European Optical Society

Coherence for Europe ®

How optics and photonics address Europe's challenges of the 21st century

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How optics and photonics address Europe's challenges of the 21st century

Published by:
European Optical Society (EOS)
July 2010

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Printing:
LEO Druck GmbH, Robert-Koch-Str. 6, 78333 Stockach
leodruck.com

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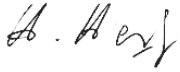
Foreword by the President

Dear Reader,

with pleasure I present you the new EOS brochure "How optics and photonics address Europe's challenges of the 21st century".
It's a collection of ongoing and future research projects conducted by researchers from European research laboratories, industries and universities.
72 contributions have been submitted from 20 countries. Nearly 50% of the contributions are from Germany, which is an indication of the strong support of photonics on the national level. It would of course be wrong to conclude that other countries are less active. However, defending the importance of photonics in smaller countries is not easy everywhere, in particular, if no big optics industry is present in a particular country. It does not mean that optics is less important, but the development of optics is rather ongoing in small companies, which can not defend their interests.
This brochure is not only for scientists, who would like to know the recent trends and learn about future cooperation in European projects. It also demonstrates politicians and the broad public how photonics addresses the future challenges in health, energy, environment, production, communication, security and other areas.
An EOS Jury has selected the best contributions for publication in the printed brochure. Maybe they have not selected those you would find most interesting. Therefore, all contributions will be published in a web gallery at www.myeos.org.
I hope that our brochure is inspiring to you and that the contributions will be the germ of new collaborations. We are particularly grateful to the authors of the projects who made this collection possible.



Hans Peter Herzig
EOS President

The century of light

Since the European Commission has raised the importance of photonics to one of the key-enabling technologies for the future, it is obvious that the tremendous efforts in research and development are on track with the long term goals of the European Commission. Today, Europe has a worldwide leading position in many fields of photonics (sometimes also referred to as optical technologies). This position is based on a long-term strategy of collaboration between science, industry and administration (funding policy).

The major challenges in the modern world - solutions for health, environment, energy, IT, production and security - are driven in their development by the production and manipulation of photons, the basic unit of light. Today, more than 250,000 people in Europe work with and for photonics, the revenues of the European photonics industry are higher than those in microelectronics, and the total share of the world market is about 20%. The growth rate of about 7.5 percent is more than twice as high as the average growth rate of the GDP [1)].

Europe with it's highly innovative production is aware of the future challenges. More than 5000 small and medium sized companies in photonics in Europe are operating in a highly cross-linked system on different levels: regional, national and European-wide. The excellence in research and development we have reached today should not be used as a pillow; it must be the driving force for the future. Photonics are no longer an enabling technology only, nowadays they are more and more a product by themselves.

The enabling factor of photonics is extremely high, depending on the technology or product between 5 and more than 1000. Even if it is obvious today that the use of photons is the key for modernization in many sectors, it is just the beginning. Present-day tools, sources, systems and applications allow us only a small fraction of the ultimate performance of photonic systems. There can be no doubt that photonics and optical technologies will be among the most influential drivers of innovation in the 21st century.

The European Optical Society (EOS) as the voice for optics in Europe serves for this development. The fundamental mastery of light for the main challenges in Europe is completely depending on a successful networking between R&D-structures and industry. Reflecting the main topics in the EU political strategies we collected the best contributions showing the influence of photons in health, environment, energy, production, communication and security. Photonics is probably the technology with the highest investment in R&D, more than 10% of the annual turnover is re-invested in research. And for this reason we are proud to present simply the best [2)].

Some projects could have been assigned to more than one area. This however also reflects the high enabling factor of the use of light.

1) Photonics in Europe, Economic Impact, Photonics21 and OPTECH CONSULTING, 2007
2) Lighting the way ahead, Second Strategic Research Agenda in Photonics, Photonics21, 2009

Introduction

We finally decided for a structure that shows the reader some highlights which are still in the laboratory phase today, but will very soon find their way to "the real world":

The reduction of energy consumption and the production of sustainable energy is based in many areas on 'Green Photonics'. Cost-effective Organic Light Emitting Diodes – OLED's (see R2Flex and OLED100) are one aspect. Highly efficient organic and conventional solar cells for the production of energy are another aspect (page 12 and 13).

Fast results for in-field-applications in environmental or biological research and control will become reality in the near future. 'Lab-on-a-foil' is the key-technology which will give us also an instrument for rapid point-of-care diagnosis in medicine (page 15). Novel optical diagnostic methods will lead to better therapies (page 17). A better understanding 'how the brain works' (page 18) or implantable biosensors are only some examples where the photon will support us while taking care of our environment and on ourselves.

Information and communication technologies of the last century were based on electrons. But the limits of these technologies have been reached. Without the increased use of photons as the transmitting and storing medium for information the IT future would have ended already. Several examples of the latest developments are given on page 23ff. Smaller, faster, safer seem to be simple and quantitative steps only. But for sure, they are not.

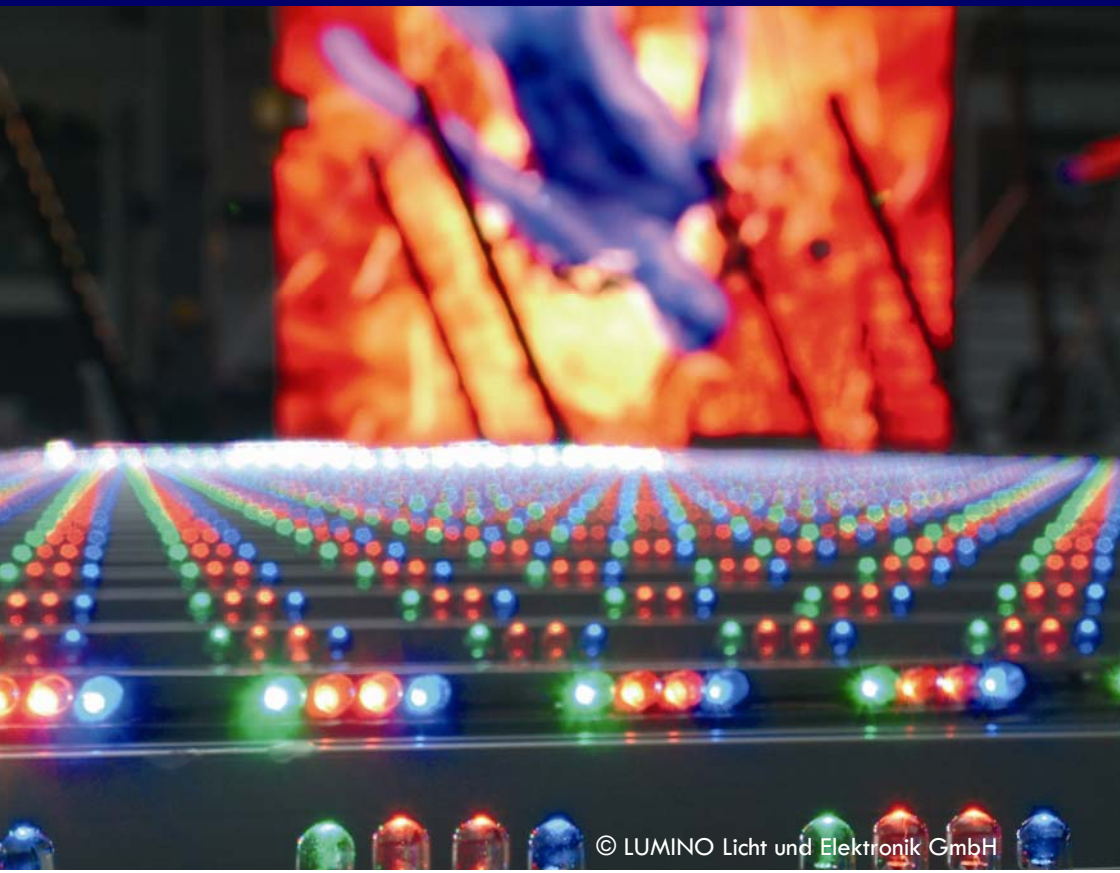
Modern production technology without the use of lasers is barely imaginable. New Laser sources i.e. for micromachining (page 32) or new metrological applications for terahertz technologies are some of the actual approaches for the future of Europe's production technology.

And last but least: security. The issue is not only about avoiding terroristic attacks through terahertz applications that can make concealed dangerous objects visible (page 34). The high demand of the modern individualistic transportation system (vulgo: driving a car by night) is: Make the invisible visible ! (page 34).

This printed version is only a selection of excellent research projects driven by young scientists at universities and research institutes Europe-wide. Planned and conducted in a strong collaboration with the related industry. If you want to search through a wider range of interesting projects, either looking for interesting partners for new ideas or just to understand more about this fascinating technology, visit www.myeos.org. If you are a student interested in photonics and looking for an internship or contacts just send an email to: info@myeos.org.

