June 16, 2023 (Friday)	
Session 1 (10:00 – 12:00)	
Speaker and Oral topic	Abstract
Takashige Omatsu Nano/micro fabrication with light fields possessing angular momentum	We review optical vortex nano/micro fabrication, in which the chirality of fabricated structures is selectively controlled by controlling the handedness of an irradiating optical vortex laser beam. Also, we address the enantioselective control in chiral crystallization with a high crystal enantiomeric excess of >50%. The optical vortex nano/micro fabrication will offer new fundamental insights into the enantioselective control of engineered materials.
Ken-ichi Yuyama Formation and manipulation of liquid microdroplets by optical forces	Two laser-induced phenomena on liquid microdroplets are presented. One is the formation of a core-shell droplet. Upon focusing a near-infrared continuous-wave laser onto a thermo-responsive ionic liquid/water solution, a single core-shell droplet is formed at the focal spot. Another one is the microprinting of liquid droplets. Optical vortex laser illumination to a viscous liquid film induces ejection of a spinning microdroplet. The ejected droplet is transferred to a receiver substrate, enabling 2-dimensional high-definition printing. The mechanism of these phenomena is discussed in view of generation of optical forces and laser heating.
Kyoko Masui Microstructure fabrication of metal nanoparticle/polymer composite assisted by two-photon polymerization	Polymer-based nanocomposites are materials in which nanometer-sized particles are dispersed and fixed in a bulk-sized polymer. Since the optical properties and shape of the nanoparticles are preserved in the polymer, the fabricated structures combine the properties of the nanoparticles with the mechanical and functional properties of the polymer. We have established a method to fabricate microstructures of gold nanorod/polymer composites assisted by two-photon polymerization reaction. By femto-second laser irradiation, the two-photon polymerization reaction occurred only at the surface of gold nanorods based on the localized surface plasmon resonance. By continuous irradiation of laser light, the polymer-wrapped nanorods were aggregated at the focal spot and the polymerized resin worked as glue to adhere each other, resulting in a unique mechanism of gold nanorods aggregated microstructure formation. This method has a potential to create plasmonic optical materials into desired microstructures by controlling the alignment of gold nanorods.

June 16, 2023 (Friday)	
Session 2 (12:10 – 13:30)	
Speaker and Oral topic	Abstract
Yit-Tsong Chen Nanomaterial-Based Optoelectronic Devices for Light Emission and Photo Detection	Nanomaterials with a wealth of exotic dimensional-dependent properties are promising candidates for next-generation optoelectronic devices. In this talk, the spectroscopic, optical, and electrical characterizations of some two-dimensional nanomaterials and their utilization in optoelectronic devices will be presented. The phonon modes of chemical vapor deposition (CVD)-grown **CdSe** nanobelts were observed by surface-enhanced Raman scattering (SERS) spectroscopy. A blue-shift of 2.4 cm^{-1} for the longitudinal optical (LO) phonon of CdSe nanobelts, relative to bulk CdSe, is attributed to a lattice contraction in the nanostructure. Room-temperature photoluminescence (PL) at ~1.74 eV from a single CdSe nanobelt shows a 3-fold enhancement compared to that from bulk CdSe powder, indicating the illuminating capacity improved by structural crystallinity. The epitaxial growth of a bilayer *p*-MoS_2/*n*-MoS_2 vertical heterostructure was carried out in a stepwise temperature-controlled CVD reaction. The *p*-MoS_2/*n*-MoS_2 was further transferred on top of a bilayer *p*-GaN to form a tetralayer (4L) ***n*-MoS_2/*p*-MoS_2/*p*-GaN** heterostructure, which emits electroluminescence (EL) in a forward bias voltage. The EL, composed of three colors at 481 nm (from *p*-GaN), 525 nm (from *p*-MoS_2), and 642 nm (from *n*-MoS_2), grants the ultrathin 4L *n*-MoS_2/*p*-MoS_2/*p*-GaN an excellent building block for a white light-emitting diode with the white color purity of CIE (0.41, 0.41). **$ReSe_2$** nanosheets-fabricated light-emitting transistors (LETs) exhibit nearly symmetric ambipolar characteristics in electrical transport. Judicious selection of asymmetric Pt/Cr electrodes, with their work functions matching respectively the conduction- and valence-band edges of ambipolar $ReSe_2$, generates a low turn-on voltage $ReSe_2$-LET with the balanced number density and field-effect mobility of bipolar carriers (i.e., electrons and holes). This $ReSe_2$-LET emits near-infrared EL of 980 nm at room temperature under a bias voltage of <1 V. Taking one step further, we will integrate this nanoscale $ReSe_2$-LET with photonic crystal cavities to construct a 980-nm nanolaser. The electrically pumped nanolaser is eligible for a wide range of on-chip optoelectronic applications, e.g., data communication and processing, photonic quantum control, molecular sensors, etc.

