



Taishan Hotel  
Beijing, China

18-21 September, 2026

## Welcome Message from Chairs

On behalf of Organizing Committee, we warmly welcome you to the 2nd Symposium on Light Applicable Materials and Process (LAMP) and China-Russia-Brazil Seminar on Low-Carbon Energy (CRB-LCE) in Beijing, China.

The goal of LAMP is to exchange cutting-edge insights and ideas on recent advancements. We are confident that LAMP will provide a vibrant platform for fruitful scientific discussions and collaborations. In addition to the engaging academic exchange, attendees will have the opportunity to experience Beijing's rich 5,000-year cultural heritage, breathtaking landscapes, and renowned cuisine.

Finally, we hope to express our deepest thanks to all those who have contributed to making our LAMP another rousing success: our speakers, presenters, our colleagues, and our participants. We do hope you enjoy and benefit from your time with us.

Do have a very pleasant time in LAMP.

### Conference Chairs of LAMP

#### **Prof. Jia Hong Pan**

School of Resources, Environment and Materials  
Guangxi University, China



#### **Prof. Kai Zhang**

School of Energy Power and Mechanical Engineering  
North China Electric Power University, China





## Conference Programme

**Thursday, 17 September, 2026**

|             |                                                                    |
|-------------|--------------------------------------------------------------------|
| 12:00-24:00 | Check in the hotel. You do not need to register. We do not set it. |
|-------------|--------------------------------------------------------------------|

**Friday, 18 September, 2026**

Venue: Shangyi Hall (尚义厅), 2<sup>nd</sup> Floor, Taishan Hotel

| Session 1: Opening Ceremony.              |                                                                                                                                                                      | Chair: Jia Hong Pan |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 08:00-08:10                               | Welcome Talk<br><b>Jia Hong Pan</b><br>North China Electric Power University                                                                                         |                     |
| 08:10-08:40                               | The intermediate role of alkanes in the photocatalysed destruction of stearic acid on TiO <sub>2</sub> 'self-cleaning' films<br><b>Andrew Mills</b>                  |                     |
| 08:40-09:05                               | Heterostructured photoactive materials for photochemical solar energy conversion<br><b>Aleksei V. Emeline</b>                                                        |                     |
| 09:05-09:30                               | Photothermal Evaporation and Photocatalytic Degradation/removal of Microplastics Using Titanium Mesh Supported TiO <sub>2</sub> Nanotube Arrays<br><b>Shanhu Liu</b> |                     |
| 9:30-9:55                                 | Manipulating surface solvation of quantum dots for stable solar inks<br><b>Xintong Zhang</b>                                                                         |                     |
| 09:55-10:15 Coffee Break and Photography  |                                                                                                                                                                      |                     |
| Session 2: Solar Photo(electro)catalysts. |                                                                                                                                                                      | Chair: Shanhu Liu   |
| 10:15-10:40                               | Beyond the Ruddlesden–Popper Paradigm: Dion–Jacobson Perovskites as an Untapped Platform for Strong Light–Matter Coupling<br><b>Dmitry Shtarev</b>                   |                     |
| 10:40-11:05                               | Process Intensification Strategies for Efficient CO <sub>2</sub> Capture, Durable Green H <sub>2</sub> Production, and Enhanced Fuel Synthesis<br><b>Yongli Li</b>   |                     |
| 11:05-11:30                               | Exploration in photocatalyst and photocatalysis<br><b>Yohei Cho</b>                                                                                                  |                     |
| 11:30-11:55                               | From Local Structure to Active States: Regulating Electronic Structure and Reaction Pathways in Semiconductor Catalysis<br><b>Yanjie Wang</b>                        |                     |
| 11:55-12:20                               | The synergistic mechanism of ultrasound-enhanced photocatalysis for phthalate compounds degradation<br><b>Xinzhu Pang</b>                                            |                     |



|                                                                     |                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12:20-13:30 Lunch                                                   |                                                                                                                                                                                                                                                             |
| Session 3: Electrocatalysis for Fuel Generation. Chair: Yanjie Wang |                                                                                                                                                                                                                                                             |
| 13:30-13:55                                                         | Engineering oxide photoanodes beyond oxygen evolution<br><b>Fatwa Firdaus Abdi</b>                                                                                                                                                                          |
| 13:55-14:20                                                         | Sequence Matters: Treatment Order Tunes Surface Reconstruction in BiVO <sub>4</sub> Photoanodes for Efficient Water Oxidation and Selective Glycerol Conversion<br><b>Ferry Anggoro Ardy Nugroho</b>                                                        |
| 14:20-14:45                                                         | Embrapa Instrumentation: possibilities of partnership<br>Guest of Honor: <b>José Manoel Marconcini</b>                                                                                                                                                      |
| 14:45-15:10                                                         | New materials and strategies for photo(electro)chemical conversion of biomass residues into green H <sub>2</sub> and value-added chemicals<br><b>Antonio Otavio de Toledo Patrocinio</b>                                                                    |
| 15:10-15:25 Coffee Break                                            |                                                                                                                                                                                                                                                             |
| Session 4: New Material. Chair: Xintong Zhang                       |                                                                                                                                                                                                                                                             |
| 15:25-15:50                                                         | Towards CO <sub>2</sub> Reduction in Non-Aqueous Media: From Conventional Solvents to Supercritical CO <sub>2</sub><br><b>Caue Ribeiro de Oliveira</b>                                                                                                      |
| 15:50-16:15                                                         | Engineering Activity, Selectivity, and Stability of Electrocatalysts for CO <sub>2</sub> Conversion to HCOO <sup>-</sup> and CO<br><b>Osmando Ferreira Lopes</b>                                                                                            |
| 16:15-16:40                                                         | Metal Oxide Nanostructures for Photocatalysis<br><b>Jéssica Cristina de Almeida</b>                                                                                                                                                                         |
| 16:40-16:55                                                         | Proton-rich interfacial microenvironment engineering enables efficient and durable hydrogen evolution<br><b>Huan Zheng</b>                                                                                                                                  |
| 16:55-17:10                                                         | Reaction Performance of CH <sub>4</sub> , CO <sub>2</sub> and H <sub>2</sub> O Dissociation and Reforming Under Non-Equilibrium Plasma<br><b>Yiping Sun</b>                                                                                                 |
| 17:10-17:25                                                         | Photo-Enhanced Electronic Metal Support Interaction Boosts Low-Temperature Water-Gas Shift Reaction via Ni <sup>δ+</sup> -O <sub>v</sub> -Ce <sup>3+</sup> Interfacial Redox Cycling<br><b>Jie Tian</b>                                                     |
| 17:25-17:40                                                         | In situ exsolved M-Ru bimetallic sites with fine-tuned charge distribution for enhanced CO <sub>2</sub> /H <sub>2</sub> O co-electrolysis performance in La <sub>0.75</sub> Sr <sub>0.25</sub> CrO <sub>3-δ</sub> -based SOEC cathodes<br><b>Xinyu Wang</b> |
| 17:40-17:50                                                         | Closure Remark. Prof. Jia Hong Pan                                                                                                                                                                                                                          |
| Dinner xxxxx                                                        |                                                                                                                                                                                                                                                             |

**Saturday, 19 September, 2026**

|       |                                                               |
|-------|---------------------------------------------------------------|
| 08:30 | Meet at Lobby, and depart to Summer Palace. Lunch at PM 12:00 |
| 13:00 | Go to National Museum                                         |

**Sunday, 20 September, 2026**

|       |                                                                   |
|-------|-------------------------------------------------------------------|
| 08:00 | Meet at Lobby, and depart to Forbidden City and Temple of Heaven. |
|-------|-------------------------------------------------------------------|

**Note:** we have to go the Forbidden City early to avoid the crowds in the weekend.

## The intermediate role of alkanes in the photocatalysed destruction of stearic acid on TiO<sub>2</sub> ‘self-cleaning’ films