Klaus Nowitzki
EOS Executive Director

Energy



Solutions for energy

One of Europe's big imperatives for the 21st century is improving energy efficiency and sustainability.
Here, photonics enable manifold approaches and solutions for

> saving energy

> reducing emissions and

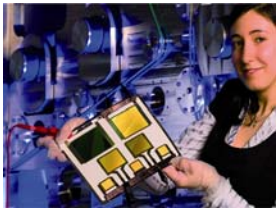
> increasing energy efficiency

Incandescent lamp - the way of the dodo

R2Flex

Organic Light Emitting Diodes (OLEDs) are a promising candidate for the replacement of the inefficient incandescent lamp. Compared to other lighting technologies, OLEDs can combine a very high power efficiency, a good color quality with new luminaire designs such as OLEDs on large area, flexible foils. For the commercial success of the OLED technology, a reduction of the production costs is essential. In the scope of the r2flex project a technology for the roll-to-roll fabrication of highly efficient OLEDs on flexible metal foils is developed, which will meet this target. However, the deposition of OLEDs onto rough and opaque substrates such as metal foils bears scientific challenges: The OLEDs have to emit light through a thin, metallic top electrode, and due to the roughness of the low-cost substrates, the OLEDs are prone to shortcuts. This can be solved by the use of the pin OLED technology employing thick doped layers and a thorough optical optimization of the OLED microcavity. Besides the scientific challenges, the research is focused on the roll-to-roll processing technology of OLEDs on metal foils. Novel evaporation sources are introduced that can reach high deposition rates and a thin film encapsulation technology is optimized that protects the OLEDs from the normal atmosphere and leads to long-living OLEDs. Combining technological expertise with scientific research will lead to further improvements in performance of OLEDs produced on a Roll-to-Roll coater.

Project start: 01 January 2007
Project end: 31 May 2012
Submitted by:
Institute of Applied Photophysics, TU Dresden, Germany
Funded by:
German Federal Ministry of Education and Research (BMBF), Germany

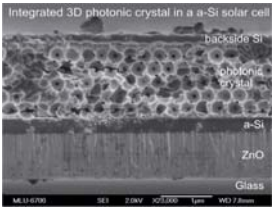


Nanostructures give photovoltaics a boost!

Nanosun & Nanovolt – optical nanostructures for photovoltaics

Photovoltaic is assigned to a sustainable energy supply and it has by far the highest potential of all renewable energy sources. The protection of our environment, resources and climate and the access to high quality electrical power in the developing countries are main aspects. A reduction of expenses of the power generation by photovoltaic systems is the key for an accelerated market launch and distribution of this innovative technology. For a notable reduction of costs a significant enhancement of the efficiency of the solar cells and the modules is necessary. The design of optical properties of materials by novel methods of nanotechnologies, like the use of optical nanostructures, is a development which has influenced significantly optoelectronic devices within the last decade. Although photovoltaics needs new feasible concepts for an increase of the efficiency, this development was ignored by this field. Within this project new concepts should be developed and realized for the spectrally-broadband photon management. The concepts tested in the project will show the basic possibilities of the use of the optical nanostructures for the enhancement of the solar cell efficiency. But also within photonics the application area of photovoltaic is an outstanding challenge because of the spectral range of usable radiation given by the solar spectrum. Till now most ideas to use optical nanostructures within photovoltaic only exist as sketches.

Project start: 01 January 2006
Project end: 31 December 2012
Submitted by:
Martin Luther Universität Halle-Wittenberg , Germany
Further project partners:
Forschungszentrum Jülich, Johannes Gutenberg Unitversität Mainz, Friedrich Schiller Universität Jena, Fraunhofer ISE Freiburg , Carl von Ossietzky Universität Oldenburg, Universität Stuttgart, Universität Paderborn, RWTH Aachen, Germany
Funded by: German Research Foundation (DFG). German Federal Ministry of Education and Research (BMBF), Germany



Fast, faster, DGV

Doppler Global Velocimetry

Velocity field measurements with high temporal resolution are necessary for investigating complex turbulent flows e.g. occurring in turbomachines. In order to increase the machine power and reduce the fuel consumption, flow analysis is essential to develop new machine designs. Doppler global velocimetry (DGV) is an optical measurement technique, which can be applied to turbomachines and allows to achieve a high temporal resolution. Thereby, a flow seeded with particles is illuminated by a laser light sheet and imaged through a molecular absorption cell onto a camera. Since the light transmission through the absorption cell depends on the light frequency, the frequency shifts due to the Doppler effect can be measured in a plane as intensity changes. A novel DGV technique using sinusoidal laser frequency modulation (FM) is applied, which requires only one single camera instead of two. Currently, a fiber-coupled avalanche photodiode array with 25 elements is implemented, which allows to achieve high sensitivity and in comparison with usually applied CCD cameras a much wider bandwidth. As a result, a maximum measurement rate of 100 kHz was achieved and already successfully applied for the acquisition of turbulence spectra in the wake flow of a cylinder. The application of the FM-DGV measurement system for investigating fast, turbulent, non-steady flows in turbomachines such as in axial and radial compressors is the main part of this research project.

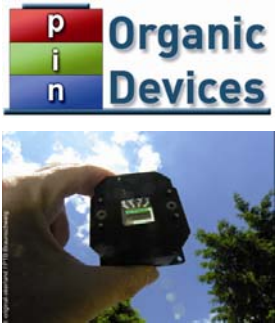
Project start date: 01 July 2010
Project end date: 30 June 2013
Submitted by:
Technische Universität Dresden, Germany
Further project partners:
Fakultät Elektrotechnik und Informationstechnik, Institut für Grundlagen der Elektrotechnik und Elektronik, Professur für Mess- und Prüftechnik, Germany
Funded by:
German Research Foundation (DFG), Germany

Sunny developments!

Organic p-i-n devices

The InnoProfile project „Organic p-i-n devices“ concentrates on research and development of organic solar cells and light-emitting diodes. This quickly growing new technology is currently at the threshold from basic research to industrial implementation on a large scale. It allows for flexible and light weight devices and has the potential for low cost, large area production as well as a nearly inexhaustible availability of raw materials. However, in order to be able to compete with established technologies, further research on properties, processability and long term stability of materials and devices is essential. This project focuses on the promising p-i-n concept based on so called “small molecules” – i.e. vacuum processed small organic semiconducting molecules synthesized from hydrocarbons. The key to this concept is molecular p- and n-doping of charge carrier transport layers which has led to world record efficiencies for both organic solar cells and light emitting diodes. The project is in the process of building up a technology and development platform for organic devices and to further strengthen the regional position in the field. In the last year it has been involved in several certified records for organic solar cells that have been developed in cooperation with Heliatek GmbH, one of the institute's spin-offs. The research group is funded by the InnoProfile program as part of a BMBF Innovation Initiative for the New German Länder.

Project start: 01 November 2006
Project end: 31 October2011
Submitted by:
Institut für Angewandte Photophysik, TU Dresden, Germany
Funded by:
German Federal Ministry of Education and Research (BMBF), Germany



OLED lighting can help save the planet!

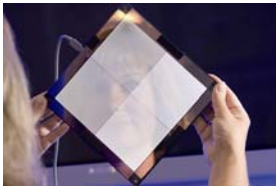
OLED100.eu

Organic light-emitting diodes (OLEDs) are efficient light sources with new exciting features. OLEDs can cover large areas, they are extremely thin, fully dimmable, and instant-on. There are various colours available and the quality of the emitted light is high. Furthermore, OLEDs can be made transparent or flexible. OLED100.eu, an integrated research project funded by the European Community's Seventh Framework Programme, brings together a consortium of experts from leading industry and academic organizations to accelerate the development of OLED technologies for lighting applications in Europe. Since almost 20% of the world's electrical power consumption is due to lighting, there is a tremendous energy saving potential when efficient OLEDs are used instead of conventional light sources. The attractive design features of OLEDs will help to increase the acceptance of this technology. OLED100.eu is working on the development of the technological basis for efficient OLED applications for the general lighting industry by focusing on five main goals:

- High power efficacy (100 lm/W)
- Long lifetime (100.000 h)
- Large area (100x100 cm2)
- Low-cost (100 Euro/m2)
- Measurement standardization / application research

Further info can be found at www.oled100.eu.

Project start: 01 September 2008
Project end: 31 August 2011
Submitted by:
Philips Research Laboratory
Aachen, Germany
Funded by:
European Commission, EU



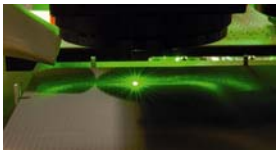
Doping for your solar cells

Laser doping of solar cells

Photovoltaics is one option for a sustainable energy supply and is a strong emerging market in Europe. The LasSol project investigates the laser doping of solar cells. This technology allows to increase the efficiency of solar cells and to reduce the costs for solar power. The 3-year project is funded with about 3.2 million € by the German government. The partners are TRUMPF Laser GmbH & Co. KG, LIMO Mikrooptik GmbH, Manz Automation AG, Schott Solar GmbH, Solarwatt Cells GmbH, and the IFSW and the ipe from the University of Stuttgart. The goal of the project is to demonstrate a significant enhancement of the efficiency of silicon solar cells by the fabrication of selective emitter structures with higher doping concentration by laser-induced doping. The demonstration will be performed under conditions relevant for the volume production of solar cells. The selectively doped structures will be generated on wafers with low doping concentration using a pulsed green laser source. This process will increase the efficiency of the solar cells and therefore will reduce the specific costs significantly. In contrast to the published alternative approaches, the proposed laser doping process allows to create a selective emitter structure with only one additional processing step and to keep the preceding and following steps the same. The economic potential of the proposed process is enormous. This laser technology will support and accelerate the boom of the European solar energy market.

