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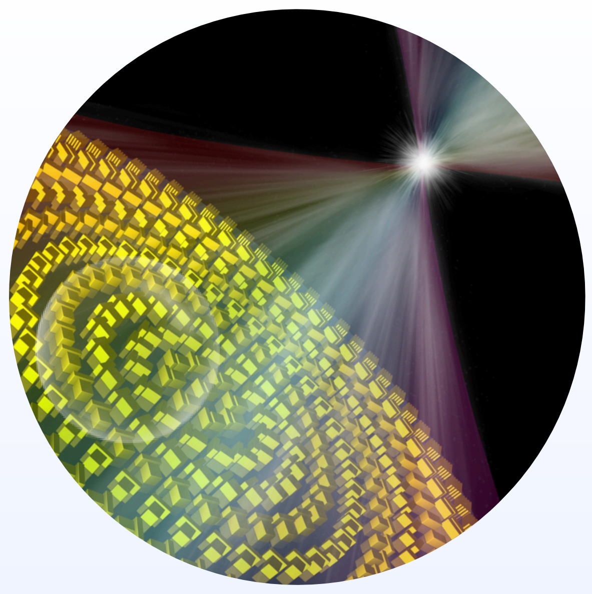
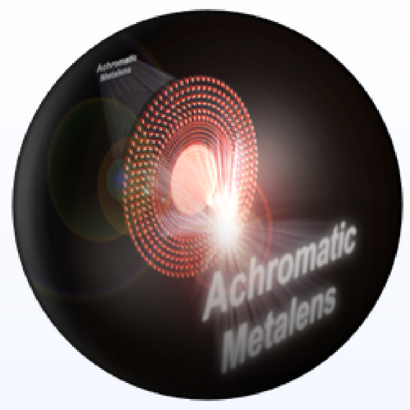
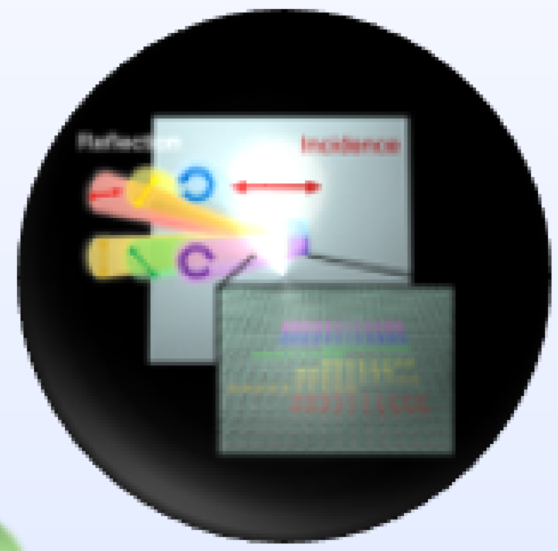
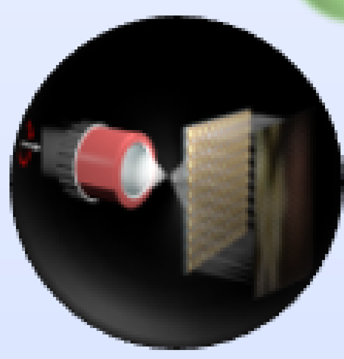
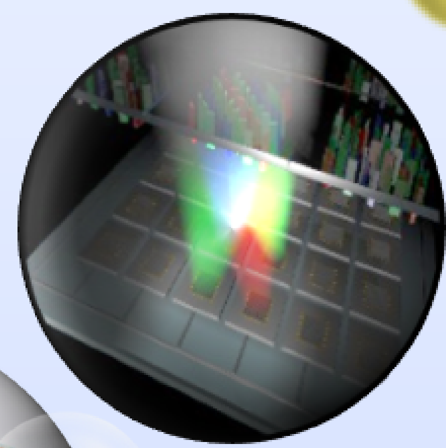
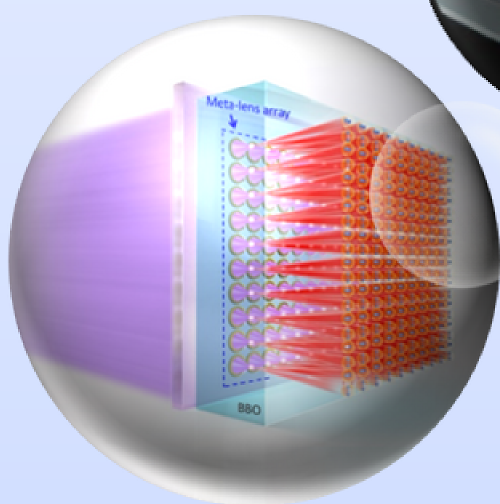





META-LENS WORLD SUMMIT 2025

Date: 26 May 2025 (Mon)

Time: 9:30am - 5:15pm

Venue: LT-3 (C Y Sun Lecture Theatre), Yeung Kin Man Academic Building, City University of Hong Kong


