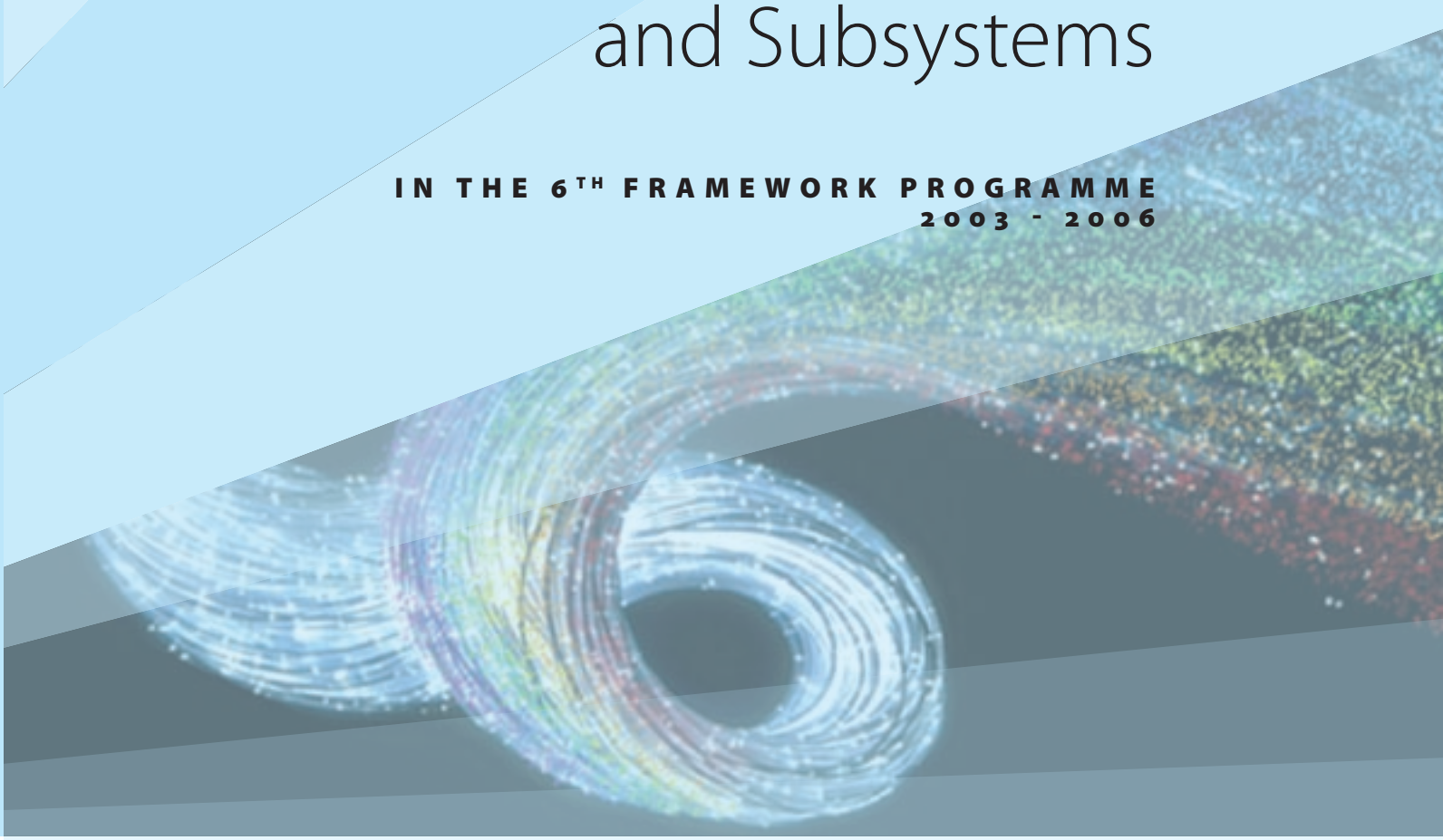
Photonics
Components and Subsystems

IN THE 6TH FRAMEWORK PROGRAMME
2003 - 2006



Photonics Unit
DG Information Society and Media

European Commission
Information Society and Media

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Foreword

The term Photonics was coined in 1967 by Pierre Aigrain, a French scientist, who gave the following definition: *'Photonics is the science of the harnessing of light. Photonics encompasses the generation of light, the detection of light, the management of light through guidance, manipulation, and amplification, and most importantly, its utilisation for the benefit of mankind.'*

The 20th century is often called the century of the electron because of the technological breakthroughs enabled by the mastery of the electron. Similarly the 21st century is predicted to be known as the century of the photon!

Today, at the beginning of the 21st century, European scientists and engineers are achieving a new level of mastery of light, which is resulting in a quantum leap in growth and competitiveness in key economic areas, such as communication, entertainment, health care, manufacturing, lighting and biosciences.

Photonics is a diverse technology, bringing together the disciplines of physics, nanotechnology, materials science, and electrical engineering. It is this 'edge effect' that drives innovation. Since the first demonstration of the laser in the 1960's Photonics has made huge progress, surging ahead to become one of the key technologies. The next innovation boost in this field will come from mastering the manipulation of the elementary particles of nature, exploiting the effects of quantum physics, further reducing the footprint of optical elements to the micro- and nano-meter scale, tailoring the propagation of electromagnetic waves with the help of metamaterials, extending Photonics to spectral regions like THz which at present are underexploited, and learning from biology how to manipulate and process light.

The importance of Photonics can be seen from the multitude of application sectors where it is increasingly seen to be driving innovation. These sectors include *information processing, communication, imaging, lighting, displays, manufacturing, life sciences and health care, and safety and security.* Photonics is offering new and unique solutions in these areas where today's conventional technologies are approaching their limits in terms of speed, capacity and accuracy.

Thierry Van der Pyl
Head of Unit, Photonics
DG Information Society & Media, European Commission

Summary

Photonics is one of the most promising and exciting fields currently being developed. Photonics is to light what electronics is to electricity. The subject was born with the invention of the laser in 1960, which together with the development of optical fibres for communications has led to high capacity telecommunications and is the current backbone of the internet. Photonics holds a huge potential – not only for new and even better forms of communications and entertainment but also in many other applications, including manufacturing, medicine, displays, and a whole range of sensors for chemicals, biological materials and in the environment. Ultimately, photonics even promises to completely replace microelectronics as the technology that computers use to 'think', leading to a huge increase in performance.

Today, some 200,000 people are employed directly in the photonics industry in Europe, and two million other jobs depend on it. The global market for products enabled by photonics is already €150bn per annum and increasing. In Germany alone, there are some 1,000 optics and photonics SMEs employing 36,000 people – a figure expected to grow by more than 40% by the year 2010. But a crucial point is that apart from its economics, photonics is also a vital strategic technology – Europe must maintain its expertise and know-how so as to avoid being left behind in a very quickly changing market. It's not enough to be in the photonics race – you've got to be the best.

The present brochure describes our main activities in the area of photonics and contains a summary of

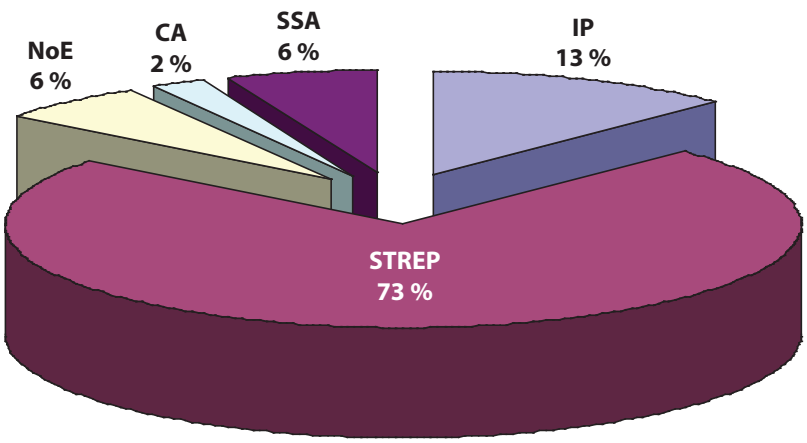


Figure 1: Distribution of funding by type of Funding Instrument

all the projects funded within the Framework Programme 6 (49 FP6 projects in photonics) administrated by Unit G5 –*Photonics* of the Directorate General *Information Society and Media*. These summaries provide an overview of the projects' objectives, the consortia and reference to the projects' homepage. The forty-nine projects included in this report receive 134 million Euro funding from the European Commission. Most of the funding (86%) is for supporting collaborative research projects, where the Specific Targeted Research Project (STREP) is the main funding instrument[1].

The projects can be clustered around *lasers*, *optoelectronic components*, *photonic integrated circuits and photonic integration*, *solid state lighting and display components*, *optical fibres*, *optical memories and data storage*, *support measures and networks of excellence*, although several projects are of relevance to more than one cluster. About one project out of three is addressing lasers, while one out of five is dealing with photonic integrated circuits. The other clusters are far less populated.

The balance of the clusters has changed after the first call in FP7 for projects addressing Photonic Components and Subsystems, where the emphasis has been put on photonic components and subsystems underpinning photonics-based applications in communications, health, well-being, environment, safety and security.

The Photonics projects funded by the European Commission contribute to establishing a European Photonics Community and help establish and implement a coherent European strategy in Photonics. In particular the Support Measures and Networks have a more strategic role, but there are also large efforts outside the projects towards this goal i.e. the European Technology Platform in Photonics (Photonics21).

[1] 13% Integrated Projects (IP) and 73% STREPs

Coverage

The projects managed by the *Photonics Unit* of *Directorate General Information Society Technology and Media* were selected in the context of the following FP6 Calls for proposals:

1. FP6-2003-IST-2 (***Optical, optoelectronic and photonic functional components***)

   The objective was to develop advanced materials, micro- and nano-scale photonic structures and devices, solid-state sources and to realise optoelectronic integrated circuits (OEIC). In the past 20 years, optics and photonics had become increasingly pervasive in a wide range of industrial applications. It has now become the heart of a new industry, building on microelectronics with which it will be increasingly linked.

   Projects were expected to address research challenges for 2010 and beyond in one or more of the following application contexts: (1) 'telecommunication and infotainment' (components for 'low-cost high-bandwidth' and 'Terabyte storage'), (2) 'health care and life science' (minimally invasive photonic diagnostics and therapies, biophotonic devices), and (3) 'Environment and Security' (photonic sensors and imagers).

2. FP6-2004-IST-5 (***Photonic components***)

   The objective was to develop advanced materials, solid-state sources and micro- and nano-scale photonic devices, and to integrate photonic functions in micro/nanoelectronics components ('Photonic system on a chip'). Projects were expected to address research challenges for mid-term to long-term industrial exploitation in one or more of the following application contexts: (1) 'Information technologies for health care and life science': bio-photonic functional components and sub-assemblies; and (2) 'Communications and Infotainment': components and subsystems for low-cost or high-performance.

3. FP6-2002-IST-C (***FET-Open***)

   The purpose of FET-Open in FP6 was to enable a range of ideas for future and emerging technologies to be explored and realized. The scheme was open to the *widest possible spectrum* of research opportunities that relate to Information Society Technologies. FET-Open offered funding implemented through *Specific Targeted Research Projects (STREP)* for work that could lead to breakthroughs or major advances, in particular: (1) the realization of *bold ideas that would involve high risks* or (2) high quality *longer term research with sound objectives*.

4. ***NMP-IST joint call*** (FP6-2004-IST-3) addressing projects related to 'materials, equipment and processes for production of nano-photonic and nano-electronic devices'.

As a result, **forty-nine Photonics projects** with a budget of **134 million euro** belong to the portfolio of the Photonics Unit. The coverage of projects funded is rather broad, from optical communications, optical storage, optical information processing, light sources, to nanophotonics, sensors, photonic integrated circuits, integration technologies,

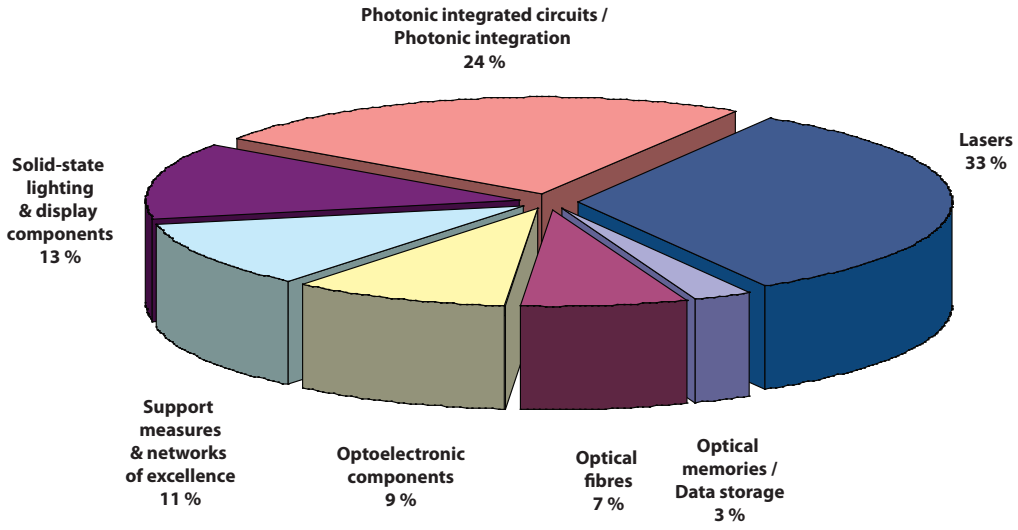


Figure 2: Clusters split by area

materials processing, transceivers, light guiding structures, etc… Although projects can span several thematic clusters, they can be grouped together into the 7 categories below:

- Lasers (15)
- Optoelectronic components (7)
- Photonic integrated circuits and photonic integration (12)
- Solid-state lighting and display components (3)
- Optical fibres (3)
- Optical memories and data storage (2)
- Cross-theme Support Measure and Thematic Networks (including Networks of Excellence) (7)

List of Projects arranged by cluster

Lasers

Acronym	Funding	End Date
Circles of Light	1.649.004 €	31/08/2009
DOMINO	2.027.919 €	31/05/2008
FAST ACCESS	1.369.000 €	31/08/2007
LANCER	2.199.942 €	31/08/2009
MOSEL	2.391.345 €	31/05/2009
NANDOS	2.500.000 €	31/07/2008
NANO UB-SOURCES	2.199.971 €	31/08/2008
NATAL	2.731.350 €	30/06/2008
NEMIS	2.000.000 €	31/08/2009
OLAS	1.600.000 €	31/12/2008
TERANOVA	5.000.000 €	31/08/2008
VERTIGO	1.900.000 €	31/05/2009
VILLAGE	1.800.000 €	30/06/2009
WWW.BRIGHTER.EU	9.700.000 €	30/09/2009
ZODIAC	4.992.331 €	30/04/2008

