systems, and advanced functional materials industries.



Nitika
(नतिकि)
Symposium J

Symposium J: Partial Selenization of NiCr-LDH to $\text{Ni}_{0.85}\text{Se}@\text{NiCr-LDH}$ Heterostructure as an Efficient Electrocatalyst for Hydrogen Generation in AEM Electrolyser
Nitika (नतिकि), Indian Institute of Technology Roorkee, Uttarakhand, India and University of Surrey, Guildford, United Kingdom

Developing efficient and cost-effective electrocatalysts for anion exchange membrane (AEM) electrolyzers is essential for sustainable hydrogen production through water electrolysis.

In this work, NiCr layered double hydroxide (NiCr-LDH) and its partially selenized heterostructure, $\text{Ni}_{0.85}\text{Se}@\text{NiCr-LDH}$, were developed as bifunctional electrocatalysts for overall water splitting. The catalyst was synthesized via a hydrothermal route followed by controlled selenization and comprehensively characterized to understand its structural, morphological, and compositional features. Compared with pristine NiCr-LDH, the $\text{Ni}_{0.85}\text{Se}@\text{NiCr-LDH}$ heterostructure demonstrated significantly enhanced catalytic activity for both the oxygen evolution reaction (OER) and hydrogen evolution reaction (HER) in alkaline media. It achieved low overpotentials of 258 mV for OER and 85 mV for HER at a current density of 10 mA/cm². The superior performance originates from its higher electrochemically active surface area, improved electrical conductivity, reduced charge-transfer resistance, and optimized adsorption of reaction intermediates. The practical applicability of the catalyst was further demonstrated in a 5 cm² AEM electrolyser employing optimized porous transport layer materials. The electrolyser delivered a cell voltage of 2.31 V at 1 A/cm², confirming the potential of $\text{Ni}_{0.85}\text{Se}@\text{NiCr-LDH}$ as a scalable and economically viable catalyst system for industrial hydrogen production. These results highlight the effectiveness of heterostructure engineering in developing high performance, non-precious-metal electrocatalysts for next-generation water electrolysis technologies.



Bhanu
JAI SINGH
Symposium J

Symposium J: Strain-Controlled Phonon Transport in van der Waals Heterostructures: A Quantum Study

Bhanu Jai Singh, PhD student at IM2NP Aix-Marseille University

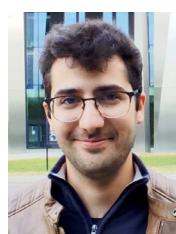
Nanoscale miniaturization and AI-driven hyperscale data centers are creating unprecedented thermal management challenges due to self-heating and energy-intensive cooling. Current solutions are unsustainable, with data center power use projected to double by 2026, reaching levels comparable to national

electricity consumption. Urgent innovation in thermal technologies is essential. In that context, two-dimensional transition metal dichalcogenides (TMDs) provide a promising platform for controlling heat flow due to their mixed covalent and van der Waals bonding, with mechanical strain offering a direct and tunable control parameter.

In this work, we investigate strain-dependent phonon transport in monolayer MoS_2 , bilayer MoS_2 , and MoS_2/WS_2 van der Waals heterostructures using a first-principles non-equilibrium Green's function (NEGF) framework. Dynamical matrices derived from density functional theory are used to analyze phonon dispersion, transmission, and thermal conductance under both in-plane (tensile and compressive) and cross-plane strain. A distinctive aspect of this work is the quantitative analysis of strain effects using the Frobenius norm of the dynamical matrix, enabling a direct link between strain-induced changes in lattice stiffness and phonon transport.

The results show a strong and systematic modulation of thermal transport with strain: tensile strain suppresses phonon transmission and reduces thermal conductance by up to ~11% due to phonon softening, while compressive strain enhances lattice stiffness and increases thermal transport by up to ~24%. In bilayer and heterostructure systems, thermal conductance remains close to the additive monolayer limit, demonstrating that intralayer interactions dominate, while cross-plane strain and van der Waals coupling have a comparatively minor effect.

These findings establish strain engineering as an efficient and physically transparent strategy to control thermal transport in TMD-based systems, with direct relevance for thermoelectric energy conversion, where reduced lattice thermal conductance is essential for improved device performance.



Marc
ARNAU ROCA
Symposium K

Symposium K: The "Ironing" Effect: Ultra-Crystalline ZrO_2 Active Supports for Electrochemical Synthesis of Aminoacids

Marc Arnau Roca, Polytechnic University of Catalonia (UPC), Innovation in Materials and Molecular Engineering (IMEM) research group.

The development of next-generation catalysts is currently prioritizing achieving competitive catalytic yields (compared to conventional catalysts) while operating at mild reaction conditions and employing sustainable, abundant, and cost-effective materials.

This challenging trade-off has driven the scientific community to explore new strategies for enhancing the electrical conductivity of promising materials. To address this, the IMEM Research Group at the Polytechnic University of Catalonia (UPC) has developed a

thermal treatment based on lattice-engineering principles, known as “thermally stimulated polarization” (TSP). This method involves the simultaneous application of heat and an electric field to induce lattice dipole reorientation and crystalline rearrangement, ultimately resulting in tuning of the material’s electrical properties.