Patrice GENEVET
Colorado School of Mines


Takuo TANAKA
RIKEN, Japan


Sir John PENDRY
Imperial College London


Che Ting CHAN
Hong Kong University of Science and Technology


Shuang ZHANG
The University of Hong Kong


Dangyuan LEI
City University of Hong Kong


Wakana KUBO
Tokyo University of Agriculture and Technology


Xiaobo YIN
The University of Hong Kong


Shengxian SHI
Shanghai Jiao Tong University


Gengbo Wu
City University of Hong Kong


Shuming WANG
Nanjing University


Shubo WANG
City University of Hong Kong


Chia-hung CHEN
City University of Hong Kong

Program & abstract

Organized by Prof. Din Ping Tsai
Chair Professor
Department of Electrical Engineering
City University of Hong Kong
Email: dptsai@cityu.edu.hk

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META-LENS WORLD SUMMIT 2025

PROGRAM

Time	Title	Speaker
09:30-09:35	**Opening**	Prof. Din Ping Tsai
09:35-09:55	Three-dimensional robust transport in photonic topological heterostructures	Prof. Che Ting Chan
09:55-10:15	Vacuum fluctuation induced non-linear Landau fan-diagram in graphene	Prof. Shuang Zhang
10:15-10:35	Optical Metasurfaces: Physics and Applications	Prof. Patrice Genevet
10:35-10:50	***Break (15 mins) *Please stay for the photo session****	
10:50-11:20	Imaging Space-Time Systems	Prof. Sir John Pendry
11:20-11:40	Metamaterials for Sustainability	Prof. Xiaobo Yin
11:40-12:00	Electron Hopping Induced Phonon Pumping in Plasmonic Nanojunctions	Prof. Dangyuan Lei
12:00-14:30	***Lunch (2hr30m)***	
14:30-14:50	Optical imaging based on metasurfaces	Prof. Shuming Wang
14:50-15:10	High-temperature Measurement with Dispersive Meta-lens	Prof. Shengxian Shi
15:10-15:30	Synthetic Moving Enabled by Space-Time Metasurface Antennas	Prof. Gengbo Wu
15:30-15:50	Living Metasurface Sensors via Microfluidics for Precision Medicine	Prof. Chia-hung Chen
15:50-16:05	***Tea Break (15 mins)***	
16:05-16:25	Three-dimensional metasurface for ultra-sensitive spectroscopic devices	Prof. Takuo Tanaka
16:25-16:45	Nonradiative cooling	Prof. Wakana Kubo
16:45-17:05	Pancharatnam-Berry phase induced by transverse spin	Prof. Shubo Wang
17:05-17:15	**Award Ceremony and Closing**	Prof. Din Ping Tsai

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Che Ting CHAN
Hong Kong University of Science and Technology

C.T. Chan received his BSc degree from the University of Hong Kong in 1980 and his PhD degree from the University of California at Berkeley in 1985. He is currently serving as the Interim Director of the Institute for Advanced Study at HKUST. He is also concurrently the Daniel C K Yu Professor of Science, Chair Professor of Physics, and the Director of Research Office of HKUST.

Three-dimensional robust transport in photonic topological heterostructures

We showed that we can use Chern vectors to construct a topological heterostructure, where large-volume nonreciprocal topological transport in 3D is achieved. The shape of the cross section in the heterostructure can be arbitrary designed, and we experimentally observed the distinctive cross-shaped field pattern transport, nonreciprocal energy harvesting, and the ability of electromagnetic wave to traverse obstacles and abrupt structure changes without encountering reflections in 3D space.

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Shuang ZHANG
University of Hong Kong

Shuang Zhang is a chair Professor and interim Head of the Department of Physics at the University of Hong Kong. He obtained his PhD in Electrical Engineering from the University of New Mexico. Thereafter he worked as postdoc at UIUC and UC Berkeley. He joined the University of Birmingham, UK as a Reader in 2010 and was promoted to professor in 2013. Prof. Zhang joined the University of Hong Kong as a Chair Professor in 2020. He was the recipient of IUPAP Young Scientist Award in Optics (2010), ERC consolidator grant (2015-2020), Royal Society Wolfson Research Award (2016-2021), and New Cornerstone Investigator program (2023-2028). He was elected OSA fellow in 2016, APS fellow in 2022, and has been on the list of highly cited researchers (by Clarviate) since 2018.

Vacuum fluctuation induced non-linear Landau fan-diagram in graphene

We design a cavity resonator that is ultra-strongly coupled with graphene within the terahertz regime. Our observations reveal that the vacuum fluctuations of the cavity can significantly affect quantum Hall transport, leading to the appearance of a nonlinear Landau fan diagram. Specifically, by tuning the gate voltage, we find that the Landau plateaus shift away from the integer filling factors. This unconventional behavior suggests that electrons in the lower Landau levels can be pumped to higher levels by the virtual photons in the cavity resonator, presumably from localized to extended states.

