

## Modules (optical computing, video, communication, light source)

**Co-CRO/Professor HARAGUCHI Masahito**  
Realization of new optical devices using functions derived from nanostructures  
Realization of new integrated optical devices for sensing, light control, etc. using optical localization and the electric field enhancement at the interface between metal nanostructures and dielectric nanostructures.

**Professor FUJIKATA Junichi**  
Functional Optical Device via Optical Integrated Circuit  
We are researching optical information processing technology using functional optical devices and optical integrated circuits to realize high-speed and high-capacity communication and neural network computing. Furthermore, we are researching optical and THz-wave sensor-construction technology for the next-generation information communication to realize low-noise and secure network society.

**Associate Prof. DR. KISHIKAWA Hiroaki**  
Research on high-capacity optical communication technology using optical vortices  
Optical vortices are beams with angular momentum (OAM) and are understood to exist with different azimuthal orders. It is expected to increase the capacity of optical communication by using OAM multiplexing. The novel beam-like observational optical vortices to form a vortex optical communication system are constructed as desired by structure fabrication. This study aims to realize optical vortices and to demonstrate the optical vortex beam formation method by changing angular momentum of optical vortices.

**Assistant Professor TAKASHIMA Yasuko**  
Deep ultraviolet to visible photonic devices with lower meta-surfaces  
Photonic devices utilizing optical resonance in highly lossy materials-based meta-surfaces were designed for deep ultraviolet (DUV) to visible (VIS) wavelength region. Utilizing the resonance layer material-based nanostructures and metal stacking, we demonstrated easy surface applications, such as near perfect DUV absorbers with 71 nm highly lossy aluminum film. Moreover, dynamic control of ultra-ultraviolet resonant colors and colorless reflective index sensor were realized (Fig. 2).

**Associate Professor NAGAMATSU Kentaro**  
Development of an ultra-high temperature MOVPE for deep UV LEDs and a novel microscope  
We aim to realize deep UV LEDs as a long lifetime by suppressing crystal defects.

## Inspection (sensing and imaging)

**Chief Research Officer (CRO) / Professor YASUI Takekichi**  
THz Optical Comb  
Medical / Industrial  
Barcode photos of THz optical comb, and medical phenomena driving optical communication.

**Professor UEDA Takao**  
Health diagnosis of infrastructure concrete structures using near-infrared spectroscopy  
Internal structure of cables and metallic rods, one of the causes of aging of concrete, is measured by spectroscopy using near-infrared light to quantify the risk of collapse.

**Professor SHIMBORI Masam.**  
Development of multimedia systems utilizing AI technology  
Development of multimodal multimedia systems such as clothing systems that detect cancer cells from medical images (real images) using AI technology, and detection systems of foreign objects in food using optical technology and deep learning model.

**Associate Professor OKAMOTO Toshihiro**  
Material development  
Development of new optical communication technology that combines non-destructive and mass production.  
Elucidation and application development of novel phenomena derived from metamaterials.  
Elucidation of novel phenomena such as negative refractive index, optical invisibility, and complete light absorption, and their applications in various areas.

**Professor YAMAMOTO Kenji**  
Video research aimed at acquiring a faster sense of motion  
Immersive and stereoscopic images  
Various research and development are being conducted for images that give a sense of motion, but among them, we are researching shooting technology, information processing technology, and display technology with a focus on stereoscopic images. Regarding photography technology, we are conducting research on a camera for light field photography and stereoscopic dynamic images. Regarding display technology, for example, we are researching displays that use holography, and we are working on making it possible to display images that could previously only be displayed as still images.

## Fundamentals (Engineering)

**Professor FURUE Akhiro**  
Advanced functional nanomaterials  
Advanced laser spectroscopy  
Development of a three-wavelength spectroscopy system specialized for actual distance measurements based on a laser-based line-of-sight measurement system. It is used only for a very short period (less than 100 μs).

**Associate Professor KATAYAMA Tamara**  
Elucidation of reaction mechanism by space-temporal spectroscopy  
Development of space-temporal spectroscopic measurement technology that can observe all chemical species by combining pump-probe measurement technique and angle-resolved spectroscopic measurement technique that can enable direct observation of chemical reactions.

**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 photovoltaic energy, and chemical materials with steadily improved performance that can be applied to 3D displays and security tags.

**Co-CRO/Professor YASUTOMO Koji**  
Detection of biomarkers using new light technology  
Elucidation of disease mechanism by analyzing pathological models based on genetic analysis of immune and inflammatory diseases in humans and mice, and development of optical devices that can detect blood circulation correlated with the pathological condition.

**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.

## Medical Care (Diagnosis)

**Professor YANO Takashi**  
Development of nanoscale optical devices/structures for highly sensitive optical sensing and imaging  
Physics and materials for nanoscale manipulation of light in DEU, visible, infrared and THz region.

**Designated Assistant Professor SHIRAKA Daisuke**  
Development of electrochromic/infrared fluorescence (ECL) biosensor for the detection of cardiac troponin and inflammatory marker (CRP) with improved sensitivity in biological fluids.  
Hybrid structures combined with a sandwich fluorescence significantly enhanced the sensitivity of biosensor. Electrochromic 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) diagnosis.

**Designated Assistant Professor HASE Eiji**  
Maintaining mechanical properties of biological materials  
Development of fibrous containing nanoscale based on fibrous 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 technology for the industrial measurements such as MEMS devices.

**Associate Professor MURAKAMI Akikazu**  
Development of Next-Generation Antibiotics  
The research focuses on the development of diverse anti-genotoxic antibiotics, including VMAs, VMAs, boron-nitrogen-sulfur combination, and boron sulfide by particle, advanced phage display technology is employed to identify novel antibiotic systems based on library models that do not require natural immunization. This strategy enables the efficient generation of antibodies with high affinity and specificity, promoting their application in diagnostic and therapeutic fields.

**Research Professor KOMA Takashi**  
Virus insertion-sites using deep ultraviolet light  
We will elucidate the mechanism of virus insertion by deep ultraviolet light and conduct research on induction to inactivation effects based on virus type.

## Medical Care (Treatment)

**Professor NOMAGUCHI Masako**  
Promotion of medical and optical collaborative research in the field of viral infections.  
We make a cross-disciplinary research for "Visualization" and "Detection" of viruses by combining imaging and optics.

**Professor TSUNENAGA Koichi**  
Research and development of new cancer diagnosis technology  
Establishment of auxiliary morphological diagnosis methods combining AI and machine learning and development of rapid diagnosis methods for hemopathologic cells using Roman numeral light analysis/monitoring with the aim of improving the quality of cancer diagnosis operatively with the aim of improving the quality of cancer diagnosis operatively with the aim of improving the quality of cancer diagnosis.

**Associate Professor SHIRAKI Akhiro**  
Synergistic sterilizing power with light plus natural products  
Used to control pathogenic microorganisms and improve drug efficacy in the food and medical fields.

**Associate Professor SHIRAKI Akhiro**  
Synergistic with UV plus α  
Establishment of sterilizing power with UV plus α (collaboration with antibacterial activity, addition of low concentrations of antimicrobial agents). Used to control pathogenic microorganisms and improve drug efficacy in the food and medical fields.

**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.