Project start: 01 September 2009
Project end: 31 August 2012
Submitted by:
TRUMPF Laser GmbH & Co. KG, Germany
Futher project partners:
LIMO Mikrooptik GmbH, Manz Automation AG, Schott Solar GmbH, Solarwatt Cells GmbH, IFSW & ipe Universität Stuttgart , TU Dresden, Germany
Funded by:
German Fed. Ministry of Education and Research (BMBF), Germany

LasSol



Solutions for the environment

Stopping the increasing environmental pollution through environment-friendly and sustainable energy sources while at the same time providing advanced tools for environmental monitoring are the basis for ensuring a healthy environment for future generations. Photonics contribute to reaching these aims through

> sensing and instrumentation tools for environmental monitoring

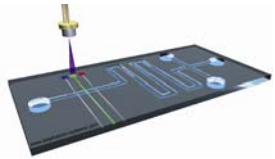
> increasing the energy efficiency of photovoltaic systems

Lasers on chip

Disposable integrated biophotonic polymer chip

Currently, one finds a wide variety of approaches for integrated lab-on-a-chip systems developed for applications in the biomedical field. Our interdisciplinary independent junior research group is utilizing mass production techniques and heads for lab-on-a-foil systems with solely optical and fluidic interfaces, avoiding electrical interconnects. We implement fluidic structures in the chips by using the same technologies, which are chosen to create the optical elements, thus achieving a limited number of process steps. We generate organic semiconductor lasers by creating a resonator with thermal nano imprint lithography into bulk PMMA and subsequent thin film evaporation of organic semiconductor active material. Varying geometrical parameters allows selecting the lasing wavelength in the visible light regime of the on-chip lasers. Waveguides are monolithically integrated in PMMA and laser light is guided to the biological sample in the microfluidic channel on chip. We design & process micro-optical cavities to be functionalized for detecting biological binding events in the channel. Surface functionalization is carried out for integrated label-free detection as well as for fluorescence excitation of biomarkers. This will enable for rapid point-of-care diagnosis in the medical area & fast results for in-the-field applications in environmental or biological research & control.

Project start: 01 June 2007
Project end: 31 May 2011
Submitted by:
Karlsruhe Institute of Technology (KIT), Germany
Funded by:
Timo Mappes' Young Investigator Group receives financial support from the „Concept of the Future" of the Karlsruhe Institute of Technology within the framework of the German Excellence Initiative.

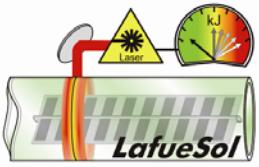


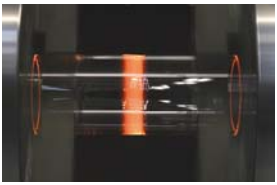
"Sunglasses" – laser made!

LafueSol – Laser joining of glass tubes for solar

A new laser based joining technology for the production of solar receivers is being developed which will substitute the conventional flame technology and increase the energy efficiency of the process. Due to the reduction of the energetic losses typical for the burner production, the energy demand can be decreased and faster heating can be achieved. This results in an increase in productivity. In order to transfer the process technology it is necessary to automate the process. For this purpose, the temperature field during the joining process needs to be captured and processed in a control loop for the process. In order to be able to produce storable and cost-effective components, it is further necessary to carry out a residual stress analysis during the cooling processes and also to analyze their influence. A prototype will demonstrate the fully automated process. These measures aim at achieving an optimized production of large quantities of solar receivers with regard to energy use and productivity. Further sub-goals of the project are the development of a fast residual stress capturing method as well as a glass-specific cost-effective infrared camera.

Project start: 01 June 2009
Project end: 31 May 2012
Submitted by:
Laser Zentrum Hannover (LZH), Germany
Funded by:
German Fed. Ministry of Education and Research (BMBF), Germany





Solutions for health

Health is our greatest wealth and the most important prerequisite for economic and social prosperity. Facing demographic changes and an ageing society, novel tools and methods for preventive medicine and earlier diagnostics are becoming even more important for reducing healthcare costs and improving the quality of life for the people in Europe. Here, photonics applications help to

> faster diagnosis

> better therapies

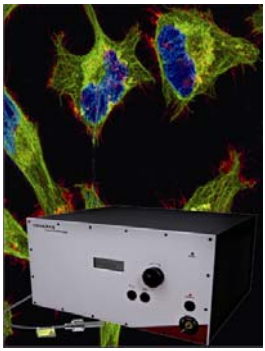
> a better understanding of the human body

IR Lasers make the invisible visible

Infrared supercontinuum sources for seeing the invisible

Light plays a crucial role in solving today's main scientific and medical challenges. The molecules that define a disease, a pollution or an impurity in a food sample all have a characteristic optical fingerprint, which can be read by detecting the light that the sample absorbs. NKT Photonics have over the last five years build up a leading position within visible light supercontinuum sources for analysis of biological samples. Now NKT Photonics will together with researchers from the Technical University of Denmark and the University of Aarhus develop a new generation of lasers that have the same extreme bandwidth but cover the near infrared range from 2 to 5 µm. Such a laser does not exist today, but it would have vast potential within chemical and biological analysis, as all chemical and biological materials absorb light within this range. A main challenge for the project is that conventional silica fibers have strong absorption and cannot be used for this area. Instead the project will utilize the new and emerging technology of soft glasses, which poses significant challenges in terms of fiber design and interfacing. An added advantage of the project, is that the development implies making new eye safe IR fiber lasers and high power amplifiers, which in themselves have commercial potential e.g. for monitoring of pollutants and in LIDARs. The project is supported by the Danish National Advanced Technology Foundation and has a total budget of 4 mio Euro.

Project start: 01 September 2009
Project end: 31 August 2012
Submitted by:
NKT Photonics, Denmark
Funded by:
Danish National Advanced Technology Foundation, Denmark



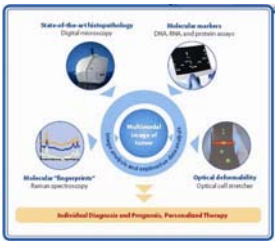
A novel diagnostic method for fighting cancer

EXPRIMAGE

While pathologists can safely distinguish tumorous from healthy tissue by microscopic inspection of tissue sections, their prognosis of the course of disease unfortunately remains vague in many cases. The "Exprimage" research network aims to change this by establishing novel parameters for cancer diagnostics. For this purpose, the latest methods in optics and molecular biology are integrated into a novel diagnostic platform. Here, tissue diagnostics is brought to a new level by implementing digital microscopy and automated image recognition. Further diagnostic parameters are supplied by biomolecular analysis, optical measurements of cell elasticity and Raman spectroscopy. In the course of the project, these methods are applied to ten thousands of tissue sections and the results judged in a synoptic review. The involved medical partners supply not only their large experience in cancer diagnostics and tissue pathology, but also an exceptionally large and well-documented casebook. The novel diagnostic method shall help to predict individual courses of disease more precisely and thus lead to better therapy recommendations.

Project start: 01 August 2007
Project end: 31 July 2011
Submitted by:
Research Program "Biophotonics" funded by German Federal Ministry of Education and Research

Further project partners:
Carl Zeiss MicroImaging GmbH, QIAGEN GmbH, WITec GmbH, Universitätsklinikum Hamburg-Eppendorf, RWTH Aachen, Friedrich-Schiller-Universität Jena, Germany
Funded by:
German Fed. Ministry of Education and Research (BMBF), Germany

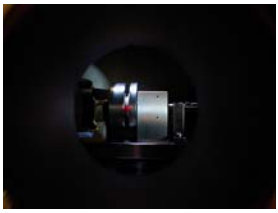


Lasers give CT a new face

LaserTron

The intention of the Lasertron consortium was to develop the basic principles of a locally-excited laser-driven high-current electron source as one of the key-components for future X-ray devices. These devices will find application especially in Computed Tomography (CT), where high-power X-ray sources are needed, combining high brightness and high modulation capability. The advantages for CTs are an increase of temporal and spatial resolution of the 3-D images and simultaneously a decrease of dose rate for patients. The project comprised on the one hand the analysis of applicable electron emission mechanisms, such as photo-electrical emission with wavelengths from IR to UV and plasma-based electron emission. Both realized by Laser radiation. Emission currents of more than 1 A where produced with a plasma cathode, based on a Laser-induced discharge plasma and grid controlled electron emission. Circuit times less than 1 µs and temporal modulation strongly connected to Laser-burst duration were measured. X-ray imaging verified high brightness and low emittance of the electron beam. On the other hand ultrafast Lasers were investigated and developed with pulse durations from fs to ps, repetition rates in the MHz regime and (as the main part) average output powers of multiple 100 W. Additionally, suitable optics where designed, manufactured and tested with special regard to damage threshold and dispersion.