Optoelectronics Components

Acronym	Funding	End Date
FUNFOX	2.092.929 €	30/06/2007
GIBON	1.850.000 €	30/04/2009
HECTO	2.364.992 €	31/10/2009
NitWave	1.932.000 €	31/07/2007
synQPSK	1.695.000 €	31/12/2007
WAPITI	1.516.000 €	30/09/2007
WISDOM	1.140.000 €	30/06/2009

Solid-State Lighting and Display Components

Acronym	Funding	End Date
OLLA	12.000.000 €	30/06/2008
PLEAS	2.800.000 €	31/08/2009
STABILIGHT	2.331.869 €	31/08/2008

Optical Memories and Data Storage

Acronym	Funding	End Date
ATHOS	2 000.000 €	30/06/2007
MICROHOLAS	1.500.000 €	30/06/2007

Photonic Integrated Circuits and Photonic Integration

Acronym	Funding	End Date
ePIXnet	6.000.000 €	31/08/2008
HIBISCUS	2.000.000 €	31/08/2009
IOLOS	1.250.000 €	31/08/2009
IPHOBAC	5.829.832 €	31/05/2009
MEPHISTO	2.099.966 €	31/03/2008
MUFINS	2.694.795 €	31/08/2007
PHODYE	1.920.000 €	30/09/2009
PHOLOGIC	2.000.000 €	31/05/2008
PICASSO	2.400.000 €	30/09/2009
PI-OXIDE	1.853.392 €	31/08/2008
PLASMOCOM	1.849.710 €	31/08/2009
UROOF	2.200.000 €	31/12/2008

Optical Fibres

Acronym	Funding	End Date
NextGenPCF	6.649.046 €	31/05/2009
POLYCOM	1.550.000 €	30/04/2009
URANUS	1.412.000 €	30/06/2007

Cross-theme Support Measures and Thematic Networks (including Networks of Excellence)

Acronym	Funding	End Date
ACCORD	997.676 €	31/08/2009
FASCINATION OF LIGHT	369.000 €	30/04/2008
MONA	953.988 €	30/11/2007
NEMO	6.400.000 €	31/08/2008
OPERA 2015	949.986 €	31/03/2008
PHOREMOST	4.700.000 €	30/09/2008
WIDGAP	230.000 €	15/06/2006

Structuring **photonics** in **Europe**

Europe has a strong Photonics sector, supported by a competitive industry and a research of high scientific excellence. However, the Photonics sector in Europe is highly fragmented not only by application domains (i.e. optical communications, life-sciences, lighting and security), but also by region, leading to a duplication of efforts and waste of resources. Therefore, to maintain its leading position of Europe and defend against threats coming from emerging economies, the fragmentation of the Photonics sector has to be overcome by:

- developing a common European vision and strategy in photonics,
- defining common research priorities of European interest,
- linking industry with research centres and universities,
- developing a cross-application photonics technology,
- coordinating the national research programs.

The Coordination Action *OPERA 2015* (*http://www.opera2015.org/home.asp*), launched 1st April 2005, is a first attempt and has contributed to the activities of the *Photonics21* Technology Platform (*http://www.photonics21.org*) which brings together the Photonics constituency around a Strategic Research Agenda.

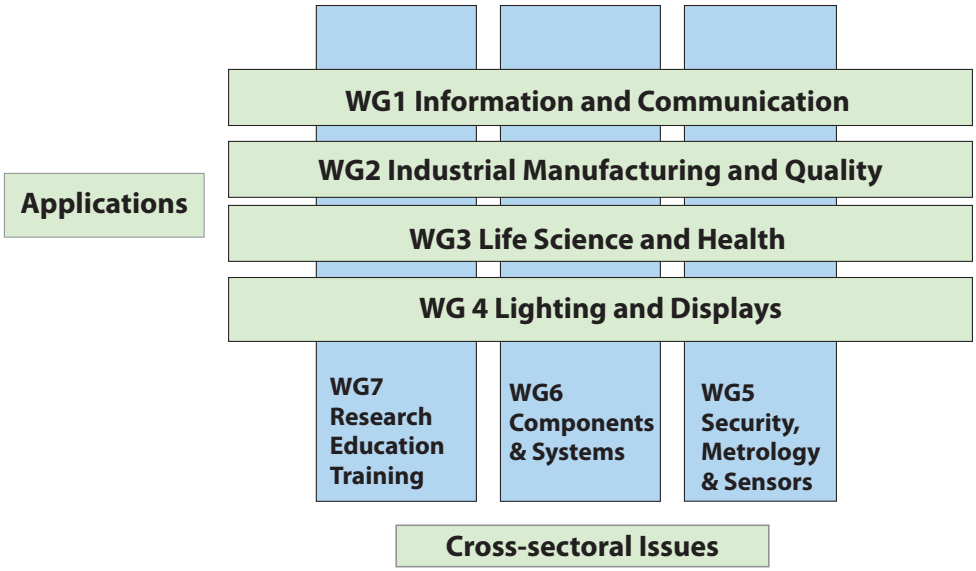
Technology Platform Photonics21

PHOTONICS 21

Photonics21 brings together the key stakeholders in Europe in the area of Photonics[2]. There are about 800 members representing the entire photonics sector, including industrialists, researchers, academics and policy makers. Its purpose is to stimulate greater and more effective investment in research and development, to accelerate innovation and to eliminate barriers to the deployment and growth of new Photonic technologies.

The purpose of Photonics21 is to establish Europe as a leader in the development and deployment of Photonics in five industrial areas (Information and Communication, Manufacturing, Life Sciences, Lighting and Displays, Metrology and Security) as well as in Education and Training. Through a vision shared with industrial and public actors, it will create the critical mass necessary for visionary and industrially relevant R&D in photonic components, systems and applications. One of the main tools for creating this shared vision is the Strategic Research Agenda, presenting medium to long-term objectives for R&D in Photonics.

[2] http://www.photonics21.org/



The activities of Photonics21 are organized according to Working Groups. Each Working Group is responsible for updating the relevant section of the Strategic Research Agenda, as well as giving strategic recommendation to the public authorities and identifying opportunities for cooperation, mutual support and joint activities. Strategic research topics as well as relevant markets are continuously monitored. Activities aiming at the involvement of a larger community include stimulating networking and establishing links among Photonics21, national and regional platforms, networks and other relevant constituencies.

Coordination Action ICT-15734 OPERA 2015

OPERA 2015

The objective of this Coordination Action (CA) is to compile an inventory of existing European Optics and Photonics research and industry infrastructure and support for the development of a mid- to long-term strategic vision of European Photonics industry and research. As such *OPERA 2015*[3] played an active role in the Photonics21 technology platform launched in December 2005.

The services *OPERA 2015* is providing are becoming a reference in support of the European Photonics community. The maturity and added value of this Action are demonstrated by the ever growing number of visits to the Action's websites. The number of visits is growing exponentially, owing to the completeness of the information provided.

The information provided on the websites and the accessibility are regularly updated. In particular, databases are available on-line to permit on-line queries. The following information sources are available:

- Event Calendar – exhaustive list of the photonics' related events worldwide;
- News & Announcements – separated into technical/scientific and originating from the EC;
- Strategic Documents – compilation of publicly available strategy/vision documents and roadmaps;
- European projects – exhaustive list of European research projects in the area of Optics and Photonics from different research programmes;
- National Activities – an extensive list of all laboratories, academic institutes and research organizations, active in field of Optics and Photonics in Europe (i.e. the 27 EU members plus Israel, Norway, Switzerland and Turkey).

[3] http://www.opera2015.org/home.asp

The national activities are collected and presented according to several axes: European R&D organisations, national photonic R&D programs, photonic clusters in EU member states, and industries. There is also a list of activities sorted by country.

- Industrial Activities – an extensive list of private companies, active in field of Optics and Photonics in Europe (i.e. the 27 EU members plus Israel, Norway, Switzerland and Turkey).

Thematic Networks

In addition to the activities of the Photonics 21 Technology Platform and OPERA 2015, other network projects contribute in bringing together the Photonics constituency and preparing roadmaps in the different areas. These actions can be summarised below:

- ePIXnet: the European FP6 Network of Excellence in the field of **photonic integrated components and circuits;**
- NEMO: the European FP6 Network of Excellence in the field of **Micro-Optics;**
- PHOREMOST: the European FP6 Network of Excellence in the field of **nanophotonics and molecular photonics**;
- MONA: it has been launched in order to bridge the gap between photonics and nanotechnologies. The ultimate objective of the project is the development of a European roadmap for photonics and nanotechnologies.

Outlook FP7

Compared to FP6, in the 7th Framework Programme (2007 – 2013) Photonics plays an increased role in the ICT Programme. This is not only noticeable in the explicit mentioning of Photonics in the ICT Workprogram 2007 – 2008, i.e. the Specific Objective ICT-2007.3.5 *Photonic Components and Subsystems*, but also through the organisational change within Directorate General *Information Society and Media* responsible for the implementation of the ICT Thematic Program.

Indeed, for the first time in the history of the Framework Programmes an operational unit dealing exclusively with Photonics has been created. In principle any Photonic component or subsystems of relevance to a broad range of applications, including ICT is supported there, although some related aspects[4] are also covered in the Specific Objectives ICT-2007.1.1 *The network of the future* (e.g. optical telecommunications), ICT-2007.3.2 *Organic and large-area electronics and display systems* (e.g. organic displays) and ICT-2007.8.0 *Future and Emerging Technologies* (i.e. any photonics related research topic of long term and foundational nature).

For the first ICT Workprogramme of FP7, covering the years 2007 – 2008, 90 M€ have been allocated to fund the following topics[5]:

a) [6] **Core photonic components and subsystems,** which are essential in multiple application fields:

(1) High performance lasers,

(2) High brightness, power efficient solid-state light sources for ICT and general lighting applications,

(3) Optical fibres for high performance and for specific functions,

(4) High performance image sensors,

(5) Sensors exploiting innovative sensing principles.

b) [6] **Application-specific photonic components and subsystems** for application fields, which are strategic for Europe and which are important drivers of photonics technology development.

(1) truly cost effective broadband core networks at 40 Gb/s or beyond per channel,

(2) scalable, future-proof and economic broadband access and local area networks,

(3) minimally invasive medical diagnosis and prevention,

(4) sensing for environment, wellbeing, safety and security.

[4] Research on photonic materials and materials processing with photons (e.g. cutting, welding) is covered in the NMP Thematic Priority of FP7.

[5] RTD on photonic components and subsystems may also cover related materials and fabrication technologies (including mounting and packaging), and related photonic system concepts.

[6] Integrating Project (IP), Small-scale focused project (STREP)

c) [6] **Underlying technologies:**

(1) *Integration and manufacturing technologies:* Holistic approaches for: reducing the size and cost of photonic components and subsystems; improving their performance, manufacturability and testability; increasing their degree of functional integration; advancing photonic/electronic convergence.

(1) *Design methodologies and tools:* Holistic and widely applicable approaches for designing photonic components to improve design quality and efficiency. This includes work on modelling, simulation and characterisation.

d) [7] **Complementary measures**

- *Joint assessment* by users of prototype components, subsystems and equipment from European suppliers.

- *Networking, integration and structuring* of advanced photonics RTD capacities and activities.

e) [8] **Support measures**

- Access to centres of expertise and foundries to facilitate the deployment of advanced technologies.

- Raising the interest of young people in careers in photonics, and stimulating cross-national schemes for graduate education.

- Supporting the development of RTD strategies through roadmapping, consensus building, coordination with Member or Associated States, and international cooperation.

All projects retained for funding were expected to have at least one of the following impacts:

- Leading position of European industry in high-value photonic products.

- New photonic based applications in several industrial sectors with emphasis on communications, health, well-being, environment, safety and security.

- Continued European leadership in RTD in photonics from components to systems, securing the necessary human resources and knowledge to design, produce and use new generations of photonic components.

Beyond the Workprogramme 2007 – 2008 the topics to be covered in the subsequent Calls covering 2009 – 2010 will be defined in 2008, gathering input from the *Photonics*[21] Technology Platform as well as through public consultations.

[7] Integrating Project (IP), Small-scale focused project (STREP), Networks of Excellence (NoE)

[8] Coordination and Support Actions (CSA)

Project summaries

ACCORD

Advanced Components Cooperation for Optoelectronic Research and Development

Project reference: 034041,
Instrument: SSA

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Gaston Crommenlaan 8, bus 201
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BELGIUM

Web site
www.ist-accord.org

Timeline
Start Date: 1 Sept. 2006
End Date: 31 Aug. 2009

Budget
Overall Cost: 1 027 359 €
Funding: 998 000 €

Project Partners
- IMEC, BE
- EUROPEAN PHOTONICS INDUSTRY CONSORTIUM, FR
- MULTITEL, BE
- HAUTE ECOLE SPECIALISEE DE LA SUISSE OCCIDENTALE, CH
- POLITECHNIKA WROCLAWSKA, PL
- SAGEM DEFENSE SECURITE S.A., FR
- SOA SERVICES LTD, UK
- PERFOS, FR

Vision & Aim

The ACCORD-proposal will create and operate a platform for cooperative industry-university research on pre-competitive optoelectronic components in the European economic area. This exchange will be carried out at no net cost to participating industries and universities.

The primary benefit to the European Community will be the education and training of engineers and scientists in advanced technologies of direct commercial potential for European optoelectronics industries. This initiative will also enhance the opportunities for industry, particularly small and medium sized industries to carry out research programmes on prototype components without having to invest in significant overhead for research and development facilities.

ACCORD will implement integration of universities and students in the accession countries into the European Community, through access to cutting-edge technologies and collaboration with photonic industries throughout the European economic area. This will promote mobility of trained engineering students throughout Europe.

ACCORD will create an additional resource to aide companies in recruiting skilled personnel. This resource will be particularly helpful for small and medium-sized enterprises that need highly skilled engineers and scientists, but which cannot afford to maintain a large human resources network.

ACCORD will be a force in the reorientation of academic training toward technologies that have near-term commercial potential. These directions are determined by the participating photonics companies. Participating researchers will be studying and training on the next generation of photonic components rather than on the previous generation of devices. This reorientation is critical in a components market that is rapidly diversifying from a pure telecomms focus to addressing new opportunities in displays, sensors, biophotonics, and solid-state lighting, and broadband access components.