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Patrice GENEVET
Colorado School of Mines

Patrice Genevet is a Professor of Physics at the Colorado School of Mines. He received his Ph.D. degree at the Université Côte d'Azur, France in 2009 on localized spatial solitons in semiconductor lasers and amplifiers. He did five years as a research fellow (2009-2014) in the Capasso group (SEAS, Harvard University) in collaboration with Prof. M.O. Scully (Texas A&M University) where he pioneered the concept of Metasurfaces. In 2014, he became a senior research scientist at ASTAR, Singapore. In 2015, He joined CNRS as ‘Chargé de Recherche’. He is the recipient of several awards, including the ERC Starting Grant 2015, the 2017 Aimé-Cotton Price from the French Physical Society, the 2019 ERC proof of Concept, and the 2021 Fabry-De Gramont Price from the French Optical Society. Since 2018, he has been named annually among the Top 1% Highly Cited Researchers by Clarivate. P. Genevet research activities concern the development of optical metamaterials, passive and active metasurfaces, and their applications and integration in optoelectronic devices. He owns 8 patents, more than 125 publications, H factor of 58 and more than 30 000 citations(Google Scholar).

Optical Metasurfaces: Physics and Applications

Metasurfaces are artificial optical interfaces designed to control the phase, the amplitude, and the polarization of an optical wavefront. They use physical mechanisms that rely on the coherent scattering of light by nano-scatterers of various shapes and material compositions. After introducing our recent fundamental works on the poles and zeros of scattering parameters to design metasurfaces [1], I will present several on-chip integrations of metasurfaces, including lasers, LiDAR, and detector arrays, and discuss how these innovative functionalities push the frontiers of optoelectronic systems beyond conventional devices.

I will briefly review our work on the realization of directional light emission and collimation of VCSEL arrays and the spin-controlled laser emission [2]. I will then present new imaging capabilities provided by 3D LiDAR metasystem, emphasizing the unprecedented performances achieved, in terms of frame rate, field of view and the simultaneous acquisition of multiple fields of views [3].

Finally, i will present our results on 3D insect-inspired directional imaging devices. We show that mimicking the peripheral vision of insects using planar metalens arrays, we could measure simultaneously the light coming from several directions to reconstruct 3D images.

I will conclude this seminar by drawing perspectives on active metasurfaces, highlighting the opportunities that this technology still has to offer, both from fundamental and application points of view.

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Sir John PENDRY

Imperial College London

John Pendry has worked at the Blackett Laboratory, Imperial College London, since 1981. He began his career in the Cavendish Laboratory, Cambridge, followed by six years at the Daresbury Laboratory where he headed the theoretical group. He has worked extensively on electronic and structural properties of surfaces developing the theory of low energy diffraction and of electronic surface states. His present research concerns the remarkable electromagnetic properties of materials where the normal response to electromagnetic fields is reversed leading to negative values for the refractive index. In collaboration with scientists at The Marconi Company he designed a series of ‘metamaterials’ whose properties owed more to their micro-structure than to the constituent materials. These made accessible completely novel materials with properties not found in nature. The simplicity of the new concepts together with their radical consequences have caught the imagination of the world’s media.

Imaging Space-Time Systems

Electromagnetic materials that vary in both space and time are the subject of increasing interest [1]. To be of interest structure must be on a spatial scale of the order of the wavelength, and a time scale of the order of a period of the radiation. This is challenging. Experiments are making rapid progress creating these structures, a typical system comprising a powerful femtosecond laser pulse interacting with an Indium Tin Oxide film but difficulties still remain, to determine what structure has been created. Recent experiments show how this might be done using time diffraction [2]. Here I shall discuss our attempts to understand experimental data taken from these systems.

[1] Photonics of Time-Varying Media
E Galiffi, R Tirole, S Yin, H Li, S Vezzoli, PA Huidobro, MG Silveirinha, Riccardo Sapienza, Andrea Alù, and J. B. Pendry,
Advanced Photonics 4, 014002 (2022)

[2] Double-slit time diffraction at optical frequencies
R Tirole, S Vezzoli, E Galiffi, I Robertson, D Maurice, B Tilmann, SA Maier, John B. Pendry, Riccardo Sapienza
Nature Physics, 19, 999-1002 (2023)

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Xiaobo YIN
The University of Hong Kong

Prof. Xiaobo Yin received his PhD from Stanford University in 2008 and is currently a Professor of Mechanical Engineering and Physics at the University of Hong Kong. He is a fellow of OSA and SPIE. Before joining the University of Hong Kong, he was the Bruce S. Anderson Faculty Fellow of the College of Engineering and Applied Sciences at the University of Colorado Boulder. His research focuses on nanostructured optical materials, radiative heat transfer, high-temperature materials, and scalable manufacturing. He authored and co-authored more than 100 journal publications and is one of the most highly cited researchers by Clarivate Analytics. His works have been featured in numerous media outlets including Nature, Science, Physics Today, Scientific American, the Economists, and Forbes. He was a recipient of the 2017 Moore Inventor Fellowships and the 2022 XPlorer Prize. His recent work on passive radiative cooling was named one of the top 10 breakthroughs of the year 2017 by the Institute of Physics (IOP) Physics World and the top 10 most reviewed news by The Economists.

