이화여자대학교 EWHA WOMANS UNIVERSITY

이화여자대학교 자율운영중점연구소 Basic Sciences Research Institute

이화여자대학교 자연과학대학

Eco-Nano Transition 2026: Ewha Basic Sciences & EGEP Shaping the Energy Future

Mon., September 21, 2026

Ewha Graduate School Building Auditorium(Room 100)

Organizers: Ewha Basic Sciences Research Institute
ACT EWHA Chemistry Education and Research Center (EGEP Program)

Sponsors: INMS INSTITUTE FOR MULTISCALE MATTER AND SYSTEMS, BK21 FOUR

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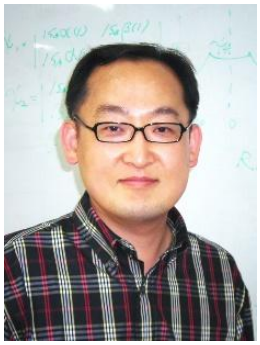
Date: Mon., September 21, 2026

Venue: Ewha Graduate School Building Auditorium(Room 100)

Opening		
13:00 ~ 13:10	**Opening Address** Prof. Dong Ha Kim, Ewha Womans University	
Session I		
13:10 ~ 13:35	SERS Probing of Dynamic Plasmon-Induced Metal–Molecule Charge Transfer	Zee Hwan Kim
13:35 ~ 14:00	Chirality in Nanomaterials: From Ground State to Excited-State Optical Activity	Jatish Kumar
14:00 ~ 14:25	Growing, Bonding, Assembling, and Shining Plasmonic Nanoparticles	Jwa Min Nam
14:25 ~ 14:40	**Break**	
Session II		
14:40 ~ 15:05	Covalent Organic Frameworks for Next-Generation Batteries: Design and Applications	Yoon Seob Kim
15:05 ~ 15:30	Charging Beyond Lithium: The Promise of Multivalent Batteries	Filipe Marques Mota
15:30 ~ 15:55	Interface Engineering and Nano-electrode Optimization for Hydrogen Production	Xiaoming Sun
15:55 ~ 16:25	**Break (Photo Time)**	
Session III		
16:25 ~ 16:55	Unlocking the Synergy of Multiple External Fields for Enhanced Electrocatalysis and Photoreforming	Zhiqun Lin
16:55 ~ 17:25	Energy in Motion: Designing and Imaging Nanomaterials	Emiliano Cortes
17:25 ~ 17:50	Peptide Encoded Chiral Inorganic Nanomaterials	Ki Tae Nam
17:50 ~ 18:00	**Closing Remarks**	



Biography of Prof. Zee Hwan Kim

Zee Hwan Kim is currently a professor of Department of Chemistry at Seoul National University. His Ph.D. thesis research focuses on the role of vibrational excitation on the gas-phase atom-polyatom reaction, and asymmetric angular momentum polarization of photofragments. As a postdoctoral associate at UC Berkeley in 2002-2004, he studied near-field microscopy techniques. Before joining the Chemistry Department at SNU, he was an associate and an assistant professor at Korea University (Seoul, Korea). His research group at SNU focuses on nanoparticle plasmonics, single molecule SERS, and development of optical nanoscopy techniques.

SERS Probing of Dynamic Plasmon-Induced Metal–Molecule Charge Transfer

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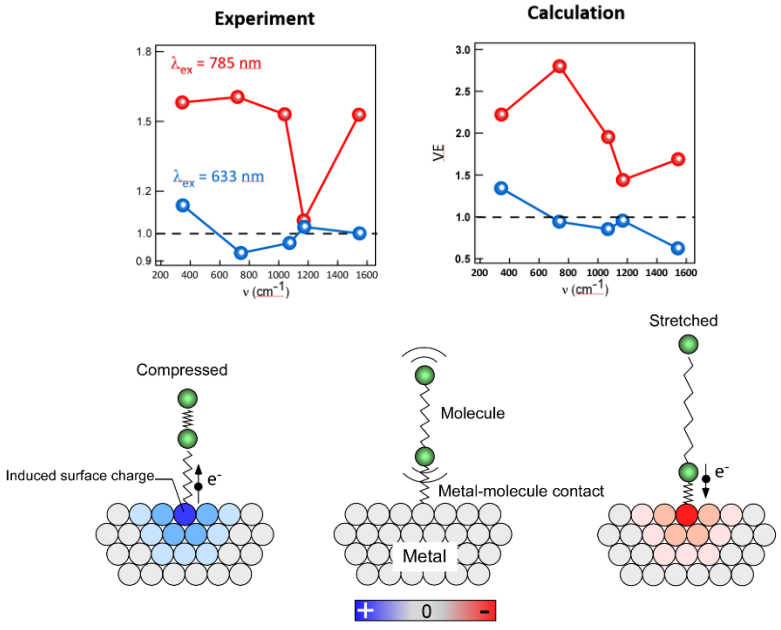
ABSTRACT