ATHOS

Advanced Technology for Holographic Storage

Project Number: 511626,
Instrument: STREP

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GERMANY

Web site
www.athos-holography.net

Timeline
Start Date: 30 July 2004
End Date: 30 June 2007

Budget
Overall Cost: 3.32 million €
Funding: 2 million €

Project Partners
- DEUTSCHE THOMSON-BRANDT GMBH, DE
- CEA, FR
- RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN, DE
- TOPTICA PHOTONICS AG, DE
- MPO INTERNATIONAL SA, FR
- OPTIMAL OPTIK OPTIKAI, ELEKTRONIKAI ES FINOMMECHANIKAI TERVESO ES FEJLESZTO KFT, HU
- TECHNISCHE UNIVERSITÄT DARMSTADT, DE
- BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM, HU

Vision & Aim

Optical memories are one of the most promising data storage technologies, economically and technically.

In 2002, around 500 million drives and 13 billion disks have been manufactured. Optical memories ideally combine media removability, random access and lowest media costs. However, the conventional bit-wise recording technologies are facing the basic diffraction limitation, which prevent to further increase the data density. A way to further boost the effective data density is volumetric storage, which is a unique feature of optics. Thanks to recent material and component technology advances, holographic data storage is now a viable solution to efficiently use the volume of a storage material.

The objective of this project is to develop the technological basis for a new-generation, high-capacity, compact and cost-effective holographic data storage system. Specific key components such as laser sources, optical and opto-electronic components, electronics and media substrates will be developed.

CIRCLES OF LIGHT

Compact SOI nanoelectronic Raman Laser and Modulator and Detector based on Circular Grating

Project reference: 034883,
Instrument: STREP

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Web site
http://www.circlesoflight.de/

Timeline
Start Date: 1 Sept. 2006
End Date: 31 Aug. 2009

Budget
Overall Cost: 2.5 million €
Funding: 1.65 million €

Project Partners
- GESELLSCHAFT FUER ANGEWANDTE MIKRO- UND OPTOELEKTRONIK MIT BESCHRANKTER HAFTUNG - AMO GMBH, DE
- IBM Research GmbH, CH
- UNIVERSITY OF SURREY, UK
- RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN, DE
- SILIOS TECHNOLOGIES, FR

Vision & Aim

The present project aims at the development of very advanced all-silicon based nanophotonic devices clearly beyond state of the art in terms of functionality, size, speed, cost and functionality. Common component of the envisaged devices are silicon-on-insulator (SOI) technology based circular Bragg resonators with very high quality factors for a concomitant increase of integration density and device efficiency. In particular, the project will realize an approach for a highly compact silicon Raman laser source, a high-speed silicon electro-optic modulator and a novel approach for resonant signal sensing in SOI waveguides. A further increase of packing densities is aimed by the integration of a multi layer SOI waveguide development.

To reach the ambitious goals of the project, the focussed effort will be guided by substantial design and modelling activities, optimizing the electro-optic response functions of each sub-component. For an improvement of device performance compared to the state-of-the-art, precise control of free carrier lifetimes in these devices is envisaged by the implantation of ultrafast recombination centers. Device fabrication strongly relies on low-cost, mass fabrication compatible nanolithography technology based on high-precision UV-Nanoimprint.

A possible route to monolithically integrated silicon photonic will be demonstrated to enable new device concepts for communication, automotive, infotainment, and biomedical system in the future. Therefore, the project activities are expected to have a profound impact on IST-related technologies.

DOMINO

Antimonide Quantum Dots for Mid-Infrared Nano-Photonic Devices

Project Number: 017383,
Instrument: STREP

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Web site
www.univ-montp2.fr/~domino

Timeline
Start Date: 1 June 2005
End Date: 31 May 2008

Budget
Overall Cost: 2.46 million €
Funding: 2.03 million €

Project Partners
- UNIVERSITE MONTPELLIER 2, FR
- THE UNIVERSITY OF HULL, UK
- ALCATEL THALES III-V LAB, FR
- FORSCHUNGSVERBUND BERLIN E.V., DE
- CONSIGLIO NAZIONALE DELLE RICERCHE, IT
- A.F.IOFFE PHYSICAL-TECHNICAL INSTITUTE OF RAS, RU

Vision & Aim

The 3 - 5 µm window of the mid-IR wavelength range is the window of choice for developing photonic-based products with important societal impact such as photonic sensors for environment monitoring, photonic diagnosis devices for health care, laser assisted surgery, free-space optical communication systems. However, there is actually a lack of suitable laser diodes (LDs) operating in this domain.

The main objective of this project is to demonstrate the feasibility of antimonides-based quantum-dots (QDs) nano-photonic quantum dots laser diodes (QDLDs) operating continuous wave (cw) at room temperature (RT) in the 3-5 µm wavelength range. Sb-based heterostructures, grown on GaSb or InAs substrates, exhibit a number of unique possibilities among III-V compounds in terms of band structure engineering. In particular, it is the only III-V technology exhibiting interband transitions in the mid-IR. However till now no quantum-well laser diode is able to operate cw at RT at wavelengths between 3 and 5 µm. QDs heterostructures are expected to extend the emitted wavelength and to strongly improve the performances of semiconductor LDs (reduced threshold, high operating temperature) as demonstrated with the GaAs and InP technologies. The successful demonstration of Sb-based QDLDs could thus pave the way to the development of high performance mid-IR optoelectronic devices and photonic sensors. However, the properties of Sb-based nanostructures remain unknown up to now.

Another goal of our project will be to retrieve a clear picture of their basic physical (structural, electronic and optical (losses and gain)) properties, which is a prerequisite to obtaining reliable, high performance, emitting devices. Further, this will allow us to define their field of applications, and in particular to assess the interest of developing other nano-photonic devices. ***DOMINO*** will thus open the route to further long-term research on semiconductor nanostructures and nano-photonic devices.

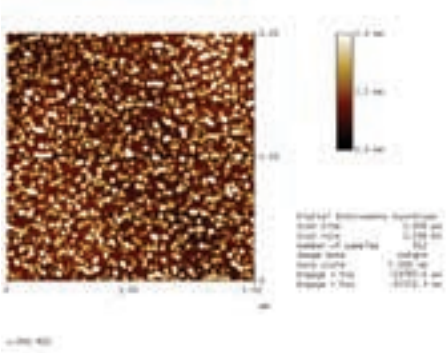

Fig. 1: Atomic Force Microscopy of InSb quantum dots on GaSb substrate.
Density: ~ 7x10^{10} cm^{-2}, diameter ~ 10-20 nm, height ~ 2-3 nm

EPIXNET

European Network of Excellence on Photonic Integrated Components and Circuits

Project Number: 004525,
Instrument: NoE

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BELGIUM

Web site
http://www.epixnet.org

Timeline
Start Date: 1 Sept. 2004
End Date: 31 Aug. 2008

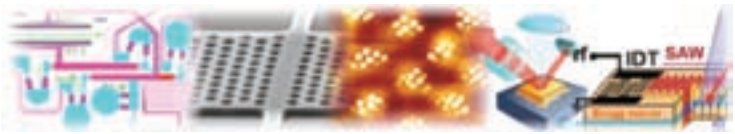
Budget
Overall Cost: 6 million €
Funding: 6 million €

Project Partners
- TECHNISCHE UNIVERSITEIT EINDHOVEN, NL
- DANMARKS TEKNISKE UNIVERSITET, DK
- EPFL, ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE, CH
- FRAUNHOFER GESELLSCHAFT, DE
- UNIVERSITY OF CAMBRIDGE, UK
- ETH, EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH, CH
- CNRS, FR
- ECOLE CENTRALE DE LYON, FR
- INSTITUT D'OPTIQUE THEORIQUE ET APPLIQUEE IOTA - SUPOPTIQUE, FR
- UNIVERSITE DE PARIS XI PARIS-SUD, FR
- UNIVERSITE DE RENNES, FR
- INSTITUT NATIONAL DES SCIENCES APPLIQUEES DE RENNES, FR
- ECOLE NATIONALE SUPERIEURE DES TELECOMMUNICATIONS DE BRETAGNE, FR
- UNIVERSITEIT TWENTE, NL
- KTH, KUNGLIGA TEKNISKA HOEGSKOLAN, SE
- COREOPTICS GMBH, DE
- AMO GMBH, DE
- UNIVERSITY OF SOUTHAMPTON, UK
- UNIVERSITY OF ST ANDREWS, UK
- UNIVERSITY OF GLASGOW, UK
- UNIVERSIDAD AUTONOMA DE MADRID, ES
- UNIVERSIDAD POLITECNICA DE VALENCIA, ES
- POLITECNICO DI TORINO, IT
- BUNDESMINISTERIUM FÜR WIRTSCHAFT UND ARBEIT, DE
- RWTH AACHEN, DE
- CEA, FR
- RAITH GMBH, DE
- UNIVERSIDAD CARLOS III DE MADRID, ES
- INSTITUTE OF PHOTONICS AND ELECTRONICS ASCR, CZ
- BOOKHAM TECHNOLOGY PLC, UK
- TECHNISCHE UNIVERSITÄT BERLIN, DE
- UNIVERSITÄT DUISBURG-ESSEN - STANDORT DUISBURG, DE
- FORSCHUNGSVERBUND BERLIN E.V., DE
- ALCATEL THALES III-V LAB, FR
- CNR, IT
- THE CENTRE FOR INTEGRATED PHOTONICS – CIP, UK
- UNIVERSITY OF SURREY, UK
- VISTEC, LITHOGRAPHY LTD, UK

Vision & Aim

The leading thread of this NoE is photonic integration. The integration of complex or high performance photonic functions will become the key enabler for a cost-effective and ubiquitous deployment of photonics in a wide range of applications, including ICT, sensors and biomedical applications. The technologies needed for photonic integrated components and circuits are characterised by high investment and exploitation cost. This calls for more integration of research at an international level. Therefore the mission of ***ePIXnet*** is three-fold. The first objective is to stimulate the restructuring of the photonic integration research community from a model of independent or collaborative research towards a model of integrated research. The second is to stimulate training activities as well as integration of educational programs. The third objective is to stimulate new opportunities for photonic integration in a wide range of application domains.

The NoE has a focus on five major themes: photonic integration technology, nanophotonics, advanced semiconductor materials, ultra fast light sources and ultra fast signal processing. The network brings together most of Europe's strongest academic and industrial actors and contributes to the quality of education and research by stimulating long lasting partnerships and by providing access to unique facilities and knowledge in the field. To this end the steering committee has selected Joint Research Activities which are organised around three Integration Technology Platforms and three Supporting platforms that provide access to unique facilities in the fields of fabrication technology, design and characterisation. The network has also developed an active program for exchange of researchers. The Network has a strong industrial partipiation. It has an open policy to include affiliate partners in particular industrial affiliate partners.



FASCINATION OF LIGHT

European Campaign 'Fascination of Light'

Project reference: 035053,
Instrument: SSA

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Web site
http://www.fascination-of-light.net/

Timeline
Start Date: 1 May 2006
End Date: 30 April 2008

Budget
Overall Cost: 369 000 €
Funding: 369 000 €

Project Partners
- FORSCHUNGSVERBUND BERLIN E.V. MAX BORN INSTITUTE (MBI) FOR NONLINEAR OPTICS AND SHORT PULSE SPECTROSCOPY, DE

Vision & Aim

The interactive travelling exhibition 'Fascination of Light' which has been developed and displayed very successfully in Germany during the past two years will be put on a European level and will be presented in ten major European regions / cities, organised by partner institutions of the consortium LASERLAB EUROPE.

The exhibition is based on a multidisciplinary approach where photonics and their pervasiveness in every-day life can be actively experienced through interactive, hands-on exhibition pieces, illustrative material and multimedia stations, functional models, visual aids, posters and simple experiments, which may provide inspirations for teaching.

The overall aims of the project are:

- to foster public understanding of science and technology related to IST and photonics;
- to raise awareness for the practical, societal and occupational potential of (photonics-based) ICT;
- to stimulate educational initiatives and provide educational support related to IST and photonics;
- to contribute to a highly qualified (next-generation) workforce in photonics-related science, research and development;
- to provide a platform for the visibility of the host institutions within their specific European regions and their general importance to the society.

FAST ACCESS

Low-cost 1.3 µm sources for FAST ACCESS technologies

Project Number: 004772,
Instrument: STREP

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Web site
http://www.fastaccessproject.eu/

Timeline
Start Date: 1 Sept. 2004
End Date: 31 Aug. 2007

Budget
Overall Cost: 1.66 million €
Funding: 1.37 million €

Project Partners
- THE UNIVERSITY OF NOTTINGHAM, UK
- MODULIGHT INC., FI
- MERGEOPTICS GMBH,DE
- CHALMERS TEKNISKA HOEGSKOLA AKTIEBOLAG, SE

Vision & Aim

The objective of the project is to develop low-cost, 1.3 µm dilute nitride laser sources for use as directly-modulated transmitters in access applications. These applications require stable and reliable sources, which can be produced at very low cost and operated in an uncooled environment. Dilute nitride lasers are expected to have significant advantages over InP-based devices in terms of both cost and temperature performance. Both edge-emitting lasers (EELs) and vertical cavity surface-emitting lasers (VCSELs) will be investigated for 2.5Gb/s and 10Gb/s applications.

The materials development will focus on improving the optical efficiency and stability of the novel dilute nitride materials, exploring the use of growth chemistry and advanced composition-, bandgap- and strain-engineered active regions. The epitaxial growth activities will exploit highly developed growth techniques and sophisticated epi-layer structures to enhance device performances while limiting the cost.

The device processing activities will investigate advanced surface microstructures to boost the device performances, reduce the number of optical components and lower the packaging complexity. All device development activities will be supported by device modelling activities.

The design activity will aim for suitable thermal, dynamic and modal performances and will examine large-signal modulation effects. Optimised VCSELs and EELs will be packaged and characterised.

The cost, performance and reliability of these devices will be compared with that of state-of-the art 1.3 µm InP-based EELs (optimised for access applications), both for current 1.0-2.5Gb/s applications and for emerging 10Gb/s applications.

The direct digital modulation performance of these devices will be evaluated and standard network modelling tools and techniques will be used to assess their transmission performance.