Metamaterials for Sustainability

Micro/nanostructured materials offer new opportunities for high-efficiency devices and systems at the nexus of energy, water, and food. Fundamental understanding at the small scale enables us to design structures and materials with unprecedented performances. However, there is a tremendous gap between the proof-of-principle demonstration at small scale and the intrinsically large scale real-world thermal and energy systems. As one example, energy use for cooling and air conditioning is poised to increase dramatically over the next several decades driven by population, climate and economics. In this talk, I will give an overview on our research progress and, more specifically, present our recent development on thermal radiation control for large scale radiative cooling applications. We demonstrated the scalable manufactured micro-optical composites with extreme light-material interaction provides a 24/7 continuous cooling power of 110 W/m2 at no additional cost for electricity nor water. We show how a laboratory setup can precisely reproduce the standard atmosphere conditions and allows accurate calibration of all radiative cooling materials. In addition, we will present our recent development on how structured photonic materials promote photosynthesis and crop yield in greenhouses and beyond.

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Dangyuan LEI
City University of Hong Kong

Dangyuan LEI is a Professor in the Department of Materials Science and Engineering and Department of Physics (joint appointment) as well as Deputy Director of the Centre for Functional Photonics at the City University of Hong Kong, and was the Provost's Visiting Professor of Physics at Imperial College London. His research interest centers on the nanoscale and quantum photonics and ultrafast nonlinear optical spectroscopy of low-dimensional quantum photonic materials, with particular interest in the nanoscale cavity-enhanced light-matter interaction physics and applications in miniaturized optoelectronics, sensing, imaging, energy conversion and saving. He has published 260 journal papers, given 1 plenary talk, 10 keynote speeches and 140 invited talks, and received 15500 citations and an h-index of 72.

Electron Hopping Induced Phonon Pumping in Plasmonic Nanojunctions

We demonstrate plasmon-mediated phonon pumping, driven by inelastic electron hopping in conductive molecules, which results in strong Raman nonlinearity at the light intensities almost three orders of magnitude lower than in the conventional optomechanical systems and up to four-fold enhancement of the effective Raman polarizability due to vibrational electron-phonon coupling.