Ruicheng Zhou<sup>1</sup>, Christopher O’Rourke<sup>1</sup> and Andrew Mills<sup>1\*</sup>

<sup>1</sup> School of Chemistry and Chemical Engineering, Queens University Belfast, UK

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The results of a study of the photocatalysed oxidative mineralisation of stearic acid (SA), will be presented which show that the destruction of an overlying *solid* film of SA, and any *solid* fatty acid, on photocatalytic, self-cleaning glass in air, involves the initial, rapid generation of a thin, *liquid* alkane layer, which dissolves the SA and so provides it with a conduit to the photocatalytic surface and its subsequent complete oxidative mineralisation. These results, and the new, *liquid alkane intermediate* mechanism, solves a well-recognised, long-standing conundrum in photocatalysis regarding how a *solid* film of stearic acid is photomineralised by a thin, flat photocatalytic film. Although the focus of the work is on SA, the most studied test solid pollutant for self-cleaning photocatalytic materials, other work suggests this newly discovered, liquid alkane intermediate mechanism also holds for all other solid fatty acids. The results of this work will be of significant interest to the global photocatalyst community, which includes not only many research groups, but the billion-dollar, self-cleaning products industries they support and feed into.

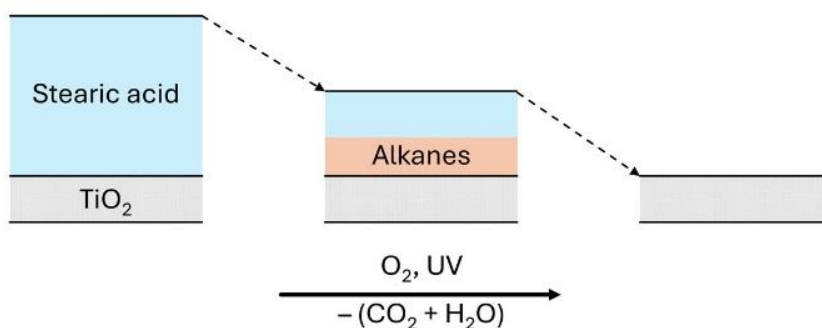


**Fig. 1.** Schematic illustrating the basic features of the liquid alkane intermediate mechanism that underpins the photocatalytic destruction of SA on self-cleaning glass.

### Biography



Andrew Mills is a Professor in the School of Chemistry and Chemical Engineering at Queens’s University Belfast, UK. He received his PhD in London University in 1983 and has since held Chairs in Swansea, Strathclyde and now Belfast University. He published over 360 peer-reviewed papers regarding photochemistry, photocatalysis, redox catalysis and optical sensors. Current research focuses on self-cleaning photocatalytic materials, 3D printed photocatalytic reactors and photocatalyst-based optical sensors.

## Heterostructured photoactive materials for photochemical solar energy conversion

A.V. Rudakova, T.V. Bakiev, A.V. Emeline\*

Department of Photonics, St. Petersburg State University, St. Petersburg, Russia

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Photochemical solar energy conversion is a potentially promising, nature-like technology for the development of alternative decentralized power systems. The target product of this conversion is so-called "solar fuel": either hydrogen as a product of water decomposition or organic products of carbon dioxide reduction (methane, methanol, formaldehyde, etc.). Other actively developing areas of solar energy conversion include technologies for creating self-cleaning functional coatings and heterogeneous photocatalysis. The main challenge in developing these technologies is the creation of photoactive materials capable of efficient conversion of visible light of the solar radiation spectrum (Fig. 1a).

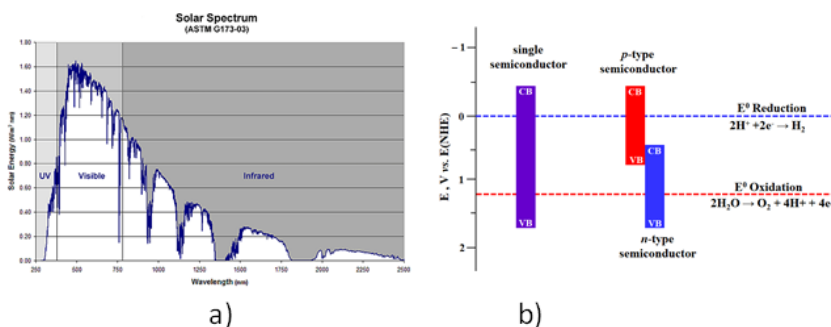


**Fig. 1.** a) Spectrum of solar radiation at the Earth's surface; b) energy diagram of the position of electron bands for a single-component ideal photocatalyst and a combination of narrow-bandgap semiconductors for an ideal two-component heterostructured photocatalyst.

One promising approach to solving this problem is the formation of heterostructured materials based on narrow band gap semiconductors that efficiently absorb visible light (Fig. 1b). This presentation will discuss: i) the basic kinetic and thermodynamic requirements for photoactive materials for efficient photochemical conversion of solar energy; ii) the fundamental principles of forming heterostructured photoactive materials; iii) the behaviour of heterostructured materials in various photochemical processes.

### Biography



A.V. Emeline is a Professor in Department of Photonics at Saint-Petersburg University. He received his PhD in Saint-Petersburg University in 1994. After a postdoctoral training at Concordia University (Canada) and KAST (Japan), he defended his D.Sc. degree and joined Saint-Petersburg University since 2011. He published over 150 peer-reviewed papers regarding semiconductor photochemistry and photophysics. Current research focuses on low dimensional halide perovskite luminescence and photoelectrochemical solar energy conversion.

## Photothermal Evaporation and Photocatalytic Degradation/removal of Microplastics Using Titanium Mesh Supported TiO<sub>2</sub> Nanotube Arrays

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Microplastics (MPs) in aquatic environments threaten ecosystems by disrupting marine life and habitat health. Herein, we report an integrated strategy that couples solar-driven photothermal evaporation with photocatalytic degradation of polyethylene (PE) microplastics using titanium mesh modified with anodically grown TiO<sub>2</sub> nanotube arrays (TMiP). TiO<sub>2</sub> nanotubes provide a high surface area for light absorption and catalytic activity, while the metallic mesh substrate ensures efficient heat conduction for localized water evaporation. Environmentally relevant PE fragments were dispersed in aqueous suspensions and exposed to simulated solar irradiation in the presence of TMiP. Photocatalytic experiments showed PE degradation efficiencies of 54.5–60%, depending on the initial concentration. Flow cytometry revealed a significant reduction in microplastic particle numbers, while SEM, FTIR, and GC–MS confirmed morphological changes, polymer chain scission, and the formation of hydrocarbon and oxygenated degradation products.

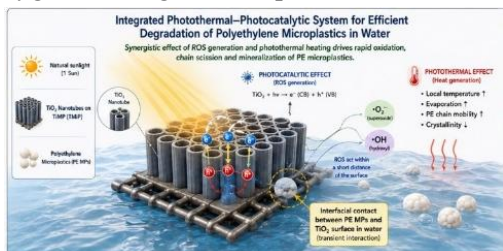


**Fig. 1.** Schematic illustration of integrated photothermal and photocatalytic degradation of PE-MPs over TMiP-TiO<sub>2</sub> nanotubes.

### References

1. C. Sijie, L. Shanhu, et al. *Advanced Functional Materials* (2025): 2423011.
2. R. Khalid, L. Shanhu, et al., *J. Mater. Chem. A* (2025) 13 (32): 26110–26128.
3. C. Sijie, L. Shanhu, et al. *Green Energy & Environment* (2026)
4. R. Khalid, L. Shanhu, et al., *Coordination Chemistry Reviews*, (2026), 218273.