FUNFOX

Functional Photonic Crystal Devices for Metropolitan Optical Networks

Project Number: 004582,
Instrument: STREP

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http://www.iota.u-psud.fr/~funfox/

Timeline
Start Date: 1 July 2004
End Date: 30 June 2007

Budget
Overall Cost: 3.31 million €
Funding: 2.09 million €

Project Partners
- EPFL, CH
- THE UNIVERSITY COURT OF THE UNIVERSITY OF ST ANDREWS, UK
- UNIVERSITA DEGLI STUDI DI UDINE, IT
- FRAUNHOFER GESELLSCHAFT DE
- PHOTON DESIGN LTD, UK
- IMEC, BE
- BAYERISCHE JULIUS-MAXIMILIANS UNIVERSITÄT WUERZBURG, DE
- ALCATEL THALES III-V LAB, FR
- THALES SA, FR
- ALCATEL SA, FR

Vision & Aim

Optical networks continue their growth in the metropolitan core and access segments. The FUNFOX project addresses the use of photonic crystals (PhC) to miniaturise and improve semiconductor optoelectronic devices needed in these networks.

It focuses on InP-based devices exploiting advances made in the FP5/IST PhC-related projects PCIC and PICCO.

It gathers for a three year duration 380 person through nine partners, including 7 academic laboratories, a large industrialist and a SME, with a total cost above 3.3 M euros.

Three device-oriented workpackages address

1) active functions;

2) passive functions;

3) the active-passive integration.

They cover the most relevant device aspects for metro networks.

Active functions to be demonstrated during the project are highly linear optical amplification and wavelength conversion. Passive functions exploit novel schemes permitted by photonic crystals, either for spectral selection, notably in relation with monitoring and multiplexing, or for polarisation management (i.e. polarisation diversity). Integration of wavelength selective functions with single-mode lasers will result in wavelength-stabilised laser sources.

Integrated devices performance will be assessed through a system testbed in the fourth main workpackage.

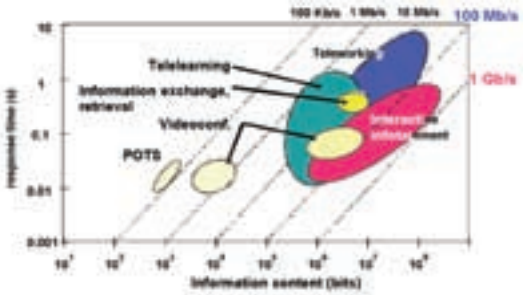

Fig. 1: Chart of Information content and response time, showing at which data flow (oblique lines) various fields of activity are of interest. A large share of the data flow will be at average data rates (100 Mbits/s) down to the end user, for 'infotainment', implying that optical networks will go closer to the home and will thus be more widely deployed in this context, distinctly different from long-haul optical link needs.

FUNFOX

The objectives take into account the emerged knowledge of losses in two-dimensional photonic crystal structures. It exploits both the 'membrane' and the 'conventional heterostructure' approaches of the former FP5/IST projects, and in particular their combination by bringing their advantages into a single device.

All these devices, with improved performance and high degree of integration, thus potentially low-cost, will contribute to future large scale deployment of metropolitan core and access networks for new services of 'infotainment'.

Compared with previous projects, and with most of the photonic crystal activity worldwide, FUNFOX aims at providing photonic crystal solutions for the real world.

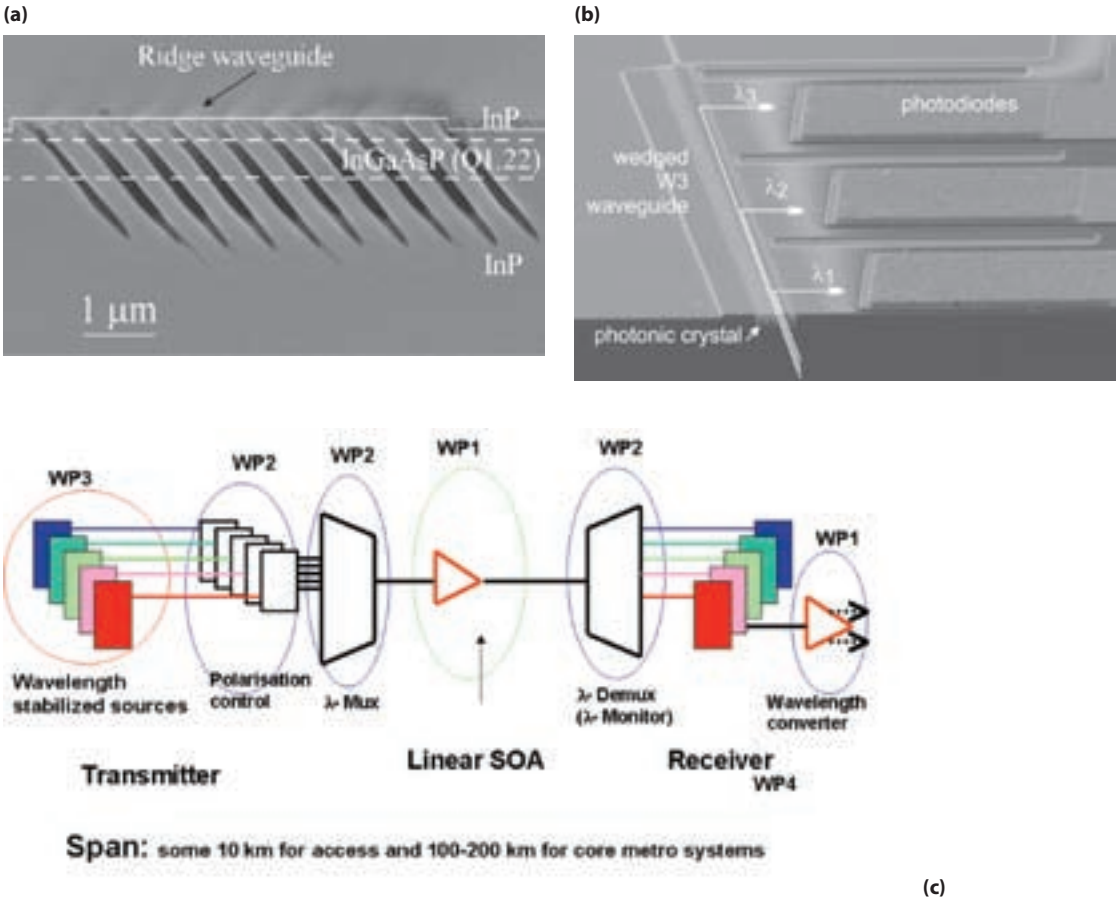

Fig. 2: Examples of photonic crystal structures and their applications in a transmission trunk, as represented in (c): The microscopic picture (a) is a photonic structure that ensure polarisation conversion within a length of a few microns only, picture (b) is a demux device for separation of various wavelengths, here integrated with photodiodes, each spaced by ~20 microns. (c) is a metropolitan area optical network trunk with various elemnts (sources, multiplexing devices, . . . up to a wavelength converter), the labels 'WP1', 'WP2', 'WP3', refer to the work packages in the project in which we incorporate photonic crystal elements in corresponding devices

GIBON

Optoelectronic Integration for 100 GigabitEthernet Optical networks

Project reference: 034183,
Instrument: STREP

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Web site
www.ist-gibon.eu

Timeline
Start Date: 1 May 2006
End Date: 20 April 2009

Budget
Overall Cost: 2.92 million €
Funding: 1.85 million €

Project Partners
- ALCATEL THALES III-V LAB, FR
- FRAUNHOFER GESELLSCHAFT, DE
- DANMARKS TEKNISKE UNIVERSITET, DK

Vision & Aim

This project addresses the challenges of very high bit rate optoelectronics transceivers suitable for 100 Giga bit Ethernet type applications. Observation of the steady improvement in Silicon CMOS performances, as well as the increase in data traffic projections, are incentives for this evolution, expected to become an industrial reality in the first part of the next decade.

In this project, the focus is on the demonstration of the highest speed components that integrate the optoelectronic transducers (light modulator and photodiode) with their driving electronics (driver and preamplifier respectively).

Really new optoelectronics components will be developed based on designs experienced for lower bit rates (40 and 80 Gbit/s) and their characteristics will be optimised in order to match specifications that will be derived from systems considerations. As important as the optoelectronic devices characteristics themselves is the Opto-Electronic Integrated Circuit technology that will be used for the transceivers.

Two parallel routes will be followed in this project for the transmitter and receiver: while the monolithic integration is chosen for the later, with its associated advantages of lower added parasitics and shorter interconnections than conventional approaches, a flip-chip integration is to be used for the former, to benefit from optimised technologies for both the Electro-absorption Modulated Laser and the electronic driver and to better accommodate thermal issues. Guidelines for this production of integrated devices as well as for the components packaging will be given by a supporting Electro-Magnetic simulation activity.

This project will be completed by an assessment of the fabricated components with respect to the projected application.

HECTO

High-speed Electro-optical Components for integrated Transmitter and receiver in Optical communications

Project reference: 033868,
Instrument: STREP

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Web site
http://www.hecto.eu/

Timeline
Start Date: 01 Nov. 2006
End Date: 31 Oct. 2009

Budget
Overall Cost: 3.87 million €
Funding: 2.36 million €

Project Partners
- KUNGLIGA TEKNISKA HOEGSKOLAN, SE
- FRAUNHOFER GESELLSCHAFT, DE
- SYNTUNE AB, SE
- DANMARKS TEKNISKE UNIVERSITET, DK
- ACREO AB, SE
- U2T PHOTONICS AG, DE
- SIEMENS AKTIENGESELLSCHAFT, DE
- PANEPISTIMIO PELOPONNISOU EIDIKOS LOGARIASMOS KONDILION EREVNAS, GR

Vision & Aim

In recent years efforts have been made to achieve higher data rates in optical communication systems. In the IST projects FASHION and TOPRATE it has been shown that data rates of 160Gbit/s can be transmitted using Optical Time Division Multiplexing. The focus of these projects has been in the optical domain rather than realization of cost-efficient components.

Further IST-projects address IP-based optical networks and develop concepts for optical packet switched networks, e.g. IST-LASAGNE and IST-IP NOBEL. In optical packet networks, the next logical step after 10 Gigabit Ethernet (GbE) is 100GbE.

The objective of HECTO is development of photonic components, transmitter and receiver, for high-performance and high-speed but cost-efficient communication systems. Applications are Time Division Multiplexed (TDM) optical systems with up to 160Gbit/s and optical packet networks based on serial 100GbE signals requiring about 110Gbit/s.

Transmitters will be developed with Traveling-Wave Electro-Absorption Modulators (TWEAM) with bandwidths of 100GHz or more, integrated with continuous-wave lasers. Electronic driver amplifiers and multiplexers will be developed for the connection between the modulators and external electronics at lower speeds.

Receivers with bandwidths of 100GHz and above will be developed with waveguide pin diodes integrated with electronic amplifiers, and the required high-speed electronics for electrical clock recovery and demultiplexing to lower speeds.

The components will be tested in systems experiments. To ensure that they will meet the demands of the future market, technology application assessment will accompany the technical investigation and development.

The HECTO project will allow European companies to gain share in the increasingly competitive photonic component and packet switching market. HECTO will form a basis for cost-efficient extension of European networks, and the introduction of end-to-end broadband services for all European citizens.

HIBISCUS

Hybrid Integrated Biophotonic Sensors Created by Ultrafast laser Systems

Project reference: 034562,
Instrument: STREP

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Web site
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Timeline
Start Date: 1 Sept 2006
End Date: 30 Aug 2009

Budget
Overall Cost: 3.48 million €
Funding: 2.0 million €

Project Partners
- POLITECNICO DI MILANO, IT
- UNIVERSITÄT HANNOVER, DE
- UNIVERSITEIT TWENTE, NL
- THE UNIVERSITY OF HULL, UK
- LIONIX BV, NL
- HIGH Q LASER PRODUCTION GMBH, AT
- ZEBRA BIOSCIENCE, NL

Vision & Aim

A biochip is a device that squeezes the functionalities of a biological laboratory on a single substrate through a network of microfluidic channels, reservoirs, valves, pumps and micro-sensors. Its advantages are high sensitivity, speed of analysis, low sample consumption and measurement automation and standardization. This concept promises dramatic advances both in basic research and in clinical applications as a low-cost diagnostic tool.

We propose the demonstration of a new technology, based on high intensity femtosecond laser pulses, providing an integrated platform for the fabrication of biochips with photonic functionalities. Such technology enables to include a network of femtosecond written optical waveguides on a standard biochip. The waveguides can be arranged in different configurations with respect to the microfluidic channels, exploiting the unique three-dimensional capabilities of the femtosecond writing technique, to implement photonic biosensors.

An additional goal is the use of the femtosecond laser technology to directly write the microfluidic channels. If both goals are achieved, we can envisage a single production machine for the biophotonic chips, based on a high-power femtosecond laser, that can manufacture both the microfluidic channels and the optical waveguides.

To achieve these goals we will demonstrate advanced diode-pumped femtosecond laser sources, with average power higher than currently available. These laser sources need to be sufficiently compact, reliable and user-friendly for industrial environment.

The unique integration of photonics and microfluidics, enabled by the inscription of optical waveguides on the biochips, will allow to implement a wealth of novel biosensing functionalities. We concentrate on two prototypical devices, available as demonstrators at the end of the project: microreactors for chemical synthesis of polypeptides and proteins, and biomolecule assays based on capillary electrophoresis.

IOLOS

Integrated Optical Logic and Memory using ultrafast Micro-ring bistable Semiconductor Lasers

Project reference: 034743,
Instrument: STREP

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Web site
http://www.iolos.org/

Timeline
Start Date: 1 Sept. 2006
End Date: 31 Aug. 2009

Budget
Overall Cost: 1.43 million €
Funding: 1.250 million €

Project Partners
- UNIVERSITY OF BRISTOL, UK
- UNIVERSITY OF GLASGOW, UK
- UNIVERSITÀ DEGLI STUDI DI PAVIA, IT
- UNIVERSITAT DE LES ILLES BALEARS, ES
- VRIJE UNIVERSITEIT BRUSSEL, BE
- INTENSE LTD, UK
- SIEMENS, S.A., PT

Vision & Aim

The research proposed by IOLOS aims to develop a new and universal optical digital building block, thereby creating the necessary integration technologies for future all-optical digital and logic functional sub-systems.

The key approach is the exploitation of the strong and robust directional optical bi-stability in semiconductor ring lasers (SRLs) as the fundamental mechanism for all-optical digital building blocks - from which digital functions of all types can be synthesised.

The central concept is that the switching between two digital logic states within an SRL device (the two possible directions of operation) can be triggered by an external optical signal - and can occur at ultra-high speeds, being limited solely by the round-trip time of the optical laser cavity.

The innovation lies in the development of proven technologies that enable the progressive down-scaling of the dimensions of micro-SRLs to less than 20 microns, thus allowing optically induced switching times of 10 ps.

IOLOS will develop theoretical understanding and numerical models for the design and optimisation of the directional bistability and switching speed of micro-SRLs. IOLOS will study the ultimate limits of device down scaling, thus predicting future technological development capability.