My latest research, which I presented at the E-MRS Spring Meeting 2026, focused on applying the polarization process to yttria-stabilized zirconium dioxide (YSZ). The polarized YSZ samples (p-YSZ) exhibited vast monocrystalline domains extending over 100 nm. Moreover, the high crystallinity achieved, combined with the absence of lattice defects, resulted in a two-order-of-magnitude increase in conductivity compared to the non-polarized YSZ. Benchmarking the samples via electrocatalytic glycine synthesis revealed that p-YSZ exhibited the highest catalytic yield. Furthermore, p-YSZ was also evaluated as an active support by loading the samples with gold nanoparticles (Au NPs), which displayed excellent electron transfer and yielded higher glycine production. Ultimately, these results demonstrate the effectiveness of the TSP process for the nanoscale design of ultracrystalline and low-defect catalytically active materials.



Alberto PEINADOR
Symposium L

Symposium L: Assessing the intrinsic thermal stability of D18-based bulk-heterojunctions: morphology and device performance

Alberto Peinador, Universidade da Coruña, CITENI

There has been steady progress in the field of organic photovoltaics (OPVs) over the years. Recently, power conversion efficiencies of lab-scale devices have reached over 20% bringing the community closer to larger scale commercial interest in the technology. Still, one of the main drawbacks to these high-performance devices is the relatively disappointing stability.

One key unavoidable source of degradation is heat. It is commonly understood that the optimal blend morphology happens to be out of thermodynamic equilibrium, leading to degradation via phase separation of the donor and acceptor materials. This intrinsic process in the active layer is yet to be fully characterized but usually assumed to be rather dominant and rapid in the case of D18-based bulk-heterojunctions.*

In our work, we aim to shed some light on this intrinsic process and in the meantime prove that D18-based devices can show impressive stability when kept in inert atmosphere in the dark at 65 C. Additional irradiance-dependent analysis can tell us more precisely the driving force for degradation, which happens to be the same as the limiting factor for device performance: transport resistance caused by limited charge carrier mobility. To aid in the research, classic characterization techniques, like calorimetry, AFM, or GIWAXS can help us unravel the composition, morphology, and crystallinity of the active layer throughout the degradation process.

Through this work, we hope to further understand thermal degradation in organic solar cells, eventually, helping to develop new efficient strategies to inhibit this form of degradation.

*D18 is a high-performance, narrow-bandgap conjugated polymer donor.



Han YU
Symposium M

Symposium M: Freestanding BaTiO₃ Membranes for Electro-Optic Performance Enhancement and Hybrid Integration with Silicon Photonics

Han Yu, School of Materials Science and Engineering, Tsinghua University

The integration of high-performance electro-optic materials with silicon photonics is essential for compact and energy-efficient optical devices. However, their integration with photonic chips nevertheless remains challenging. Direct growth can suppress the electro-optic response through

lattice mismatch and substrate clamping, while bonding processes may increase fabrication complexity and cost.

In this work, epitaxial BaTiO₃ films were released from the substrates through a water-soluble sacrificial layer, forming freestanding membranes that can be directly transferred onto pre-patterned photonic chips. Releasing the substrate constraint simultaneously facilitates heterogeneous integration and relaxes lattice strain, driving in-plane polarization reorientation and more effective electro-optic modulation. The freestanding membranes exhibit an effective linear electro-optic coefficient of 300 pm/V, more than five times higher than that of the as-grown films, while retaining a substantial response up to 493 K.

The membranes were further integrated with silicon nitride micro-ring resonators. Applied voltages shift the optical resonances through electrically induced refractive-index changes, enabling efficient modulation. The hybrid resonators achieve a 3 dB voltage-length product of 0.07 V-cm and maintain stable tuning after more than 107 bipolar voltage cycles. Their hysteretic and non-volatile optical states also indicate potential for low-power modulation and multi-state photonic memory. This work provides a versatile route for combining functional-oxide optimization with hybrid photonic integration



Maël LAUPRETRE
Symposium N

Symposium N: Tamm Plasmon Lasers Enabled by Metal-DBR Material Engineering

Maël Laupretre, Institut Lumière Matière (ILM), Lyon 1 Claude Bernard University, Lyon, France

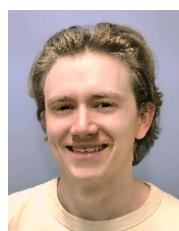
Semiconductor lasers are at the heart of many modern technologies, from telecommunications to sensing and information processing. However, in conventional laser architectures, the optical cavity is often defined by the semiconductor structure itself, limiting the flexibility for tailoring the spatial and spectral properties of the emitted light. Tamm laser diodes provide an

attractive alternative by shifting the control of the optical mode from the semiconductor cavity to a patterned metallic layer.

My research focuses on a new type of semiconductor laser diode based on a surface-confined Tamm optical mode. Tamm modes are electromagnetic states localized at the interface between a distributed Bragg reflector (DBR) and a metallic layer. A key feature of these modes is that optical confinement can be achieved through the lateral structuring of the metallic layer, enabling both efficient mode confinement and the realization of complex laser geometries while leaving the underlying DBR completely unmodified.

A first major objective of my work has been to demonstrate electrical injection in these devices and to achieve laser emission under electrical excitation. This is a key milestone toward the practical use of Tamm lasers in real-world applications. We recently demonstrated an electrically injected Tamm laser based on a silver microdisk integrated on a GaAs/AlAs DBR containing InGaAs quantum wells. The metallic microdisk simultaneously acts as an electrical contact and as an optical confinement element, enabling laser operation through a simple device architecture.