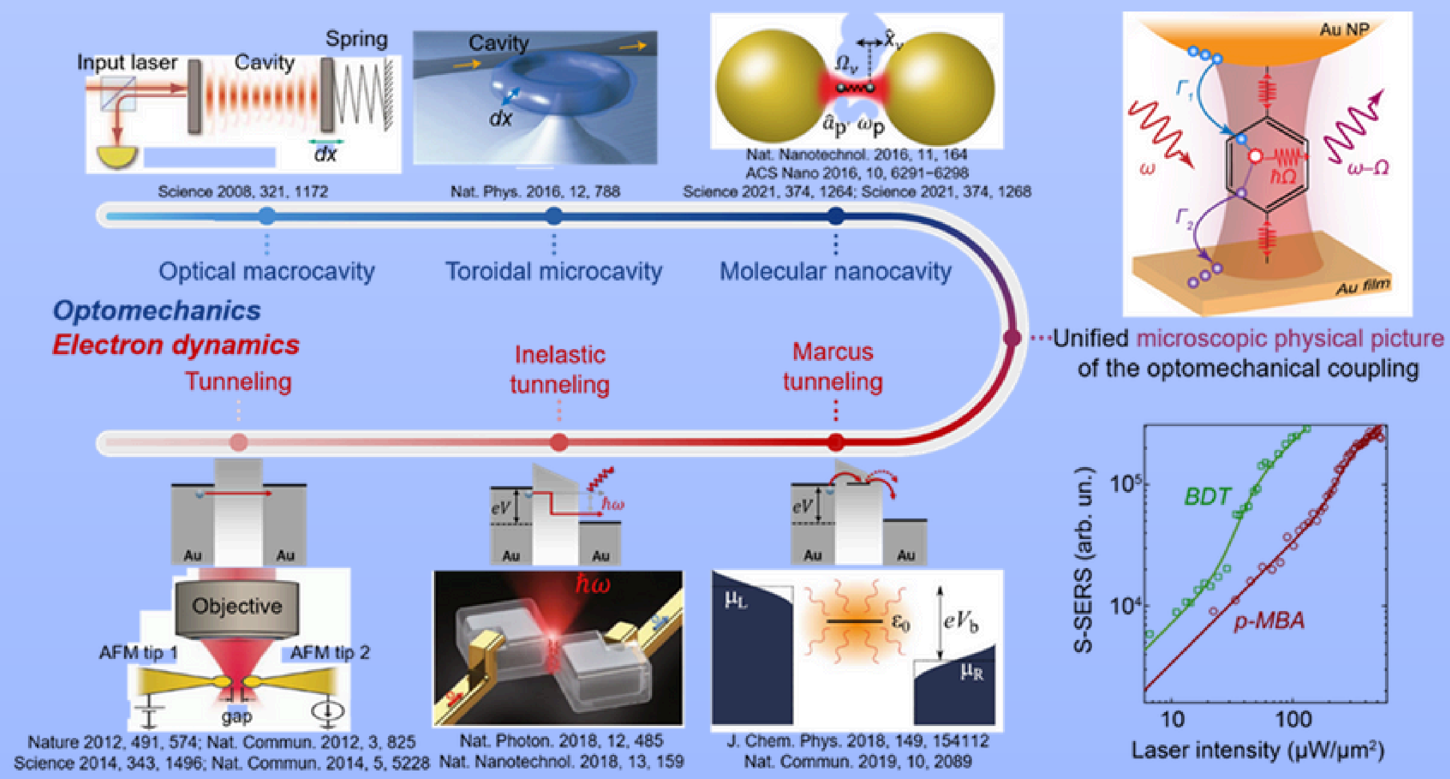

Fig. 1 Schematic overview of the research background and our new concept. The blue axis highlights key milestones in the development of optomechanics, with references to representative works. The red axis outlines significant advancements in the study of electron tunneling in nanoscale gaps, accompanied by notable references. On the right, we present the mechanistic illustration underlying this work, along with our main experimental data and corresponding theoretical fitting.

Reference:
[1] Bai, Y., Razdolski, I., Guan, Z., Tang, P., Liang, X., Srolovitz D. J., Zayats, A. V., Lei, D., 2025, Year. Electron hopping induced phonon pumping in optomechanical molecular nanocavities, arXiv:2501.01671v1 [physics.optics], https://doi.org/10.48550/arXiv.2501.01671

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Shuming WANG
Nanjing University

Shuming Wang, professor for School of Physics, Nanjing University, specializes in nanophotonics, metasurfaces (metamaterials), plasmonics, and quantum optics. He has received the National Science Fund for Distinguished Young and the Forth Jiangsu Youth Optical Science and Technology Award. Prof. Wang has authored more than 80 research publications, with more than 4000 citations.

Optical imaging based on metasurfaces

Ideal imaging technique simultaneously requires the three-dimensional (3D) high spatial-resolution and the high spectral-resolution. To date, while compact 3D imaging technique and spectrometer have been individually developed, the combination of these techniques has only been realized in cumbersome systems, significantly limiting their practical applications. A long-standing and critical challenge is how to integrate the 3D spatial-resolution and the spectral-resolution into a single nanophotonic device. Herein, based on the precise wavefront control of metasurface and deep-leaning algorithm, we experimentally demonstrate the first ultracompact spectral light field imaging (SLIM) camera. Owing to the high dispersion of metalens, both the 3D position information and the spectrum can be re-constructed without sacrificing the light throughput. The demonstrated spectral-resolution is as high as 4nm and the spatial-resolution reaches the diffraction limit, enabling the capability of SLIM in precise 3D imaging and material discrimination. Moreover, by using the end-to-end method, the real time facial recognition based on transversely dispersive metalens array has been achieved. By employing an inverse-design method, we demonstrate a pixel-level metasurface-based Bayer-type colour router, with the brightness twice as high as that of a commercial camera.

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Shengxian SHI

Shanghai Jiao Tong University

Professor Shengxian Shi received his Bachelor's degree and Master's degree from National University of Defense Technology and Central South University in 2002 and 2005, Respectively. He pursued further research and obtained his PhD degree from The University of Liverpool, UK in 2010. After that he joined Shanghai Jiao Tong University and continued this research on developing optical diagnostic techniques. Aiming for high-temperature, flow field and 3D geometry measurement for aeroengine, he focused on light-field based measurement techniques, and developed light-field particle image velocimetry, light-field multispectral thermometry. Intrigued by the compactness and multifunctionality of meta-lens, most of his recent efforts have focused on Meta-lens Particle Image Velocimetry and Dispersive Meta-lens Thermometry. His researches have been funded my NSFC (5), National Major Science and Technology Project on Aero Engines and Gas Turbines (2) and SJTU-AECC HAPRI projects. He composed book (Springer Nature) and published many journal papers on Advanced Materials, Journal of Fluid Mechanics, Optics Letters, Experiments in Fluids.

High-temperature Measurement with Dispersive Meta-lens

This talk starts with the significance of high-temperature measurement for aeroengine and challenges that faced by current method. It then unfolds how meta-lens would be a promising solution for space-limited scenarios by introducing dispersive meta-lens design, hyperspectral reconstruction and 2D temperature calculation algorithms. It will demonstrate a meta-lens based hyperspectral thermometry system, as well as temperature measurement results for black body (1673-2973K) and hydrogen impinging flame (1340~1440K). This talk will end with our early research outcomes on Meta-lens Particle Image Velocimetry and Meta-lens Digital Image Correlation.