IOLOS will further develop technologies to monolithically integrate the SRL bistable devices into functional all-optical digital and logic chips that incorporate optical access couplers, passive waveguides, and all-optical gates. These chips will be used to realise and demonstrate all-optical set/reset flip-flop functions, all-optical threshold devices for all-optical data regeneration and retiming, and optical memory units with all-optical write, read, and reset control functions.

IPHOBAC

Integrated Photonic mm-Wave Functions for Broadband Connectivity

Project reference: 035317,
Instrument: IP

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Web site
www.ist-iphobac.org

Timeline
Start Date: 1 June 2006
End Date: 31 May 2009

Budget
Overall Cost: 8.78 million €
Funding: 5.83 million €

Project Partners
- UNIVERSITÄT DUISBURG-ESSEN (STANDORT DUISBURG), DE
- THALES SYSTEMES AEROPORTES SA, FR
- ALCATEL THALES III-V LAB
- KUNGLIGA TEKNISKA HOEGSKOLAN, SE
- CNRS, FR
- ACREO AB, SE
- FRANCE TELECOM, FR
- U2T PHOTONICS AG, DE
- THE CENTRE FOR INTEGRATED PHOTONICS LTD, UK
- UNIVERSITY COLLEGE LONDON, UK
- UNIVERSIDAD POLITECNICA DE VALENCIA, ES
- FAKULTETA ZA ELEKTROTEHNIKO UNIVERZA V LJUBLJANI, SI

Vision & Aim

IPHOBAC will develop a new photonic based mature transmitter and receiver technology to support millimeter-wave applications.

IPHOBAC aims at developing innovative millimeter-wave photonic components and integrated functions generically based upon the combination of radio and optics technologies.

IPHOBAC has a set of innovative approaches for the development of millimeter-wave photonic components and integrated functions for the generation, the modulation and the emission of millimeter-wave signals.

IPHOBAC ambitious objectives will bring millimeter-wave photonics components and integrated functions to a level of maturity such that take-up actions by industry will be ensured. The new integrated functions enabled by IPHOBAC will support multiple mm-wave applications in broadband telecommunications, security, radar, and instrumentation.

Advanced and compact photonic sources will be developed, including spectrally pure, highly stable millimeter wave sources and ultra-wide tuneable sources and transceivers with integrated antennas. These compact sources can neither be implemented by any extension of individual optics nor individual radio technologies. They will be used in Gbit/s radio-over-fiber systems, optically controlled antennas and instrumentation applications.

IPHOBAC integrates a chain of partners, from academic research to industrials, from technology centers over component manufacturers to end-users, all known for their previous achievements in microwave photonic components and technologies. The joint efforts will bring millimeter-wave photonic components for generation and detection of high purity millimeter waves to a level of maturity enabling commercial exploitation.

LANCER

Light Amplifiers with NanoClusters and ERBium

Project reference: 033574,
Instrument: STREP

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Timeline
Start Date: 1 Sept. 2006
End Date: 31. Aug. 2009

Budget
Overall Cost: 3.16 million €
Funding: 2.20 million €

Project Partners
- CNRS, FR
- UNIVERSITA DEGLI STUDI DI TRENTO, IT
- UNIVERSITAT DE BARCELONA, ES
- TEEM PHOTONICS S.A., FR
- UNIVERSITY COLLEGE LONDON, UK
- OPTOELECTRONICS RESEARCH CENTRE, UNIVERSITY OF SOUTHAMPTON, UK
- INSTITUT NATIONAL POLYTECHNIQUE DE GRENOBLE, FR
- SCUOLA SUPERIORE SANT ANNA DI STUDI UNIVERSITARI E PERFEZIONAMENTO, IT

Vision & Aim

Lancer will realise compact, high-performance, CMOS-compatible and cost-effective planar optical amplifiers and lasers for next generation optical networks.

The drive to combine the functionality of silicon electronics with optical data transmission to yield silicon opto-electronic integrated circuits operating at 1.5 μm is currently a technological priority of both the communication and the microelectronics communities.

The project intends to exploit the quantum properties of Si nanoclusters (Si-ncs) to efficiently excite erbium ions, which are the optically active species responsible for light amplification. In this way, the project will overcome the principal problems that have precluded the development of such amplifiers to date: poor emission efficiencies of erbium in silicon, small excitation cross-sections for erbium in silica, the requirement for expensive pump sources.

The project will exploit two approaches: hybrid and monolithic integration. The hybrid approach will involve, for example, flip-chip bonding of an ion-exchanged glass waveguide with a planar Er/Si-nc codoped layer. Monolithic silicon amplifiers will be fabricated by co-doping silicon waveguides with Si-ncs and erbium ions. The devices will be electrically and/or optically pumped, the latter using a low-cost LED. Planar packaged devices with gains of 10dB less than 5cm in length are envisaged, allowing the deployment of inexpensive photonic components for metropolitan networks and fibre-to-the-home.

The consortium includes universities, research centres active in electronics, signal processing and advanced optics, and a well-established SME in the field of optical subsystems.

MEPHISTO

Merger of Electronics and Photonics Using Silicon Based Technologies

Project Number: 511466,
Instrument: STREP

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Web site
http://www.hhi.de/mephisto/

Timeline
Start Date: 1 Aug. 2004
End Date: 31 March 2008

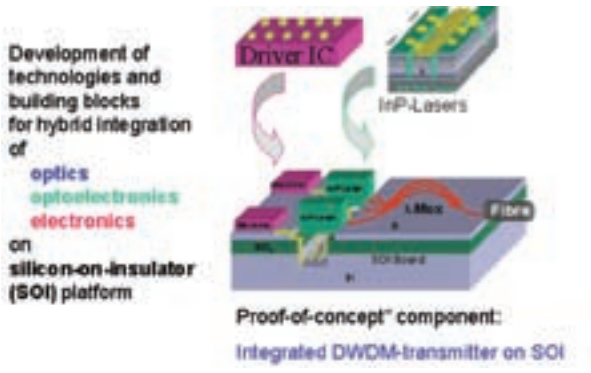
Budget
Overall Cost: 4.05 million €
Funding: 2.1 million €

Project Partners
- FREESCALE HALBLEITER DEUTSCHLAND GMBH, DE
- HYMITE A/S, DK
- VALTION TEKNILLINEN TUTKIMUSKESKUS, FI
- OKMETIC OYJ, FI
- INTEXYS SA, FR

Vision & Aim

The overall aim of MEPHISTO is to develop a silicon-on-insulator (SOI) based hybrid integration platform ('optical motherboard') for implementing optical subsystems encompassing optical, opto-electronic and electronic functions. Such a comprehensive hybridised integration will be a key technology to meet the demands of increasing compactness and complexity, mass production, cost reduction, and reliability of future optical components to be used in photonic networks, but also for other emerging areas like Si photonics, sensor and micro- & nanosystems technologies, and in particular optical interconnects in high-speed VLSI electronics. It is unlikely that in the foreseeable future such complex integrated subsystems will rely on a fully monolithic integration approach due to inherent drawbacks with respect to overall performance and yield. SOI material will be employed as integration platform because it offers a number of distinct advantages over competing materials (silica-on-silicon, polymers or silicon-oxynitride), both technically and economically.

Compared to previous developments in this field the target of the MEPHISTO project takes the concepts of optical motherboards much further, involving the hybridisation of the active III-V components with sophisticated silicon optical circuits which will comprise arrayed wave-guide gratings and variable optical attenuators, and the hybrid integration of Si VLSI electronics. More specifically, the goals of MEPHISTO are to study and develop crucial, innovative enabling technologies and building blocks for realizing advanced SOI based OMB subsystems. These will be used in particular to implement 'proof-of-concept' integrated dense wavelength division multiplexing transmitter components for C-band wavelength operation incorporating complex optical, opto-electronic, and electronic functions. The practicability, the issues and challenges involved in the SOI based optical motherboard technology will be assessed.



MICROHOLAS

Microholographic Data Disk for Archival Storage

Project Number: 511437,
Instrument: STREP

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Timeline
Start Date: 1 July 2004
End Date: 30 June 2007

Budget
Overall Cost: 1.98 million €
Funding: 1.5 million €

Project Partners
- UNIVERSITA POLITECNICA DELLE MARCHE, IT
- JENOPTIK LASER, OPTIK, SYSTEME GMBH, DE
- UNIVERSITE D'ANGERS, FR
- OPTILINK KFT, HU
- BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM, HU

Vision & Aim

The overall objective of MICROHOLAS is to implement the microholographic technique for optical storage on CD/DVD-like disks for digital data. The project aims at long-term storage by utilizing periodic nanostructures in the disk volume rather than on the surface as in conventional optical storage systems. A prototype read/write device will be designed and constructed to demonstrate the feasibility of volume microholographic storage on a rotating removable disk. Bit-formatted data is stored as microholograms in a thin photopolymer layer.

The microholographic recording technique allows for an increase of the storage capacity far beyond the limits of current DVDs and next generation blue-Ray disks by applying wavelength multiplexing combined with multilayer storage. The proposed new and original system relies on and benefits from well-established CD and DVD technology. This will ease realizing the device and open a viable route for Terabyte storage. The design and construction of the demonstrator test bed will be accompanied by research focused on characterization and development of photopolymers with improved properties as required for long-term and Terabyte storage.

A thorough testing programme starting from initial laboratory measurements up to dynamic tests with the device under development will be undertaken to optimise the design at all stages of the technological realization. In the final phase an experimental system will be tested for data archiving. The implementation of microholography for digital data storage on a disk has the potential to become a major breakthrough in realizing Terabyte optical storage. Additionally, innovation beyond the state of the art is expected with new and improved photopolymers as well as with optical and laser components required for the device. At the end of the project a microholographic storage disk and a demonstrator device will be available which will have been successfully tested for archival storage.

MONA

Merging Optics and Nanotechnologies

Project Number: 017255,
Instrument: SSA

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Timeline
Start Date: 1 June 2005
End Date: 30 Nov. 2007

Budget
Overall Cost: 953 988 €
Funding: 953 988 €

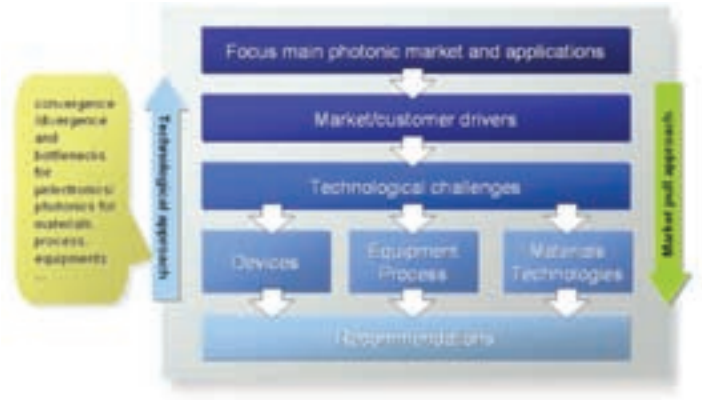
Project Partners
- IMEC, BE
- SCHOTT AG, DE
- VDI TECHNOLOGIEZENTRUM GMBH, DE
- EPIC ASSOCIATION, FR
- ALCATEL THALES III-V LAB, FR
- THALES SA, FR
- ALCATEL SA, FR
- PROMOUVOIR LA VALLEE DE L'OPTIQUE, FR
- ASM INTERNATIONAL N.V., NL
- YOLE DEVELOPPEMENT, FR
- AIXTRON AG, DE
- ACREO AB, SE

Vision & Aim

Microelectronics and Photonics are two of the most important key enabling technologies for the markets of the 21st century. They influence our entire life and are technological drivers for multi-billion industry sectors such as automotive, telecommunication, life sciences, information technologies, sensing or industrial production by providing key components and applications.

The goal of the MONA project (Merging Optics and Nanotechnologies) is to leverage synergies in photonics and nanotechnologies, seeking to increase the impact and efficiency of investment on European research. There are three principal objectives:

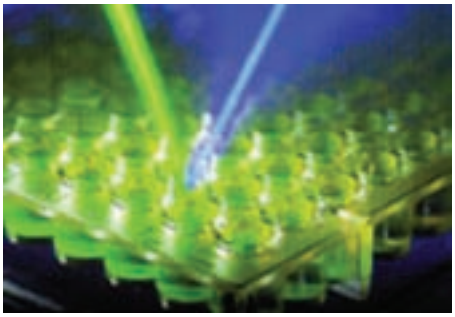
- Create a common site for the exchange of information concerning research, networks of excellence, and integrated projects in photonics and nanotechnologies.
- Promote the timely exchange of scientific results, market development, and technology needs through ***MONA***-developed workshops.
- Develop a European roadmap for photonics and nanotechnologies.



The MONA project contributes directly to the development of synergies between photonics/nanophotonics and nanomaterials/ nanotechnologies. The challenge of mastering nano-electronics and nano-photonics science and technologies at an industrial scale (i.e. aiming at low cost mass production capability) is of utmost strategic importance for the competitiveness of the European industry in a global context. Through the cooperative work between equipment manufacturers, nanotechnologies and photonics experts, MONA will help to identify and address the most critical manufacturing issues.

MONA

The Workpackages address: materials, technologies for manufacture, marketing, two-way relationships and exchanges with other nanotechnology research programmes, and a dissemination programme that emphasizes effective communications both inside and outside FP-6. The consortium consists of R&D laboratories, industry leaders and strategic planning organizations, with a broad complementarity and European coverage.



This will ensure the building of a strategic comprehensive approach for the key technologies in order to shape the future of this highly important area for the European Union.

MOSEL

Monomode Surface Emitting Lasers

Project reference: 035183,
Instrument: STREP

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Web site
http://www.ist-mosel.org/

Timeline
Start Date: 1 June 2006
End Date: 31 May 2009

Budget
Overall Cost: 3.67 million €
Funding: 2.39 million €

Project Partners
- CEA, FR
- ALIGHT TECHNOLOGIES A/S, DK
- BEAMEXPRESS S.A., CH
- EPFL, CH
- SA INTEXYS, FR
- KUNGLIGA TEKNISKA HOEGSKOLAN; SE
- DANMARKS TEKNISKE UNIVERSITET, DK

Vision & Aim

Vertical cavity surface emitting lasers (VCSELs) have several particular advantages over the edge emitting lasers (EEL) for replacing them in optical communications applications, as the possibility of wafer-level testing during the fabrication process as well as facilitated optical coupling and overall module packaging. Nevertheless, several major improvements should be brought to the existing VCSELs before they become widely used in high speed optical datacom links. Among existing limitations, a limited power delivered by high speed (10 Gbit/s and up) transversely monomode VCSELs. This limitation is a key issue for the introduction of VCSELs in FTTx devices, especially in Passive Optical Networks where the power launched into the fiber must be rather high. Hence, mode size and polarization control are key issues in design of high performance VCSELs. Introducing elements of photonic crystal is an efficient way to increase the mode size while maintaining or even improving operating characteristics.