A molecular tunnel junction made of two metal electrodes and a molecular monolayer serves as an ideal platform for probing electron tunneling through molecular orbitals. Yet critical parameters such as metal–molecule coupling, orbital alignment, and bias-induced (Stark) shifts cannot be extracted from simple current–voltage curves. Here we demonstrate that *in-situ* SERS of plasmonic tunnel junctions reveal metal-molecule coupling and resonances. Junctions comprising a nanoparticle, an organic monolayer, and a metal thin-film exhibits SERS spectra whose relative peak intensities vary systematically with applied bias. The bias dependence is also altered by the changes in excitation wavelength and by the electrode Fermi level (Ag vs Au), indicating the electronic origin of the spectral change. Time-dependent DFT calculations on metal-cluster–molecule complexes under static electric fields reproduce the observed trends, which allows us attribute them to metal–molecule charge-transfer resonances, or the chemical effects of SERS. Our results establish SERS as a powerful, non-perturbative probe of molecular quantum states inside working tunnel junctions and provide a new method to study charge-transfer contributions in surface-enhanced Raman scattering.



Keywords: SERS, plasmonics, Chemical-enhancement, molecular tunnel junctions, molecular conductivity

Biography of Dr. Jatish Kumar

Dr. Jatish Kumar obtained his PhD in 2013 from CSIR-NIIST, Trivandrum, India working under the guidance of Professor K. George Thomas. Subsequently, he joined Prof. Tsuyoshi Kawai's group at the Nara Institute of Science and Technology (NAIST) in Nara, Japan, as a JSPS postdoctoral fellow where he continued working as a Specially Appointed Assistant Professor. In 2016, he moved to CIC biomaGUNE, San Sebastian, Spain as a Marie Curie postdoctoral fellow to work in the group of Prof. Luis M. Liz-Marzan. In December 2018, Jatish began his independent career as an Assistant Professor at the Indian Institute of Science Education and Research (IISER) Tirupati, India, where currently he is serving as an Associate Professor. Jatish is a Physical Chemist with a research focus on Materials Science. His research interests include synthesis, characterization, and photophysical investigations of organic, inorganic, plasmonic and luminescent nanomaterials. Currently, the work in the group is focused towards understanding the ground and excited state chirality of various nanosystems. He has authored 73 SCI publications. He serves as Editorial Advisory Board Member of *ACS Applied Optical Materials*.

Chirality in Nanomaterials: From Ground State to Excited-State Optical Activity

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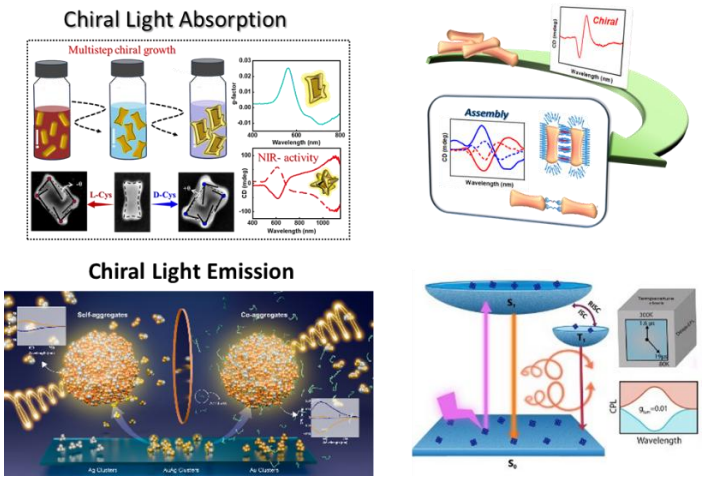
ABSTRACT

Chirality is ubiquitous in nature and has been extensively studied in molecular and supramolecular systems for several decades. In recent years, advances in nanoscale science have revitalized the field of chirality, generating significant interest in the design, synthesis, and optical properties of chiral nanomaterials. Several strategies have been developed to introduce chirality into nanostructures, including (i) the synthesis of intrinsically chiral nanoparticles, (ii) chiral induction through the incorporation of chiral ligands, and (iii) template-assisted approaches involving the formation of hybrid nanocomposites[1,2].

Circular dichroism (CD) spectroscopy has long been a powerful tool for probing ground-state optical activity and elucidating chiral interactions in molecules and nanomaterials[3,4]. More recently, increasing attention has been directed toward circularly polarized luminescence (CPL), which provides insight into the excited-state chiroptical properties of emissive materials by measuring the differential emission of left- and right-circularly polarized light. The complementary information obtained from CD and CPL aids exploration on the relationship between structural chirality and optical activity across both ground and excited states.