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Gengbo WU

City University of Hong Kong

Gengbo Wu is an Assistant Professor with the Department of Electrical Engineering, CityU, Hong Kong. He is a member of the State Key Laboratory of Terahertz and Millimeter Waves (SKLTMW) at CityU. He has published more than 50 peer-reviewed journal papers. He was the recipient of Gold Model with Congratulations of the Jury and Gold Model in the 49th and 48th International Exhibition of Inventions Geneva in 2024 and 2023, and the IEEE Antennas and Propagation Society Fellowship (APSF) in 2022. His research interests include millimeter-wave and terahertz antennas, reconfigurable intelligent metasurfaces, spatiotemporal modulation technology, integrated sensing and communications.

Synthetic Moving Enabled by Space-Time Metasurface Antennas

While the global commercialization of fifth-generation (5G) wireless communications is gradually taking off, there is already significant interest in the next generation of wireless communications. 6G, which is scheduled to be launched in 2030, will provide a Tbps data rate, microsecond latency, and almost unlimited bandwidth for the connectivity of numerous mobile and intelligent networks. Antennas and metasurfaces are ubiquitous and indispensable components to generate and manipulate electromagnetic (EM) waves. In this talk, I will share the development and design of space-time metasurface antennas that can synthesize moving envelopes and hence control the radiated waves' properties. The space-time metasurface antenna can further facilitate information manipulation, which can fundamentally simplify the architecture of information transmitter systems. The unparalleled wave and information manipulation capabilities of the metasurface antenna will spark a surge of applications from next-generation wireless systems, cognitive sensing to imaging.

Chia-Hung CHEN
City University of Hong Kong

Prof. Chen focuses on developing integrative platforms for biomedical applications. Unlike conventional platforms that rely primarily on genetic sequencing for quantitative biology, integrative functional assays offer distinct advantages in rapidly characterizing biological samples for diagnostics and timely precision medicine. These platforms enable high-throughput screening and cell sorting, allowing the extraction of statistically robust data for effective quantitative biological analysis. For instance, Prof. Chen previously developed an intelligent system that combines imaging technology, multiplexed chemical sensors, and computational data analysis to evaluate small physiological samples and assess cancer progression in individual patients. Prior to joining City University of Hong Kong, he held research positions at the National University of Singapore and the Massachusetts Institute of Technology. He received his Ph.D. from the University of Cambridge, M.S. from Harvard University, and B.S. from National Taiwan University.

Living Metasurface Sensors via Microfluidics for Precision Medicine

Single-cell multidimensional analysis is advancing biomarker discovery and enabling precision medicine. However, achieving both high flexibility and throughput in single-cell secretion assays remains challenging. This thesis presents the Living Metasurface Immunosorbent Assay (LISA), a microfluidic platform for sensitive, high-throughput, multiplexed single-cell analysis. LISA captures cell secretions using molecular sensor–grafted cells encapsulated in droplets, followed by flow cytometry to profile cytokines and surface proteins for rapid deep phenotyping. The platform was validated using THP-1 cells, M1 macrophages, and dendritic cells by detecting IFN-γ, TNF-α, and CD13 under various stimulations. Stimulated peripheral blood mononuclear cells (PBMCs) exhibited diverse immune activation profiles. Notably, PBMCs from nasopharyngeal carcinoma patients showed a higher baseline frequency of cytokine-secreting cells ($2.82 \pm 1.48\%$) compared to healthy donors ($0.70 \pm 0.29\%$), supporting its potential for immune profiling and disease monitoring.

Takuo TANAKA

RIKEN, Japan

Takuo Tanaka is a team director of RIKEN. He received his PhD degree in 1996 from Osaka University. After that, he joined faculty of Engineering Science, Osaka University as an assistant professor. In 2003, he moved to RIKEN as a research scientist in Nanophotonics Laboratory. He was promoted to associate chief scientist in 2008 and to chief scientist in 2017. His research background is three-dimensional microscopy such as confocal microscope and two-photon microscope. Recently, he is studying about nanophotonics, plasmonics, and metamaterials fields with developing many new nanofabrication techniques. He has also experimental and theoretical experiences about high precision optical measurements and spectroscopy.