### Biography



Liu Shanhu is a Professor and PhD Supervisor at the College of Chemistry and Molecular Sciences of Henan University and a Fellow of the Royal Society of Chemistry (FRSC). He received his PhD from Nanjing University and subsequently conducted research at the Kanagawa Academy of Science and Technology, as a JSPS Foreign Research Fellow, followed by an appointment as Guest Associate Professor at Tokyo University of Science, working under the supervision of Prof. Akira Fujishima. His research focuses on photo/electrothermal energy conversion, self-cleaning surfaces, and sustainable resource recovery. He has published over 150 peer-reviewed articles with a H-index of 56.

## Manipulating surface solvation of quantum dots for stable solar inks

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Lead sulfide (PbS) colloidal quantum dots (CQDs) are promising for solution-processed photovoltaics due to their size-tunable bandgap, ligand-modulated doping, and high chemical stability. Effective ligand engineering is critical for controlling electrical properties and surface solvation to produce stable CQD inks. While n-type PbS QD inks stabilized by halide ligands in polar solvents have been developed, their long-term stability is limited. Similarly, stabilizing p-type PbS CQDs with short-chain ligands remains a challenge, impeding efficient single-step deposition for heterojunction CQD solar cells. In this work, we introduce advanced ligand engineering strategies to achieve months-long shelf stability for both n-type and p-type PbS CQD inks. A butylamine vapor-solvation strategy is employed to prepare n-type PbS CQD inks in various polar solvents with stability over months, while a hydrogen-bonding solvation approach utilizing 2-mercaptoethanol (ME) ligands in DMSO enables highly stable p-type inks. By integrating these stable n-type and p-type inks, we fabricated PbS CQD solar cells with efficiencies exceeding 12%, advancing the development of high-performance, solution-processed CQD photovoltaic devices.

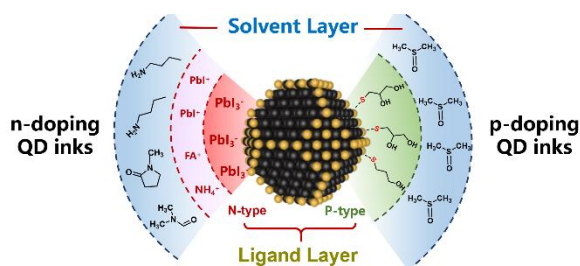


**Fig. 1.** Solvation modulation strategy for highly stable PbS QD solar inks.

## References

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2. C. Wang, X. Zhang et al., *Adv Mater.*, 2026, DOI: 10.1002/adma.74535.
3. X. Li, X. Zhang et al., *Nano Res*, 2026, 19, 94908957.

## Biography



**Xintong Zhang** works as a Full Professor at School of Physics, Northeast Normal University. He does research on Materials and Devices for Light Energy Utilization, such as semiconductor photocatalysis and photothermocatalysis, photoelectrochemistry, solution plasma chemistry, quantum dot solar cells, CZTSSe solar cells and dye-sensitized photoelectrochromic devices. He has published over 300 peer-reviewed articles with a H-factor of 63.

## Beyond the Ruddlesden–Popper Paradigm: Dion–Jacobson Perovskites as an Untapped Platform for Strong Light–Matter Coupling

Anna Shtareva<sup>1</sup>, Mikhail Balanov<sup>2</sup> and Dmitry Shtarev<sup>1\*</sup>

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Layered hybrid perovskites — natural quantum wells formed by alternating inorganic slabs and organic spacer layers — offer exciton binding energies far exceeding thermal energy at room temperature, giant oscillator strengths, and unprecedented chemical tunability. These features make them a unique material platform for room-temperature polaritonics, spin-optoelectronics, and coherent light sources. This talk traces the pathway from molecular design to functional devices, with a particular focus on the comparison between Ruddlesden–Popper (RP) and Dion–Jacobson (DJ) architectures.

We show how the structure of the organic spacer — its length, parity, and denticity — programs the crystal lattice, band structure, and exciton dynamics of the resulting hybrid crystals. Systematic studies of homologous diammonium series reveal an odd–even effect that switches the lattice between DJ and RP stackings, modulates the bandgap and octahedral tilting, and governs the balance between free-exciton and self-trapped exciton emission, including room-temperature free-exciton luminescence enabled by the rigid DJ-type lattice. Against this background, we analyze the current frontier of the field, where the overwhelming majority of polaritonic demonstrations — room-temperature polariton condensation, the onset of very-strong coupling, chiral polariton lasing, and spin-LEDs — rely on RP phases. We argue that the DJ family, with its reduced interlayer distance, enhanced dielectric confinement, and superior structural rigidity, remains a largely untapped resource whose potential for strong light–matter coupling and spin-dependent phenomena is only beginning to emerge. We conclude by discussing the remaining challenges — electrical injection, large-area homogeneity, and cavity integration — and show how rational spacer engineering positions the DJ family as a scalable material platform for polaritonic and spintronic devices. Bridging spacer chemistry with cavity and polariton physics, layered perovskites open a practical route toward next-generation optoelectronics rooted in strong light–matter interaction.

### Biography



Dmitry Shtarev is a Professor and Leading Researcher at the Laboratory of Crystallophotonics, St. Petersburg State University, Russia. He received his Doctor of Physical and Mathematical Sciences degree in 2022 from St. Petersburg State University and holds affiliations with Shenzhen MSU-BIT University (China) and the Far Eastern Federal University (Vladivostok, Russia). He has published over 90 scientific papers. His research interests span a broad area — from heterogeneous photocatalysis on fully inorganic semiconductors to hybrid halide

perovskites — with a current focus on the molecular engineering of Dion–Jacobson and Ruddlesden–Popper layered perovskites, the odd–even effect in diammonium spacers, room-temperature exciton dynamics, and their pathways to next-generation polaritonic and spintronic optoelectronics.

# Process Intensification Strategies for Efficient CO<sub>2</sub> Capture, Durable Green H<sub>2</sub> Production, and Enhanced Fuel Synthesis

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Power-to-Fuel provides a promising pathway for the production of sustainable synthetic fuels by integrating green H<sub>2</sub> with CO<sub>2</sub> utilization. In this context, process intensification of both CO<sub>2</sub> capture and green hydrogen production is essential for improving the efficiency and scalability of Power-to-Fuel systems.

For efficient CO<sub>2</sub> capture, a microreactor-based process intensification strategy is developed. The microchannel absorber achieves a mass transfer coefficient of 2.75 s<sup>-1</sup> and a CO<sub>2</sub> processing capacity of  $7.5 \times 10^{-6}$  kg/s per channel, approximately one order of magnitude higher than conventional single-channel devices. A parallelized scale-up strategy is proposed, enabling an estimated annual CO<sub>2</sub> capture capacity of 11.3 tons while maintaining a volumetric processing capacity approximately one order of magnitude higher than that of conventional equipment [1]. For green hydrogen production, electrolyzer performance is enhanced through flow-field and materials optimization. Ultra-large-area titanium bipolar plates and porous transport layers are designed to improve gas-liquid transport [2,3], while advanced coatings achieve a corrosion current density of  $\leq 0.4$   $\mu\text{A}/\text{cm}^2$  at 80 °C in acidic fluoride-containing electrolytes [4], demonstrating enhanced durability and scalability for large-scale green H<sub>2</sub> production. Together, these advances support the development of efficient and scalable Power-to-Fuel processes for synthetic fuel production.

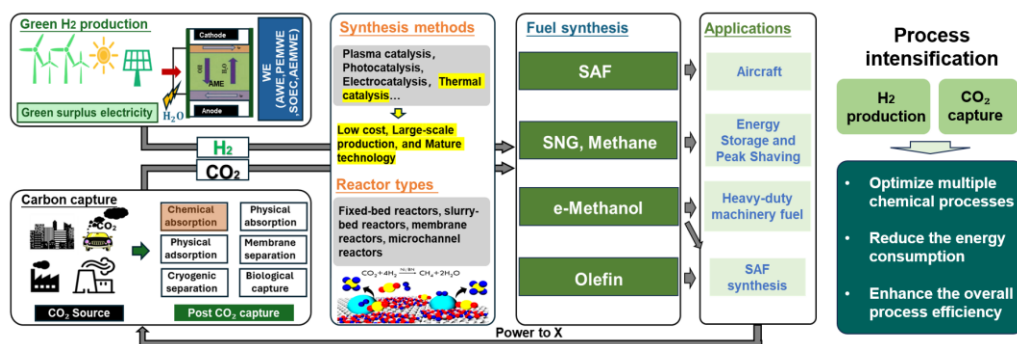


Fig. 1. Overview of the Power-to-Fuel process.

