Science Map 2025

pLED Institute of Post-LED Photonics, Tokushima University

※ Yellow = Previous research content Green = Current research content.

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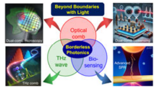
Web

Wavelength (μm): 1000 — 100 — 10 — 1 — 0.1 — 0.01 — 0.001

Terahertz
(100 μm–1 mm)

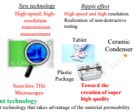
The terahertz region, characterized by a longer wavelength compared to that of visible light, is widely recognized as the "final frontier" of electromagnetic waves, with continuous progress in its development. Its ability to penetrate solid objects has garnered attention as a potential source of light for applications such as non-destructive inspection of infrastructure and detection of foreign substances in food.

Chief Research Officer (CRO) / Professor YASUI Takeshi



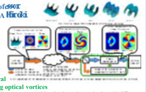
THz, Optical Comb, Medical Photonics
Borderless photonics of THz, optical comb, and medical photonics driving seamless light innovation.

Associate Professor TOKIZANE Yu



Non-destructive terahertz wave
Development of novel measurement technology
Development of non-destructive measurement technology that takes advantage of the material permeability of terahertz light, the spectroscopic ability to distinguish materials, and the safety towards the human body

Associate Professor KISHIKAWA Hiroki



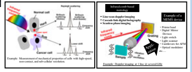
Research on high-capacity optical communication technology using optical vortices
Optical vortices are beams with orbital angular momentum (OAM) and orthogonal to each other with different azimuthal orders. It is expected to increase the capacity of optical communications by using OAM multiplexing. The spiral phase front characterizing optical vortices is shown in Fig. 1. In free-space optical wireless communication, optical vortices are distorted by atmospheric turbulence. This study investigates methods to evaluate and compensate for the effects of phase fluctuations caused by turbulence during atmospheric propagation of optical vortices.

Professor HOSAKA Keiichi

Interdisciplinary Research of Minimally Intervention Dentistry and Photonics
Dental caries affects all ages, and resin composite is key for its aesthetic and mechanical benefits. Effective adhesion is vital for creating a durable 'super-tooth' interface. Using biocompatible adhesives and photonics, we aim to investigate this interface's mechanics, aiming to innovate minimally invasive treatments that benefit everyone from children to the elderly, while mitigating economic impact.

Designated Assistant Professor HASE Eiji

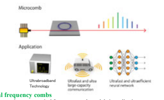
Measuring mechanical properties of biological materials
Development of Brillouin scattering microscope based on frequency combs and application for the measurement of mechanical properties of biological materials.
Application of infrared combs to industrial measurement
Development of infrared comb-based measurement techniques for industrial measurements, such as MEMS devices.



Infrared
(0.7 μm–100 μm)

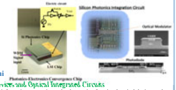
Given its ability to serve as a highly accurate ruler when shone upon objects, the utilization of this technology in the realm of healthcare is anticipated, particularly in areas such as diagnostic evaluations based on the analysis of breath components.

Professor KUSE Naoya



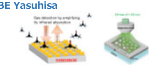
Microresonator optical frequency combs
Development of cost-effective and compact optical frequency combs and their applications to ultrabroadband wireless/optical communications and photonic computing.

Professor FUJIKATA Junichi



Functional Optical Devices and Optical Integrated Circuits
We are researching optical information processing technology using functional optical devices and optical integrated circuits to realize high-speed and high-capacity communications and neural network computing. Furthermore, we are researching optical and THz-waves seamless-connection technology for Beyond5G next-generation information communications to realize low-carbon and secure network society.

Designated Assistant Professor ABE Yasuhisa

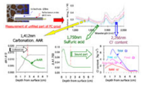


Promotion of social implementation for ultra sensitive optical sensor by developing nanostructure materials
We are aiming to construct the elemental technologies of optical devices and putting into practical use.

Professor TAKAYAMA Tetsuji

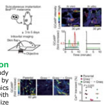
Development of novel endoscopic diagnosis and phototherapy methods for cancer using special light
Development of fluorescent probes targeting molecules specifically observed in cancer cells, development of molecular imaging diagnostic methods, and creation of novel light therapy that cauterizes only cancer cells

Professor UEDA Takao



Health diagnosis of infrastructure concrete structures using near-infrared spectroscopy
Internal erosion of salt and sulfuric acid, one of the causes of aging of concrete, is measured by spectroscopy using near-infrared light to quantify the risk of collapse

Prof. Kenta Terai



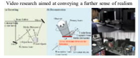
Live-imaging with two-photon
We use two-photon microscopy to study disease pathophysiology in live mice by imaging neuronal and vascular dynamics in real time. This technique, coupled with fluorescent probes, helps us visualize target cells and molecules.

Visible light
(400 nm–700 nm)

The electromagnetic waves that we commonly experience as "light" can be perceived as colors by the human brain, the hue of which varies as a function of its wavelength.