Building on this achievement, my current research aims to exploit the unique flexibility offered by Tamm mode cavities. In particular, we are investigating more complex cavity geometries, including metasurface-inspired metallic structures, to precisely control the polarization of the emitted light. We are also exploring networks of coupled Tamm lasers, whose collective dynamics could enable advanced functionalities such as beam steering or photonic neural networks. These developments open new perspectives for the next generation of compact and highly versatile semiconductor light sources.



**Enzo
ROLANDO**
Symposium N

Symposium N: Development of an on-demand laser process for manufacturing biosensors: Application to electrophysiology

Enzo Rolando, Aix-Marseille University, France

Enzo Rolando is a PhD candidate in materials engineering at Aix-Marseille University and CNRS (LP3, Marseille), working at the interface between ultrafast laser processing and bioelectronics. His doctoral research aims to rethink how microelectrode arrays (MEAs) and related neural interfaces are manufactured, shifting from conventional multi-step clean

room microfabrication to more agile, laser-based processes. Building on a background in physics and laser microfabrication, he has progressively specialised in conducting polymers and electrophysiology to bridge optical fabrication tools with functional neural recording devices.

The work recognised by the EMRS Young Researcher Award presents the first proof-of-concept of a generic all-laser microfabrication platform for bioelectronics. The setup combines dual-wavelength IR/UV femto-second laser beams with scanner-based optics and in-situ microscopy, enabling both subtractive patterning and additive laser-induced forward transfer (LIFT) of functional materials on the same stage and over a large working area of 50 x 50 mm². This “microfactory” concept allows cleanroom-free patterning of metal–polymer stacks, on-demand definition of high-density MEA layouts, and local post-processing steps such as site opening, remetalisation, or selective functionalisation.

Using this platform, Enzo has designed and fabricated PEDOT:PSS-based MEA sensors with 30 µm diameter recording sites at 25 electrodes/mm², followed by systematic electrochemical characterisation and neuronal culture tests. Beyond this first application, the same approach is being extended towards flexible sensors and other neural interfaces, with ongoing work consolidating these results into forthcoming journal publications



**Anjali
JAYACHANDRAN**
Symposium O

Symposium O: A Phenomenological Symmetry Rule for Chemical Reactivity under VSC

Anjali Jayachandran, Institut de science et d'ingénierie supramoléculaires, University of Strasbourg

My research focuses on how chemical reactions can be fundamentally modified by coupling molecular vibrations to confined electromagnetic fields. I work in the emerging field of vibrational strong coupling (VSC), where molecules interact with the quantum fluctuations of light confined within an optical resonator, forming hybrid light–matter states.

By combining experimental results with group-theoretical analysis, we identified, for the first time, a symmetry rule governing chemical reactivity under VSC. This rule provides a framework for predicting whether a chemical reaction will be enhanced or suppressed under vibrational strong coupling, offering a unified explanation for observations that were previously difficult to rationalise.

Our work establishes a connection between the symmetry of vibrational modes, the molecular point group, the reaction coordinate, and the cavity electromagnetic resonance. This insight opens new opportunities to control chemical reactions in a non-invasive manner. As a result, the field is attracting growing interest from industry because of its potential impact on catalysis, materials science, and sustainable chemistry.

In the long term, I hope my research will contribute to redefining how we control matter with light, enabling more selective, efficient, and energy-conscious chemical processes.



**Rana
LOMLU**
Symposium O

Symposium O: Unlocking Highly Tunable Energy Transfer with Strong Light-Matter Coupling

Rana Lomlu, Cornell University

Hybridization of light and matter via strong coupling results in the formation of new states called polaritons. Inheriting characteristics of both light and matter, polaritons offer unique pathways to modify material properties non-synthetically. One illustration of this is their robustly demonstrated ability to enhance the energy transfer radius from nanometre to micrometre scales in donor-acceptor systems when both species are coupled to a

common photonic mode. This type of energy transfer is critical for devices like organic photovoltaic cells and OLEDs, and having rational control over the process is essential for improving their efficiencies. However, highly constrained microcavity designs are hindering the extraction of mechanistic understanding of polariton-enhanced energy transfer.

In our work, we break free of these design constraints by only strongly coupling the donor to the photonic mode, and we demonstrate highly tuneable energy transfer from donor polaritons to weakly coupled acceptors through photoluminescence quenching experiments. Using this platform, we systematically explore the effects on energy transfer of design parameters such as donor-acceptor ratio, light-matter coupling strength, and spectral overlap. Next, we turn to time-resolved measurements to study the effects on the energy transfer dynamics, where it has proved challenging in the past to identify significant changes to bulk photochemical dynamics. Our measurements reveal that polaritons are redirecting the dynamics of the full ensemble of coupled molecules in the presence of weakly-coupled acceptors. Rate modelling uncovers an

effective polaritonic energy transfer rate that is orders-of-magnitude faster than the rate in bare films, and it suggests that the rapid energy transfer from highly delocalized polaritons is limited by competition with localization onto molecular sites. Overall, with this approach, we gain insights into achieving polaritonic modification of molecular photochemistry and identify the knobs that can be turned to control polaritonic effects.