Three-dimensional metasurface for ultra-sensitive spectroscopic devices

Ultra-sensitive biomolecular sensing and identification technologies are becoming increasingly essential in our modern daily lives. Among the wide variety of available techniques, infrared (IR) absorption spectroscopy stands out as particularly promising due to its intrinsic label-free and noninvasive detection capabilities. However, practical applications are often hindered by weak signals, which stem from the inherently low IR absorption of natural substances and significant background noise from the surrounding environment. To address these limitations, we recently introduced metamaterial absorbers to enhance the sensitivity of infrared spectroscopy by minimizing unwanted background signals. By utilizing plasmonic-enhanced electromagnetic fields and plasmon-molecular coupling within the metamaterial absorbers, we achieved molecular sensitivity down to the attomolar level (10^{-18} mol). This was demonstrated through the use of self-assembled monolayers of 16-Mercaptohexadecanoic acid as a solid sample, which fully covered the surface of the device1). This sensing mechanism has also been successfully extended to liquid samples. Specifically, we developed a three-dimensional metal-insulator-metal (MIM) metasurface absorber that incorporates a nanofluidic channel with a depth of several tens of nanometers as the insulator layer2, 3). Using this hybrid metamaterial-nanofluidic device, analyte molecules are precisely introduced into the hot spot region of the metamaterial absorber, and due to the strong interaction between the molecules and the metamaterial, molecular sensitivity was achieved at a density of approximately 10^{-4} molecules/Å²—an improvement of 2 orders of magnitude compared to existing plasmonic-enhanced IR detection methods. As the next phase, we are focusing on applying this advanced sensing mechanism to gas samples. Since the signal strength from molecules depends critically on the density of hot spots within the metamaterial, we designed and fabricated a vertically aligned MIM (v-MIM) structure with a nanogap of 25 nm, as shown in Figure 1(a), to increase the density of hot spots4). Using this device, we successfully observed the absorption signals of butane and carbon dioxide at the bottom of the metamaterial absorber's absorption band. Moreover, as a physically durable and optically efficient structure, we propose a three-dimensional coaxial double-cylinder metamaterial, shown in Figure 1(b). This innovative metamaterial was applied to the detection of carbon dioxide and butane, which exhibit distinct C=O and $-CH_2$ vibrational modes at 4.35 μm and 3.39 μm, respectively. Thanks to the broad absorption band of the coaxial double-cylinder metamaterial, the characteristic peaks of these gases were clearly and effectively observed, as shown in Figure 1(c).

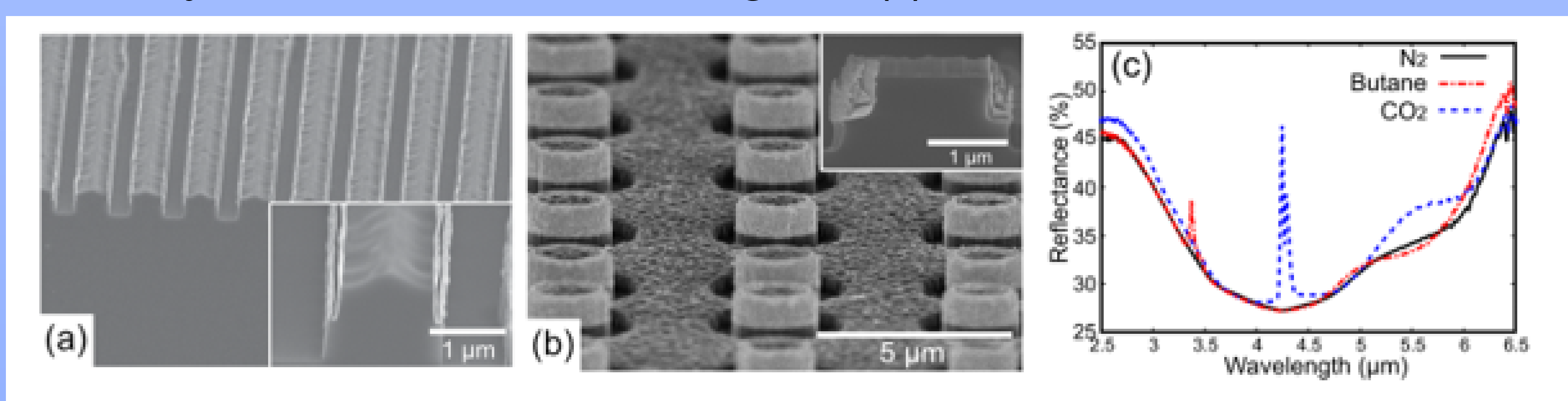

Figure 1 (a) v-MIM, (b) 3D coaxial double-cylinder metamaterial, (c) experimental results.