Project start: 01 April 2005
Project end: 31 March 2008
Submitted by:
Fraunhofer ILT, Aachen, Germany
Funded by:
German Fed. Ministry of Education and Research (BMBF), Germany



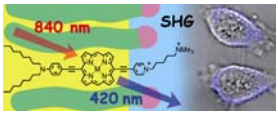
Membrane potential for brainiacs

Imaging membrane potential via second harmonic generation

Understanding how the brain works is one of the great unsolved scientific challenges. We need a way of mapping the voltage changes in neurons, with high sensitivity, high spatial resolution and high temporal resolution. Microelectrodes are currently the primary method for measuring membrane potentials; they give excellent sensitivity and temporal resolution, but poor spatial resolution. Optical microscopy has the potential to revolutionize this field by allowing the non-invasive, real-time, high resolution imaging of voltages along individual neurons, within their native networks. At present, the most effective optical probes for membrane potential are fluorescent calcium indicators.

However changes in calcium concentration do not accurately reflect voltage transients, and provide no information on the voltage waveform. Second harmonic generation (SHG) imaging has emerged as a powerful alternative. Push-pull chromophores orientated in the neuronal plasma membrane generate a high contrast signal that is sensitive to the local electric field. The high polarizability and intense optical transitions of porphyrins make them excellent candidates for engineering efficient SHG voltage-sensitive probes. Our studies on porphyrin-based voltage probes led to dyes which exhibit strong SHG and have high affinities for biological membranes. We plan build on these results to create a new series of voltage-sensitive porphyrin-based dyes for studying neuronal networks.

Project start: 15 May 2010
Project end: 15 May 2014
Submitted by:
Oxford University, United Kingdom
Funded by:
Engineering and Physical Sciences Research Council CEPSRCS, United Kingdom



All you need is CARS

Chemical selective imaging for drug improvement

Many drugs need to be delivered slowly over an extended period of time. We built a microscope that provides chemically selective (CARS) imaging so that the diffusion of the drug can be visualized as it leaves the tablet. Improved imaging and characterization of the drug distribution inside the tabel and during the release will aid drug development.

Project start: 04 May 2006
Project end: 04 May 2014
Submitted by:
University of Twente, Netherlands
Funded by:
Dutch Ministry of Economic Affairs, Netherlands

Optical Sciences

Full body tomography for human health. And that's a (ph)fact.

PHACT

State of the art X-ray computer tomography uses the absorption contrast to make a 3D image of a sample . This method is relatively insensitive for only small differences in the absorption coefficient. A novel approach uses the phase shift of x-rays traveling through a sample to calculate a corresponding image. Within the PHACT project a consortium of two research institutes and two industrial partner aim to bring this novel technology to the level, where it can be integrated into todays CT-scanners. This would allow for medical images with higher contrast especially in case of soft tissue. The phase shift is detected by an x-ray talbot interferometer comprising two different types of optical gratings. Especially the so called absorption grating requires high aspect ratio gold microstructures with dimensions in the micron range and heights of more than 100 µm, which is far above the limits of todays fabrication technologies. Further improvement in the LIGA process together with an optimization of the grating geometry offers the potential to achieve this challenging goal. Thus, the PHACT project makes X-ray phase contrast imaging possible in a conventional CT-scanner even at energies used for full body tomography; it paves the way for better examination of human tissue and will contribute to better and more precise health care.

Project start: 01 April 2009
Project end: 31 March 2012
Submitted by:
Karlsruhe Institute of Technology (KIT), Germany
Funded by:
German Fed. Ministry of Education and Research (BMBF), Germany

PHACT

Managing the invisible

in-vivo optical projection tomography

Optical Projection Tomography (OPT) is a light microscopical technique developed by James Sharpe [1]. Similar to X-Ray Computed Tomography, small animals are illuminated, and projection images are taken from several sides, which then enter an inverse Radon transform to reconstruct a three-dimensional representation of the object, allowing non-invasive structural, morphological, and functional imaging of animals in the size range between some tens of micrometers up to a few centimeters. Many model organisms of biomedical research are excellent candidates for studies using OPT, since functional analyses of organs, organelles, down to the single cell are necessary for insights in many human diseases. Due to the lack of alternative imaging modalities - because either they make use of harmful radiation or are otherwise unsuitable for in-vivo imaging - this technique is a most promising novel approach closing the gap between high resolution microscopy and macro-scale imaging such as magnetic resonance tomography.

Project start: 01 January 2008
Project end: 31 December 2010
Submitted by:
Foundation for Research and Technology - Hellas, Greece

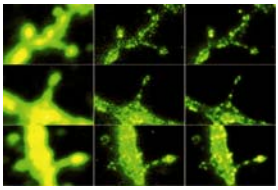
Further project partners:
Heraklion, Greece, and Medizinisches Laserzentrum Lübeck GmbH, Germany
Funded by:
European Commission, EU

Show me your macromolecules!

Imaging of macromolecules with nanoscale super-resolution microscopy

The purpose of this project is to contribute further to this understanding of the 'molecules of life', and especially to resolve questions not possible to dissect with common live-cell microscopy techniques. To achieve this we have implemented the nanoscale super-resolution technique of stimulated emission depletion (STED) microscopy invented by Prof. Stefan W Hell. This technique provides novel possibilities for directly analyzing nanoscopic protein assemblies and machinery in living cells. The accurate determination of a protein's spatial distribution inside a cell is often intimately related to its function. It also facilitates direct visualization of molecular interactions and transport dynamics at the nanoscale. Full understanding of molecular functions in cells is only achievable if all interactions are considered and visualized (cf. research project image). Applying STED, the possibility to provide an enhanced understanding of the function and regulation of cellular machineries is improved considerably. When one is able to in detail understand the nanomachineries of the cell, how it works, how it is regulated and signals, the pathway to develop new and more efficient pharmacological strategies lays open. This would lead to a healthier European population and promote its pharmaceutical industry.

Project start: 01 August 2009
Project end: 31 July 2012
Submitted by:
Royal Institute of Technology/ Karolinska Institute Stockholm, Sweden
Funded by:
VR (The Swedish Research Council), Sweden

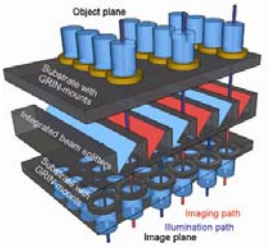


Innovation in miniature

Miniaturized parallel microscopy for system biology

High throughput microscopy is a key technology for system biology. To investigate e.g. the effect of viral infection in living cells, genome wide screens of human cells are required. The present limitation is given by the rate of microscope data that can be recorded and processed in a given time. In our miniaturized parallel microscopy project, this bottleneck is addressed by constructing an array of miniaturized imaging systems, which enable a speed-up of several orders of magnitude.

Project start: 01 January 2007
Project end: 31 December 2010
Submitted by:
University of Heidelberg, Germany
Funded by:
German Federal Ministry of Education and Research (BMBF), Germany



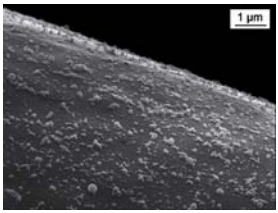
Next generation nanoparticles. From any material, for any purpose.

Customized nanomaterial for better medical devices

The project is funded by the German Federal Ministry of Economics and Technology in the support programme "EXIST Transfer of Research". It aims at the industrial development and production of pure, customized nanoparticles by laser ablation in liquids that can be used for the improvement of medical devices. One of the applications of laser-generated nanoparticles from specific alloys is the secure coating of implant surfaces with nanoparticles to generate a nanoroughness. The result is an improvement of biological compatibility of metallic implants that can contribute to a longer lifetime of a wide field of products such as stents, osseous nails, neural electrodes, or heart valves, the demands of which keep increasing as people become older in every generation.

Project start: 01 September 2008
Project end: 31 December 2011
Submitted by:
Particular GmbH, Germany
Funded by:
German Federal Ministry of Education and Research (BMBF), Germany

Particular
customized material



A smart choice for diabetes monitoring

Development of an implanted biosensor for continuous care and monitoring system of diabetic patients: the P.Cezanne project

Development of an Implanted Biosensor for Continuous Care and Monitoring System of Diabetic Patients: the P.Cezanne Project Our project (FP6-031867) is developing an implantable device for glucose monitoring, integrating engineered proteins with fluorimetric detection and hydrogel waveguide technology. The implant feeds a stream of interstitial fluid glucose values into a telemedicine system and can eventually integrate an insulin pump, thus fulfilling the goal of an "artificial pancreas". The sensor is based on a bacterial Glucose Binding Protein (GBP), fused with a fluorescence donor-acceptor pair, Cyan and Yellow Fluorescent Proteins. Between the fluorescent proteins Fluorescence Resonance Energy Transfer (FRET) occurs. On glucose binding GBP undergoes a conformational change of FRET. Mutant derivatives of GBP were designed to achieve glucose sensitivity between 2 and 30 mM, the range of clinical utility. Sensor proteins are embedded in a hydrogel matrix, which serves as a waveguide for single-wavelength excitation by a blue laser diode. Fluorescence is monitored at two separate wavelengths. The FRET signal is processed inside the implant and wirelessly transmitted to a personal mobile device.