***Co-authors:** Kelly Leiby and Andrew J. Musser, Cornell University



**Mattia
FAUSTI**
Symposium P

Symposium P: Bimetallic Ir-Eu Complexes for Electrochemically-Sensitized Circularly Polarized Luminescence*

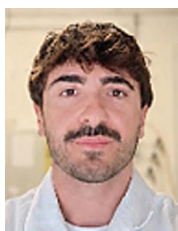
Mattia Fausti, Institut de Physique et Chimie des Matériaux de Strasbourg (IPCMS)

During my PhD studies at the Institut de Physique et de Chimie des Matériaux (IPCMS) in Strasbourg, I am developing new molecular materials that combine electrochemistry and chiral light emission for future sensing and imaging applications. Many molecules found in nature are chiral, meaning they exist as two

mirror-image forms that cannot be superimposed. Distinguishing between these forms is crucial in areas ranging from biology and medicine to materials science. Circularly polarized luminescence (CPL) is a powerful technique that exploits chirality by detecting the polarization of emitted light. Electrochemiluminescence (ECL), on the other hand, generates light through electrochemical reactions without requiring external illumination, offering high sensitivity and low background signals.

My research aims to merge these two approaches into a new concept: electrochemically sensitized circularly polarized luminescence (ECS-CPL). To achieve this goal, we designed innovative heterobimetallic complexes containing iridium and europium. In these systems, iridium acts as the electrochemically active center, while europium is responsible for circularly polarized emission. By connecting both metals within the same molecular architecture, we can independently optimize their electrochemical and optical properties while promoting efficient energy transfer. Our first results demonstrate strong circularly polarized emission and efficient iridium-to-europium energy transfer. Preliminary experiments further indicate that electrochemical excitation can successfully activate the europium emissive state, providing the first validation of the ECS-CPL concept. These new materials could enable future applications in chiral biosensing, bioimaging, and advanced optoelectronic devices.

***Alternative title:** Bridging Electrochemiluminescence and Circularly Polarized Luminescence with Iridium–Europium Complexes



**Giuseppe
PROIETTO
SALANITRI**
Symposium Q

Symposium Q: Visual Saturation-Responsive Thiol–Porphyrin Cryogels for Mercury Removal in Water Treatment*

Giuseppe Proietto Salanitri, University of Bologna

Water contamination by heavy metals remains a critical global challenge. Among toxic pollutants, mercury (Hg) stands out for its severe health and environmental impacts, making efficient and selective removal of Hg from water a pressing need.

This work presents a macroporous cryogel designed to address this challenge through

an innovative dual-function approach: high-performance adsorption combined with real-time, naked-eye sensing. The material is based on a methacrylic acid (MAA) network, post-synthetically functionalized in the solid state with thiol (–SH) groups as high-affinity Hg(II) binding sites. A small amount of a synthetically tailored porphyrin-acrylate monomer (0.25 wt%) is covalently embedded as an optical probe, enabling a visible colour response without compromising adsorption efficiency.

The interconnected macroporous architecture (pore size: 3–23 μm) ensures rapid water diffusion and full accessibility of active sites. Within this framework, thiol groups and porphyrin units act synergistically: mercury ions bind preferentially to thiols, while the porphyrin coordinates the metal only as the primary sites approach saturation, triggering a clear, reversible colour change from red to green that signals the material's saturation state without the need for external instruments.

Performance results are outstanding: a maximum adsorption capacity exceeding 1200 mg of Hg(II) per gram of material, selectivity above 95% in competitive ion mixtures, stability over multiple adsorption-regeneration cycles, and consistent efficiency across a broad pH range.

Beyond material design, the system is integrated into a proof-of-concept continuous industrial flow setup in which an AI-based camera monitors colour transitions in real time and automatically stops the flow as saturation approaches, assisting the operator with process control and regeneration timing. This work demonstrates that cryogel adsorbents can act not only as passive purification media but as a versatile platform for self-monitoring water treatment technologies.

*For further details, readers are referred to the full study: G. Proietto Salanitri et al., *European Polymer Journal*, 233 (2025), 113982, DOI: 10.1016/j.eurpolymj.2025.113982.



**Jingyi
SHAN**
Symposium Q

Symposium Q: Photosensitization-Controlled Dynamic Organic Room-Temperature Phosphorescence*

Jingyi Shan, State Key Laboratory of Flexible Electronics (LoFE), Northwestern Polytechnical University

Dynamic organic room temperature phosphorescence (RTP) materials are promising for intelligent optoelectronics due to their reversibly tunable luminescence. However, in most reported systems, chromophores serve as both phosphorescent emitters and

oxygen sensitizers, causing uncontrollable dynamic processes and reduced phosphorescence performance. Herein, we present a strategy for achieving controllable dynamic RTP and maintaining the phosphorescent performance by integrating triplet photosensitisers into the RTP polymer. Specifically, by tuning the photosensitizer concentration, the photoactivation time could be precisely controlled from 3 to 30 seconds. After photoactivation, the phosphorescence lifetime increased from 558 to 1017 ms, exceeding that of polymers without a photosensitizer. The strategy was further validated through copolymerization, physical doping, and different photosensitisers. This work advances the development of controllable dynamic RTP polymers for intelligent optoelectronics.

***Co-Author:** Prof. Long Gu



Emma PAPPAS
Symposium R

Symposium R: Chiral Domains Induced by Structural Phase Transition in CsCuCl₃ **Emma Pappas**, University of Illinois Urbana-Champaign, USA

The rapidly growing interest in chiral inorganic materials motivates me and my collaborators to find new ways to control and characterize chirality. My research aims to understand and manipulate the mechanisms leading to the formation of chiral domains so that we may verify their practical applications and the new phenomena they can host. To induce and control

chiral domains, we propose to use chiral/achiral phase transitions with minimal atomic rearrangement. We employ a wide range of methods to synthesize material candidates and to reveal the impact of phase transitions on chirality. We explore multiple *in-situ* measurements that can spatially map chirality to establish which ones are the most reliable and versatile when faced with various sample constraints.