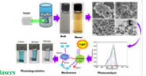
Professor YAMAMOTO Kenji

Video research aimed at conveying a further sense of realism



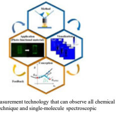
Immersive and stereoscopic images
Various research and development are being conducted for images that give a sense of realism, but among them, we are researching shooting technology, information processing technology, and display technology with a focus on stereoscopic images. Regarding photography techniques, we are conducting research on a camera for light field photography that can capture images in natural colors. Regarding display technology, for example, we are researching displays that use holography, and we are working on making it possible to display moving images that could previously only be displayed as still images.

Professor KOINKAR Pankaj Madhukar



Nanomaterials by high-intensity lasers
Synthesis of two-dimensional nanomaterials is performed with pulsed laser ablation technology
We aim to control integrated two-dimensional materials and apply them to energy-related devices, such as optoelectronics and photocatalysts, utilizing metal nanostructures

Associate Professor KATAYAMA Tetsuro



Elucidation of reaction mechanisms by spatio-temporal spectroscopy
Development of spatio-temporal spectroscopic measurement technology that can observe all chemical species by combining pump probe measurement technique and single-molecule spectroscopic measurement technique that can enable direct observation of chemical reactions.

Professor YAMAMOTO Tetsuya

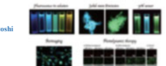
AI-Driven 3D Agents with Volumetric Projection for Interpersonal Support
Continuously interactive and customizable, with potential applications in industry, healthcare, education, and welfare.

Co-CRO/Professor YASUTOMO Koji / Assistant Professor TSUKUMO Shin-ichi

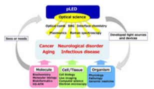
Detection of biomolecules using new light technology
Elucidation of disease mechanisms by analyzing pathological mice models based on genetic analysis of immune and inflammatory diseases in humans and mice, and development of optical devices that can detect blood molecules correlated with the pathological conditions

Associate Professor YAGISHITA Fumitoshi

Exploring the optical function of pi-electron organic molecules
Development of highly luminescent organic molecules that can be applied to displays, solid-state lasers, bioimaging, and photodynamic therapy, and chiroptical materials with circularly polarized luminescence that can be applied to 3D displays and security inks.



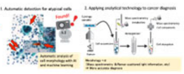
Associate Professor SAKANE Ayuko



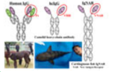
Basic research aimed at elucidating disease pathogenesis and creating optical devices leading to innovative diagnoses and treatments
Aiming to elucidate the pathogenesis of various diseases, we develop new integrated research with photonics scientists, and promote the development of new light sources and devices.

Professor TSUNEYAMA Koichi

Research and development of new cancer diagnosis technology
Establishment of auxiliary morphological diagnosis methods combining AI and machine learning, and development of rapid diagnostic methods for heteromorphic cells using Raman scattered light analysis/mass spectrometry with the aim of improving the quality of cancer diagnosis



Associate Professor MURAKAMI Akikazu

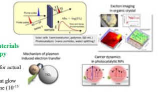


Development of Next-Generation Antibodies
This research focuses on the development of diverse next-generation antibodies, including VHHs, VNARs, human single-domain antibodies, and human scFvs. In particular, advanced phage display technology is employed to establish antibody selection systems based on library methods that do not require animal immunization. This strategy enables the efficient generation of antibodies with high affinity and specificity, promoting their application in diagnostic and therapeutic fields.

Co-CRO/Professor YASUTOMO Koji / Assistant Professor OTSUKA Kunihiro

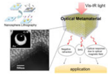
Elucidation of the pathogenesis of intractable diseases and development of new diagnostic and therapeutic methods
Our goal is to clarify the pathogenesis of diseases that are difficult to diagnose and treat, such as autoimmune diseases, cancer, and infectious diseases, at the molecular level, and to apply to medical treatment by integrating it with the new technology of Institute of Post-LED Photonics.
【Research theme】
1. Identification of autoimmune disease-specific molecules and development of new diagnostic and therapeutic methods based on single-cell transcriptome analysis
2. Elucidation of the pathogenesis of COVID-19 and development of new diagnostic and therapeutic methods
3. Elucidation of the pathogenesis of intractable diseases by Raman spectroscopy and development of new diagnostic methods.

Professor FURUBE Akihiro



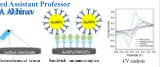
Optical functional nanomaterials
Advanced laser spectroscopy
Development of a time-resolved spectroscopy system specialized for actual device measurements based on a femtosecond laser light source that glow only for a very short period of time (10^{-13} seconds)

Associate Professor OKAMOTO Toshihiro



Metamaterial development
Development of metamaterial fabrication technology that combines nano processing and mass production
Elucidation and application development of novel phenomena derived from metamaterials
Elucidation of novel phenomena such as negative refractive index, optical magnetism, and complete light absorption, and the application to various sensors

Designated Assistant Professor SHARMA Abhinav

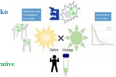


Development of electrochemical/electrochemiluminescence (ECL) biosensor for the detection of cardiac troponins and inflammatory marker (CRP) with improved sensitivity in biological fluids.
Hybrid nanostructures combined with a sandwich immunocomplex significantly enhance the sensitivity of biomarker detection. Electrochemical sensors are highly efficient, offering rapid response, simple operation, ease of miniaturization and direct electrical readout make them especially well-suited for point-of-care (POC) diagnostics.

