Graduate School of Engineering, Osaka University
Dept. Material and Life Science, Itoh Laboratory

Our research and education cover the multidisciplinary fields of ultrafast optics, image processing and signal processing. Recent research topics are listed below.

Micro-photonics

The development of world-wide optical networks demands high-speed, all-optical signal processing devices. We are working on femtosecond-laser techniques for writing and integrating micro-optical circuits and optical switches in a bulk of glass and polymer. We also develop a novel technique of laser micro-welding for joining transparent micro-optical devices.

Time-space photonics

Multi-dimensional property of light in time and space domains suggests the latent potential of ultra-fast, and massive parallel optical signal processing. We are exploring optical system solutions based on novel time-space concepts for a wide range of applications including next-generation photonic networks and ultra-fast optical measurements.

Bio-photonics

Aiming at exploring signal transduction in biological systems, we are developing novel bio-medical imaging techniques including single organelle tracking and stimulated parametric emission microscopy, which can visualize 3-D distribution of molecules in living cells with high-sensitivity and sub-micron resolution.

Laser-photonics

Ultrashort pulsed lasers have found a wide range of applications, leading to an increasing demand for highly practical laser sources. We are developing novel, optical fiber-based ultrashort optical sources with various functionality. We are also working on their application to 3D measurement, ultrahigh-resolution tomography, and optical signal processing through ultrafast nonlinear optical phenomena.

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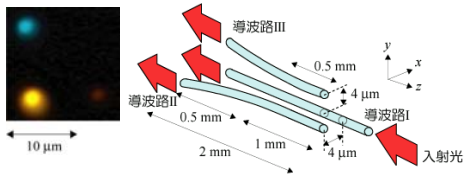
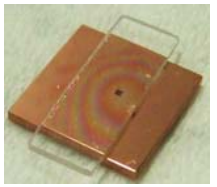
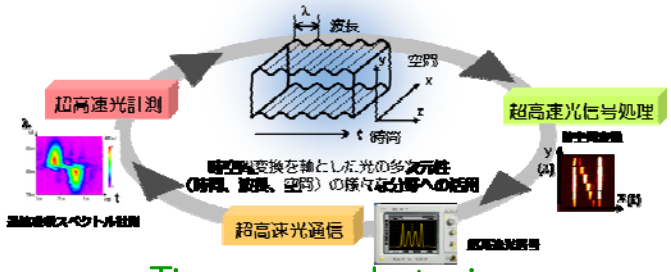


3D waveguides inside glass (right) and its application to wavelength-division demultiplexer (left).

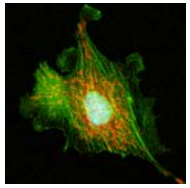


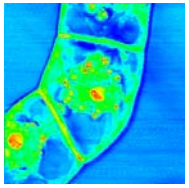
Copper and glass substrates joined by femtosecond laser welding technique

Micro-photonics



Time-space photonics

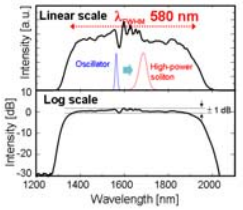




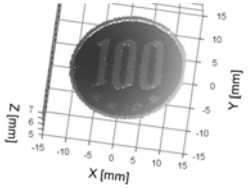
Left: Multi-spectral two-photon excited fluorescence microscopy image of living cell.

Right: Stimulated parametric emission microscopy image of unstained living cells.

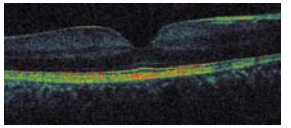
Bio-photonics



Optical spectra of high quality ultra-wideband supercontinuum.



3D-image of 100-yen coin.



Ultrahigh-resolution tomographic image of human retina.

Laser-photonics