When fully developed, our implantable system may provide an autonomous solution for continuous glucose monitoring.

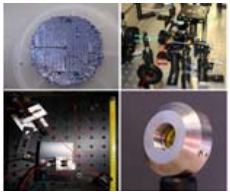
Project start: 01 December 2007
Project end: 31 December 2010
Submitted by:
Tel Aviv University, Israel
Further project partners:
Fraunhofer Institute,
Polymer Institute of the Slovack Academy of Sciences Research
Funded by:
European Commission, EU

Making change possible

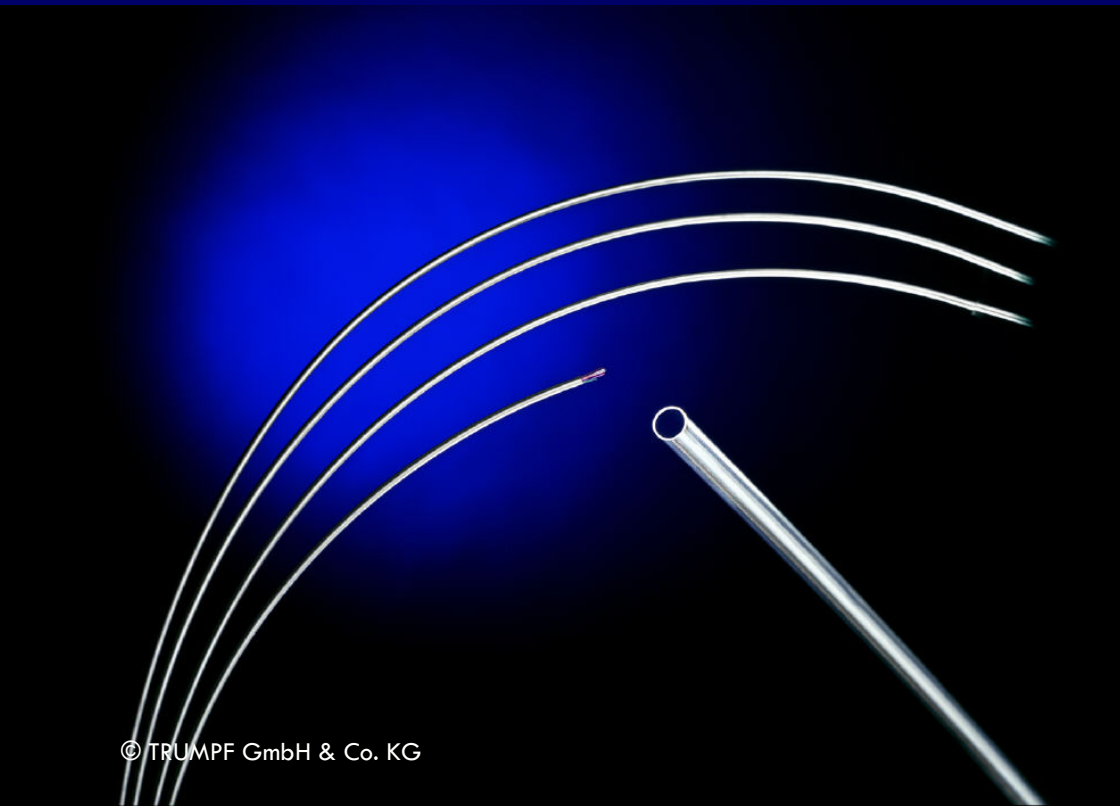
MIRSURG

The MIRSURG project, comprising researchers from 9 European institutes and companies, is focused on development of a laser source that will enable minimally invasive neurosurgery. The laser should emit at a wavelength near 6.45 µm and provide high single pulse energy and average power. The penetration depth at this wavelength will be comparable to the cell size (several micrometers), which will make it possible to avoid collateral damage when ablating the tissue. Earlier tests carried out in the USA with free electron lasers (FELs) have proved that brain surgery performed at a wavelength of 6.45 µm leads to good results. Such lasers generate coherent radiation with very high brilliancy. For applications in biomedicine however, FELs are not practical since they are coupled to huge and expensive accelerators. Therefore, it is important to develop new technologies to replace the FELs with table-top solid-state photonic sources. The main strategy is to exploit nonlinear optical techniques (OPO) in combination with novel near-IR laser pump sources (near 1 and 2 µm) and new materials (e.g. orientation patterned GaAs) to obtain an unprecedented energy level (10 mJ) near 6.45 µm at a repetition rate of 100 Hz (an average power of 1 W). The systems will provide improved control and higher accuracy for treatment and prevention either at individual cell level or cellular structures depending on the pulse shapes utilized.

Project start: 01 June 2008
Project end: 31 May 2011
Submitted by:
Max Born Institute - Forschung Verbund Berlin, Germany
Funded by:
European Commission, EU



Information & Communication



Solutions for information and communication

Our modern life has become unthinkable without the internet and mobile phones. Be it purchasing goods, applying for a job, keeping contact with family and friends, working in multi-national teams or controlling and monitoring a production system - high-performance information and communication systems are the gateway to the world and the basis for the knowledge society. Among others, photonics contribute to

> faster and safer data transmission

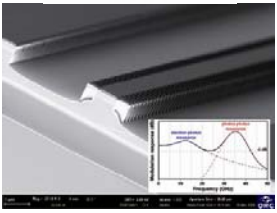
> low-cost technologies for high-speed communications

DeLightful telecommunications at low costs

DeLight

The FP7 ICT project DeLight is developing advanced structures and technologies for the low-cost fabrication of high-performance telecommunication lasers. Surface gratings a thousand times smaller than the diameter of human hair are used to generate ultra-pure light, while multiple laser sections provide direct-modulation speeds capable of sending the content of approximately 10 full DVDs per second (43 Gbit/s). The DeLight project removes the need of epitaxial overgrowth, employed in the current fabrication techniques of distributed feedback (DFB) and distributed Bragg reflector (DBR) lasers, by using surface gratings. This fabrication advantage is augmented by the use of Nano-Imprint Lithography (NIL), which is an emerging cost-effective wafer-level lithographic technology based on the mechanical embossing principle, which can achieve pattern resolutions at the atomic scale, beyond the limitations set by the diffraction and scattering for the conventional projection techniques. By exploiting high-order photon-photon resonances DeLight extends the direct-modulation bandwidth far beyond the current limits imposed by electron-photon resonance. This will reduce the cost and complexity of high-speed optical transmitters by eliminating the need of an external modulator. The ultimate goal of DeLight is to provide fast and cheap optical communications by a combination of direct modulation, ultra-high bandwidth and low fabrication costs.

Project start: 01 September 2008
Project end: 31 August 2011
Submitted by:
Tampere University of Technology, Finland
Funded by:
European Commission, EU



High-speed for transmitters and receivers

High-speed electro-optical components for integrated transmitter and receiver in optical communication

HECTO has been an FP6-IST project partly funded by the European Commission with 2.36 million euro out of a total project budget of 3.87 million euro. It was started in 2006-11-01 and ended in 2010-02-28. The focus of this project has been on the development of photonic components, transmitters and receives, for high-performance and high-speed but cost-efficient communication systems. The main objectives of the project are summarized as follows:

- To develop transmitters and receivers suitable for optical systems based on serial 100GbE signals requiring 112Gbit/s.
- To determine specifications for all interfaces of the photonic components taking into account emerging relevant standards, and to determine application areas for the components and their impact on the specifications.
- To test the transmitters and the receivers in laboratory tests and field trials.
- To disseminate the results of the project, e.g. through the involvement of end users in the field trials.
- To exploit the results of the project, including plans for commercial exploitation by the SME component vendors of the consortium. The HECTO project ended successfully with field trials of serial 100 GbE signal at 112 Gbit/s over several kilometers.

Project start: 01 November 2006
Project end: 28 February 2010
Submitted by:
Royal Institute of Technology / Kungliga Tekniska Hogskolan, Sweden
Funded by:
European Commission, EU

When photonics meet electronics

HELIOS

The aim of the project HELIOS is to combine a photonic layer with a CMOS circuit by different innovative means, using microelectronics fabrication processes. The objectives of HELIOS are manifold:

• Development of high performance generic building blocks that can be used for a broad range of applications: WDM sources by III-V/Si heterogeneous integration, fast modulators and detectors, passive circuits and packaging

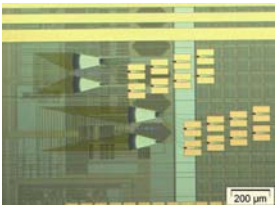
• Building and optimization of the whole "food chain" to fabricate complex functional devices. Photonics/electronics convergence will be addressed at the process level and also at the design level since HELIOS will contribute to the development of an adequate design environment

• Realization of several complex photonic IC's addressing different industrial needs, including a 40Gb/s modulator, a 16x10 Gb/s transceiver, a Photonic QAM-10Gb/s wireless transmission system and a mixed analog and digital transceiver module for multifunction antennas..

