International Workshop on Innovative Optical Materials and Related Technologies

IWIOFM25

Place: Kiichiro Toyoda Memorial Hall, Toyota Technological Institute, Japan

Date: March 8, 2025

Program

12:10 - Registration (at Kiichiro Toyoda Memorial Hall Entrance)

13:00 - 13:05 Opening Remarks
Ohishi Yasutake, Toyota Technological Institute, Japan

13:05 - 13:35 A Journey from Photonic Glasses to Biomedical Photonics
Senthil Murugan Ganapathy, Southampton University, UK

13:35 - 14:05 Research Progress in Our Photonic Crystal Fibers and the Applications
Meisong Liao, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Science, China

14:05 - 14:35 Decaying Dynamics of Harmonic Mode-Locking in a Mode-Locked Fiber Laser with SESAM
Weiqing Gao, Hefei University of Technology, China

14:35 - 14:45 Break

14:45 - 15:15 Study on Nonlinear Characteristics in the Soft-Glass Microstructured Optical Fibers
Tonglei Cheng, Northeastern University, China

15:15 - 15:45 Soft-Glass Optical Fibers for Nonlinear Applications
Than Singh Saini, National Institute of Technology Kurukshetra, India

15:45 - 15:50 Closing Remarks
Takenobu Suzuki, Toyota Technological Institute, Japan

16:00 Transfer to Banquet Venue (Taxi arrangements planned)

17:00 Banquet & Alumni Reunion (at Hoshigaoka Art Grace Club)

A Journey from Photonic Glasses to Biomedical Photonics

Senthil Murugan Ganapathy
Optoelectronics Research Centre, University of Southampton, UK

The evolution of photonics is driven by advancements in materials, device engineering, and application-driven innovations. This presentation traces my research journey from photonic glasses to biomedical photonics, highlighting the development of integrated optical device platforms for on-chip spectroscopy and diagnostics. By leveraging materials such as heavy metal oxides, chalcogenides, and germanium on silicon, we have created compact, efficient, and high-sensitivity spectroscopic solutions for both biomedical and environmental applications.

A key focus will be vibrational spectroscopy, including infrared (IR) and Raman modalities, which enable rapid, label-free molecular characterization. To overcome longstanding challenges such as bulky instrumentation, low detection sensitivity, and atmospheric interference, we have developed a silicon-based ATR platform enhanced with metasurfaces, significantly improving signal intensity and biomolecular detection. Additionally, an adaptive atmospheric correction algorithm ensures spectral accuracy without the need for nitrogen purging, while the fusion of IR and Raman spectral data with machine learning enhances diagnostic precision.

These advancements have significant biomedical implications, including early detection of neonatal respiratory distress syndrome (nRDS) and cancer biomarker quantification from blood samples. By bridging photonic materials and devices research with real-world diagnostics, this work paves the way for point-of-care solutions, particularly in resource- limited settings.

Research Progress in Our Photonic Crystal Fibers and the Applications

Meisong Liao

Advanced Laser and Optoelectronic Functional Material Department, Shanghai, Institute of Optics and Fine Mechanics, Chinese Academy of Science, China

In recent years, we have developed various new types of photonic crystal fibers, including highly nonlinear photonic crystal fibers, polarization maintaining photonic crystal fibers, hollow core photonic bandgap fibers, etc. We have studied their applications in the fields of supercontinuum spectrum generation, dispersion wave generation, and fiber optic gyroscopes.

Decaying dynamics of harmonic mode-locking in a mode-locked fiber laser with SESAM

Weiqing Gao

School of Physics, Hefei University of Technology, China

The entire decaying dynamics of harmonic mode-locking (HML) are studied utilizing the dispersive Fourier transform (DFT) technique in a SESAM-based mode-locked fiber laser. It is unveiled that the harmonic solitons do not disappear directly, but undergo transitional processes from the higher-order HML to the lower-order HML and then to the fundamental mode-locking (FML), and finally vanish. The "big corner" can also exist in the decaying process rather than just in the buildup process of HML, and there is at least one "big corner" during the decaying process between the consecutive multi-pulsing states. The energy stabilization phase (ESP) cannot be observed during every transitional process. A breathing behavior and a vibrating soliton molecule are observed in the decaying process from the 2nd HML to the FML and in the decaying process of the FML, respectively. Our work would enrich the understanding of HML behaviors and may contribute to the laser designs.

Study on nonlinear characteristics in the soft-glass microstructured optical fibers

Tonglei Cheng
Northeastern University, China

Soft-glass microstructured optical fibers (MOFs) include fluoride, tellurite, and chalcogenide MOFs, which present a wider transparency window in the mid-infrared region. They are good candidates for MIR supercontinuum generation, solitons, four-wave mixing, and so on.

Soft-Glass Optical Fibers for Nonlinear Applications

Than Singh Saini
National Institute of Technology Kurukshetra, India

The nonlinear optical effects in the optical fibers play a vital role in design and development of compact photonic devices for various potential applications including tunable mid-IR light sources, supercontinuum generation for molecular imaging and sensing, fiber lasers and amplifiers. Also, the optical fibers are very suitable medium to generate entangled photons pair based on the principle of spontaneous down conversion and four-wave-mixing processes. In this talk, I will discuss about our work related to the soft-glass optical fibers carried out at the Toyota Technological Institute, Nagoya, Japan. More specifically, I will discuss the supercontinuum generation in tapered chalcogenide step-index optical fiber and four-wave-mixing in microstructured optical fiber. The step-index optical fiber having core of $AsSe_2$ chalcogenide material with As_2S_5 cladding can be used to generate supercontinuum spectrum extending from 1.6 – 3.7 μm using the fs pumping at 2.6 μm. Further, the four-wave- mixing in As_2S_5 based microstructured optical fiber can be obtained using the pumping at 2 μm. Furthermore, the fabrication steps of step-index fiber with $AsSe_2$ core with As_2S_5 cladding; and the fabrication of As_2S_5 microstructured optical fiber shall be explored. The characterization setup to obtain the supercontinuum generation and the four-wave mixing signal will also be discussed.