In this context, our recent work focuses on the synthesis of chiral nanomaterials and the investigation of their ground- and excited-state optical activity using CD and CPL spectroscopy. We have demonstrated (i) ground-state optical activity in structurally chiral plasmonic nanostructures[5,6] and (ii) excited-state chirality in luminescent metal clusters.[7–9] These studies provide insights into how nanoscale structural features, surface chemistry, and electronic interactions contribute to chiroptical responses. Our recent efforts toward understanding the fundamental origins of optical activity in structurally chiral nanomaterials, with particular emphasis on the interplay between structure, electronic states, and chiroptical response in the ground and excited states, will be briefly discussed. Beyond their fundamental importance, these chiral nanostructures hold significant promise for applications in asymmetric catalysis, chiral sensing, and the development of advanced chiral light-emitting devices.



Keywords: Optical Activity, Plasmonic Chirality, Chiral Metal Cluster, Hellicoidal Nanostructures, Circular Dichroism, Circularly Polarized Luminescence

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Biography of Prof. Jwa-Min Nam

Jwa-Min Nam received his Ph.D. degree in chemistry from Northwestern University (Chad Mirkin & Mark Ratner) (2004) and worked as a postdoctoral fellow at the University of California, Berkeley (Jay Groves) (2004-2005). He is currently a Professor in Chemistry and an Adjunct Professor in Biological Sciences at Seoul National University. He has served as the Vice Dean (Planning & Public Relations) of College of Natural Sciences, Seoul National University and the Director, SNU Science Outreach Center from 2024 to 2026.

He has been elected as a Fellow of the Korean Academy of Science and Technology (KAST) (2024), and is to be inducted as a Fellow of the American Institute of Medical and Biomedical Engineering (AIMBE). Jwa-Min Nam won many awards including Collegiate Inventors Award from the National Inventors Hall of Fame and US Patent and Trademark Office) (2004), Victor K. LaMer Award from the American Chemical Society (2006), Presidential Young Scientist Award from the President of the Republic of Korea (2012), SNU Excellence in Research Award from the President of Seoul National University (2021), Outstanding Inorganic Chemist Award from the Division of Inorganic Chemistry, Korean Chemical Society (2022) and the Basic Science Award from the Ministry of Science and ICT, South Korea (2022).

He is currently serving as a Senior Editor of Accounts of Chemical Research (ACS Publications) (2025-Current). He served as an Associate Editor (2020-2023) and an Executive Editor (2024) for Nano Letters (ACS Publications). He is on the editorial advisory board of ACS Central Science (ACS Publications), Small Methods (Wiley-VCH), Particle and Particle Systems Characterization (Wiley-VCH), Journal of Nanobiotechnology (BMC) and Sensors & Diagnostics (Royal Society of Chemistry).

Jwa-Min's research interests include plasmonic nanoparticles, surface-enhanced spectroscopy, nanobiosensors, nanobiocomputing, nanomachines and nanoparticle-based therapeutics.

Growing, Bonding, Assembling, and Shining Plasmonic Nanoparticles

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Plasmonics seeks to understand and control light–matter interactions mediated by collective electron oscillations in metallic nanostructures, enabling optical fields to be confined and manipulated at length scales far below the wavelength of light. Chemical nanoplasmonics focuses on the reciprocal interplay between nanoscale chemistry and plasmonics: using chemical principles and processes to design, synthesize, and control plasmonic nanostructures, while harnessing plasmonic phenomena to address fundamental questions and key challenges in chemistry and related fields. The ability to design and synthesize metal nanostructures with ultrahigh precision, structural uniformity, and reproducibility across large populations is essential for their reliable and widespread use in chemistry, materials science, optics, nanoscience, biotechnology, and medicine. In this presentation, I will discuss the design principles, synthetic strategies, and characterization of molecularly tunable, structurally precise, and highly reproducible plasmonic nanostructures. These include metal nanogap structures, multicomponent nanoparticles, mechanically interlocked nanostructures such as gold nanocatenanes and nanorotaxanes, and nanocube-assembled supercrystals. These structures exhibit strong, controllable, and quantitatively predictable plasmonic responses, including plasmonic-nanogap-enhanced Raman scattering. I will then demonstrate their potential to address major challenges in plasmonics, materials science, and biotechnology, and discuss how these emerging plasmonic materials and platforms may enable breakthroughs in nanochemistry, nanophotonics, next-generation disease diagnostics, molecular computing, and nanomachines and nanorobotics.