## References

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2. Li Y., et al. *Energy Technol.*, 2024, 12, 2301603.
3. Zhu Z., et al. *Small*, 2025, 21, 2411817.
4. Zhao H., et al. *Int. J. Hydrogen Energy*, 2026, 229, 154706.

## Exploration in photocatalyst and photocatalysis

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Exploration, often combined with machine learning, has accelerated materials discovery in fields including batteries, catalysis, and drug development. In this talk, I will discuss directions, scales, and system architectures based on our high-throughput studies. At the most automated end, closed-loop autonomous systems are expected to pursue research. Yet, in our screening of 200 candidates from a materials database, less than 10% showed notable photocatalytic activity. This low “hit ratio” can be explained by the strict requirements needed to show photocatalytic performance: both an effective light response (light absorption, charge separation, and carrier transport) and sufficient surface catalytic activity. Obtaining enough data for machine learning may therefore require on the order of  $10^3$  experiments, making fully autonomous exploration costly. At the other extreme, simple parallelization can speed up laboratory research. However, with only several data points, a machine cannot make predictions beyond human expectations. In my opinion, an interesting direction lies between these extremes: carefully selecting the measurements, improving the throughput of critical experiments, and expanding the materials space beyond specific hypotheses. In our studies, light intensity and reaction temperature were selected as high-throughput-compatible variables. By systematically changing them, we compared the balance between charge supply and interfacial transfer across many materials without a separate hypothesis for each material. Finally, reaction exploration, or photocatalysis exploration, offers another possibility. Changing the target reaction may uncover activity in materials inactive for one fixed reaction, reveal their characteristics, and connect photocatalyst discovery with useful reactions.

### References

1. Y. Cho\*, K. Yanagiyama, E. Sawade, et al. J. Mater. Chem. A, 2026, in press.
2. Y. Cho\*, O. Tagami, K. Yanagiyama, et al. ACS Environ. Au, 2026, 6, 134.
3. Y. Cho\*, K. Yanagiyama, P. Mukherjee, et al. J. Mater. Chem. A, 2025, 13, 16204.

### Biography



Dr. Yohei Cho is an Assistant Professor at the Institute of Science Tokyo. He received his Ph.D. in Materials Science and Engineering from Tokyo Institute of Technology in 2023 under the supervision of Prof. Masahiro Miyauchi and was a visiting student with Prof. James Durrant at Imperial College London. His research focuses on photocatalysis, photoelectrochemistry, and high-throughput experimentation.

## From Local Structure to Active States: Regulating Electronic Structure and Reaction Pathways in Semiconductor Catalysis

Yanjie Wang<sup>1\*</sup>

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Local atomic structures play an important role in determining the electronic properties and catalytic behavior of semiconductors. In this presentation, we will discuss our recent studies on how local coordination, defects, dopants, and interfacial interactions regulate charge distribution and reaction pathways. Using several representative systems, we show that subtle changes in local structure can strongly influence charge transfer, CO<sub>2</sub> activation, competing hydrogen evolution, and product selectivity. In situ characterization and theoretical calculations further reveal the relationship between local structure, electronic states, and catalytic active states. These results highlight the importance of understanding catalysts beyond their average crystal structures and provide insights into the rational design of semiconductor catalysts for CO<sub>2</sub> conversion.

### References

1. Y. Wang, M. Luo, Y. Li, H. Chen, W. Yin, S. C. E. Tsang, *Appl. Catal. A: Gen.* 2026, 720, 120977.
2. Y. Wang, H. Wang, L. Guo, T. He, *J. Colloid Interface Sci.* 2023, 648, 889–897.
3. D. Li, S. Hussain, Y. Wang, C. Huang, P. Li, M. Wang, T. He, *Appl. Catal. B: Environ.* 2021, 286, 119887.
4. M. B. Akbar, Y. Wang, X. Zhang, T. He, *J. Photochem. Photobiol. A Chem.* 2023, 437, 114483.

### Biography



Dr. Yanjie Wang is an Associate Professor at the National Center for Nanoscience and Technology, China, where she also received her Ph.D. in Physical Chemistry. From 2022 to 2024, she conducted postdoctoral research in the Department of Chemistry at the University of Oxford. Her current research focuses on the rational design of nanomaterials for sustainable energy conversion, with an emphasis on mechanistic studies using in situ techniques, theoretical calculations, and related approaches.

## The synergistic mechanism of ultrasound-enhanced photocatalysis for phthalate compounds degradation

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<sup>a</sup>, Department of Chemistry, School of Forensic Medicine, China Medical University, Shenyang, 110122, P.R. China

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Phthalate esters (PAEs) are ubiquitous environmental contaminants characterized by high environmental persistence and endocrine-disrupting activity. They pose risks to aquatic ecosystems and human health, thereby demanding efficient and advanced remediation technologies. Hybrid advanced oxidation processes (AOPs) integrating photocatalysis and acoustic cavitation have emerged as a promising strategy for PAE degradation. The underlying synergistic mechanisms of this coupled system, however, remain poorly understood, with inconsistent reports regarding the influences of contaminant hydrophobicity and operational parameters on treatment performance. We systematically investigated the synergistic effects for a suite of typical PAEs (DMP, DEP, DBP) under varying experimental conditions. This suite of compounds possesses similar chemical properties yet exhibits differences in physical characteristics. By exploring how physical properties and experimental conditions influence the synergy, we aim to provide mechanistic insights into the ultrasound-enhanced photocatalytic system. The findings will be of interest to researchers in photocatalysis and environmental remediation.

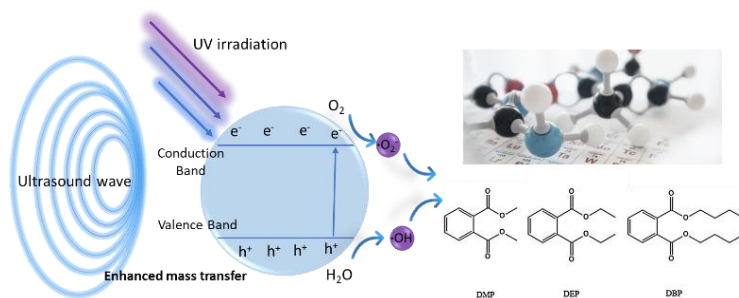


**Fig. 1.** Illustration of ultrasound-enhanced photocatalysis for phthalate compounds degradation.

### Biography



Dr. Xinzhu Pang is an associate professor at the School of Forensic Medicine, China Medical University. She received her PhD from Queen's University Belfast, UK, in 2022. She has authored over 10 peer-reviewed articles in photochemistry and environmental catalysis. Her current research focuses on photocatalysis, cavitation and machine learning for sustainable water remediation.