	For photo detections, few-layered InSe field-effect transistors (FET) are capable of conducting broadband photodetection from the visible to near-infrared region (450−785 nm) with high photoresponsivity (12.3 A W-1 at 450 nm), excellent detectivity (1.07×1011 Jones), and fast photoswitching. In addition, the p-SnS/n-MoSe2 vertical heterojunction exhibits a sharp and highly symmetric anti-ambipolar transfer curve at 77 K with the peak-to-valley ratio of 103 operating under a low bias voltage of 1 V. This anti-ambipolar cryo-transistor, holding a broad response in the spectral range of 250−900 nm at 77 K with the high photoresponsivity (2×104 A W−1) and detectivity (7.5×1013 Jones) under the 532-nm excitation, can be used for the multi-valued logic circuits performed in cryogenic conditions.
Shun-Jen Cheng Light-matter interactions between twisted lights and excitons in 2D materials	A twisted light is a spatially structured light that carries quantized orbital angular momenta (OAM), being a new degree of freedom in addition to that of intrinsic spin angular momentum (SAM), i.e., polarization. Unlike SAM, the optical OAM of a twisted light exist in an unbounded set of helical modes and pave a new way to boost the prospective higher dimensional quantum systems, i.e. qudits. Transition-metal dichalcogenide monolayers (TMD-ML's) are known as an excellent optoelectronic 2D materials with excellent exciton effevts and superior light-matter interaction. Using a SAM-OAM-encoded twisted light to excite valley excitons in TMD-ML's sets up an intriguing photoexcited system which couples comprehensively the excitonic and photonic multi-degrees of freedom, including the center-of-mass motion and valley polarization of exciton and the both optical OAM and SAM. In this talk, I will present our recent comprehensive theory-experiment-joint investigations of the intriguing light matter interactions between twisted lights and valley excitons of TMD-MLs.

June 16, 2023 (Friday)	
Session 3 (16:00 – 17:20)	
Speaker and Oral topic	Abstract
Ting-Hua Lu Structured light- 2D materials interaction: Exploring their optical properties	Recent studies on controlling valley polarization in layered transition metal dichalcogenide (TMD) materials have gained significant attention due to the potential applications of valleytronics devices. The tunable bandgap of layered TMD materials, along with their distinctive electronic, optical, and mechanical properties, make them highly promising for a wide range of applications, including transistors, sensors, and photovoltaics. Monolayer molybdenum disulfide (MoS2) exhibits an optical bandgap of 1.8eV and a valley degree of freedom that can be modulated through circularly polarized light or strain engineering, making it a material with distinctive characteristics. While circularly polarized light or strain engineering can alter the valley degree of freedom in monolayer MoS2, it remains difficult to achieve precise control over its spin behavior via these approaches. To address this challenge, researchers are exploring new techniques to manipulate the spin properties of MoS2, such as using magnetic fields, electrical gating, or hybridizing with other materials. Our study aims to examine the captivating phenomenon that arises when the structured light possessing orbital angular momentum (OAM), a previously unexplored degree of freedom, interacts with layered MoS2. The establishment of the orbital angular momentum of light as light sources for excitation was made possible by using a spatial light modulator in combination with an optical measurement system, which allowed for the measurement of optical and electrical properties for TMD materials. The interaction between OAM light and MoS2 materials will be discussed with regards to the responses observed in photoluminescence and Raman spectroscopy, as well as electric measurements. Insights gained from this study can enhance the capability to manipulate spin properties of TMD materials, thereby opening up new possibilities for spin-based optoelectronics.
Yann-Wen Lan Twisted light interacts with nanomaterial transistor - electrical properties	In this talk, I will introduce twisted light, nanoelectronics, and the novel discoveries resulting from their interaction. Twisted light refers to light beams with orbital angular momentum. Nanoelectronics utilize nanomaterials to fabricate and exhibit improved performance. The interaction between twisted light and these devices has led to exciting findings. Twisted light can manipulate electronic properties, control charge transport, and induce unique optical effects in nanoscale devices. These discoveries open new avenues for utilizing twisted light as a degree of