In the present project, we aim to achieve an overall improvement of the VCSELs performances using micro and nanoscale patterning. The novel cavity configurations explored will allow:

- to increase the size (and thus the power) of the fundamental transverse mode of the VCSEL;
- to keep the laser transversely monomode at much larger current ranges;
- through the latter, to improve the modulation speed of the lasers;
- to control the polarisation of the emitted beam in temperature range and under modulation.

Two general geometrical configurations, patterning of the mirrors and patterning of the cavity close to the active layer will be explored. The objective of the project is to demonstrate a configuration of the vertical cavity that would allow a 10-fold improvement in the monomode powers over the conventional VCSEL structures operating at 850 and 1310 nm. This improvement should be obtained while keeping appreciable modulation speed (10 Gbit/s) and a single polarisation.

MUFINS

Multi - Functional Integrated Arrays Of Interferometric Switches

Project Number: 004222
Instrument: STREP

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Web site
http://mufins.cti.gr/

Timeline
Start Date: 1 Sept. 2004
End Date: 31 Aug. 2007

Budget
Overall Cost: 3.53 million €
Funding: 2.69 million €

Project Partners
- RESEARCH ACADEMIC COMPUTER TECHNOLOGY INSTITUTE, GR
- TECHNISCHE UNIVERSITEIT EINDHOVEN, NL
- UNIVERSITY OF BRISTOL, UK
- TELECOM ITALIA SPA, IT
- FRAUNHOFER GESELLSCHAFT, DE
- THE CENTRE FOR INTEGRATED PHOTONICS LTD., UK
- SIEMENS, S.A., PT
- UNIVERSITY OF ESSEX, UK

Vision & Aim

In the past decade, we have witnessed a remarkable advance in all-optical signal processing techniques and rapid maturity in the fabrication of compact all-optical switches. All-optical computing has been the holy grail of researchers since the invention of the laser. Even though general purpose all-optical processing is still a long way off, there are specialized applications in high data rate telecommunications and networking, where ultra high speed, low complexity all-optical circuits are ideally suited. The next key step in all-optical technology evolution is to develop the means to manufacture compact and low cost arrays of all-optical gates, that is, to develop the capability of moving towards the VLSI of all-optical gates.

MUFINS combines the efforts of 8 European research groups as the first step in this direction. Specifically, MUFINS aims to demonstrate 2- and 4-element monolithically integrated arrays of packaged and pigtailed, InGaAsP, 2x2 all-optical switches on single InP substrates for operation at 10 and 40 Gbits/s, as well as 4-element, hybridly integrated 2x2 switches for operation at 40 Gbits/s. Concerning the monolithically integrated arrays, two different integration techniques will be used; active/passive integration based on regrowth and Active Vertical Coupling (AVC). Additionally, MUFINS will develop and demonstrate a fully integrated, 3-element, 40 Gbits/s all-optical Burst Mode Receiver.

The performance of the 2- and 4-element arrays will be evaluated in complicated, multi-gate, all-optical circuits at 10 and 40 Gbits/s, such as Exchange Bypass, Clock and Data Recovery, Header Extraction, 4-wavelength Burst Mode Receiver, Half- and Full-Adder, 4x4 all-optical Switching Matrix, Data Vortex Switch and Time Slot Interchanger. The choice of the evaluation experiments was such as to show that generic, multi-element arrays of integrated all-optical gates can find application in different telecommunication domains. By integrating many generic, MZI gates on a single chip, MUFINS aims to draw the path towards cost reduction, as well as to assure that the developed multi-gate elements can have an adequate market to support them as products after the end of the project.

MUFINS

Up to now, the 40 Gb/s, hybrid, 4-element MUFINS array has been fully developed, packaged and pigtailed, as shown in Figure 1:

Figure 1: Fully packaged and pigtailed, 4-element, 40 Gb/s MUFINS array, using hybrid integration

Additionally, the monolithic platforms are underway, as shown in Figures 2 and 3, for the AVC and the active/passive regrowth techniques respectively.

Figure 2: 2-element, monolithically integrated MUFINS device, using the AVC integration technique

Figure 3: 4-element, monolithically integrated MUFINS device, using the active/passive integration technique based on regrowth

Concerning the evaluation experiments, the Exchange Bypass switch and the Clock and Data Recovery at 10 Gb/s, as well as the Burst Mode Receiver at 40 Gb/s have been successfully demonstrated using single, hybridly integrated MUFINS devices. Evaluation of the developed multi-element arrays is currently underway.

NANDOS

Nanophotonic and Nanoelectronic Devices from Oxide Semiconductors

Project Number: 016924,
Instrument: STREP

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Timeline
Start Date: 1 Aug. 2005
End Date: 31 July 2008

Budget
Overall Cost: 3.23 €
Funding: 2.5 €

Project Partners
- OSRAM OPTO SEMICONDUCTORS GmbH, DE
- TECHNISCHE UNIVERSITÄT BRAUNSCHWEIG, DE
- CNRS, FR
- LIGHTLAB AKTIEBOLAG, SE
- NATIONAL CENTRE FOR SCIENTIFIC RESEARCH 'DEMOKRITOS', GR
- UNIVERSITE JOSEPH FOURIER GRENOBLE 1, FR
- UNIVERSITÄT LEIPZIG, DE

Vision & Aim

Self-organisation of nanostructures is an attractive way to fabricate nanodevices. A variety of self organised ZnO nanostructures have been realised recently (nanopillars, nanowires, nanobelts) that could have novel applications in optoelectronics, sensors, transducers etc. ZnO is a wide bandgap semiconductor with a record value of exciton binding energy and extremely large oscillator strength, which make it a good candidate for UV nanophotonics at room temperature. Oxides can also be used for gas sensing applications and the large surface area of nanostructures is one of their attractive aspects in this regard.

ZnO based devices will find their application in areas such as communication, security environment or biomedical sciences. ZnO based nanodevices can be fabricated on a variety of substrates, including silicon or flexible polymer, which makes them compatible with existing silicon technology and organic electronics and optoelectronics.

The objective of this project is to develop and optimise ZnO nanostructures that will give rise to a variety of nanodevices. Among the many potential applications, we have chosen to demonstrate devices in one specific sector, optoelectronics, with a particular emphasis on lighting technology. For this purpose, we will:

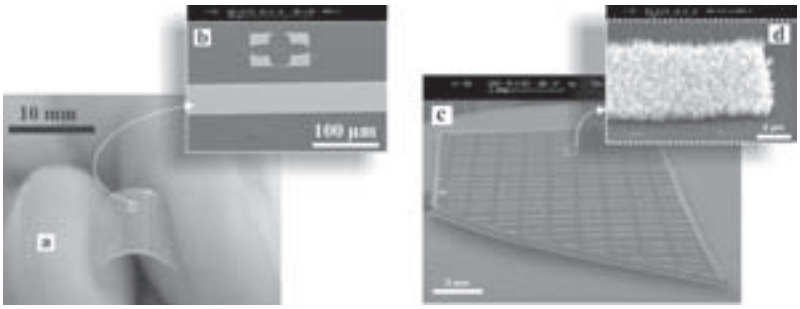
1) Grow self-organised ZnO based nanostructures on various substrates, such as sapphire, silicon, as well as polymer substrates, by different techniques,

2) Optimise the control of self-organisation in terms of position, distribution, orientation, size, shape, electrical conductivity, radiative quantum efficiency,

3) Demonstrate ZnO nanodevices comprising: light emitting devices (nano-LEDs), in the UV as well as for white light emitters, ZnO nanolasers operating at room temperature.

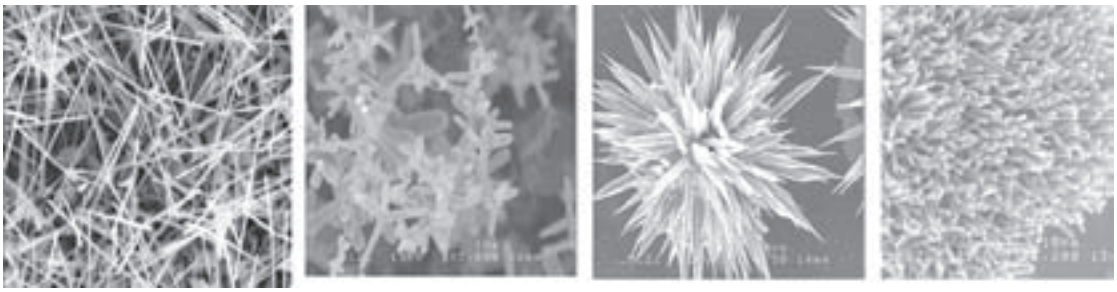
4) Optimise fabrication.

NANDOS



Patterned arrays of ZnO nanopillars generated via postgrowth lithography / wet chemical etching:

(a) photograph of PEN foil; (b) SEM picture of PEN foil enlarged of (a); (c) SEM picture of silicon (100); (d) SEM enlarged of (c)



Various ZnO nanostructures grown on Si substrates at different conditions by vapor-liquid-solid.

Above: SEM image of ZnO nanorods gown at low temperature on ITO

Below: Digital photograph showing white light emission from ZnO nanrod LED made from (a)

NANO UB-SOURCES

Ultrabroad bandwidth light *sources* based on nano-structuring devices

Project reference: 017128,
Instrument: STREP

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Web site
http://www.nano-ub-sources.org/

Timeline
Start Date: 1 Sept. 2005
End Date: 31 Aug. 2008

Budget
Overall Cost: 3.13 €
Funding: 2.2 €

Project Partners
- FORSKNINGSCENTER RISOE, DK
- CRYSTAL FIBRE A/S, DK
- ALCATEL THALES III-V LAB, FR
- POLITECNICO DI TORINO, IT
- TECHNISCHE UNIVERSITÄT DARMSTADT, DE
- LUNDS UNIVERSITET, SE
- CARDIFF UNIVERSITY, UK
- THALES, FR
- UNIVERSITY OF SHEFFIELD, UK

Vision & Aim

The key objective of this project is to develop optical broad bandwidth sources using the unique properties of multilayer quantum dot structures and nonlinear photonic crystal fibres for bio-photonics applications. The proposal presents a unique synergy between nanotechnology, information science and technology and life sciences.

The source development is targeted at biomedical applications such as:

- Optical coherence tomography (OCT): an emerging, non-invasive, imaging technology for diagnosis (age macular degeneration; skin cancer);
- Medical instrumentation based on spectroscopy.

For OCT in particular, the lack of optical bandwidth in available commercial technology is the main bottle-neck in achieving ultra-high resolution imaging systems. Addressing this issue enables successful penetration of this important diagnostic tool into hospital clinics.

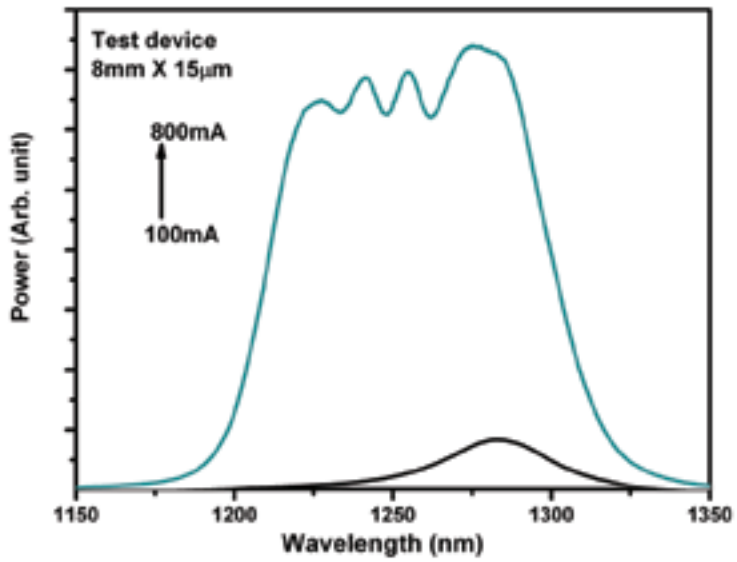
To overcome this bottle-neck, we propose to develop a breakthrough technology based on innovative concepts. The core technology development in the project is based on the most recent scientific advances in quantum dot materials. The use of these nanoscale strained islands provides the unequalled advantages of access to wavelengths and to broadband gain spectra not reachable by quantum well technology, thus overcoming the limiting bottle-neck of current laser sources.

Two pathways will be investigated for achieving large optical bandwidth with sufficient power levels together with high beam quality and low noise:

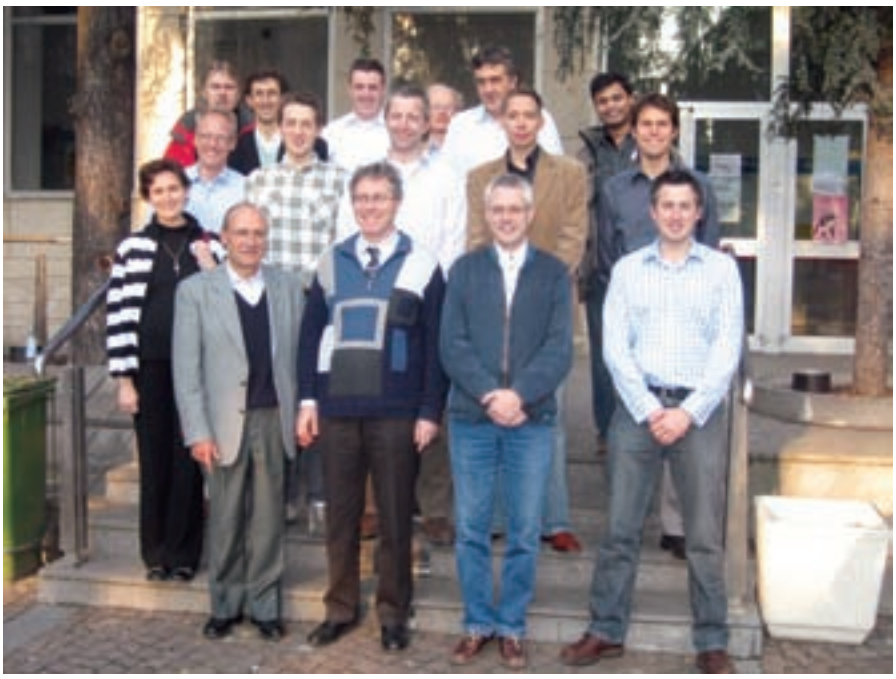
- Quantum dot (QD) superluminescent diodes and wavelength multiplexed QD superluminescent diodes;
- High peak power, pulsed QDs lasers, based on mode locking, or high-power continous wave QD lasers for the pumping of nonlinear photonic crystal fibres to achieve significant spectral broadening.

