FINESSE

ITN - FINESSE

(Fiber NErvous Sensing SystEms)
A European Innovative Training Network

PhD School on Speciality Fibres

Register by 31 March 2018

http://itn-finesse.eu/te3

Leibniz Institute of Photonic Technology
Jena, Germany
9-11 April 2018

FINESSE consortium

Contributing partners to this PhD school

ITN FINESSE Training Event 1: Fundamentals of Optical Fibre Sensors

Overview of FINESSE Training Event 3

The purpose of this training event (TE) is to offer to the participants the opportunity to attend a series of key lectures given by experts in the field of Specialty Fibres. This TE is focused on the newest trends in the development of specialty fibres with a specific relatedness to practical exercises and applications. Besides, a general introduction into preform and fibre fabrication technologies specific aspects of material (e.g. silica glass network and defects, diffusion of dopants, crystallization, fibre coating) will be discussed. A second issue is the direct relationship to fibre optic sensing with a focus on Fibre Bragg Grating (FBG) inscription, characterization and application. The courses will be complemented by practical demonstrations in preform, fibre and sensor fabrication as well as characterization.

TE3 progamme at a glance

General Schedule of FINESSE Training Event 3 – Jena, Germany

Day	Topic	Time	Lecturer
Monday 9.4.2018	Doped Silica – Optical properties, defects, impurities and Gas phase deposition technologies – Part I	09:00 – 10:10	Laurent Bigot (Uni Lille)
	Gas phase deposition technologies – Part II and Powder based fabrication techniques	10:10 – 11:20	Robert Müller (IPHT)
	Coffee break	*11:20 – 11:50*	
	Fiber drawing and the principles of coating application	11:50 – 12:40	Jens Kobelke (IPHT)
	Lunch	*12:40 – 14:00*	
	Demonstration MCVD	*14:00 – 15:00*	
	Rare-earth-doped fibers for fiber lasers and amplifiers	15:00 – 15:50	Matthias Jäger (IPHT)
Tuesday 10.4.2018	Fiber characterization (optical properties, tensile strength, NA, …)	09:00 – 09:50	Anka Schwuchow
	High power cw fiber laser and its limitations	09:50 – 10:40	Thomas Schreiber (IOF)
	Coffee break	*10:40 – 11:00*	
	Tuneable fiber lasers based on fiber Bragg gratings	11:00 – 11:50	Matthias Jäger (IPHT)
	Supercontinuum generation with ultrashort pulses in silica fibers	11:50 – 12:40	Alexander Hartung (IPHT)
	Lunch	*12:40 – 14:00*	
	Demonstration Fiber drawing and coating application	*14:00 – 15:00*	
	High Power Fiber Lasers with advanced fiber designs	15:00 – 15:50	P. Roy (XLIM)
Wednesday 11.4.2018	Draw tower fiber Bragg gratings in multicore fibers for curvature sensing	09:00 – 09:50	Jan Van Roosbroeck (FBGS)
	FBG in sapphire and sapphire derived hybrid fibers	09:50 – 10:40	Tino Elsmann (IPHT)
	Coffee break	*10:40 – 11:00*	
	Gradient index micro optics	11:00 – 11:50	Bernhard Messerschmidt (Grintech)
	Microstructured optical fibers - Principles of fabrication	11:50 – 12:40	Johannes Nold (IOF)
	Lunch	*12:40 – 14:00*	
	Demonstration Stacking	*14:00 – 15:00*	
	Antiresonant fibers for UV transmission	15:00 – 15:50	Markus A. Schmidt (IPHT)
	SOCIAL EVENT	*19:00 – 22:00*	

Last minute changes:

The “Draw tower fiber Bragg gratings in multicore fibers for curvature sensing” lecture will be given by Christian Voigtländer instead of Jan Van Roosbroeck

Detailed programme of TE3

Day 1: Monday 09/04

09.00 – 10.10: Doped Silica – Optical properties, defects, impurities and gas phase deposition technologies – Part I
Laurent Bigot – University of Lille / CNRS
Abstract: My talk will focus on techniques for manufacturing silica optical fibers using methods derived from Chemical Vapor Deposition (CVD) techniques. Developed since the 1970s, these synthetic routes (MCVD, OVD, VAD) are still at the heart of the realization of most of the silica optical fibers, whether they are conventional optical fibers or micro-structured fibers. After a few reminders about glasses in general and silica glasses in particular, I will present different CVD-based approaches, from their basic principle to their main advantages and disadvantages. The changes made or in progress to these synthesis routes will also be discussed.