Ultraviolet / deep ultraviolet / X-ray
(1 pm–380 nm)

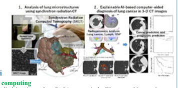
The deep ultraviolet region is anticipated to play a central role as the successor to mercury lamps in the treatment and sterilization of water. Efforts are underway to realize a prolonged lifespan through the suppression of internal crystal defects in LED technology, and to exploit this capability in innovative ways across a wide range of fields, including medicine, air purification, and cellular research.

Professor NOMAGUCHI Masako



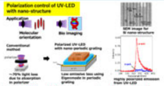
Promotion of medical and optical collaborative research in the field of viral infections.
We tackle to create a fundamental technology for "visualization" and "detection" of viruses by combining virology and optics.

Professor KAWATA Yoshiki



Medical imaging and computing
This field is related to medical imaging and medical image analysis. We are working on three-dimensional CT image processing algorithms, which are the core computer-aided technology mainly based on three-dimensional CT images, and high-performance computer-aided technology that supports lung cancer detection, differential diagnosis, and prediction of malignancy and prognosis from three-dimensional CT images.

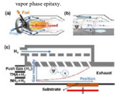
Professor NAOI Yoshiki



Development of multifunctional LEDs and light sensors using sub-wavelength nanostructures
Development of an integrated LED/optical sensor device focusing on single-layer sub-wavelength nanostructures having a period slightly smaller than the wavelength of light for the wavelength range of ultraviolet to visible light.

Associate Professor NAGAMATSU Kentaro

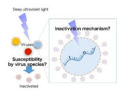
High-temperature growth is realized by imitating jet engine gas flow metalorganic vapor phase epitaxy.



Development of an ultra-high temperature MOVPE for deep UV LEDs and a novel microscope for observing crystal defect
We aim to realize deep UV LEDs at a long lifetime by suppressing crystal defects.

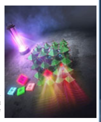
K. Nagamatsu *et al. Scientific Reports*, **12** (2022) 7662,

Research Professor KOMA Takaaki



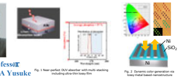
Virus inactivation using deep ultraviolet light
We will elucidate the mechanism of virus inactivation by deep ultraviolet light and conduct research on differences in inactivation effects based on virus type.

Professor OISHI Masatsugu



Development of ceramic phosphors
Researches on the environmentally friendly-energy conversion devices such as fuel cells, storage batteries and solid-state lightings, with the goal of contributing to the global environmental problems.

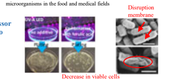
Assistant Professor TAKASHIMA Yusuke



Deep ultraviolet to visible photonic devices with lossy meta-surfaces
Photonic devices utilizing optical resonance in highly lossy materials-based meta-surfaces were developed for deep ultraviolet (DUV) to visible (VIS) wavelength region. Utilizing the resonances lossy material-based nanostructures and multi stackings, we demonstrated many unique applications, such as near perfect DUV absorbers with 17 nm highly lossy ultra-thin film. Moreover, dynamic control of ultra-wideband structural colors and colorimetric refractive index sensor were realized (Fig. 2).

Associate Professor SHIRAI Akihiro

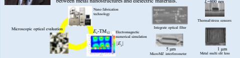
Sterilize with UV plus α
Sterilizing power can be improved with UV plus α (substances with weak antibacterial activity, addition of low concentrations of antimicrobial agents)
Synergistic sterilizing power with light plus natural products
Used to control pathogenic microorganisms and spoilage-causing microorganisms in the food and medical fields



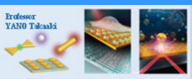
Research involving a wide range of wavelengths

Co-CRO/Professor HARAGUCHI Masanobu

Realization of new optical devices using functions derived from nanostructures
Realization of new compact optical devices for sensing, light control, etc. using optical localization and the electric field enhancement at the interface between metal nanostructures and dielectric materials.



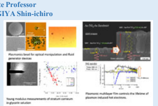
Professor YANO Takaaki



Development of nanoscale optical devices/structures for highly sensitive optical sensing and imaging
Plasmonics and metamaterials for nanoscale manipulation of light in DUV, visible, infrared and THz regions

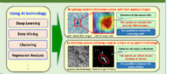
Associate Professor YANAGIYA Shin-ichiro

Physical properties of medical nanomaterials
Development of photothermal composite-materials and devices for nanosurgery applications.



Research in collaborative fields

Professor SHISHIBORI Masami



Development of multimedia systems utilizing AI technology
Development of intelligent multimedia systems such as cytology systems that detect cancer cells from medical images (cell images) using AI technology, and detection systems of foreign objects in food using optical technology and deep learning model.