• Investigation of more promising but challenging alternative approaches offering clear advantages in terms of integration on CMOS for the next generation of CMOS Photonics devices

• Road mapping, dissemination and training, to strengthen the European research and industry in this field and to raise awareness of new users about the interest of CMOS Photonics. HELIOS will make integration technologies accessible for a broad circle of users in a foundry-like, fabless way.

Project start: 01 May 2008
Project end: 01 May 2012
Submitted by:
CEA-Leti, France
Funded by:
European Commission, EU

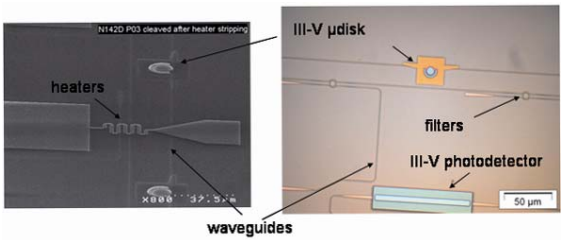


Tune up your data transfers!

WADIMOS

Wavelength Division Multiplexed Photonic Layer on CMOS The enormous computing power of multi-processor systems and manufacturing tools now on the drawing table will require data transfer rates of over 100Terabit/s. These data rates may be needed on-chip, e.g. in multicore processors, which are expected to need total on-chip data rates of up to 100TB/s by 2015, or off-chip, e.g. in short distance data interconnects, requiring up to 100TB/s over a 10m to 100m long distance. The only viable technology for transmitting this level of information is using optical interconnects. Besides a huge data rate, optical interconnects also allow for additional flexibility through the use of wavelength division multiplexing. This additional flexibility may be employed for the realization of more intelligent interconnect systems, such as the optical network-on-chip system also investigated in this project. WADIMOS will build a complex photonic interconnect layer incorporating multi-channel microsources, microdetectors and different advanced wavelength routing functions directly integrated with electronic driver circuits and demonstrate the application of such electro-photonic ICs in two representative applications, an on-chip optical network and a terabit optical datalink.

Project start: 01 January 2008
Project end: 31 December 2010
Submitted by:
IMEC - Ghent University, Belgium
Funded by:
European Commission, EU

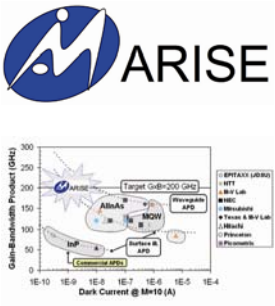


Anybody can make a mistake? We don't agree.

MARISE: Materials for avalanche receiver for ultImate sensitivity

Avalanche photodiodes (APDs) are key components for many applications (telecom, ranging, sensing, spectroscopy,...) because their internal gain improves the photoreceiver sensitivity considerably. Two III-V materials of interest have emerged: AlGaAs and AlInAs, lattice-matched to GaAs and InP, respectively, and both characterised by a wide bandgap. In recent years, a breakthrough in the impact ionisation characteristics was identified and the major importance of a thin avalanche multiplication layer was clearly demonstrated. MARISE ambition is aiming to develop innovative engineered APD components with thin avalanche layers to benefit from their promising characteristics likely to advance the present state of the art. MARISE objectives are to push the limits of the new APDs in two directions: speed and sensitivity: - For 10Gb/s access and single photon detection, AlInAs/GaInAs will be developed exhibiting low dark current and high responsivity, - The development of a very challenging evanescent waveguide APD structure in the same material system will allow for 40Gb/s operation with a record gain-bandwidth product of 200 GHz. The following figure shows a simulation of the optical signal propagation in a waveguide photodiode structure. - AlGaAs will be combined with a GaInAsN absorber into an innovative, very low noise and potentially low cost GaAs-based APD, suitable for 1.3 µm telecom applications.

Project start: 01 May 2008
Project end: 30 April 2010
Submitted by:
Alcatel-Thales III-V Lab, France
Funded by:
European Commission, EU



Time to change

European manufacturing platform for photonic integrated circuits (EuroPIC)

The objective of the EuroPIC project is no less than to effect a fundamental change in the way applications based on photonic integrated circuits (PICs) in Indium Phosphide are designed and manufactured. The key development is to facilitate access by small companies (SMEs) to development and manufacturing of photonic micro-systems in the form of advanced but very cost effective PICs. EuroPIC intends to bring forth a new methodology; addressing the whole production chain from idea via proof of concept, design and prototype to production and application The consortium will carry out research which will lead an open-access industrial generic foundry production capability for Europe; a new business sector with the potential for very significant future growth. This will be done by developing a generic technology that is capable of realising complex PICs from a small set of basic building blocks. EuroPIC will demonstrate the potential of this approach by fabricating a number of Application Specific PICs (ASPICs) with a record combination of complexity and performance. The consortium is in an excellent position to carry out this ambitious task. It includes Europe's key players in the technology. Further, EuroPIC is building a strong User Group, many of them SMEs, with members from different application fields, thereby providing Europe with a competitive advantage over the US and the Far East. EuroPIC builds on the FP6 European Network of Excellence, ePIXnet.

Project start: 01 August 2009
Project end: 31 July 2012
Submitted by:
Oclaro (UK), FGh-HHI, Germany
Funded by:
European Commission, EU

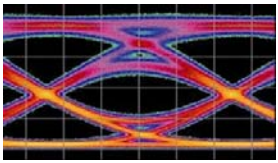
Fast and (user-) friendly

POF-PLUS

The POF-PLUS project focuses on developing new photonic components and transmission technologies for large core plastic optical fibre (POF) systems, aiming at the unprecedented implementation of tens of Gbps transmission over this medium. The different flavours of large core POF with core diameters in the range of 1 millimetre allow us to envision an extremely simple installation technology, significantly more user friendly than traditional glass optical fibre (GOF) or even standard copper solutions (UTP, coaxial, etc). The extreme simplicity of POF has to date come at the expense of lower transmission capacity with respect to GOF. Strategies to overcome these limitations based on novel transmitter and receiver components are the core goal of POF-PLUS. POF-PLUS has a two-fold objective:

1. To help build the home networks of the future, which must deliver wired and wireless broadband services, by reducing the cost of ownership with respect to existing optical technologies and increasing performances in terms of speed and usability in terms of "do-it-yourself" installations.
2. To create the foundations and encourage the birth of new business models, which shall exploit the possibilities offered by unprecedented low-cost high speed interconnect.

Project start: 01 May 2008
Project end: 30 April 2011
Submitted by:
Istituto Superiore Mario Boella , Italy
Funded by:
European Commission, EU

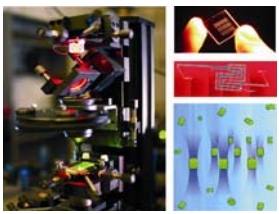


Open a new horizon of light

Nonlinear photonics - tailoring light at the nanoscale

The goal of our activities is to combine the areas of nanophotonics and nonlinear photonics to open new horizons for optical structuring, manipulation and control by light. By this means, new photonic structures that allow engineering light in an innovative way will be possible, new techniques for optical micromanipulation of particles and fluids will be developed, and the non-invasive investigation and manipulation of biomedical systems, e.g. biological molecular motors or cells will become reality. The key to these ground-breaking techniques is the combination of material structuring with all-optical, phase-engineered wave front control by the unconventional combination of nonlinear micro- and nanoscopic manipulation tools, thereby resolving a series of actual challenges in the field of nanophotonics, biophotonics, and neighbouring areas. The potential impact on technology includes advanced devices for non-dispersive and diffractive information processing by nonlinear spatio-temporal beam engineering, the nondestructive and non-invasive manipulation and imaging of micro-objects, patterning and templating of micro-devices, and novel sensor and analysis devices for nanodevices, cells and microfluids. This ground-breaking project will contribute considerably to scientific understanding and technological advancement in nanoinformation, and nanobiotechnology.

Project start: 24 May 2010
Project end: 24 May 2015
Submitted by:
Institute for Applied Physics and Center for Nonlinear Science, WWU Münster, Germany

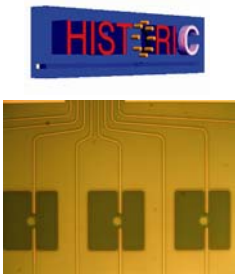


Perfect silicon solutions

Heterogeneous InP on silicon technology for optical routing and logic

HISTORIC focuses on digital photonic integrated circuits containing active and passive photonic elements for all-optical packet switching. The building blocks are ultra-compact gates based on micro-disk lasers and photonic crystal lasers, fabricated using heterogeneous integration of InP membranes on top of silicon on insulator (SOI) passive optical circuits. We use high precision growth and processing techniques available to the InP platform, and take advantage of the extreme accuracy of CMOS processing. Several all-optical flip-flops and gates are integrated on a single chip, and are interconnected by short SOI waveguides. The extreme dimensions of the flip-flops, gates and their interconnections result in competitive footprint, speed and power consumption. The ultra small dimensions of the all-optical flip-flops result in record low switching times (< 60 ps) and switching energies (< 2 fJ). The unique features of the lasers can also be exploited for other optical signal processing, e.g. wavelength conversion for contention resolution. The possibility of integrating a large number of photonic digital units opens new perspectives for all-optical signal processing and optical buffers. The project therefore also focuses on designing relevant new optical switching and routing architectures. System tests will demonstrate the advantage of the new optical approach for processing and buffering over the conventional electronic approach.