10.10 – 11.20: Gas phase deposition technologies – Part II and Powder based fabrication techniques
Robert Müller – Leibniz Institute of Photonic Technology
Abstract: The talk will give an overview of the capabilities and limitations of the modified chemical vapor deposition technology and the powder-sinter technology for the preparation of optical fiber preforms made from high silica glasses with focus on laser active materials with Al/rare earth doping. A comparison with conventional technologies is given.

11.20 – 11.50 Coffee Break

11:50 – 12:40: Fiber drawing and the principles of coating application
Jens Kobelke - **Leibniz Institute of Photonic Technology**
Abstract: The talk gives an overview of different methods of fiber manufacturing, e.g. crucible drawing, Rod-in-Tube technique, preform drawing. Preparation aspects of compact fibers as well as microstructured fibers are discussed. The talk considers viscosity and dopant diffusion effects during fiber drawing. The fiber coating is discussed in terms of polymer and metal materials. It includes the approximation of layer thickness by gravity and pressure coating.

12.40 – 14.00 Lunch Break

14.00 – 15.00 Demonstration: MCDV

15.00 – 15.50: Rare-earth-doped fibers for fiber lasers and amplifiers
Matthias Jäger – Leibniz Institute of Photonic Technology
Abstract: The lecture will review the special spectroscopic properties of rare earth ions in glassy hosts that make them particularly attractive for fiber-based amplifiers and lasers. Several effects, including ion-ion interactions as well as multi-phonon decay will be discussed. Finally, a few basic concept and limitations of fiber lasers will be discussed.

16.00 – 17.00 FINESSE Activities (Only for FINESSE ESRs)

Day 2: Tuesday 10/04

09.00 – 09.50: Properties of special optical fibers
Anka Schwuchow – Leibniz Institute of Photonic Technology
Abstract: **Light microscopy, raster electron microscopy** - inner geometry / structural defects and material defects **Fiber loss and bulk absorption measurement** - Basic Material loss, absortpion bands of dopands and impurities - Guiding properties (cutoff) - Crosstalk, bending sensitivity **Fluorescence measurements** - Fluorescence bands and lifetime of dopands and glass defects **Bending and tensile strength**

09.50 – 10.40: High power CW fiber laser and its limitations
Thomas Schreiber – Fraunhofer-Institut für Angewandte Optik und Feinmechanik
Abstract: TBA later

10.40 – 11.00 Coffee Break

11.00 – 11.50: Tunable fiber lasers based on Fiber Bragg Grating (FBG) arrays
Matthias Jäger – Leibniz Institute of Photonic Technology
Abstract: This talk will introduce a powerful tuning concept for fiber-integrated lasers. The wavelength selection is entirely based on an electronic signal and allows fast switching and broad tunability. Two different resonator designs (Sigma- and Theta cavity) will be introduced and their features discussed. Finally, results on the synchronous emission of two independently tunable wavelengths will be presented.

11:50 – 12:40 Supercontinuum generation with ultrashort pulses in silica fibers
Alexander Hartung – Leibniz Institute of Photonic Technology
Abstract: Ultrashort optical pulses with its high peak powers give rise to a multitude of nonlinear effects especially in combination with the tight light confinement in small core optical fibers. This enables the generation of ultra-broad spectra called supercontinua, whose origin and properties are discussed. Emphasize is put on the impact of the fibers group velocity dispersion which has a profound impact on the nature of the supercontinuum.