Biography of Prof. Yoonseob KIM

Prof. Yoonseob Kim is an associate professor in the Department of Chemical and Biological Engineering, The Hong Kong University of Science and Technology. He studied Chemical Engineering at Hanyang University, Korea (2010) summa cum laude and received his Ph.D. from the Department of Chemical Engineering at the University of Michigan, Ann Arbor, in 2016. His Ph.D. work earned him the ProQuest Distinguished Dissertation Award, DSM Science & Technology Award, ACS, etc. Subsequently, he worked at the Department of Chemistry, Massachusetts Institute of Technology, as a postdoctoral associate from 2016 to 2019. His research group at the HKUST synthesizes sustainable polymers and porous crystalline polymers for battery applications. He has successfully managed 3 GRF, 1 CRF, and 1 ITF (Seed) grants totaling over HK$16 M. His independent works were published in J. Am. Chem. Soc., Adv. Mater., Angew. Chem., Int. Ed., Nat. Commun., Adv. Sci. etc. He has received numerous awards/recognitions in his independent career, including Early Investigator from PMSE, ACS, Rising Star from ACS Materials Au, Emerging Investigator from Nanoscale, Influential Researcher from I&EC Research, Young Scientist from World Laureate Forum etc.

Covalent Organic Frameworks for Next-Generation Batteries: Design and Applications

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ABSTRACT

One of the recently developed polymers with high porosity and crystallinity, called porous crystalline polymers, includes covalent organic frameworks (COFs). COFs with ionic functional groups can rapidly, selectively, and reliably transport ions, e.g., Li+, Na+, Zn2+, or Ca2+. These ionic COFs (iCOFs) are incorporated in energy devices for enhanced transport and safety, outperforming known electrolytes and enabling the next-generation batteries. A key feature of the iCOFs is that they are solid-state single-ion conductors. We developed new iCOFs, including those bearing hypervalent nodes, redox-active moieties, three-dimensional network topologies, etc. We have demonstrated that iCOF-based batteries offer significantly improved safety while showing better performance than the liquid electrolytes. The iCOFs we have developed showed the highest Li+ conductivity of 9.8 mS cm–1 at r.t. and a transference number of 0.92 (J. Am. Chem. Soc. 2023). We demonstrated that iCOF/polymer composite can be an excellent all-solid-state electrolyte for lithium metal batteries (LMBs), meeting industry standards (Adv. Energy Mater. 2024). We also demonstrated that multicomponent reactions can yield iCOF-based quasi-solid-state electrolytes (QSSEs) for LMBs (Angew. Chem. Int. Ed. 2024), and phosphonium COFs as QSSEs for zinc–air batteries (Angew. Chem. Int. Ed. 2024). Current efforts include iCOF applications in anode-free alkali (Li/Na) metal batteries, high-valent ion batteries, e.g., Ca-ion batteries, lithium–sulfur batteries, etc. Overall, iCOF's advantageous properties enable the development of next-generation batteries (Adv. Mater. 2021; Adv. Mater. 2024).

Keywords: Covalent organic frameworks; Polymer electrolytes; Artificial solid electrolyte interphase; Lithium metal batteries; Anode-less and -free batteries

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[p]my PG students, [d]my postdocs, [+]my UG students, [†]equal contribution, and *corresponding author

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Biography of Dr. Filipe Marques Mota

Dr. Filipe Marques Mota received his Ph.D. degree in Bioscience Engineering from K.U. Leuven in 2013. He took postdoctoral positions in South Korea at the Institute for Basic Science in KAIST and at Ewha Womans University. Currently, Dr. Marques Mota holds a permanent position as a Senior Lecturer (Research & Teaching) at the Department of Chemistry at University of Lincoln (U.K.), which he joined in 2023. Dr. Marques Mota serves as the B.Sc./M.Chem. Deputy Programme Leader for Chemistry, having previously served as the M.Sc. Programme Leader for "Energy Materials and Battery Science". At Lincoln, he is also Head of the Energy Transitions and Nanomaterials research group (https://etn-research.com). Dr. Marques Mota has >15 years of research experience (including 4 in the industry), with a current focus on the development of multivalent metal–ion batteries and conversion-type technologies. To date, he has published 36 SCIE Publications (including 5 cover articles) and 3 book chapters [H-index: 23]. Dr. Marques Mota is the co-inventor of 15 granted/6 published patents (including 4 EP, 3 US, 1 WO), has delivered >40 communications, and has secured >£320k of research funds as PI in Lincoln. He is a Fellow of the Higher Education Academy and a Member of the Royal Society of Chemistry.