## Engineering oxide photoanodes beyond oxygen evolution

Fatwa F. Abdi<sup>1,\*</sup>

<sup>1</sup> School of Energy and Environment, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon, Hong Kong SAR, China

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Replacing water oxidation with alternative anodic oxidation reactions in photoelectrochemical (PEC) systems offers a powerful route to enhance the value of solar-driven fuel production.<sup>[1]</sup> By coupling H<sub>2</sub> evolution with selective oxidation of organics, PEC devices can convert low-value feedstocks into valuable chemicals. However, controlling reaction selectivity remains a central challenge. In this talk, I will present our recent work on understanding and steering selectivity in PEC oxidation reactions using oxide-based systems. Using glycerol oxidation as a model reaction, we show that electrolyte composition plays a critical role in governing reaction kinetics and product distribution, where ion-specific interactions and interfacial buffering strongly influence glycolaldehyde formation.<sup>[2]</sup> We further demonstrate that reaction selectivity can be tuned through light intensity (Fig. 1), which modulates surface hole accumulation and shifts reaction pathways from partial to deeper oxidation to formic acid via identifiable intermediates.<sup>[3]</sup> In parallel, interfacial engineering strategies, including heterojunction and doped overlayer design, enable suppression of non-selective radical pathways and improved control of C–C bond scission. Finally, extending these concepts beyond biomass-derived feedstocks, we demonstrate a coupled PEC–thermal approach for solar-driven upcycling of PET waste, where O<sub>2</sub> generated at the photoanode is utilized to selectively convert ethylene glycol into glycolic acid while simultaneously producing H<sub>2</sub>.

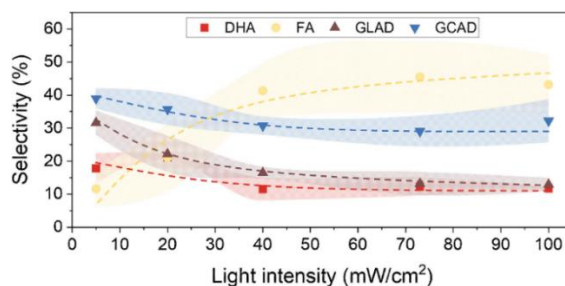


**Fig. 1.** Selectivity of PEC glycerol oxidation using BiVO<sub>4</sub> at various light intensities.<sup>[3]</sup>

## References

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## Biography



Fatwa F. Abdi is an Associate Professor in the School of Energy and Environment at City University of Hong Kong (CityUHK). He received his PhD (cum laude) in Chemical Engineering from Delft University of Technology, the Netherlands, and was awarded the Martinus van Marum Prize by the Royal Dutch Society of Sciences and Humanities. Prior to joining CityUHK in 2023, he spent a decade at Helmholtz-Zentrum Berlin, Germany, where he served as Group Leader and Deputy Director of the Institute for Solar Fuels. His research focuses on the development of materials, devices, and integrated systems for solar-to-chemical conversion.

## Sequence Matters: Treatment Order Tunes Surface Reconstruction in $\text{BiVO}_4$ Photoanodes for Efficient Water Oxidation and Selective Glycerol Conversion

Ferry Anggoro Ardy Nugroho,<sup>1,\*</sup> Yudhistira Tirtayasri Amrillah<sup>1</sup> and Fatwa F. Abdi<sup>2</sup>

<sup>1</sup> Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Depok 16454, Indonesia

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Surface treatments are widely used to improve  $\text{BiVO}_4$  photoanodes, but the role of treatment order remains largely unexplored. Here, we show that electrochemical reduction and alkali etching produce distinct surface reconstruction pathways when applied in opposite sequences. Reduction followed by etching (RE) generates a Bi-rich, oxygen-deficient surface with favorable facet redistribution, giving a 52% increase in photocurrent and an 81% increase in applied-bias photon-to-current efficiency relative to pristine  $\text{BiVO}_4$ . The same sequence also enhances selective glycerol oxidation toward dihydroxyacetone by 19%, whereas the reverse sequence favors glycolaldehyde. These results establish treatment sequence as a simple design parameter for tuning photoelectrode performance and selectivity.

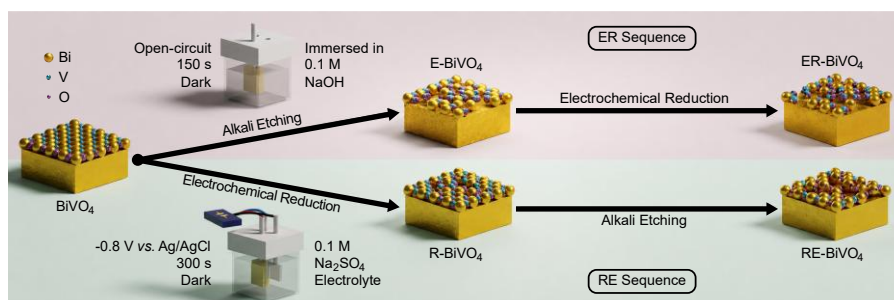


**Fig. 1.** A schematic of the different sequential treatments studied.

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## Biography



Ferry Nugroho is an Assistant Professor in Department of Physics, Universitas Indonesia. He received his PhD at Chalmers University of Technology in 2018. After a postdoctoral in Vrije Universiteit Amsterdam, he joined Universitas Indonesia in 2023. He has published >60 papers, predominantly on the topic of nanoplasmonics. His current research focuses on developing plasmonic hybrid materials for energy applications including photocatalysis and photoelectrochemistry.

## **Embrapa Instrumentation: possibilities of partnership**

José Manoel Marconcini<sup>1\*</sup>

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I will present about technologies developed at Embrapa Instrumentation and possibilities of partnership with Chinese institutions. Founded in 1984 in São Carlos (São Paulo state), Embrapa Instrumentation aims to produce innovations in instruments, sensors, methodologies, and materials that contribute to increased productivity and sustainability in agribusiness. It combines the expertise of physicists, chemists, and engineers (electronic, materials, and other exact sciences fields) with that of agronomists and veterinarians in a multidisciplinary approach, developing technological solutions grounded in scientific knowledge and rigor while remaining aligned with market needs. Embrapa Instrumentation's laboratory infrastructure is organized into three national multi-user facilities: the National Nanotechnology Laboratory for Agriculture (LNNA), the National Reference Laboratory for Precision Agriculture (Lanapre), and the National Agro-Photonics Laboratory (LANAF). This physical infrastructure and multi-user laboratory model enable partnerships with other Embrapa units, universities, national and international research institutions, government bodies, and private companies, fostering an innovation ecosystem that spans from basic science to startup creation and technology transfer to small, medium, and large enterprises. Since 2023, the center has operated as an Embrapa Unit named ItechAgro, currently managing contracted projects.

### **Biography**



José Manoel Marconcini is researcher and general head at Embrapa Instrumentation. He received his PhD in Federal University of São Carlos in 2005. Nowadays is researcher and general head of Embrapa Instrumentation. He published over 100 peer-reviewed papers regarding nanotechnology applied to agriculture. Current research focuses on solution blown spinning technique, nanonellulose, and polymer processing of biodegradable materials.

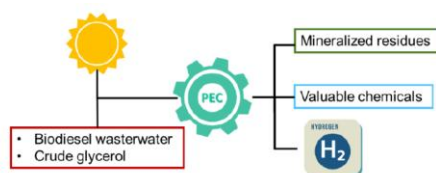
## New materials and strategies for photo(electro)chemical conversion of biomass residues into green H<sub>2</sub> and value-added chemicals

Antonio Otavio T. Patrocínio<sup>1\*</sup>, Lucas L. Nascimento<sup>1</sup>

<sup>1</sup>Laboratory of Photochemistry and Materials Science – LAFOT-CM, Institute of Chemistry, Federal University of Uberlandia.

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This talk will present new strategies for the development of materials and devices based on inorganic semiconductors for converting solar energy into fuel. The topic has great current relevance given the need to reduce the emission of greenhouse gases resulting from the use of fossil fuels. Solar energy presents itself as a more abundant and accessible renewable source, but it needs to be stored in the form of fuel for later distribution and use.



During the presentation, recent results from the development of nanostructured materials capable of promoting specific reactions in the presence of visible radiation will be presented. Particularly, the photoreforming of biomass derivatives to produce green H<sub>2</sub> and high value-added chemical inputs will be presented. Studies on the role of morphological and electronic properties of materials in process efficiency will be presented, along with challenges to be overcome for possible large-scale application.