I had the pleasure of presenting our recent work on CsCuCl₃ at the E-MRS 2026 Spring meeting. We selected CsCuCl₃ as a model polymorphic compound to drive and observe chiral domain formation. To better understand the material's phase transition, we examined its local structure using *in-situ* pair distribution function analysis. Our work confirmed that the high temperature structure of CsCuCl₃ is Jahn-Teller distorted and revealed short range order of approximately 9 Å. To investigate the impact of the phase transition on the material's handedness, we performed *in-situ* single crystal x-ray diffraction experiments. We found that the transition induces domains of mixed handedness in originally homochiral crystals, highlighting the potential use of phase transitions to control chiral domains. Further investigations using resonant circularly polarized x-ray diffraction to map the chirality of CsCuCl₃ *in-situ* are underway.



Harshita RAI
Symposium S

Symposium S: Single-Atom Substitution in Keplerate Polyoxometalates for Reservoir-Dynamics Engineering in Physical Reservoir Computing†

Harshita Rai,* Kyushu Institute of Technology, Kitakyushu, Japan

Artificial intelligence is advancing rapidly, but conventional hardware struggles to keep pace with the complexity of algorithms. Physical reservoir computing (PRC) offers an elegant alternative by shifting the computational burden away from algorithms and directly into the

intrinsic nonlinear dynamics and short-term memory of materials. However, a major bottleneck has historically held the field back: the lack of clear design principles for systematically tuning a material's memory, stability, and nonlinearity without overhauling the entire device architecture.

My research tackles this challenge directly by establishing a new, materials-driven "tuning knob" for computation: a single-atom substitution within Keplerate polyoxometalate clusters. To build a bridge between molecular chemistry and neuromorphic function, we synthesized two structurally analogous Keplerate systems, Mo₇₂V₃₀ and W₇₂V₃₀. By altering just a single central atom (Mo versus W) while preserving the overall cluster framework, we introduced a reproducible chemical control parameter. This minimal, highly deliberate atomic modification translates directly into measurable differences in how

the device processes information. When driven by time-varying electrical inputs, the Mo₇₂V₃₀-based reservoir demonstrated remarkable waveform-processing capabilities. By relying on a simple linear readout trained on the material's native response, the system achieved very high reconstruction accuracy. This computational richness stems from the Keplertes' multilevel redox activity and coupled electronic/ionic polarization, which jointly provide accessible short-term memory and nonlinear transformation. Ultimately, by proving that an atomically defined change can dynamically retune a material's computational power, this work moves the field of neuromorphic hardware away from empirical trial-and-error and toward rational, chemically programmable materials engineering.

†Alternative title:

Tuning the "Brain" of a Material: A Single-Atom Approach to Neuromorphic Computing.

***Full author list:**

Harshita Rai^{1,*}, Kshitij RB Singh^{1,2}, Muzhen Xu², Yuki Usami^{1,2}, Hirofumi Tanaka^{1,2}, Shyam S. Pandey^{1,2}

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² Research Center for Neuromorphic AI Hardware, Kyushu Institute of Technology, Kitakyushu, Japan.



Yingxin LI
Symposium S

Symposium S: Impact of La doping on the filament stability and noise characteristics of HfO₂-based RRAM revealed through a comparative study

Yingxin Li,*Advanced Thin Film Technology, Institute of Materials Science, Technische Universität Darmstadt, Germany

HfO₂-based resistive random-access memory (RRAM) devices have attracted significant attention as a next-generation memory technology. In particular, La-doped devices exhibit gradual switching and capability of

linear conductance modulation, making them promising candidates for neuromorphic computing. However, low-frequency noise (LFN) remains a major challenge, as it degrades readout accuracy. At the same time, it can serve as a valuable probe of defect dynamics and conductive filament evolution.

In this work, the impact of La doping on noise characteristics is investigated through a comparative study. The improved signal uniformity and narrowing of the read current distribution observed in La-doped devices indicate enhanced filament stability and readout reliability. Also, distinct resistance-dependent noise scaling behaviours are observed in undoped and La-doped devices, revealing a strong correlation between noise characteristics and filament configurations. In undoped devices, complete filament rupture creates a higher density of active traps within the gap, resulting in increased noise level, while trap redistribution at higher resistance states suppresses noise, consistent with time-domain signals. In contrast, the incomplete rupture of filaments in La:HfO₂ devices leads to an early saturation of normalized noise due to filament depletion. Complemented by the investigation of the low-resistance state (LRS), these results establish a resistance–noise scaling framework spanning a wide resistance range.

Furthermore, a systematic noise suppression during DC cycling occurs in both the high resistance state (HRS) and LRS for undoped HfO₂ devices. This behaviour is attributed to the continuous incorporation of oxygen vacancies into the conductive filament. In contrast, La:HfO₂

devices exhibit markedly different noise evolution. In the HRS, both noise magnitude and resistance remain stable over hundreds of cycles, indicating reduced cycle-to-cycle variability and enhanced filament stability. In the LRS, the presence of La atoms acts as preferential accumulation sites for oxygen vacancies and modulates the active fluctuator number, leading to a great cycle-to-cycle variance.