Charging Beyond Lithium: The Promise of Multivalent Batteries

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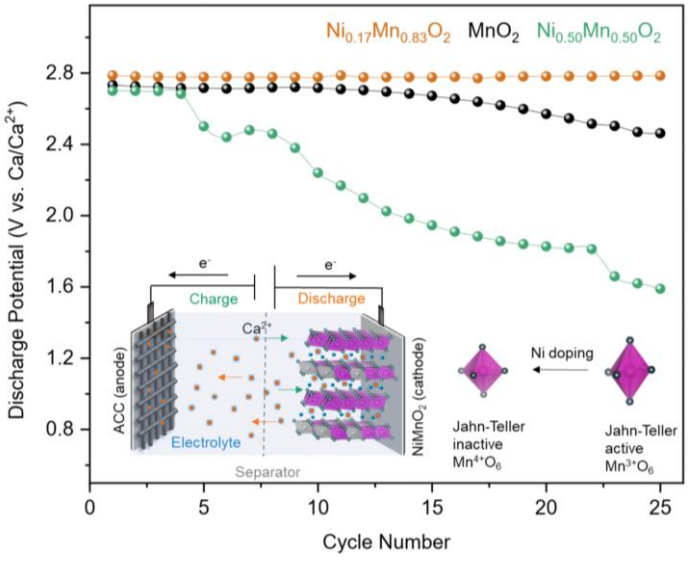
ABSTRACT

The commercial lithium–ion battery currently represents an inadequate solution to the rapidly growing global market of electric vehicles and is unable to deliver grid scales and answer seasonal storage dynamics. Alternative technologies, attaining specific energies >500 Wh/kg, while assuring cell costs <£50/kWh and stability levels up to 3,000 cycles, are an urgent research focus in both academia and industry. In this context, the development of divalent calcium–ion batteries with practical high energy density, lifetime, and stable electrochemical behaviour is particularly attractive. The wide availability of calcium (against lithium) as well as the promising Ca2+/Ca reduction potential (–2.87 VSHE), and the divalent-transporting cation delivering higher capacities, have prompted an assessment of the promise of calcium–ion devices against lithium counterparts. High-performance cathode materials capable of reversible and efficient Ca2+ storage remain, however, limited due to slow Ca2+ diffusion kinetics and rapid host structural degradation.

Here, recent advances on the development of rationally designed advanced cathode materials (including layered transition metal oxides and polyanions) acting as Ca2+ hosts during (de)intercalation in calcium–ion batteries will be first discussed. For the most promising materials, ex-situ XRD, Raman, and XPS studies have demonstrated reversible lattice breathing and Faradaic intercalation involving cooperative redox processes, whereas in-situ Raman showcased reversible vibrational transitions during galvanostatic cycling [1]. Our works offer valuable benchmark strategies for Ca-hosts with long-term structural robustness and uncover pioneering electrochemical mechanistic insight for their application in next-generation batteries.

In the context of the above, we will then also discuss the status of multivalent calcium–“air” technologies against previous reports on lithium–air counterparts [2, 3], assessing the discharge mechanism and providing insight into the envisioned implementation of these devices with extraordinary energy density against calcium–ion counterparts. The presentation will also include brief insight into emerging strategies to address issues of efficiency and rechargeability.



Keywords: Energy storage, Multivalent batteries, Layered transition metal oxides, Calcium–ion, Calcium–air

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Biography of Porf. Xiaoming Sun

Prof. Sun obtained his Bachelor of Science degree in 2000 and PhD in Science in 2005 from the Department of Chemistry at Tsinghua University. After completing postdoctoral research at Stanford University in 2008, he returned to China and joined the State Key Laboratory of Chemical Resource Engineering at Beijing University of Chemical Technology. His research focuses on inorganic nanomaterials chemistry, with significant advancements in water electrolysis, fuel cells, and gas superwetting electrode devices.

To date, he has published over 400 papers (Web of Science Core Collection Metrics) in mainstream international energy and chemistry journals including Nature, Nature Catalysis, Joule, Chem, Nature Communications, Proceedings of the National Academy of Sciences of the United States of America (PNAS), Journal of the American Chemical Society, Angewandte Chemie International Edition, Advanced Materials, Chemical Society Reviews, and Accounts of Chemical Research, with citations exceeding 66,000. The researcher has filed 13 international patent applications (3 granted) and obtained over 80 Chinese invention patents, with 16 patents successfully commercialized. The researcher is currently leading multiple research projects including key projects of the National Natural Science Foundation of China and National Key Research and Development Programs.

Interface Engineering and Nano-electrode Optimization for Hydrogen Production

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ABSTRACT

This report addresses fundamental challenges in electrode material design and interfacial wetting behavior regulation, aiming to enhance hydrogen production efficiency through micro/nanostructural optimization. We propose a heterovalent ion repulsion strategy to engineer layered double hydroxide (LDH) electrodes, achieving atomic-level dispersion of trivalent ions (e.g., Fe3+, Co3+) in Ni(OH)2-based matrices. Introducing high-valence ions (e.g., V4+, Fe2+) further significantly improves oxygen evolution reaction (OER) activity. To mitigate the bubble shielding effect, we construct superaerophobic nanoarray-based integrated electrodes, reducing bubble detachment volume to 1/1000 of its original size and increasing the current ramp-up rate by ~60%, thereby enhancing energy efficiency under high current densities. To address cathode oxidation and halide corrosion during intermittent seawater electrolysis, non-metal species (e.g., phosphorus) are introduced to synergistically form an in-situ passivation layer with metal oxides, effectively suppressing cathode deactivation during shutdown periods. The resulting HER electrocatalyst achieves over 10,000 hours of stable intermittent seawater electrolysis at 0.5 A·cm-2 with a voltage decay rate below 0.5% khr-1. Finally, by combining nano-electrode optimization with anion engineering, we overcome practical challenges including high salinity (saturated NaCl), elevated temperature (80 °C), and high current density (1–2 A·cm-2). Building upon these advances, we developed the world's first megawatt-scale industrial seawater electrolysis system and verified its energy efficiency and operational stability.