	freedom in nanoelectronic devices. This research holds promise for advancing photonics, optoelectronics, and information processing. The study of twisted light in nanoelectronics provides new insights and opportunities for enhancing the performance of nanoscale electronic systems.

June 17, 2023 (Saturday)	
Session 1 (09:00 – 10:40)	
Speaker and Oral topic	Abstract
Atsushi Taguchi Inverse photonic design as a tool for structured light science	Structured light is an emerging topic in advanced laser technology due to its intriguing light-matter interaction. However, the inherent complexity of the electromagnetic field associated with structured light poses challenges in creating suitable nanostructures to control structured light at the nanoscale. Here, using an inverse design technique, we demonstrate a new class of nanoantenna structures, which can efficiently couple circularly polarized light of a specific handedness while achieving a significant field enhancement. The designed structure exhibits a pronounced chiral dissymmetry, where the field at the nanogap is strong for a particular handedness of circularly polarized incident light, but not for the other. I also discuss the potential application of the inverse design technique in controlling chiral light-matter interaction.
Hao-Tse Su Optical trapping-induced enantioselectivity switch in chiral crystallization of NaClO3 using gold nanoparticles	Our research group has experimentally demonstrated crystallization and polymorphic controls for various organic and inorganic compounds using this optical trapping method and has called this method "optical trapping-induced crystallization (OTIC)". In this study, we use various sizes of gold nanoparticles (Au NPs) ranging from 10 to 250 nm and perform experiments to realize enantioselectivity control in the chiral crystallization of NaClO3 using the OTIC method. When a 1064 nm continuous-wave circularly polarized laser beam at 1.0 W was focused on the air-solution interface of a NaClO3 aqueous solution including Au NPs, NaClO3 crystallization was triggered in a few seconds to minutes. The generated crystal showed crystal birefringence, suggesting that laser irradiation first produced the achiral metastable NaClO3 crystal. When the generated crystal was further irradiated with the focused laser beam, the crystal birefringence decreased significantly, indicating a polymorphic transition from the achiral crystal to the chiral crystal showing no birefringence was triggered. The results show a significant imbalance in the generation probability of enantiomorphs (crystal enantiomeric excess (CEE) value of 37%). One of the most critical results is that the dominant handedness of the generated chiral crystals is switched by simply changing the size of Au NPs. In the presentation, the