Project start: 01 July 2008
Project end: 30 June 2011
Submitted by:
imec-Ghent University (Belgium), CNRS-LPN (France)
Further project partners:
Technical University Eindhoven, Netherlands, IBM Zurich Research Laboratory, Switzerland
Funded by:
European Commission, EU



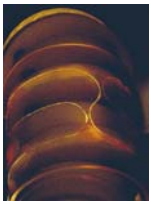
It all starts with the fibre

PHOSFOS - Photonic skins for optical sensing

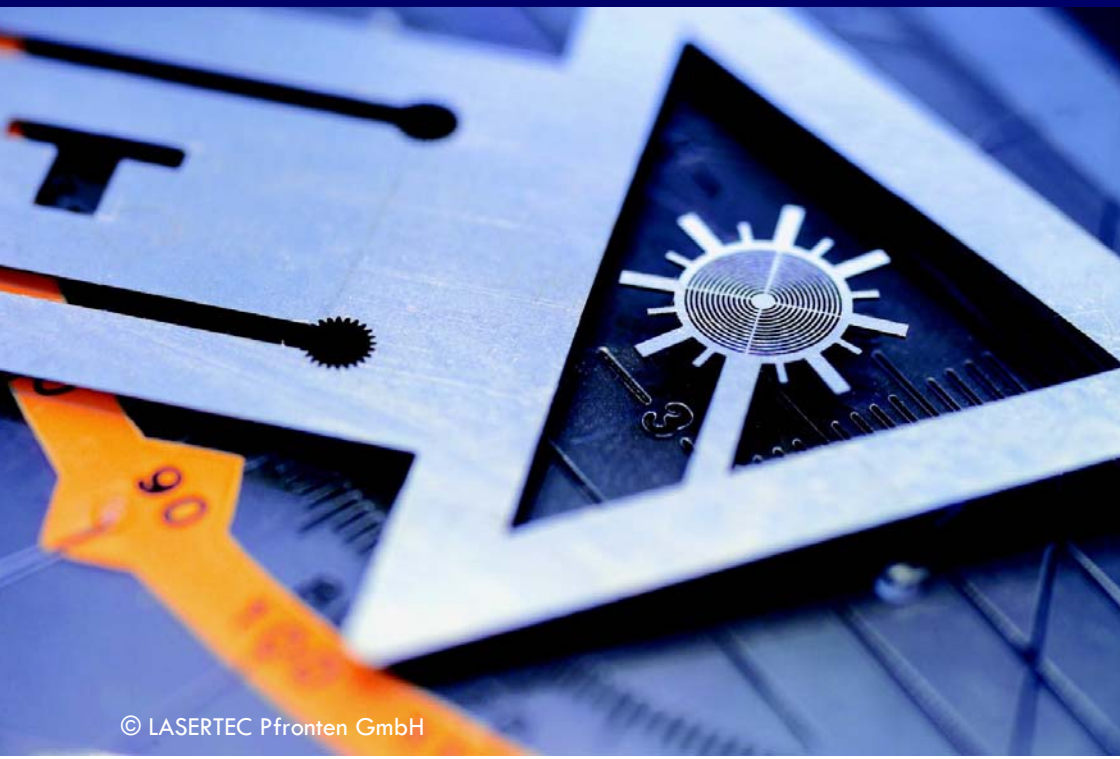
PHOSFOS develops a flexible and stretchable foil that integrates optical sensing elements. The photonic skins find applications in continuously monitoring the integrity and the behaviour of different kinds of civil engineering structures and energy production facilities. PHOSFOS thereby contributes to safety of the public and personnel. The highly flexible skins will also serve long term monitoring of respiration and cardiac activity. PHOSFOS will therefore also contribute to better healthcare. The sensing elements rely on highly birefringent micro-structured optical fibres and on polymer optical fibres, both with fibre Bragg gratings. The silica fibres exhibit almost zero temperature sensitivity to cope with the traditional temperature cross-sensitivity issues of conventional fibre sensors. Polymer fibres are used for their very specific property that their length can be stretched up to 300% before breaking. Two SMEs participate in PHOSFOS. The first SME, active in the field of structural health monitoring, forecasts a commercial revenue of 125 kEURO after five years. The second SME, active in healthcare, forecasts total income to rise to 2.1 MEURO after 9 years. PHOSFOS tackles essential issues such as packaging and fully -fledged system integration to support wide deployment of optical fibre sensor technologies. Together with the expected revenues, this will strengthen the competitiveness of European industry in this field and ensure job creation in the involved SMEs.

Project start: 01 April 2008
Project end: 31 March 2011
Submitted by:
Vrije Universiteit Brussel, Belgium
Funded by:
European Commission, EU

PHOSFOS
Photonic Skins For Optical Sensing



Production



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Solutions for production

Laser systems have become an integral part of industrial production technology. Europe holds a leading position in this field and academia and industry are constantly working on novel solutions and applications for production, such as

> lasers with more light output for a given energy input

> new concepts for manufacturing technologies and

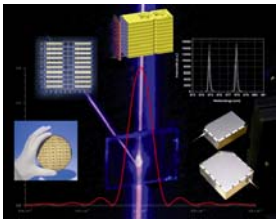
> reduced production costs for optical components

Pimp your diode laser!

SPEKTRALAS : Improvement of the spectral characteristics of high-power diode lasers

Spectrally stabilized high brightness diode lasers enable power scaling concepts in the field of high brightness laser modules. Therefore direct material processing and the increase of the pumping efficiency of solid state lasers can be realized by the implementation of this technique. In frame of the SPEKTRALAS project the increase of the output power of high-power diode lasers including multimode single emitter and diode laser bars with DFB-structures or external cavity feedback are investigated. The global target of the project is the manufacturing of diode laser modules with 95 % power inclusion in less than 1 nm spectral bandwidth. Laser diodes with 100 µm facet width, 10 W output power and a conversion efficiency of 60 % will be produced. Laser prototypes will be developed based on single emitters and arrays (bars) with a maximum amount of 19 emitters each. One field of application of diode lasers with narrowed spectra is pumping of solid state lasers. Because of the thermal insensibility the cooling system can be simplified. Wavelength stabilization also enables the pumping of solid state lasers in narrow spectral absorption regions. Thus new pumping center wavelengths can be used to increase the efficiency of solid state lasers. This project is funded by the Bundesministerium für Bildung und Forschung (BMBF) in Germany.

Project start: 01 September 2008
Project end: 31 August 2011
Submitted by:
DILAS, Diodenlaser GmbH, Germany
Funded by:
German Federal Ministry of Education and Research (BMBF), Germany

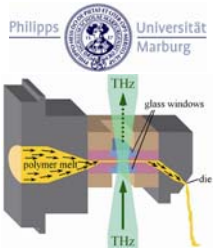


For every kind of sunshine

New quasi-optical components based on polymeric compounds overcoming the current imaging limitations of production monitoring THz and sub-mm wave systems

Terahertz(THz) systems are used in many applications, e.g. online production quality control, detection of foreign bodies in foods and several of imaging applications. Terahertz-quasi-optical components such as free-space lenses or substrate-lenses are one of the essential parts of a T-Ray measurement system. The emitted wavelength is settled at a few hundred microns which is much bigger than in the optical regime. Because the dimensions of beam guiding elements, e.g. lenses, lie within the same order of magnitude, diffraction effects have to be accounted for. So far, free-space lenses are made of high-density polyethylene, polypropylene or other polyolefines. These materials exhibit relatively small refractive indices and give rise to big lens curvatures leading to undesired aberrations. In contrast to this, conventional substrate lenses based on silicon show good functionality but are quite expensive. To overcome these drawbacks, material systems based on polymeric compounds could be a promising and low-priced alternative due to their mass production capability. Their refractive indices can be tuned to higher values by adding high-refractive substances resulting in smaller lens curvatures improving the image quality. Our recent project aims for designing and evaluating these new quasi-optical components based on polymeric compounds in order to improve existing T-Ray measurement systems with respect to image quality, functionality and cost-efficiency.

Project start: 25 January 2010
Project end: 24 June 2011
Submitted by:
Philipps-Universität Marburg, Germany
Funded by:
Arbeitsgemeinschaft industrieller Forschungsvereinigungen e.V. (AiF), Germany



Light up your life!