The resulting developments from this project will enable unprecedented early diagnosis of diseases that are worldwide leading causes for blindness, cancer diagnosis of neoplastic changes and real time therapy monitoring in dermatology.

NANO UB-SOURCES



Caption: Preliminary results showing output power vs emission wavelength for a QD SLD with center wave length around 1260 nm with bandwidth exceeding 100 nm. The test device is 8 mm long and 0.015 mm wide (courtesy M. Hopkinson, Univ. Sheffield, UK).



Group photo from second consortium meeting at Politecnico di Torino, Italy, in December 2005.

NATAL

Nano-Photonics Materials and Technologies for Multicolor High-Power Sources

Project Number: 016769
Instrument: STREP

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Timeline
Start Date: 1 July 2005
End Date: 30 June 2008

Budget
Overall Cost: 3.88 million €
Funding: 2.73 million €

Project Partners
- TOPTICA PHOTONICS AG, DE
- OSRAM OPTO SEMICONDUCTORS GMBH, DE
- OPTOCAP LIMITED, UK
- EPICRYSTALS OY, FI
- TECHNISCHE UNIVERSITÄT BERLIN, DE
- UNIVERSITY OF STRATHCLYDE, UK
- CHALMERS TEKNISKA HOEGSKOLA AKTIEBOLAG, SE

Vision & Aim

NATAL aims to develop a new core technology of powerful and compact laser sources for the visible and ultraviolet spectral ranges. Such devices are needed for a variety of applications including nano-materials processing, medicine, RGB displays, life sciences, as well as UV lithography and surface chemistry.

The lasers envisaged by ***NATAL*** represent a radical departure from the existing technologies. Nanophotonic materials and science are the key themes running throughout the proposed programme.

The main areas addressed by ***NATAL*** include

1) development of innovative nano-structured gain devices;

2) development of advanced micro-optical elements to enable the functionality and control of lasers.

Central focus of this programme is the concept of the Optically-Pumped Vertical External Cavity Surface-Emitting Semiconductor Laser (OP-VECSEL). These sources retain the power-scaling, beam quality and intracavity control capability of solid-state lasers, while offer the wavelength versatility, broadband pump absorption and compact gain region supplied by semiconductor technology.

NATAL will use the innovative thermally-conductive optical windows bonded directly to the surface of the OP-VECSEL chip. This approach allows the facilitation of wavelength extension and power scaling, microchip operation and novel schemes for optical mode control, in addition to integrated device formats with a wide range of functionality. Specific wavelength targets include direct operation in the red (630-670 nm) and frequency-doubled OP-VECSELs operating at 315-335 nm (UV), 470 nm (blue), 520 nm (green), and 610 nm (red). These wavelengths cover important absorption bands in a host of materials significant to nanotechnology (quantum dot and conventional fluorphores, light-emitting polymers, photoresists, biomaterials) and large-scale consumer applications.

Fig. 1: Picture of a frequency doubled VECSEL operating at 620 nm.

NEMIS

New mid-infrared sources for photonic sensors

Project reference: 031845,
Instrument: STREP

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Web site
http://www.nemis.eu

Timeline
Start Date: 1 Sept. 2006
End Date: 31 Aug. 2009

Budget
Overall Cost: 2.51 million €
Funding: 2.0 million €

Project Partners
- TECHNISCHE UNIVERSITÄT MUENCHEN, DE
- UNIVERSITE MONTPELLIER II, FR
- INSTITUTE OF PHYSICS OF THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC, CZ
- CHALMERS TEKNISKA HOEGSKOLA, SE
- VERTILAS GMBH, DE
- OMNISENS SA, CH
- SIEMENS AG, DE

Vision & Aim

The objectives of the NEMIS project are the development and realisation of compact and packaged vertical-cavity surface-emitting semiconductor laser diodes (VCSEL) for the 2-3.5µm wavelength range and to demonstrate a pilot photonic sensing system for trace gas analysis using these new sources. The availability of electrically pumped VCSELs with their low-cost potential in this wavelength range that operate continuously at or at least near room-temperature and emit in a single transverse and longitudinal mode (i. e. single-frequency lasers) is considered a basic breakthrough for laser-based optical sensing applications. These devices are also mode-hop-free tuneable over a couple of nanometers via the laser current or the heatsink temperature. They are therefore ideal and unmatched sources for the spectroscopic analysis of gases and the detection of many environmentally important and/or toxic trace-gases, which is a market in the order of 10 million Euro today with an expected increase into several 100 million Euro with the availability of the new VCSELs.

The semiconductor technology underlying the VCSELs relies on GaSb-based quantum well structures and the devices are based on insulating apertures as well as on buried tunnel junctions for the lateral current and mode confinement. The project is organized into six workpackages dedicated to specifications/design, epitaxy, VCSEL technology, VCSEL characterisation, applications, and project management. The consortium comprises seven complementary and highly skilled partners from five European countries: Technische Universität München, Germany (buried-tunnel-junction VCSEL), Universite Montpellier 2, France (insulator-confined VCSEL), Institute of Physics of the Academy of Sciences, Czech Republic (VCSEL characterisation), Chalmers University of Technology, Sweden (Design), VERTILAS GmbH, Germany (VCSEL packaging and characterisation), Omnisens, Switzerland (Applications) and Siemens AG, Germany (Applications).

NEMO

Network of Excellence for Micro-Optics

Project Number: 003887,
Instrument: NoE

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Web site
http://www.micro-optics.org/

Timeline
Start Date: 1 Sept. 2004
End Date: 31 Aug. 2008

Budget
Overall Cost: 6.4 million €
Funding: 6.4 million €

Project Partners
- VRIJE UNIVERSITEIT BRUSSEL, BE
- FORSCHUNGSZENTRUM KARLSRUHE GMBH, DE
- POLITECHNIKA WROCLAWSKA, PL
- HERIOT-WATT UNIVERSITY, GB
- FRAUNHOFER-GESELLSCHAFT, DE
- TECHNISCHE UNIVERSITEIT DELFT, NL
- UNIVERSITE DE NEUCHATEL, CH
- UPPSALA UNIVERSITET, SE
- NATIONAL INSTITUTE OF TELECOMMUNICATIONS, PL
- UNIVERSITEIT GENT, BE
- FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN – NUERNBERG, DE
- THALES, FR
- CHALMERS TEKNISKA HOEGSKOLA AKTIEBOLAG, SE
- CNRS, FR
- VALTION TEKNILLINEN TUTKIMUSKESKUS, FI
- KOC UNIVERSITY, TR
- CONSIGLIO NAZIONALE DELLE RICERCHE, IT
- UNIWERSYTET MARII CURIE-SKLODOWSKIEJ, PL
- SUSS MICROOPTICS SA, CH
- STUDIECENTRUM VOOR KERNENERGIE - CENTRE D'ETUDES DE L'ENERGIE NUCLEAIRE, BE
- LAMBDA LASER OPTICS, BE
- LIGHTTRANS GMBH, DE
- SABANCI UNIVERSITY, TR
- POLITECHNIKA WARSZAWSKA, PL
- UNIWERSYTET WARSZAWSKI, PL
- UNIVERSITY OF STRATHCLYDE, GB
- JOENSUUN YLIOPISTO, FI
- UNIVERSIDADE DE SANTIAGO DE COMPOSTELA, ES

Vision & Aim

Micro-optics is a generic technology that allows the manipulation of light and the management of photons with 'micron'- and 'sub-micron'-scale structures and components. Micro-optics is therefore the corner-stone enabling technology to interface the macroscopic world we live in with the microscopic world of opto- and nano-electronic data processing circuits. It is recognized as the key-link between photonics and nano-electronics, the two dominating information technologies in tomorrow's society.

This Network of Excellence on Micro-Optics NEMO aims at providing Europe with a complete Micro-Optics food-chain, by setting up centers for Optical Modelling and Design; Measurement and Instrumentation; Mastering, Prototyping and Replication; Hybrid Integration and Packaging; Reliability and Standardization.

A first objective of the NEMO network is to make these service and technology centres accessible to academic research institutes, SME's, and large companies to enhance the competitiveness of photonic-based products and the durable embedding of novel photonic functionalities in a myriad of products.

A second objective is to use these service and technology centres to support the network's six long-term application-oriented research topics on micro-optics: Mid-Infra-Red micro-optics, Sub-wavelength structured optical surfaces, Platforms for optical MEMS, Non-conventional micro-optical elements, Micro-optical structures for sensing, and Micro-optic interconnects.

These long-term research topics aim at widening the scope of present-day research and at introducing novel concepts and components, thus creating new photonic functionalities applicable in virtually any region of the optical spectrum and beyond. With its long-term research NEMO is targeting a wealth of novel optical and photonic applications to increase the quality of daily life.

Fig. 1: The micro-optical elements for the NEMO's Educational kit 'Learn and Teach Optics' are replicated with Hot Embossing technology.

Fig. 2: Distance sensor micro-optical bench.

Fig. 3: The food-chain of micro-optics sciences and technologies.

NEXTGENPCF

Next Generation Photonic Crystal Fibers

Project reference: 034918,
Instrument: IP

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Web site
http://www.nextgen-pcf.eu/index.html

Timeline
Start Date: 1 June 2006
End Date: 31 May 2009

Budget
Overall Cost: 12.23 million €
Funding: 6.65 million €

Project Partners
- DRAKA COMTEQ, FR
- DRAKA COMTEQ FIBRE BV, NL
- ALCATEL LUCENT, FR
- DEGUSSA NOVARA TECHNOLOGY S.P.A., IT
- HERAEUS QUARTZGLAS GMBH, DE
- VITRON SPEZIALWERKSTOFFE GMBH, DE
- RED-C OPTICAL NETWORKS LTD, IL
- OPTICAL SYSTEMS & RESEARCH FOR INDUSTRY AND SCIENCE, FR
- FIBER OPTIC SENSORS AND SENSING SYSTEMS BVBA, BE
- ALTECHNA, LT
- FRANCE TELECOM, FR
- HORIBA ABX, LT
- UNIVERSITE DES SCIENCES ET TECHNOLOGIES DE LILLE - LILLE I, FR
- UNIVERSITE DE LIMOGES, FR
- UNIVERSITY OF BATH, UK
- INSTITUT FUER PHYSIKALISCHE HOCHTECHNOLOGIE E.V., DE
- INESC PORTO, PT
- MULTITEL, BE

Vision & Aim

The project NextGenPCF arises from the observation that progress and continuing technological development in many fields will depend on new ways of producing and guiding light, and mastering its interaction with the environment. Actors in health care require lasers at new wavelengths or broadband sources for diagnosis. Telecom players look for more flexible amplifiers, and for easy-to-install, low-cost fibres. The environmental sensor industry is searching for sensitive gas detector systems.

Photonic Crystal Fibre (PCF) technology has the potential to become an enabling optical component. Indeed, Photonic Crystal Fibres have re-defined what an optical fibre is and does, and dramatically enlarged the available design space. The claim of the partners is that the basic PCF designs are now defined and demonstrated, and that the turn into material optimisation and industrialisation has to be implemented.

NextGenPCF integrates the key European industrial and academic groups, from raw material developers to final users. It aims at being the incubator of key devices in three fields of applications that correspond to three IST strategic fields:

- Biomedical: Raman laser for photodynamic therapy and wideband sources for cytology;
- Telecom: easy-to-install, low-cost fibre for indoor wiring, Raman optical amplifier;
- Sensors for environment: methane detection in mining.

The technological developments will be driven by these applications. The integration of all the actors in a coordinated development process is expected to create a virtuous circle of market growth linking end user, device, fibre and raw material, while spreading knowledge and avoiding redundancy. It will provide a key competitive advantage to European firms in the future.

NITWAVE

Nitride Intersubband Devices at Telecommunication Wavelengths

Project Number: 004170,
Instrument: STREP

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Web site
http://pages.ief.u-psud.fr/nitwave/

Timeline
Start Date: 1 June 2004
End Date: 31 May 2007

Budget
Overall Cost: 2.7 million €
Funding: 1.93 million €

Project Partners
- CEA, FR
- EPFL, CH
- UNIVERSITE JOSEPH FOURIER GRENOBLE 1, FR
- FORSCHUNGSVERBUND BERLIN E.V., DE
- TECHNISCHE UNIVERSITÄT WIEN, AT
- TOP-GAN SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA, PL
- CENTRUM BADAN WYSOKOCIENIENIOWYCH POLSKIEJ AKADEMII NAUK, PL
- CNRS, FR
- UNIVERSITE DE NEUCHATEL, CH

Vision & Aim

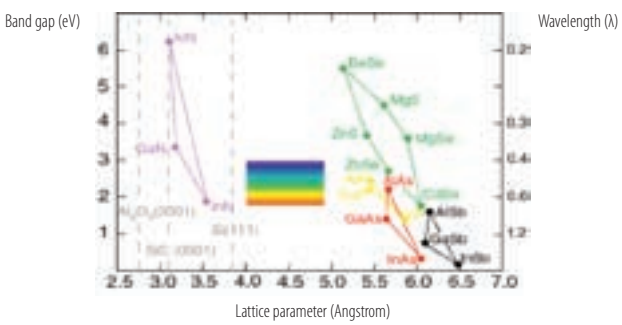
This project aims at investigating the building blocks of an emerging semiconductor technology for ultra-high bit rate optoelectronic devices operating at fibre-optics telecommunication wavelengths.

The advanced materials that we will investigate are nitride-based heterostructures (GaN/Al(Ga)N, GaN/AlInN). We will engineer the electronic quantum confinement at a nanometre scale to realize active devices relying on intersubband absorption/emission at 1.3-1.55 µm. The ultimate deliverables are high-speed photodetectors, optical switches and modulator devices. We will also investigate optically and electrically pumped emitting devices as stepping stones towards advanced unipolar sources (Quantum Fountain and Quantum Cascade lasers / amplifiers).

While existing semiconductor technology is dominated by InP-based interband devices, nitride intersubband devices will provide novel functionalities and superior performances like wavelength tunability, speed, high power handling capabilities, and material hardness. The potential of intersubband devices has already been demonstrated at mid- and far-IR wavelengths using GaAs- or InP-based materials.