12.40 – 14.00 Lunch Break

14.00 – 15.00 Demonstration: Fiber drawing and coating application

15.00 – 15.50: High Power Fiber Lasers with advanced fiber designs
Philippe ROY – Xlim Limoges – Fiber Photonics department
Abstract: The beginning of the presentation will consist of a "with the hands" tentative explanation of guiding properties in complex structures of optical fibers. Several groups around the world are developing innovative Ultra Large Mode Area fibers for the amplification or generation of short pulses, very high peak power/energy levels. The most relevant will be presented and discussed paying a particular attention of their sensitivity to thermal loading.

16.00 – 17.00 FINESSE Activities (Only for FINESSE ESRs)

Day 3: Wednesday 11/04

09.00 – 09.50: Draw tower fiber Bragg gratings in multicore fibers for curvature sensing
Christian Voigtländer – FBGS Technologies GmbH
Abstract: The Draw Tower Gratings in multicore fibers offer a very unique tool to measure curvature or the shape of optical fibers, which becomes more and more demanding for medical applications. By bending a multicore fiber with inscribed gratings in all cores the differential strain can be calculated leading to the curvature of the fiber at the grating position. The draw tower technology gives the possibility to produce gratings with high spatial resolutions for such applications.

09.50 – 10.40: FBG in sapphire and sapphire derived hybrid fibers
Tino Elsmann – Leibniz Institute of Photonic Technology
Abstract: Fiber Bragg gratings (FBGs) are well-established sensing devices especially for harsh environments. But their use under extreme high temperatures (>800°C) is still a challenging research topic, due to the physico-chemical mechanisms of the fiber materials itself. One approach to fabricate FBGs for such high temperature bases on the utilization of single crystalline sapphire or sapphire-derived hybrid fibers.

10.40 – 11.00 Coffee Break

11.00 – 11.50: Gradient index micro optics
Bernhard Messerschmidt – GRINTECH GmbH
Abstract: Gradient index micro optics in Glas with plane optical surfaces offers a great potential for miniaturization and integration of optical systems with complex function. The lens performance of GRIN lenses is achieved by specific refractive index profiles in rods and plates, which are produced by ion exchange processes in boro-alumina-silicate glasses. No curved surfaces are needed, which allows a miniaturization of the lenses down to 200 µm in diameter. The talk will introduce GRIN optics and the related optical design, presents potentials and current limits of the technology as well as applications in optical metrology and medical or biophotonic multimodal image acquisition.

11.50 – 12.40: Johannes Nold
Johannes Nold – Fraunhofer-Institut für Angewandte Optik und Feinmechanik
Abstract: TBA later

12.40 – 14.00 Lunch Break

14.00 – 15.00 Demonstration: Stacking

15.00 – 15.50: Antiresonant fibers for UV transmission
Markus A. Schmidt – Leibniz Institute of Photonic Technology
Abstract: Hollow core fibers represent a new type of microstructured optical fiber, which has led to numerous applications in fields such as nonlinear photonics, biosensing and particle tracking. Particular interesting is that the optical mode in this type of fibers is not guided by total internal reflection but by other guiding principles such as low density of state or the photonic band gap effect. During this presentation I will focus on anti-resonant hollow core optical fibers. Specifically I will explain the underlying physics using planar waveguide models and will focus on applications of this type of fiber, including issues such as nonlinear light generation and absorption spectroscopy.