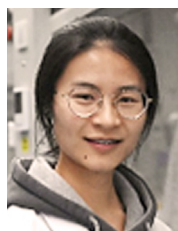
This study highlights the critical role of defect engineering in controlling noise characteristics and enhancing the performance of RRAM devices. By establishing clear correlations between noise evolution and resistance states as well as DC cycling, it provides a robust framework for noise tailoring in HfO_2 -based systems. Moreover, it demonstrates that low-frequency noise measurements are not only diagnostic but also a powerful tool for probing device physics and guiding the design of reliable, noise-aware neuromorphic hardware.

Full author list:

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**Kan
LIU**
Symposium T

Symposium T: “Stick-and-Tear”: Monolayer Coatings Directly from Unpurified Suspensions Kan Liu, Department of Materials Science and Engineering, Westlake University

Two-dimensional (2D) monolayer coatings are model systems and essential platforms for diverse applications. Most 2D materials are produced by solution exfoliation, yielding crude suspensions with ionic impurities and heterogeneous structures. However, high-purity single-layer dispersions are non-negotiable prerequisites for conventional coating methods,

which require extensive exfoliation and purification—a challenge particularly acute for high-aspect-ratio sheets. We introduce a “stick-and-tear” method that directly fabricates uniform monolayer coatings from crude, unpurified suspensions. Compliant species (monolayers, few-layer sheets, loose aggregates) stick, while gentle sonication tears away excess layers and wrinkles, leaving dense, contaminant-free monolayers with near-complete coverage. The method exhibits remarkable robustness, achieving >90% coverage over wide ranges of graphene oxide (GO) concentration (>0.5 mg/mL), pH (2–8), and salt levels exceeding typical synthesis maxima. Monolayer coatings are also demonstrated on SiO_2/Si , glass, indium tin oxide (ITO)/glass, and curved metal surfaces. The material-agnostic nature is further validated by producing dense monolayers of MXene and vermiculite directly from their crude suspensions. As proof-of-concept, such precise GO monolayer serves as an effective hole-transport layer on ITO for high-performance organic photovoltaics. This work leverages inherent mechanical contrasts in 2D materials to establish a rapid, scalable route to precise monolayer coatings, circumventing purification and exfoliation bottlenecks and enabling functional devices from diverse colloidal 2D materials.



**Ángel
LABORDET
ÁLVAREZ**
Symposium T

Symposium T: Raman fingerprints of inter-ribbon coupling in atomically precise graphene nanoribbon arrays

Ángel Labordet Álvarez, EMPA – Swiss Federal Laboratories for Materials Science and Technology

Atomically precise graphene nanoribbons are one-dimensional semiconductors whose properties are determined by their width, edge structure, and local environment. My work focuses on 9-atom-wide armchair graphene nanoribbons (9-AGNRs), using Raman and photoluminescence spectroscopy

to understand how densely packed nanoribbon arrays behave when neighbouring ribbons are no longer independent.

At the E-MRS Spring Meeting 2026, I presented temperature-dependent Raman measurements of aligned 9-AGNR arrays grown on vicinal Au(788). By comparing low- and high-coverage samples, the inter-ribbon spacing could be used as the main experimental variable. Low-coverage arrays follow the expected behaviour: Raman linewidths broaden with temperature due to phonon–phonon scattering. In contrast, high-coverage aligned arrays show an unusual non-monotonic, U-shaped linewidth dependence, where several Raman modes first become narrower upon heating and then broaden again at higher temperature.

This behaviour is accompanied by changes in Raman peak shape, including a high-frequency asymmetry at low temperature, and by a reduction of the radial-breathing-like-mode intensity relative to the graphite (G) band. Together, these observations suggest that dense arrays cannot be treated as isolated ribbons. Instead, they point towards inter-ribbon coupling, possibly involving a Davydov-like splitting of a resonant electronic excitation. In this picture, two weakly split Raman scattering pathways may contribute at low temperature, while temperature-dependent changes in resonance conditions can progressively hide the weaker partner.

Photoluminescence measurements provide a complementary optical signature: the emission response changes with lateral coverage and inter-ribbon distance, suggesting that dense packing modifies not only the vibrational response but also the electronic structure of the GNR array. The broader message is that inter-ribbon spacing is not just a structural parameter. It can act as an additional design knob for tuning the optical and vibrational response of graphene nanoribbon arrays, with potential relevance for future nanoribbon-based optoelectronic and sensing devices.



**Asmaa
KHALIL**
Symposium U

Symposium U: Carbon Quantum Dots as Nanodrug Delivery Systems for Nose-to-Brain Drug Delivery

Asmaa Khalil, Institut d'électronique de microélectronique et de nanotechnologie (IEMN), Université de Lille, France

Neurodegenerative diseases (NDDs) represent a growing global health challenge, motivating the development of advanced nanomaterials for enhanced brain drug delivery. Our research focuses on engineering nanomaterials that enhance the transport of therapeutic agents to the brain, especially where the biological barriers limit treatment efficiency.

We investigate carbon quantum dots (CQDs) as multifunctional nanocarriers to enhance nose-to-brain delivery. The intranasal route offers a promising, minimally invasive alternative to systemic administration by exploiting the direct anatomical connection between the nasal cavity and the brain and overcoming the blood-brain barrier (BBB). By engineering CQDs with controlled physicochemical properties, including size, surface charge, functionalization, and chirality, we aim to optimize their interactions with biological interfaces and enhance their transport across the nasal epithelial barrier. This is being achieved by investigating a human *in-vitro* nasal epithelial barrier model developed on a Transwell system and performing mechanistic studies to understand transport pathways across nasal epithelia as well as a preclinical human BBB model.