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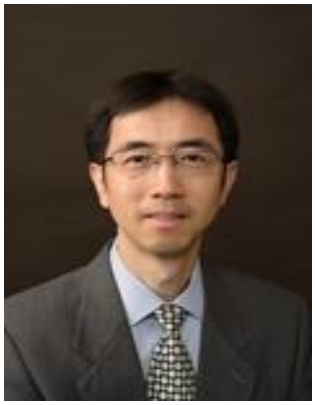

Biography of Prof. Zhiqun Lin

Dr. Zhiqun Lin is currently Professor of Chemical and Biomolecular Engineering at the National University of Singapore (NUS). He received his BS degree in Materials Chemistry from Xiamen University in 1995, Master degree in Macromolecular Science from Fudan University in 1998, and PhD degree in Polymer Science and Engineering from University of Massachusetts, Amherst in 2002. He did his postdoctoral research at University of Illinois at Urbana-Champaign. He joined the Department of Materials Science and Engineering at the Iowa State University as an Assistant Professor in 2004 and was promoted to Associate Professor in 2010. He moved to Georgia Institute of Technology in 2011, and become a Professor in 2014. He relocated to National University of Singapore in 2022. His research interests include solar cells, photocatalysis, electrocatalysis, batteries, block copolymers, conjugated polymers, functional nanocrystals, hierarchically structured and assembled materials, and surface and interfacial properties. He has published more than 450 peer-reviewed journal articles (with an h-index of 129), 19 book chapters, and 9 books. He is a Fellow of MRS, ACS, AAAS, and RSC. Currently, he serves as a co-Editor-in-Chief of Nano Energy.

Unlocking the Synergy of Multiple External Fields for Enhanced Electrocatalysis and Photoreforming

Zhiqun LIN

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ABSTRACT

Conventional strategies such as optimizing morphology, composition, and electronic structure have achieved notable enhancement in catalytic performance, yet approaching their intrinsic limit in activity improvement. Overcoming such limitations requires new strategies that can dynamically modulate catalytic energetics during operation rather than relying solely on static material design. In this context, the application of external fields has emerged as a powerful paradigm for catalyst regulation. External magnetic, photo, and thermal fields can introduce new degrees of freedom that reshape charge, spin, and lattice dynamics, thereby enabling kinetic pathways that are inaccessible under conventional conditions.1 These external fields can act cooperatively, producing synergistic effects that transcend the sum of their independent contributions. In this talk, I will discuss photothermal effect2 and the synergy of magnetic field and chiral-induced spin selectivity (CISS) in promoting oxygen evolution reaction activity. I will then introduce a robust strategy that integrates CISS, ferroelectricity, and photocatalytic heterostructures to significantly improve charge carrier dynamics, enabling efficient photoreforming of plastic waste into value-added products.

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Biography of Prof. Emiliano Cortés

Emiliano Cortés is Professor of Experimental Physics and Energy Conversion at LMU Munich in Germany, where he leads the Nanomaterials for Energy group. He is also a visiting researcher at Imperial College London and Ewha Womans University and, since March 2026, Associate Editor of ACS Catalysis.

His interdisciplinary research bridges chemistry and physics, combining nanomaterials design with advanced imaging to advance sustainable energy conversion. He has published more than 200 scientific articles, co-edited the first book on Plasmonic Catalysis, co-founded two spin-offs, and holds four patents.

Trained in chemistry at Universidad Nacional de La Plata, Argentina, Emiliano received a Marie Skłodowska-Curie Fellowship and European funding for the ERC CATALIGHT, SURFLIGHT, and INSyT-one projects. Named a Royal Society of Chemistry Emerging Investigator in Materials Science in 2021, he has ranked among the world's top 2% most-cited researchers since 2022. He serves as evaluator for the European Science Commission, chaired the 2025 Gordon Research Conference on Plasmonically Powered Processes, and will chair the 2027 Faraday Discussion on Thermoplasmonics and MATSUS Spring 2027 Sustainable Materials Conference.