16.00 – 18.00 FINESSE Executive Board (Only for FINESSE members)

19.00 – 22.00 Social event

- End of TE3 -

Day 4: Thursday 12/04 (Only for FINESSE members)

09.00 – 11.00: FINESSE seminar (Part I)
ESR 8 - ESR 15 (oral presentation + question)

11.00 – 11.15 Coffee Break

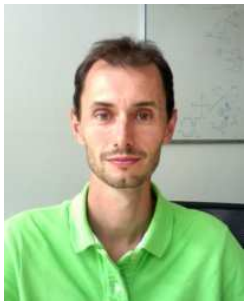
11.15 – 13.00: FINESSE seminar (Part II)
ESR 1 - ESR 7 (oral presentation + question)

13.00 – 13.50 Lunch Break

14.00 – 16.00 FINESSE Supervisory Board

Lecturer's biography (by alphabetical order)

Laurent Bigot – University of Lille – CNRS, PhLAM laboratory



Laurent Bigot received the Ph.D. degree in physics in 2002 from the University of Lyon, France. His Ph.D. work involved the study of spectroscopic properties of erbium-doped glasses for optical amplification. In 2002–2003, he has been with Alcatel R&I at Marcoussis, France, working on fiber-based components for optical regeneration. In 2003-2004, he joined CNRS and Physics of Atoms and Molecules laboratory (PhLAM) of University of Lille, France, where he is now research director. In the Photonic group, he is in charge of glass elaboration by MCVD and OVD and his research interest concerns the design and characterization of both conventional and micro-structured fibers. He is particularly involved in the design and realization of optically active fibers like optical amplifiers and fiber lasers.

Tino Elsmann – Leibniz Institute of Photonic Technology

Tino Elsmann received his diploma degree in physics from the Friedrich-Schiller-Universität, Jena, Germany, in 2010. Since then he is a researcher at the Fiber Optics Department, Leibniz Institute of Photonic Technology, Jena, where he finished his doctoral studies in 2016 focused on the inscription of fiber Bragg gratings in various fibers with the emphasis onto high temperature sensing. His research interests include photosensitivity mechanisms, fiber Bragg gratings, and fiber-based sensors.

Alexander Hartung – Leibniz Institute of Photonic Technology

Alexander Hartung received his diploma degree in physics from the Friedrich-Schiller-Universität, Jena, Germany, in 2007. Since then he is a researcher at the Fiber Optics Department, Leibniz Institute of Photonic Technology, Jena, where he finished his doctoral studies focused on nonlinear pulse propagation and supercontinuum generation in 2012. His research interests include nonlinear pulse propagation, fiber lasers, and hollow-core optical waveguides.

Matthias Jäger – Leibniz Institute of Photonic Technology

Matthias Jäger was born in Jena, Germany, on August 28, 1965. He received the Diploma in physics from the Friedrich Schiller University, Jena, in 1992, and the Ph.D. degree in optics from the University of Central Florida (College of Optics and Photonics/CREOL), Orlando, FL, USA, in 1997. He held a postdoctoral position at the Swiss Federal Institute of Technology (ETH), Zürich, Switzerland, from 1997 to 1999. Following a two-year stay at Agilent Technologies, Böblingen, Germany, as a Development Engineer, he joined ITF Optical Technologies, Montreal, QC, Canada, in 2001, serving as Director Test and Measurement. From 2006 to 2011, he worked on the development of fiber lasers at JT Optical Engine GmbH & Co. KG, Jena. Since 2011, he has been leading the fiber laser research group at the Leibniz Institute of Photonic Technologies (IPHT), Jena. His research interests include new materials for active and passive fibers and tunable fiber lasers. Dr. Jäger has published five book chapters and more than 100 papers and conference contributions. He is a Senior Member of the Optical Society of America (OSA) and member of the International Society for Optical Engineering (SPIE).

Jens Kobelke - Leibniz Institute of Photonic Technology

Jens Kobelke studied chemistry and received his Ph.D. from the Technische Hochschule Merseburg in 1986. Since this time he works at Institute of Photonic Technology (IPHT) Jena on the development and preparation of special optical fibers.