Furthermore, we investigate the combination of CQDs with platelet-pellet lysate (PPL) and platelet-derived extracellular vesicles (pEVs), which have shown promising neuroprotective and regenerative properties. Using both an *in-vitro* human nasal model and *in-vivo* mice models, we evaluate how CQDs can enhance the intranasal permeability of these biotherapeutic agents as well as their delivery to the brain.

By integrating materials science, nanotechnology, and biomedical engineering, our research helps in the development of advanced nanomedicine approaches for NDDs by overcoming main challenges in brain drug delivery.



**Sara
PANDOLFI**
Symposium U

Symposium U: Direct SERS Probing of Aptamer Conformation on Silver Colloids

Sara Pandolfi, Industrial Chemistry department, University of Bologna

Aptamers are short single-stranded nucleic acids capable of adopting complex three-dimensional structures that govern their properties and interactions. While surface-enhanced Raman scattering (SERS) is widely employed in aptamer-based biosensors for target detection, its potential as a direct tool for probing aptamer structure remains largely unexplored.

In this work, we investigated whether direct SERS can distinguish different conformational states of a model 34-nucleotide thiolated aptamer adsorbed on silver colloids. Two structural forms of the same sequence were generated through controlled thermal treatments: an extended conformation obtained by rapid cooling after denaturation and a folded hairpin-like conformation produced by slow cooling.

To explore the role of nanoparticle surface chemistry in the spectroscopic response, three silver colloids with distinct surface chemistries were employed. The results revealed that the measured SERS fingerprint depends not only on the intrinsic folding state of the aptamer but also on the nature of the nanoparticle interface. Positively charged silver colloids synthesized in the presence of spermine enabled a clear spectroscopic discrimination between folded and unfolded conformations. By contrast, negatively charged colloids promoted surface-induced rearrangements of the adsorbed DNA, reducing the spectral differences associated with folding.

These findings demonstrate that direct SERS can provide valuable structural information on nucleic acids and highlight the crucial role of nanoparticle surface chemistry in determining the observed spectroscopic response. The work contributes to a deeper

understanding of biomolecule–nanomaterial interactions and may support the future development of SERS-based strategies for the structural characterization of nucleic acids and aptamer systems.



**Estela
BOCARANDO
SALCIDO**
Symposium V

Symposium V: Direct Laser Writing of Nanocomposites: Combining Pigmentary and Structural Colouration

Estela Bocarando Salcido, Trinity College Dublin, Ireland

My research is inspired by the sophisticated ways nature interacts with light. Biological systems use nanoscale structures to control colour, communication, camouflage, and thermal regulation. These effects arise from pigment absorption and structural colour generated through periodic nanoscale architectures, providing a blueprint for

the design of advanced photonic materials with tailored optical properties. Such systems have motivated the development of bio-based hierarchical materials, particularly core-shell nanoparticles that combine complementary optical functionalities including photon upconversion, plasmonic enhancement, and improved colour saturation with chromatic stability.

My research explores a library of colloidal core-shell nanoparticles as a platform for generating hybrid optical behaviour within ordered nanocomposite structures. Silica nanoparticles serve as a versatile and highly controllable scaffold owing to their well-established synthesis and self-assembly characteristics. By integrating plasmonic and pigmentary components, these nanoparticles can be used to combine structural colour with absorption and localized surface plasmon resonance effects, enabling multiple optical responses to be engineered within a single nanocomposite material.

A key aspect of this work is the dual control of optical behaviour through nanoparticle design and spatial organisation. Structural colour can be tuned by varying silica core size, shell composition, and refractive index contrast, while pigments suppress incoherent scattering, and metallic nanoparticles introduce plasmonic resonances. These materials are incorporated into direct laser writing (DLW)-compatible photoresists and fabricated into three-dimensional microstructures using two-photon polymerisation (TPP). Beyond geometric freedom, TPP enables controlled variation of nanoparticle organisation through fabrication parameters, providing a reproducible route to tailoring optical responses using a single material formulation.

In the Delaney Lab, we have demonstrated that two-photon polymerisation can modulate interparticle spacing within ordered nanocomposites to generate structural colour across a broad colour gamut. Building on this work, supported by Research Ireland funding, I investigate the integration of multifunctional core-shell nanoparticles into self-assembled photonic architectures, producing narrowband, tuneable structural colour within micropatterned three-dimensional structures. Through optical spectroscopy and electron microscopy, these systems provide insight into the interplay between structural resonances, absorption, and plasmonic enhancement, offering new strategies for the design of advanced photonic materials with programmable optical functionality.



**Bharti
RANA**
Symposium W

Symposium W: Synergistic ZnSnO₃/Na-FHT Hybrid Nanostructures for High-Performance Thermoplastic Polyurethane Composites

Bharti Rana, Indian Institute of Technology (IIT), Delhi

Developing multifunctional films that provide high gas barrier performance, UV protection, and suppressed photocatalysis is highly important for inflatable structures. ZnSnO₃ exhibits a broad UV absorption spectrum. It is chemically more stable than binary metal oxides and has attracted considerable interest

in recent times owing to its distinctive characteristics. However, it may undergo photocatalysis. On the other hand, 2D clays may suppress photocatalysis and offer superior gas barrier properties. Thus, the target was to fabricate a hybrid material to enhance its effectiveness against environmental weathering.