Flexible patterning of complex micro structures using adaptive embossing technology

The constant further development of light-emitting diodes (LEDs) has led to efficient, resource-saving light sources during the last years. However, the use of such light sources has so far been limited to few applications, although the advantages with regard to energy-efficiency and durability are well known. Within the context of the research project »FlexPAET« the Fraunhofer IPT develops a process in order to produce cost-effective flat optics, which will allow an area-wide use of LED-lighting engineering in the future.

Project start: 29 October 2008
Project end: 30 September 2011
Submitted by:
Ascamm Foundation, Spain
Funded by:
European Commission, EU

The next generation of glass optics

WaferLevelOptics

Micro optical components and systems often serve as an important enabler for innovative products in multiple branches. The ongoing miniaturization and the continuously growing quantities are only two issues which let to a change in optics manufacturing - from conventional grinding and polishing towards replication approaches such as the precision glass molding. Especially ultra precise glass optics feature multiple advantages so that an increased demand is expected. In polymer optics the production on wafer level is already well established and also etching technologies to produce micro glass optics are adequate and economical manufacturing approaches. Here, the economies of scale can be ideally used and innovative products such as todays mobile phone camera modules could be realized. However, when glass optics in the range of 1 – 3 mm in diameter are demanded, there is currently no manufacturing process able to meet these demands. But especially those kind of optical elements will be important components of future optical elements such as 8 mega pixel camera modules. So the need of an intelligent manufacturing approach is obvious. Derived from this lack of manufacturing processes the WaferLevelOptics project was set up. Unifying 10 partners from 6 European member states the goal of the project is to enable the precision glass molding for the replication of wafer level glass optics and therewith close the existing cap in micro glass optics manufacturing.

Project start: 01 October 2010
Project end: 30 September 2013
Submitted by:
Fraunhofer IPT, Germany
Funded by:
European Commission, EU

Small but mighty

Lasers for Micromachining and diagnostics

This project brought together four Lithuanian laser technology and photonic enterprises for developing top quality industrial lasers intended for the manufacturing processes and healthcare systems. The most significant result of the project is the development of new technologies that allow access to the global market of industrial lasers for the manufacture of photovoltaic solar cells, light emitting diodes (LEDs) and treatments for eye diseases. As the result of the project know-how two major technologies were created: The first research was focused on all steps in the particularly subtle micromachining, from basic research to photonic tools used for the manufacture of photovoltaic solar cells. Ekspla has created „PL10100" series picosecond diode pumped laser that offers high repetition rates (up to 250 kHz) and wide spectral range (355 nm to 1.5÷2 µm) suitable for polimer photovoltaic elements machining. The other research was focused on medical application, namely treatments for eye diseases. Light Conversion has created a femtosecond laser system "PHAROS" with record output parameters. The laser finds wide applications not only in medical field, but also for fabrication of LEDs and procesing of sapphire. The project contributed to the development of the laser industry in Lithuania. Based on the project results, the new branches of industrial lasers has been introduced at Ekspla and Light Conversion. Two fast-growing startup companies were also launched.

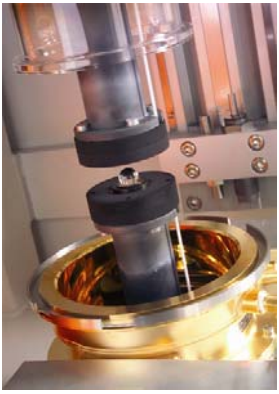
Project start: 01 April 2005
Project end: 30 October 2007
Submitted by:
Ekspla UAB, Lithuania

Grinding and polishing was yesterday ... !

Production4µ

Precision glass moulding enables the cost-efficient replicative production of precise glass optics in one single process step. With this, it makes costly non-replicative production steps such as grinding and polishing redundant. Additionally, it allows to produce forms like aspheres, arrays or even diffractive optics, which can barely be manufactured with conventional process chains. A consortium of more than 20 companies, institutes and universities from all over Europe is advancing the precision glass moulding technology. This consortium with the title "Production4µ", which is funded by the European Commission, is managed by Fraunhofer IPT.

Project start: 01 May 2006
Project end: 30 October 2010
Submitted by:
Fraunhofer IPT, Germany
Funded by:
European Commission, EU



Security

Solutions for security

Another grand challenge for Europe in the 21st century is security. Contactless sensing and measurement solutions are becoming increasingly important. Not „only“ for defence applications, but also for the safe mobility of the European people. With imaging systems based on infrared or terahertz radiation, photonics contribute to

> improving active safety systems in automobiles and to

> making travelling more secure

A new era in prevention and detection

Handheld THz-spectrometer for detection of explosive and hazardous liquids

Attempts by terrorist making use of liquid explosives in the last years have urged authorities to a higher level of security in public transport. Besides uncovering weapons and other sharp metallic devices, the need for identifying possible dangerous liquids has become a high priority task. To avoid dangerous liquids passing the security check points in harmless looking bottles, so far any kind of liquids with volumes exceeding 100 ml are prohibited in the carry-on luggage. But this is by far not sufficient to meet passengers' demands for security and comfort. Terahertz time-domain spectroscopy is a promising technology which can potentially fill this gap. It enables authorities to distinguish between liquid explosives and non-hazardous liquids, like beverages and cosmetics, due to the characteristic THz spectra (0.1 – 1 THz). The interaction between the THz radiation and the liquid under test leads to a specific spectroscopic patterns, identifying possible threads. Our approach focuses on designing and building a portable scanner, measuring absorption and refractive index of liquids in reflection. Due to the transparency of most container materials in the THz frequency range, this can be performed without opening the bottles and within seconds. This will make airport security checks faster, safer and more reliable for both customers and authorities.

Project start: 01 January 2008
Project end: 31 December 2010
Submitted by:
Philipps-Universität Marburg, Germany
Funded by:
German Fed. Ministry of Education and Research (BMBF), Germany

Philipps Universität Marburg

I CEE YOU

Infrared imaging components for use in automotive safety applications (ICU)

An EU-sponsored consortium of industry and academia under the acronym of "I CEE YOU" (ICU - Infrared Imaging Components for Use in Automotive Safety Applications) works on a low-cost sensor that will pick up images of pedestrians or animals crossing roads at night and transfer them to the drivers. The sensor will project the image onto the car's front screen, so that it is immediately visible to the driver. The breakthrough is based on infrared imaging technology and captures the energy emitted by warm (living) objects which is independent of ambient light and temperature conditions. This solution will considerably reduce the death tolls and the numbers of injuries caused by motorised transport. It is therefore a first step towards a considerable reduction of the more than 50.000 traffic fatalities and the almost 2 million injuries in Europe yearly. In addition, this infrared imaging system will also enhance operations security of heavy duty vehicles, by surveying load carrying units of lorries and/or railcars, and also warehouses and other storage facilities. Although construction of the prototype will be quite challenging in terms of integration of several complex components, the multiple applications may lower the costs of production through mass fabrication.

Project start: 01 May 2008
Project end: 31 October 2010

Submitted by:
ICU consortium: KTH Royal Institute of Technology, Sweden
Further project partners:
Acreo AB, Infineon Technologies SensoNor AS, Autoliv Development AB, Umicore nv, Vrije Universiteit Brussel
Funded by:
European Commission, EU

ICU

EOS events in 2011

Abstract due date:
5 January 2011

1ST EOS CONFERENCE ON OPTOFLUIDICS (EOSOF 2011)

Munich, Germany | 23 – 25 May 2011
www.myeos.org/events/eosof2011 | munich@myeos.org

Topics:

- Microfluidic lasers
- Fluid-fluid waveguides
- Microfluidically tuned optical fiber and interferometers
- Fluid paper
- High resolution in-chip lens less microscopy
- Optical and photonic tweezers
- High sensitivity biomolecular sensor platforms
- and specific application areas

Abstract due date:
5 January 2011

2ND EOS CONFERENCE ON MANUFACTURING OF OPTICAL COMPONENTS (EOSMOC 2011)

Munich, Germany | 23 – 25 May 2011
www.myeos.org/events/eosmoc2011 | munich@myeos.org

Topics:

- Theoretical and Practical Aspects of Manufacturing and Finishing Technologies
- Testing for Fabrication and Assembly
- Optics Manufacturing Processes
- Optical Manufacturing for Emerging Products and Processes
- A joint session will be organised with the SPIE Conference "Optical Meterology" (Optical Measurement Systems for Industrial Inspection).

1ST EOS TOPICAL MEETING ON PHOTONICS FOR SUSTAINABLE DEVELOPMENT - FOCUS ON THE MEDITERRANEAN (PSDM 2011)

Tunis, Tunisia | 11 - 13 July 2011
www.myeos.org/events/psdm2011 | psdm2011@myeos.org

Topics:

- Biophotonics
- Optics and energy
- Optics and environment
- Optical communications
- Security
- Organic photonics
- Optical sensing

2ND EOS TOPICAL MEETING ON "BLUE" PHOTONICS - OPTICS IN THE SEA

Bremerhaven, Germany | 5 - 7 September 2011
www.myeos.org/events/bluephotonics2 | bluephotonics2@myeos.org

Would you like to be alerted when the call for papers is published? Send an email with your contact details to bluephotonics2@myeos.org.

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ISBN 978-3-00-030508-5

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