Bernhard Messerschmidt – GRINTECH GmbH

Bernhard Messerschmidt studied physics at the Friedrich Schiller University Jena and has received his PhD in 1998 after being a research fellow at the Institute of Optics, University of Rochester, New York and at the Fraunhofer Institute of Applied Optics and Precision Engineering. His research focused on modeling of ion exchange processes in glass for fabricating gradient optics. He is currently a managing director of GRINTECH GmbH, a 35 employee's micro-optics company in Jena, which was founded in 1999 with 3 other colleagues as a spin-off from Fraunhofer IOF. He is responsible for R&D and new product development at GRINTECH. Main interests of GRINTECH are in the fields of biomedical imaging and optical non-contact displacement sensors for industrial applications. In addition to several journal research papers, he is the (co)inventor of 8 patents.

Robert Müller - Leibniz Institute of Photonic Technology

Robert Müller studied Material Science at the Technical University Bergakademie Freiberg with specialization Inorganic Non-metallic Materials and received his diploma in 1990. In his PhD thesis he worked with ferrite particles and got his doctor's degree in 1994. Since 1994 he has been a scientific co-worker at the IPHT and worked in different fields like magnetic glass ceramics, ferrites, high temperature superconductor ceramics, iron oxide particles for biomedical applications, noble metal particles for bioanalytics, particle transport in biological tissue and up-conversion particles. In 2016 he joined the Fiber Optics Department and worked on optical fiber preforms by the powder-sinter technology.

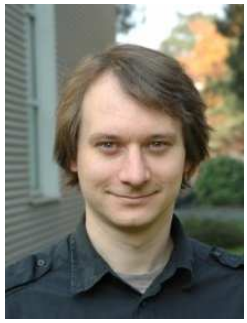
Johannes Nold – Fraunhofer-Institut für Angewandte Optik und Feinmechanik

To be made available later…

Philippe ROY – Xlim Limoges – Fiber Photonics department

Philippe ROY received his PhD degree in Microwave Electronics and Optoelectronics (speciality Photonics and Electronics Systems) in 1997 in the University of Limoges. He is now a CNRS senior researcher and head of Photonics group at XLIM, which is a mixed laboratory of University of LIMOGES and CNRS. He is involved in design, fabrication and characterisation of specialty and composite fibres mainly dedicated to advanced fibre sensor systems and to very high-power fibre lasers. He develops rare earth doped fibre with complex structure based on an aperiodic design to reach higher power levels without modal instabilities and/or non-conventional emitted spectrum.

Markus A. Schmidt – Leibniz Institute of Photonic Technology



Markus A. Schmidt owns a full professorship for Fiber Optics at the Friedrich-Schiller University Jena and is head of the research group Fiber Sensors at the Leibniz Institute for Photonic Technologies (IPHT). From 2006 to 2012 he was team leader of the group Nanowire in the division of Philip Russell at the Max Planck Institute for the Science of Light in Erlangen. He spent a twelve months research stay in the group of Stefan Maier at the Centre of Plasmonics and Metamaterials at Imperial College London in 2011. He obtained his PhD in 2006 from the Hamburg University of Technology. His main research topic is combining fibers and

nanophotonics with applications in areas such as biophotonics, optofluidics, plasmonics and nonlinear optics.

Thomas Schreiber – Fraunhofer-Institut für Angewandte Optik und Feinmechanik

To be made available later…

Anka Schwuchow – Leibniz Institute of Photonic Technology

Anka Schwuchow was born on April 18, 1970 in Jena, Germany. She received her diploma in communications engeneering at the Technische Universität Dresden in 1994.

She works at the Leibniz Institute of Photonic Technology (IPHT) Jena, Germany, as research scientist since 1994, responsible for the characterization of rare earth doped and other special fibers and glass samples.

Christian Voigtländer – FBGS Technologies GmbH

- Born 31st August 1982
- 2008 Diploma in physics at IAP (FSU Jena)
- 2010 Research stay at Macquarie University Sydney, Australia
- 2008 – 2015 Ph.D. in physics at IAP (FSU Jena)
    - Title: “Bandwidth control of femtosecond pulse written FBGs”
- 2015 Post-doctoral researcher at IAP
- Since 2015 R&D Manager at FBGS Technologies GmbH
    - Research on fiber and grating development