	mechanism of this enantioselectivity switch will be discussed in terms of 3D helical optical force depending on the size of Au NPs.
Po-Wei Yi Multilayer Assembly Formation of Lysozyme at Solution Surface by Optical Trapping of Gold Nanoparticle	Optical trapping is a technique for manipulating small particles in the solution by a tightly focused laser beam. Our group has demonstrated disk-like assembly of lysozyme solution under laser irradiation at the solution surface. A white ring resembling the border of the assembly was observed in the transmission image and it expanded with irradiation time.1 Yet, a systematic examination from various viewpoints, such as optical, fluidic, or thermal, is needed to fully address the formation mechanism of this phenomenon. In order to investigate the thermal effect on the lysozyme assembly formation, we employed 200 nm gold nanoparticles as a heat source due to its high photothermal conversion efficiency. Upon laser irradiation, concentric layers are sequentially formed in an assembly. The outer layer rapidly expanded while the inner layer remained similar. We found that the characteristic multilayer assembly arises from the sequential arrival of Au NPs which are pumped up from the bottom to the surface by the trapping laser. The timing of new layer formation matches with the arrival of next Au NP. Once the trapping laser is turned off, the layers shrank and disappeared sequentially. By adjusting the Au NPs concentration, the number of multilayers can be controlled to two layers with the present time scale. The concentration difference between different layers will be examined via fluorescence image and Raman spectroscopy and the formation mechanism will be discussed.
Chih-Hao Huang Dynamically evolving assembly of gold nanoparticles formed by optical trapping at glass/solution interface	In the late 20 century, Dr. Ashkin explored and established the utilization of photon pressure for manipulating microscopic objects, which is known as optical trapping. Until now, optical trapping has been used in various research from fundamental physical studies to biological applications. Gold is a fascinating material for studying optical manipulation due to its strong light-matter interaction arising from the surface plasmon resonance. Such property not only provides distinct responses to light depending on size and shape, but also can be applied to other fields like Surface Enhanced Raman Spectroscopy and drug delivery. In this study, we present the formation of a single assembly of fluctuating gold nanoparticles (Au NPs) by optical trapping at the upper glass/solution interface. The assembly directionally evolves and forms two swarms of NPs outside the focal spot where the trapping laser is not

	irradiated. This observation attracts our attention because, in principle, optical forces should be generated within the space of light illumination. We have investigated this phenomenon from several aspects. With linearly polarized light, the assembly evolves in the direction perpendicular to the linear polarization, while it evolves in an isotropic fashion when the circular polarization is used. Furthermore, the assembly only evolves outside when the trapping laser wavelength matches the dipole scattering band of the Au NPs. The single particle tracking analysis reveals that optical binding force, an interparticle force arising from scattered light, not only aligns the Au NPs inside the focal spot, but also exists between the irradiated and non-irradiated NPs. The possible light scattering routes increase with increasing particle number, expanding the optical binding network outside the focus. Overall, we consider the Au NPs, scattered light, and the optical potential dynamically evolve outside the focal spot, eventually leading to the swarming assembly.

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Gaussian beam formation for variety Laser pattern</td></tr>
<tr><td colspan="2">Jung-Chen Tung
Investigating the generation and propagation evolution
of multiple orange optical vortices
using frequency-doubled Nd:YVO4/KGW Raman lasers</td></tr>
<tr><td>Speaker and Oral topic</td><td>Abstract</td></tr>
<tr><td>Pi-Hui Tuan
Stable pulsed operation of Lissajous structured beams by a passively Q-switched concave-convex resonator</td><td>A Nd:YVO4 passively Q-switched (PQS) laser with a symmetric concave–convex cavity ensuring strong intracavity beam focusing on the absorber is designed for stable pulsed operation of Lissajous structured modes with transverse patterns as Lissajous figures. Setting the cavity length to fulfill the criterion for efficient passive Q-switching, as well as to meet the accidental degenerate conditions, Lissajous pulsed beams with well-defined structures and good temporal stability are created under two-dimensional off-axis pumping. Although the multi-transverse-mode oscillation inevitably induces asynchronous pulsation and leads the short-term pulse profiles to reveal parasitic effects, the overall long-term behavior of Lissajous pulses can be kept regular with amplitude fluctuations ≤15% and pulse-to-pulse timing jitter ≤5%. With the maximum peak power exceeding 500 W at a pump power of 4.5 W, the PQS Lissajous modes are further transformed into trochoidal pulsed beams to realize high-order and high-peak power structured vortex fields.</td></tr>
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