### Biography



Antonio Otávio T. Patrocínio received his B.S. degree from the Universidade Federal de Ouro Preto, Brazil (2001) and his Ph.D. from Universidade de São Paulo, Brazil (2009) with a sandwich period at University of North Carolina at Chapel Hill (2008). He spent one year as a postdoctoral fellow at Universidade de São Paulo (2010) and in 2011 he moved to the Institute of Chemistry of Universidade Federal de Uberlândia, Brazil, where he works as Full Professor, head of the Laboratory of

Photochemistry and Materials Science and Coordinator of the Advanced Research Center in Energy Transition. In 2012, he was honored by the German Federal Ministry of Education and Research (BMBF) with the Green Talents Award for his research contributions in sustainable growth and renewable energy. Between 2016 and 2018 he visited the Institut für Technische Chemie of Gottfried Wilhelm Leibniz Universität Hannover as a Alexander von Humboldt research fellow. In 2020, he was awarded with the IUPAC/UNESCO Green Chemistry Research Grant. His research focuses on nanostructured metal oxide-based thin films and photochemical properties of coordination compounds for solar energy conversion into fuels.

## Towards CO<sub>2</sub> Reduction in Non-Aqueous Media: From Conventional Solvents to Supercritical CO<sub>2</sub>

Eduardo A. dos Reis,<sup>1</sup> Allef Leite<sup>1,2</sup> and Caue Ribeiro<sup>1,3,\*</sup>

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<sup>2</sup>Department of Chemical and Biomolecular Engineering, Lehigh University, Bethlehem, PA, USA

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Aqueous CO<sub>2</sub> electroreduction (CO<sub>2</sub>RR) is inherently limited by the low solubility of CO<sub>2</sub> and by competition from the hydrogen evolution reaction. Non-aqueous media remove this constraint and offer a continuum of proton-availability and density control, from dilute organic electrolytes to supercritical CO<sub>2</sub> (scCO<sub>2</sub>), that can be exploited to steer selectivity toward multicarbon (C<sub>2+</sub>) products. In aprotic acetonitrile, Pb plate cathodes reduce CO<sub>2</sub> through the CO<sub>2</sub><sup>•-</sup> radical anion, and the cation crossing a Nafion membrane from the anolyte governs the outcome: a concentrated, alkaline (KOH) anolyte favors K<sup>+</sup> migration over proton transport, stabilizing C–C coupling and delivering tartaric acid with 60% faradaic efficiency at –2.3 V (vs Ag/Ag<sup>+</sup>), the first report of a C<sub>4</sub> product from CO<sub>2</sub> reduction on a Pb catalyst.

At the opposite end of the continuum, scCO<sub>2</sub> itself serves as reactant and medium for photocatalytic CO<sub>2</sub> reduction over Cu/Cu<sub>2</sub>O films. Isothermal and isobaric series collapse onto a single rate-density curve with no discontinuity at the critical point, identifying CO<sub>2</sub> density as the governing variable, with a rate maximum of 106–108 μmol g<sup>–1</sup> h<sup>–1</sup> at ρ = 208–294 kg m<sup>–3</sup> and a tenfold drop under liquid-like densities as viscosity suppresses diffusion. Independently, the hole scavenger sets proton availability and thus selectivity: oxalate, an aprotic donor, affords 303.6 μmol g<sup>–1</sup> h<sup>–1</sup> of CO, 2.4 times the water-fed system, while keeping H<sub>2</sub> below 8% of products. Together, these electrochemical and photocatalytic case studies show that proton availability and mass transport are unifying, tunable handles for CO<sub>2</sub> reduction selectivity across the whole non-aqueous spectrum.

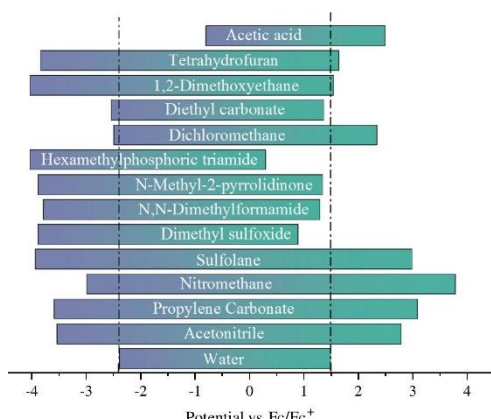


**Fig. 1.** Electrochemical potential windows of representative solvents vs Fc/Fc<sup>+</sup>, showing the markedly wider window accessible in non-aqueous media relative to water. Adapted with permission from ref. 2 (data originally reported by Izutsu, 2009, Wiley-VCH).

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## Biography



Caue Ribeiro is senior researcher at Embrapa Instrumentation (Brazil), currently acting as Coordinator of the National Laboratory of Nanotechnology applied to Agribusiness (LNNA/EMBRAPA). He is materials engineer (UFSCar, 1999), and holds a Ph.D. in physical chemistry (UFSCar, 2005). He has received the Chinese Academy of Sciences President's International Fellowship Initiative (PIFI) as a visiting researcher and the Alexander von Humboldt Fellowship for Experienced Scientists, hosted at Forschungszentrum Jülich (2018–2020). His research interests include photocatalysts & electrocatalysis for energy conversion, and materials for controlled release of fertilizers

## Engineering Activity, Selectivity, and Stability of Electrocatalysts for CO<sub>2</sub> Conversion to HCOO<sup>-</sup> and CO

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Electrochemical CO<sub>2</sub> reduction requires the integration of catalyst design, electrode architecture, and operational stability to achieve high activity and selectivity. In this presentation, we discuss our recent studies on ZnO, SnO<sub>2</sub>, and Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub>-based catalysts for CO<sub>2</sub> electroreduction. Amine functionalization of ZnO promoted CO<sub>2</sub> adsorption and reduced charge-transfer resistance, enabling CO production at current densities up to  $-130 \text{ mA cm}^{-2}$  and stable operation for 100 h in a membrane electrode assembly. For SnO<sub>2</sub>, the combined effects of morphology and oxygen vacancies were investigated, with oxygen vacancy-rich nanosheets achieving over 90% selectivity for formate at current densities above  $-200 \text{ mA cm}^{-2}$ . Bi<sub>2</sub>O<sub>2</sub>CO<sub>3</sub> nanosheets were also developed by controlling the hydrothermal synthesis conditions, reaching  $-250 \text{ mA cm}^{-2}$  with formate Faradaic efficiency above 90%. Despite their high activity and selectivity, Bi- and Sn-based electrodes showed limited stability, with performance degradation occurring within 24 h of operation. To investigate the origin of this instability, catalyst dissolution was monitored using SFC-ICP-MS under electrochemical conditions. The results provide insights into the dynamic behavior and degradation of Bi- and Sn-based electrocatalysts during CO<sub>2</sub> reduction. Overall, these studies highlight the importance of simultaneously engineering catalyst structure and surface properties while understanding degradation mechanisms to achieve efficient and durable CO<sub>2</sub> electroreduction systems.

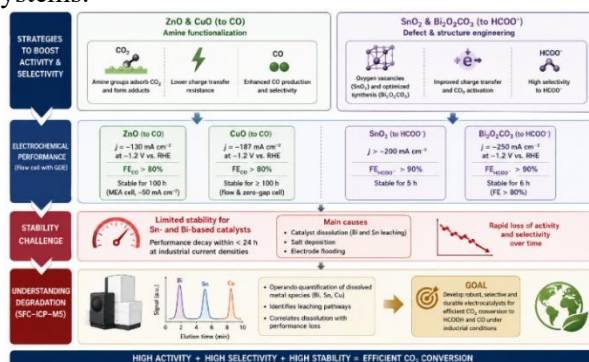


**Fig. 1.** Strategies for enhancing CO<sub>2</sub>RR activity and selectivity, and investigation of catalyst degradation by SFC-ICP-MS.