At LMU, Emiliano is an Executive Board member, Principal Investigator, and research-area coordinator in the €40 million DFG Cluster of Excellence e-conversion 2.0. Work explores how light, charge, and matter interact at interfaces. He also serves on the scientific board of Munich's Center for NanoScience, participates in solar network SolTech, the Young Academy of Europe, and the Solar Batteries Center in Germany, is CSO of INSyT Tech, and sits on the editorial boards of ACS Nano, ACS Energy Letters, Advanced Photonics Nexus, and eScience.

Energy in Motion: Designing and Imaging Nanomaterials

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ABSTRACT

Understanding and controlling how energy is generated, transferred, converted, and stored at the nanoscale is essential for developing materials that harvest light, drive chemical reactions, and store energy efficiently. Our research combines rational nanomaterial design with advanced imaging and spectroscopy to reveal and manipulate energy and charge flow across diverse functional materials [1-10].

In the first part of this talk, I will present our efforts to engineer plasmonic, photonic, and photocatalytic materials that convert light into chemical bonds. Through the synthesis of tailored nanostructures, we investigate the fundamental mechanisms underlying solar-driven H_2 evolution and CO_2 reduction, establishing design principles for efficient and scalable energy conversion.

In the second part, I will introduce imaging and characterization platforms that visualize charge and energy dynamics in real time and with nanometric precision. These approaches extend beyond light-harvesting systems to catalytic, light-emitting, battery, and two-dimensional materials, enabling imaging-guided optimization of their performance.

By linking material structure, energy dynamics, and reactivity across different material classes, this integrated approach provides a framework for designing efficient and sustainable systems for energy harvesting, conversion, and storage. Ultimately, it advances our ability to visualize, control, and optimize energy flow from the nanoscale to practical applications.

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Biography of Prof. Ki Tae Nam

Professor Ki Tae Nam received his B.S. and M.S. in Materials Science and Engineering from Seoul National University, and his Ph.D. in Materials Science and Engineering from MIT. He got the “outstanding PhD thesis award” from MIT. His PhD thesis was about the “virus-based battery” that has been highlighted as the first demonstration of virus based electrochemical devices. During his postdoc (2007-2010) at Lawrence Berkeley National Lab, he studied peptide mimetic polymer to assemble two dimensional structures. Since 2010, His group at SNU continue to pioneer the research area of bioinspired material science to make new functional materials for energy and optical applications. Recent innovations include the development of CO2 utilization chemistry (Nature Energy. 2021, 6, 733 and Nature synthesis. 2024, 3 etc) and the peptide based synthesis of chiral nanomaterials (Nature 2018, Nature 2022 and Nature Materials 2024). In 2022, He received the POSCO Chung-am Award that is one of the most prestigious award in Korea. He is an associate editor for Nano Letters and will serve as one of the chair in MRS Fall 2027 Meeting.

Peptide Encoded Chiral Inorganic Nanomaterials

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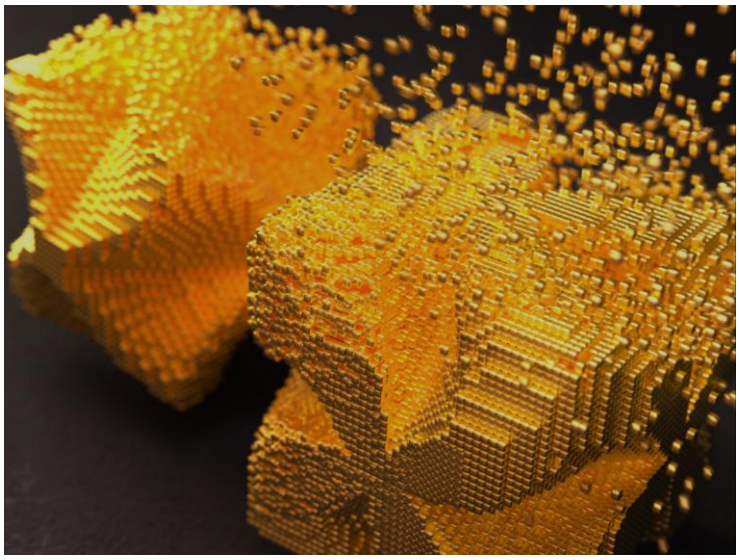
ABSTRACT

From small molecules to entire organisms, evolution has refined biological structures at the nanoscale, microscale and macroscale to be chiral—that is, mirror dissymmetric. Chiral nanoscale materials can be designed that mimic, refine and advance biological chiral geometries, to engineer optical, physical and chemical properties for applications in photonics, sensing, catalysis and biomedicine. The idea that inorganic materials can be chiral seems to be counterintuitive. In this talk, I will discuss about a new mechanism that can generate chiral nanomaterials based on the interaction between chiral peptides and high index plane of metal surface. The enantioselective interaction of chiral molecules and high-Miller-index facets can break the mirror symmetry of the metal nanocrystals. I will also discuss about interesting optical properties of these chiral gold plasmonic nanoparticles that was synthesized by the peptides and amino acid. The resulting 432 symmetric chiral morphology result in the highest dissymmetry factor (g) and the efficient coupling with other materials. I believe that this synthetic approach for the chirality control of inorganic nanomaterials can have a lot of potential to maximize the light-matter interaction, resulting in many optical, electronic and biological applications.