This study presents the preparation of a novel inorganic-organic hybrid filler by immobilizing silane-treated zinc stannate nanostructures onto organo-modified Na-fluorohectorite clay. These hybrid fillers were added to the thermoplastic polyurethane (TPU) matrix to fabricate films, and the resultant films were exposed to artificial weathering for up to 500 hours. The helium gas barrier performance was significantly enhanced by 40%-65%. Field emission SEM micrographs confirmed the superior weathering resilience of hybrid-filled films, which exhibited minimal surface cracking, in contrast to the significantly degraded surface of the neat TPU film. Thus, this strategy demonstrated synergistic effects, including enhanced gas barrier properties, retention of tensile strength, thermal properties, and UV protection performance post-weathering.



**Sanjoy
SUR ROY**
Symposium W

Symposium W: Development of Green Electromagnetic Interference Shields

Sanjoy Sur Roy, Prime Minister Research Fellow, Department of Physics, Indian Institute of Technology Guwahati, India

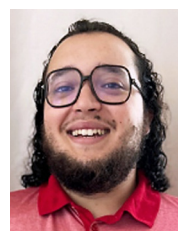
Electromagnetic interference (EMI) adversely impacts the performance of electronic devices and poses health risks. Industrial regulations guide the permitted level of emissions and shielding requirements. Current EMI shields are based on metals, and the weight penalty becomes severe as devices, chips, and systems

continue to shrink. More importantly, metals fulfil their shielding function by readily reflecting the incoming electromagnetic (EM) waves due to their high electrical conductivity and the resulting large impedance mismatch between the shield and free space. This leads to unintended secondary EM pollution, which is exacerbated due to the proliferation of electronics in modern society. Thus, absorption-dominant shields are preferred, characterized by a green index (GI) $\gg 1$, which is the ratio of absorption/reflection. Though graphene and MXenes have been explored to replace metals, they offer no relief for secondary pollution since they are highly conductive materials as well.

My work has focused on creating a shield with a conductivity gradient where the top layer features a lower conductivity aerogel of MXene nanoribbons in PEDOT:PSS* to promote absorption and a bottom layer of highly conductive MXene nanosheets in PEDOT:PSS. This shield provided a shielding effectiveness (SE) of 70 dB and a GI of 2.

Introduction of dual magnetic and conductivity gradients in the opposite direction with a Ni-MXene nanoribbons-PEDOT:PSS aerogel top layer on top of PEDOT:PSS and Ag nanowire film improved the performance to a phenomenal SE of 90 dB and average GI of 64 over the X-band. In addition to gradient-based EMI shields, my current research focuses on the development of transparent and green EMI shields based on meta structures. These engineered structures enable precise manipulation of electromagnetic waves while maintaining high optical transparency, making them attractive for applications in transparent electronics, smart windows, displays, and next-generation communication systems.

*Poly(3,4-ethylenedioxythiophene) mixed with polystyrene sulfonate.



**Ayoub
TRAVERSON**
Symposium X

Symposium X: How humidity alters blue ultramarine's chemistry in Henri Matisse's gouaches (Oral presentation), and Combined EPR, Raman and synchrotron XANES study of photo-induced processes in blue ultramarine gouaches in Henri Matisse cut-outs (Poster presentation)

Ayoub Traverson, CNRS, Université Paris-Saclay, ENS Paris-Saclay, PPSM

The last period of Henri Matisse's long career (1869–1954) is renowned for his “gouaches découpées” – shapes cut out from sheets of

paper uniformly painted with gouache, which he then arranged into compositions. His artworks, notably his masterpiece *La Tristesse du Roi* (1952), housed at the Centre Pompidou, raise conservation questions, particularly regarding colour stability. Modern gouaches are water-based paints composed of arabic gum, glycerine, pigments, and opacifiers. Understanding the chemical stability of paint layers based on synthetic blue ultramarine (Na₈Al₆Si₆O₂₄S₂) is especially important to preserve the gouaches of Matisse. While previous studies focused on the photo-induced fading of ultramarine in oil paint^[1,2], its alteration in water-based paints has never been investigated.

My research focuses on the physico-chemical processes induced by light and humidity in these composite systems. I compared artificially aged mock-up gouaches with historical samples, collected on artworks using a micro-sampling approach, developed to ensure minimal intervention while yielding sufficient material for chemical characterization. Synchrotron-based techniques, including X-ray absorption near edge spectroscopy (XANES, ID21 beamline, ESRF) and micro-X-ray powder diffraction mapping (XRPD, ID13, ESRF), provided evidence of a change in the sulphur speciation in the ultramarine pigment. In parallel, I conducted electron paramagnetic resonance (EPR) analysis under *in-situ* UV-visible irradiation at controlled wavelengths. This revealed a significant – but reversible – decrease in the concentration of sulphur radicals. This is likely due to the transfer of an unpaired electron, suggesting an indirect modification process in which the binder may have reacted with the unpaired electron.

These results provide new chemical insights into the stability of historical gouaches and will guide future strategies to conserve fragile masterpieces by Matisse.

^[1] R. de la Rie et al., *Polymer Degradation and Stability* (2017), 144, 43-52.

^[2] K. Schnetz et al., *Journal of Cultural Heritage* (2020), 45, 25-32