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## Biography



Osmando F. Lopes is a professor in Institute of Chemistry, Federal University of Uberlândia (UFU). He received his PhD in Federal University of São Carlos in 2016. After a postdoctoral training in Sao Paulo University, he joined UFU since 2018. He published over 60 peer-reviewed papers regarding photocatalysis and electrocatalysis for environmental applications. Current research focuses on the development of functional materials to be applied in photocatalysis and electrocatalysis for CO<sub>2</sub> reduction. Honors and awards includes an Alexander von Humboldt fellowship.

## Metal Oxide Nanostructures for Photocatalysis

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The escalating global crises of environmental pollution and greenhouse gas emissions demand sustainable remediation technologies. While heterogeneous photocatalysis offers a promising pathway to address both challenges, rapid charge-carrier recombination, limited visible-light absorption, and poor product selectivity often hinder its practical efficiency. This presentation outlines several rational design strategies for metal oxide nanostructures, progressing from tuning intrinsic surface properties to engineering functionalized or heterostructured catalysts. We first examine the critical role of surface chemistry and controlled phase transitions in ZnO photocatalysts. By modulating hydrothermal crystallization time, we demonstrate that a delicate balance between structural crystallinity, specific surface area, and surface hydroxyl groups strictly governs the generation of hydroxyl radicals in photodegradation processes.<sup>1</sup> Using a preformed nanoparticle building-block approach, we assembled TiO<sub>2</sub>/BiVO<sub>4</sub> heterojunctions under hydrothermal conditions. This structural design significantly extended electron-hole pair lifetimes, achieving efficient dye degradation.<sup>2</sup> Finally, the presentation shifts toward the thermodynamically demanding photoreduction of CO<sub>2</sub> into value-added solar fuels. We reveal that surface strategies can benefit CO<sub>2</sub> adsorption and conversion. By modifying TiO<sub>2</sub> anatase with dispersed iron species, we established a unified Fe<sup>3+</sup>/Fe<sup>2+</sup> redox-trap mechanism that acts as an electron sink to prolong charge separation and steer selectivity toward CH<sub>4</sub> and CO.<sup>3</sup> Parallel advancements were achieved in CuO catalysts by manipulating alkaline modifiers during synthesis. A strong synergy between monoethanolamine (MEA) and KOH enabled rapid particle nucleation and nitrogen-containing surface functionalization. This architecture optimized CO<sub>2</sub> adsorption and dramatically boosted both methane and ethane production rates.<sup>4</sup> Ultimately, this work highlights that photocatalytic efficiency and tunable selectivity are strictly governed by the meticulous integration of surface chemistry, defect engineering, and heterojunction dynamics.

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## Biography



**Jéssica C. de Almeida** is a Postdoctoral Research Fellow at Embrapa Instrumentation under the supervision of Dr. Caue Ribeiro. She received her Ph.D. in Materials Science from the Federal University of São Carlos (UFSCar) in 2024, which included a research internship at Forschungszentrum Jülich, Germany. Her research focuses on the rational design of functional nanomaterials for photo- and electrocatalysis applied to environmental remediation and sustainable energy.

## Proton-rich interfacial microenvironment engineering enables efficient and durable hydrogen evolution

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<sup>1</sup> International Joint Center of Nature-Inspired Carbon Neutrality Solutions, School of Resources, Environments and Materials, Guangxi University, Nanning 530004, China.

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To accelerate the Volmer step and reduce pH dependence, we develop a Ru<sup>3+</sup> hydrolysis-driven impregnation strategy to construct localized acidic, proton-rich interfaces. Taking Ru@Ni(OH)<sub>2</sub> as the model catalyst, Ru species are immobilized on oxygen-vacancy-rich Ni(OH)<sub>2</sub> nanosheets. Operando Raman and DFT calculations demonstrate that Ru sites boost water dissociation and serve as proton traps to generate interfacial H<sub>3</sub>O<sup>+</sup>. Such tailored microenvironment optimizes hydrogen adsorption and greatly accelerates HER kinetics. The Ru@Ni(OH)<sub>2</sub> achieves low overpotentials of 50 mV at −10 mA cm<sup>−2</sup> and 364 mV at −2800 mA cm<sup>−2</sup>, alongside 1200 h stable operation at −100 mA cm<sup>−2</sup>. This method is extendable to various transition-metal and rare-earth (hydro)oxides. This work highlights interfacial proton modulation as a powerful strategy, offering a general route toward high-performance HER electrocatalysts.

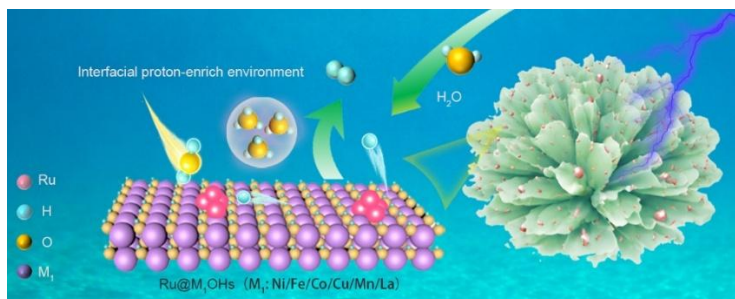


**Fig. 1.** Schematic diagram of constructing proton interface microenvironment to achieve efficient HER.

### Biography



Huan Zheng is a Ph.D. candidate at the School of Resources, Environment and Materials of Guangxi University. He is dedicated to the design of efficient catalysts for hydrogen production through water splitting. Currently, his research mainly focuses on the design of stable catalysts for high-temperature and salt-resistant seawater.

Yiping Sun<sup>1,2</sup>, Kai Zhang<sup>1,2,\*</sup>, and Dongke Zhang<sup>3,\*</sup>

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<sup>3</sup> Centre for Energy (M473), The University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia

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Non-equilibrium plasma offers an electricity driven route for activating CH<sub>4</sub>, CO<sub>2</sub> and H<sub>2</sub>O at bulk temperatures far below those used in conventional thermochemical processes. This presentation summarizes a systematic study in a coaxial dielectric barrier discharge (DBD) reactor, progressing from CH<sub>4</sub> dissociation and CO<sub>2</sub> splitting to binary CH<sub>4</sub>/CO<sub>2</sub> and ternary CH<sub>4</sub>/CO<sub>2</sub>/H<sub>2</sub>O reforming. The effects of input power, inlet gas flow rate and reactant ratio were evaluated using conversion, product yield, temperature distribution and reaction energy intensity. For CH<sub>4</sub> dissociation, a maximum CH<sub>4</sub> conversion of 46.6% was obtained at 90 W and 200 ml/min. For CH<sub>4</sub> and CO<sub>2</sub> reforming, the maximum CH<sub>4</sub> and CO<sub>2</sub> conversions were 44.5% and 27.4%, while H<sub>2</sub> and CO yields reached 17.1% and 20.2%. Introducing H<sub>2</sub>O markedly enhanced reforming at 100 W, 300 mL/min and CH<sub>4</sub>/CO<sub>2</sub>/H<sub>2</sub>O of 1:1:1, CH<sub>4</sub> and CO<sub>2</sub> conversions reached 64.2% and 36.8%, with H<sub>2</sub> and CO yields of 35.7% and 33.9%. BOLSIG+ analysis indicates that electron impact vibrational excitation initiates molecular activation, while ·O, ·OH and ·H radicals regulate oxidation, syngas formation and carbon removal. Reactor temperatures remained below 568 K, confirming predominantly plasma driven chemistry. The results identify operating trade-offs between conversion and energy utilization and show how the CO<sub>2</sub>/H<sub>2</sub>O composition can tune syngas production and suppress coking.

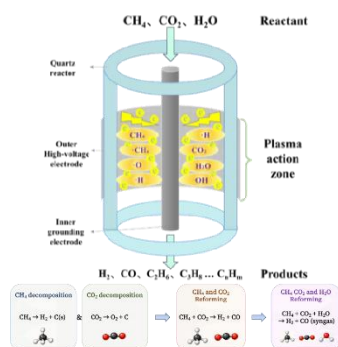


**Fig. 1.** Schematic illustration of CH<sub>4</sub>, CO<sub>2</sub> and H<sub>2</sub>O dissociation and reforming in a DBD reactor

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3. Y. Sun, J. Zhao, N. Qi, Y. Zhang, K. Zhang, D. Zhang, *J Fuel Chem Technol.*, 2026, 1-10.