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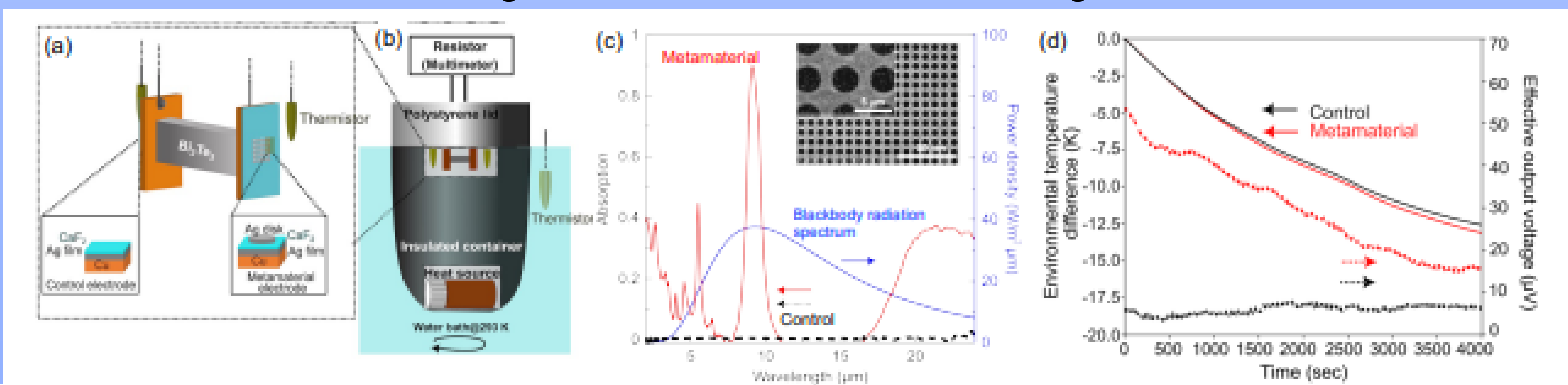
Wakana KUBO
Tokyo University of Agriculture and Technology

Wakana Kubo obtained her Ph.D. in Applied Chemistry from the University of Tokyo in 2006, focusing on the mechanisms of TiO2 photocatalysts and their applications. In 2007, she joined RIKEN, a national institute for basic science, as a postdoctoral researcher, where she began studying nanofabrication. She began her research in the field of plasmonics and metamaterials in 2010. In 2016, she joined the Division of Advanced Electrical and Electronics Engineering at Tokyo University of Agriculture and Technology (TUAT). Her current research interests lie in plasmonic energy harvesting and powering.

Nonradiative cooling

Radiative cooling is a key technology that reduces the temperature of sky-facing objects through radiative energy transfer between the objects and outer space at 4 K. However, this technology is not applicable when cooling objects and spaces surrounded by opaque absorbers. Here, we report a non-radiative cooling technology that can reduce the temperature of space surrounded by an opaque container. When a metamaterial-loaded thermoelectric device is placed in an opaque and sealed container, the metamaterial absorber absorbs the thermal radiation inside the container, and the thermoelectric element converts the thermal energy to electric current (Fig. 1(a, b)). The generated current flows to the resister placed outside the container, releasing thermal energy to free space as Joule heating. To the best of our knowledge, there is no literature reporting the cooling technology combined with the thermal gathering acquired by the MA and thermoelectric conversion. In this study, we demonstrate non-radiative cooling realized by metamaterial thermoelectric conversion and examine whether the nonradiative cooing occurs in an opaque and sealed container.
We used a MA consisting of a Ag film and Ag disk sandwiching a thin layer of calcium fluoride. Figure 1(c) shows the absorption spectra of the MA and control electrodes, and the blackbody radiation spectrum calculated at 311 K. The unbalanced absorptivity difference between the MA and control electrodes can induce an additional thermal gradient across the thermoelectric element, driving the thermoelectric conversion in an environment with uniform thermal radiation. Figure 1(d) shows the time dependence of the environmental temperature difference of the containers loaded with MA or control devices. The container with the MA device showed a faster reduction in the environmental temperature than the container with the control device, indicating that the non-radiative cooling is demonstrated.



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Shubo WANG
City University of Hong Kong

Dr Shubo Wang is an Associate Professor in the Department of Physics at City University of Hong Kong. He is interested in general wave physics including angular momentum, singular optics, non-Hermitian optics, metamaterials, photonic crystals, and optical forces. He has published ~60 papers in peer reviewed journals including Nature Communications, Science Advances, PNAS, and Physical Review Letters, among which some are selected as "Editors' Suggestion", highlighted as “Rising Stars in Photonics”, and received media coverage by EurekAlert, Phys.org, etc. He has delivered 24 invited/keynote talks at international conferences. He received the NSFC Excellent Young Scientists Fund and William Mong Outstanding Paper Award.

Pancharatnam-Berry phase induced by transverse spin

Pancharatnam–Berry (PB) geometric phase plays a crucial role in light manipulation by metasurfaces. Conventional PB phase arises from the polarization evolution of light and is fundamentally induced by the longitudinal spin of light. In this talk, I will introduce a new type of PB phase, which is induced by the intrinsic transverse spin of guided waves. We find that this new PB phase exhibits a remarkable directional property: it takes different values for the guided waves propagating in opposite directions, due to the spin-momentum locking associated with evanescent fields. Importantly, this type of PB phase can also emerge in scalar waves, such as sound waves, which, according to conventional wisdom, cannot carry PB phase due to their spin-0 nature. By leveraging the transverse-spin-induced PB phase, we design metasurfaces to control surface wave propagation in both optical and acoustic systems, enabling nearly arbitrary wavefront manipulations such as steering and focusing. Our work provides a novel mechanism for on-chip light/sound manipulation, with potential applications in designing ultra-compact optical and acoustic devices.