Reference

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[2] “Amino-Acid- and Peptide-Directed Synthesis of Chiral Plasmonic Gold Nanoparticles,” Nature. 2018, 556, 360.

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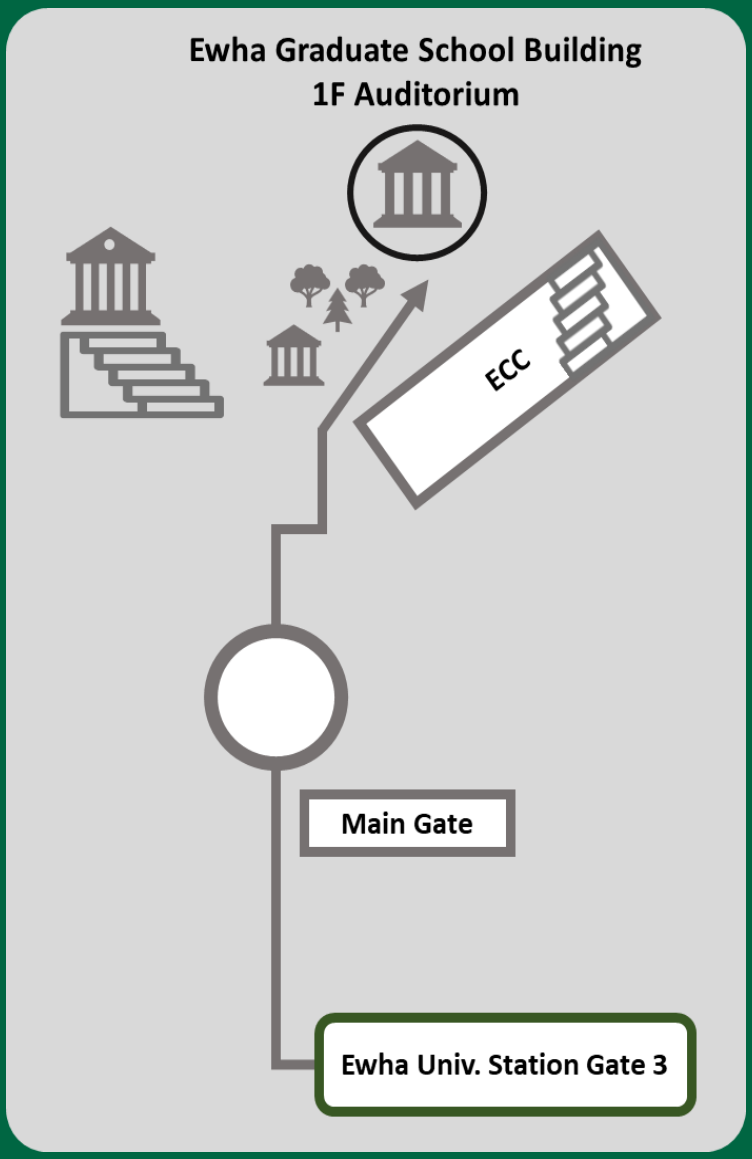

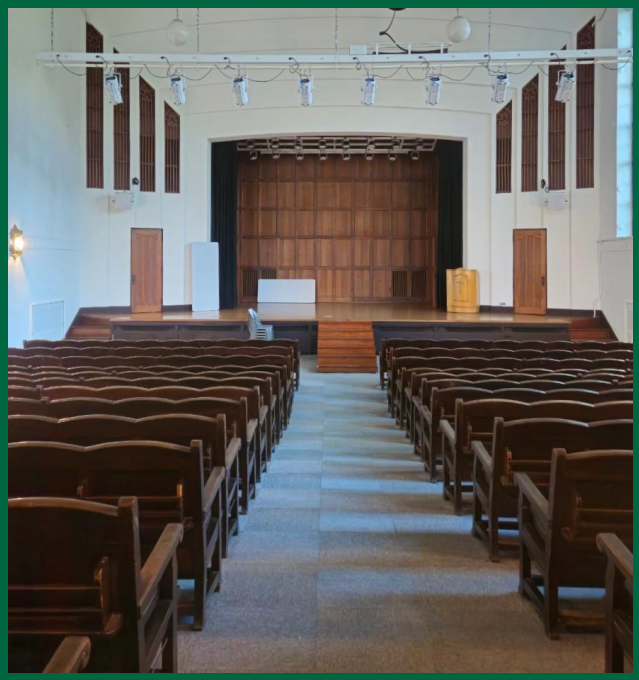

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