### Biography



Yiping Sun is a Ph.D. candidate in Power Engineering and Engineering Thermophysics at North China Electric Power University under the supervision of Prof. Kai Zhang. Current research focuses on non-equilibrium plasma conversion of methane, carbon dioxide and water in dielectric barrier discharge reactors, combining reactor experiments, electrical and thermal diagnostics, BOLSIG+ electron kinetic calculation, reaction mechanism analysis and response surface optimization.

# Photo-Enhanced Electronic Metal Support Interaction Boosts Low-Temperature Water-Gas Shift Reaction via $\text{Ni}^{\delta+}\text{-O}_v\text{-Ce}^{3+}$ Interfacial Redox Cycling

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Nickel (Ni) is an attractive non-noble-metal catalyst for the water-gas shift reaction (WGSR), yet strong CO adsorption and competing methanation severely limit its activity and selectivity. Herein, we develop a series of NiCe layered double hydroxide-derived catalysts (NCO-T) through reduction-induced  $\text{Ni}^{\delta+}$  evolution. The optimized NCO-450 catalyst achieves 95.53% CO conversion and an  $\text{H}_2$  production rate of  $102.34 \mu\text{mol}\cdot\text{g}^{-1}\cdot\text{s}^{-1}$  at ambient pressure and a catalyst temperature of  $83^\circ\text{C}$ . In situ spectroscopic analyses and theoretical calculations reveal that isolated interfacial oxygen vacancies ( $\text{O}_v$ ) stabilize the active  $\text{Ni}^{\delta+}\text{-O}_v\text{-Ce}^{3+}$  motif, responsible for the superior WGSR performance. Photoexcitation-induced directional interfacial charge transfer from Ni to  $\text{CeO}_{2-x}$  enhances the electronic metal-support interaction and continuously regenerates this active interfacial state, thereby moderating CO adsorption, promoting  $\text{H}_2\text{O}$  activation, and suppressing competing methanation. This work offers a rational design strategy for developing low-cost transition-metal catalysts with superior low-temperature activity and high selectivity.

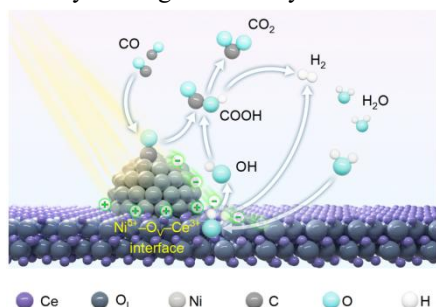
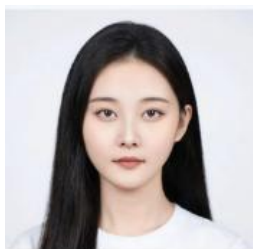


**Fig. 1.** Photo-enhanced interfacial redox cycling of  $\text{Ni}^{\delta+}\text{-O}_v\text{-Ce}^{3+}$  for low-temperature water-gas shift reaction

## References

J. Tian, J. H. Pan\* et al., *Angew. Chem. Int. Ed.* (Revised)

## Biography



**Jie Tian** is a researcher and assistant professor at the School of Resources, Environment and Materials, Guangxi University. She received her PhD in Chemical Engineering and Technology from University of Chinese Academy of Sciences in June 2024. Current research focuses on photo-electro-thermal coupled catalytic conversion of  $\text{CO}_2$ , VOCs and microplastics, design of photochemical fuel cells and photoelectrochemical cells, tandem photocatalytic reactions, as well as the design and prediction of multi-site catalysts.

# In situ exsolved M-Ru bimetallic sites with fine-tuned charge distribution for enhanced CO<sub>2</sub>/H<sub>2</sub>O co-electrolysis performance in La<sub>0.75</sub>Sr<sub>0.25</sub>CrO<sub>3-δ</sub>-based SOEC cathodes

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Advancing the co-electrolysis of CO<sub>2</sub>/H<sub>2</sub>O in solid oxide electrolysis cells (SOECs) critically relies on the development of cathode with high efficiency and excellent stability. This study designs high-performance perovskite oxide cathode materials (La<sub>0.75</sub>Sr<sub>0.25</sub>CrO<sub>3-δ</sub>M<sub>0.2</sub>Ru<sub>0.1</sub>O<sub>3-δ</sub>, LSCMR; M=Fe, Co, Ni) via in-situ exsolution of bimetallic nanoparticles, aiming to elucidate the influence of metal alloy on electrocatalytic activity. The materials underwent systematic characterization and electrochemical testing. Results demonstrate that the LSCFR (M=Fe) cathode exhibited optimal performance with superior gas diffusion and surface reaction kinetics, achieving 1.70 A cm<sup>-2</sup> at 850 °C at 1.5 V with approximately 30% enhancement after exsolution, along with excellent durability over 500 h. Density functional theory (DFT) calculations indicate that the electronegativity difference between M and Ru induces electron transfer, which lowers the Ru d-band center and optimizes adsorption energy. The Fe<sub>4</sub>Ru site exhibits the strongest H<sub>2</sub>O adsorption energy of -0.98 eV, significantly enhancing water dissociation activity. Choosing a metal M with a larger electronegativity difference relative to Ru can effectively regulate the charge distribution of active sites and thus may improve catalytic performance. This work provides an effective strategy for preparing high-performance electrodes via in-situ exsolution.

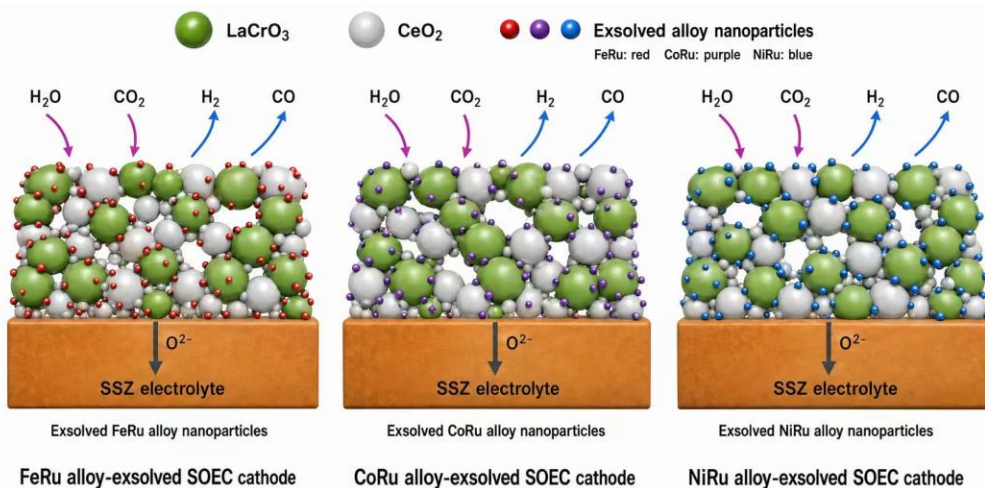


**Fig. 1.** M-Ru nanoparticles in-situ exsolved for application on SOEC cathodes.

## References

X. Y. Wang, T. Chen\*, J. Tian\*, S. R. Wang\* et al., J. Power Sources. (Revised)

## Biography



**Wang Xinyu**, Ph.D. candidate, School of Low-carbon Energy and Power Engineering, China University of Mining and Technology. At present, the research focuses on the catalytic conversion of CO<sub>2</sub> and H<sub>2</sub>O in solid oxide electrolysis cells (SOEC), the design of new electrode materials for fuel cells and the structural innovation of SOEC .