Our project doesn't target the operating principles but will exploit the know-how acquired at longer wavelengths to push this family of devices to unprecedented short wavelengths, thanks to the large conduction band offset offered by nitride heterostructures. Establishing a new state-of-the-art for growth and processing of nitride semiconductors, and developing an advanced know-how on nitride devices are major challenges of the project.

The consortium regroups world class experts on nitride technologies and intersubband devices, and the chosen strategies have been chosen to minimize the risks. This high-risk, but achievable project will enable Europe to capitalize on S & T advances, developing a lead with respect to USA and Japan competitors and preparing the future transfer of this emerging technology to the optoelectronic industry.



OLAS

Organic electrically pumped LASer by engineering of heterojunctions in field-effect devices

Project reference: 015034,
Instrument: STREP

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Timeline
Start Date: 1 Jan. 2006
End Date: 31 Dec. 2008

Budget
Overall Cost: 3.04 million €
Funding: 1.6 million €

Project Partners
- IMEC LEUVEN, BE
- INSTITUT FÜR HALBLEITERTECHNIK, RWTH AACHEN, DE
- AMO GMBH, GESELLSCHAFT FÜR ANGEWANDTE MIKRO- UND OPTOELEKTRONIK, DE
- IBM RESEARCH, ZURICH RESEARCH LABORATORY, RÜSCHLIKON, CH

Vision & Aim

The project aims at achieving foundational research on a world prime: an Organic Electrically Pumped Laser. Our novel approach is based on the engineering of organic heterojunctions in field-effect devices. On the way to realising the main objective, intermediate results and milestones represent by themselves important sub-objectives:

1) Field-effect device with high electron and hole mobility for organic integrated circuits.

2) High brightness light-emitting organic semiconductor device.

The strategy proposed to reach the ambitious goal focuses on solving the main difficulties, which are commonly faced when targeting this breakthrough: exciton quenching and photon losses. We take advantage of the know-how developed on ambipolar light-emitting field-effect devices with lateral charge injection to explore unprecedented routes towards the electrically pumped organic laser. This novel approach combines the use of high-mobility (field-effect) structures, n- and p-type materials, phosphorescent compounds, the engineering of materials in heterojunctions, as well as of advanced device and photonic technology.

The proposal activity is expected to have a profound impact on IST-related technologies. Lasers are used daily in a variety of applications. Electrically pumped lasers based on organic semiconductors possess numerous advantages over III-V semiconductor lasers, the most important being the higher integration potential on arbitrary substrates (including glass, polymers and the backend of silicon CMOS), the lower cost and the wider spectral range of possible lasing emission.

The realisation of an electrically pumped organic laser would be a breakthrough in both physics of lasers and organic opto-electronics. The research towards this goal is clearly a long-term one, and it contains a very significant risk.

OLLA

High brightness Organic LEDs for ICT and Lighting Applications

Project Number: 004607,
Instrument: IP

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Web site
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Timeline
Start Date: 1 Oct. 2004
End Date: 30 June 2008

Budget
Overall Cost: 20 million €
Funding: 12 million €

Project Partners
- RIJKSUNIVERSITEIT GRONINGEN, NL
- AIXTRON AG, DE
- SIEMENS AG, DE
- TECHNISCHE UNIVERSITÄT DRESDEN, DE
- EPFL, CH
- IMEC, BE
- KATHOLIEKE UNIVERSITEIT LEUVEN, BE
- MERCK OLED MATERIALS GMBH, DE
- UNIVERSITEIT GENT, BE
- INFM, IT
- UNIVERSITÄT KASSEL, DE
- VTT, FI
- CNRS, FR
- CNR, IT
- NOVALED AG, DE
- PHILIPS GMBH, DE
- H.C. STARCK GMBH, DE
- OSRAM OPTO SEMICONDUCTORS GMBH, DE
- UNIVERSITE LOUIS PASTEUR DE STRASBOURG, FR
- SENSIENT IMAGING TECHNOLOGIES GMBH, DE
- UNIVERSITE DE NANTES, FR
- INSTYTUT CHEMII FIZYCZNE POLSKIEJ AKADEMII NAUK, PL
- FRAUNHOFER GESELLSCHAFT, DE
- PHILIPS GMBH FORSCHUNGSLABORATORIEN, DE

Vision & Aim

Cold light, i.e. the direct conversion of electrical energy into visible light that allows for high efficiency and that can be fully customized in form, color and appearance has been a dream for long time. The realization is now within reach with Organic Light Emitting Diodes (OLEDs).

OLEDs have been researched for 15 years with major emphasis on display applications. Now a certain level of maturity has been reached, such that first display products are being introduced in the market. However, the potential of OLED technology is much larger than what has been discovered so far, and ranging far beyond the application in matrix displays. OLEDs have the potential for high efficiencies at high brightness, freedom in shape and color combinations, full tunability in brightness and color, and a variety of appearances from opaque-white over mirror like to even fully transparent.

With a number of breakthroughs in materials, optics and production technology, OLEDs could become the ultimate light source for many lighting applications, especially Liquid Crystal Display-backlighting, signage, signalling, advertising and emergency lighting. On the long term OLEDs will become the next generation light sources, replacing in about 10 to 15 years time the currently used incandescent and fluorescent lights. OLLA is the first step towards reaching this goal. To reach this challenging target, project partners will develop new high-efficient materials, research in parallel the most suitable architecture and cost effective processing technology and will build examples, to demonstrate the full spectrum of opportunities with OLEDs for illumination purposes.

Via the OLLA project, the world-class industrial, institutional and academic partners integrate their resources for R&D, in order to make a fast breakthrough in OLED technology possible, and to be able to bring European OLED applications timely on the world market.

Polymer OLEDs in various colors including white (source Siemens CT)

OPERA 2015

Optic and Photonic in the European Research Area

Project Number: 015734,
Instrument: SSA

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Web site
http://www.opera2015.org/

Timeline
Start Date: 1 April 2005
End Date: 1 March 2008

Budget
Overall Cost: 951 000 €
Funding: 951 000 €

Project Partners
- VDI TECHNOLOGIEZENTRUM GMBH, DE
- ENTERPRISE IRELAND, IE
- IMEC, BE
- NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK – TNO, NL
- MINISTRSTVO ZA VISOKO SOLSTVO, ZNANOST IN TEHNOLOGIJO, SI
- INNOVACIÓN, DESAROLLO Y TRANSFERENCIA DE TECNOLOGIA, S.A., ES
- PROMOUVOIR LA VALLEE DE L'OPTIQUE: 'OPTICS VALLEY', FR
- UNIVERSITY OF SALFORD, UK
- EUROPEAN PHOTONICS INDUSTRY CONSORTIUM, FR
- EUROPEAN OPTICAL SOCIETY, EU

Vision & Aim

With a turnover of 80 billion euro the Optics and Photonics (OP) industry is one of the most important key enabling technologies for the markets of the 21st Century. They influence our entire life and are technological drivers for multi-billion industries in IST and beyond.

The OP industry is benefiting through many RTD projects at national and international level. To withstand growing competition from low labour cost countries there is a need to join forces in industry, research and politics to meet the needs of OP industries and to solve their common problems.

The main objective of OPERA is to provide a framework for adequate interaction of European IST-research in OP and to develop and implement a joint strategy for research and industry with the title OPERA 2015 to shape the future of this highly important industrial area.

OPERA will set up an information exchange and coordination platform covering:

- IST-projects (FP6, FP5), other relevant European projects;
- National and regional funding programmes on OP in IST;
- European, national and regional clusters and organisations working at the supranational level (EPIC, EOS, EUROM, EUREKA, SPIE).

OPERA will support the creation of the European Research Area through the stimulation of interaction of EU and national initiatives and projects. This will lead to improved transparency and cooperation of research activities and will deliver a clear view of the state and future directions of European research in OP.

OPERA will furthermore foster the link between industry and research in order to strengthen Europe's competitiveness by identifying strategic opportunities for European industries and by compiling scenarios for the future development of photonics industries. The consortium gathers experts from funding agencies, innovation promotion agencies, industrial association and research from 19 countries. 23 deliverables will be developed and 9 milestones will be used to check the progress of key activities.

PHODYE

New Photonic systems on a chip based on dyes for sensor applications

Project reference: 033793,
Instrument: STREP

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Timeline
Start Date: 1 Oct. 2006
End Date: 30 Sept. 2009

Budget
Overall Cost: 3.17 million €
Funding: 1.92 million €

Project Partners
- CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS, ES
- UNIVERSIDAD DE SEVILLA, ES
- UNIVERSIDAD POLITECNICA DE VALENCIA, ES
- KUNGLIGA TEKNISKA HOEGSKOLAN, SE
- MULTITEL, BE
- CENTRE SUISSE D'ELECTRONIQUE ET DE MICROTECHNIQUE SA, CH
- EIDGENOESSISCHE MATERIALPRUEFUNGS- UND FORSCHUNGSANSTALT, CH
- ETRA INVESTSIGACION Y DESARROLLO SA, ES
- UNIVERSIDAD POLITECNICA DE MADRID, ES

Vision & Aim

PHODYE is a multidisciplinary project that aims to develop a new sensing technology based on the integration of dye thin films with photonic structures.

The developed devices should yield a distinct optical response according to changes in the environment, which can be easily measured by a chip or recognized directly by the human eye. The dye thin films will be prepared by a new plasma polymerization procedure that is fully compatible with the integrated optoelectronic technology. The dye molecules in the films react to changes in the concentration of certain gases and/or in temperature or UV radiation by a change of their absorption/fluorescence properties. A key feature of the project is to achieve an effective optical coupling between the photonic structures and the film fluorescence/absorption response, so that changes in this latter can be transformed into proportional photonic signals or visible colour shifts.

A first technological objective of PHODYE is the integration of more than one sensing element into a chip based on ring resonators that would be capable of monitoring simultaneously various gases/physical parameters. A second objective is the construction of recognition chips that upon light excitation have a predetermined fluorescence response which changes depending on a given physical or chemical parameter.

As the optical structures have dimensions of the order of 100nm, the sensor response should be very fast. Devices based on large photonic resonant structures can be easily integrated into measurement devices, communication networks etc. Their low cost and their compatibility to dangerous environments make them a unique solution for a wide range of applications.

PHODYE is intended by a consortium that integrates four research centres and three SME's companies that cover all the scientific-technological chain from the materials to the final devices. Manufacturing, packaging and testing and validation are also afforded by the partners.

PHOLOGIC

Nanophotonic Logic Gates

Project Number: 017158,
Instrument: STREP

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Web site
http://www.ist-phologic.org

Timeline
Start Date: 1 June 2005
End Date: 31 May 2008

Budget
Overall Cost: 3.58 million €
Funding: 2.0 million €

Project Partners
- CONSORZIO CREO - CENTRO RICERCHE ELETTRO OTTICHE, IT
- COMMISSARIAT A L'ENERGIE ATOMIQUE, FR
- MCMASTER UNIVERSITY, CA
- THE CENTRE FOR INTEGRATED PHOTONICS LIMITED, UK
- UNIVERSITA DEGLI STUDI DI TRENTO, IT
- UNIVERSITAT DE BARCELONA, ES
- CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS, ES

Vision & Aim

The objective of the PHOLOGIC project is to explore the mass-manufacturing compatibility of nonlinear photonic materials (CdTe and Si nanocrystals) and their associated fabrication processes with CMOS processing lines using a highly scalable photonic logic gate structure as functional validation device. For the sake of benchmarking a third technological approach based on InP planar photonic crystals is also addressed.

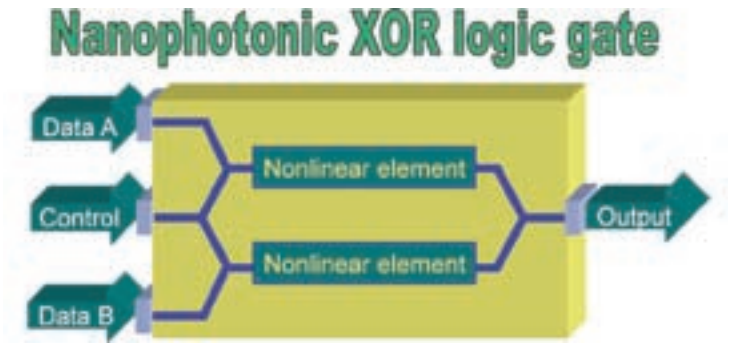
The CdTe and Si-nc materials show excellent nonlinear features and their fabrication processes can be incorporated in an intermediate step within a CMOS processing line. The full optical characterisation of the materials and the optimisation of their fabrication processes will be carried out in the PHOLOGIC project, which will suppose a radical long-term innovation beyond current state-of-the-art and a clear innovation aimed at mastering nanophotonics for low cost.

As a functional validation device an all-optical logic gate using a nonlinear Mach-Zehnder interferometer structure will be implemented offering key features for mass-manufacturing such as a high scalability and flexibility to implement advanced functional devices. Furthermore, periodic photonic structures will be used to exploit the concept of slow waveguiding reducing thus the size and power requirements of the all-optical logic gate.

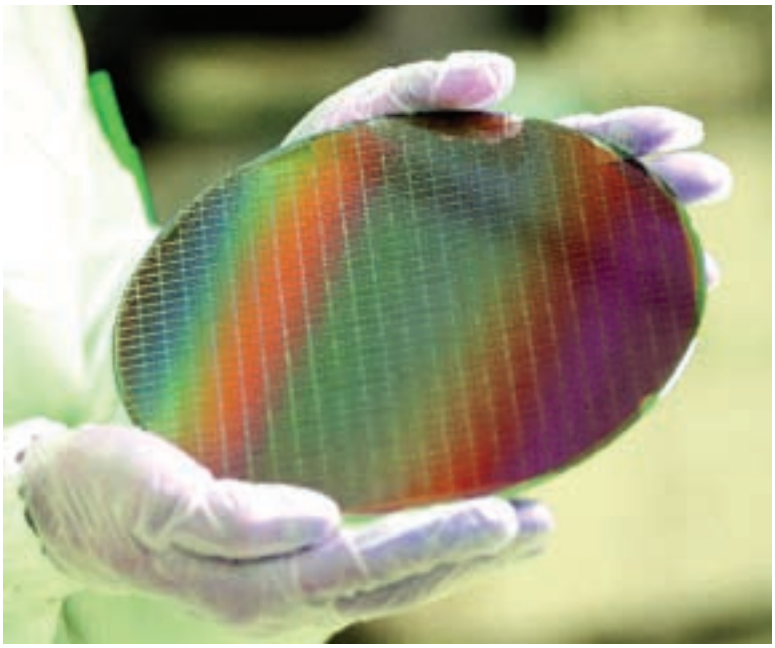
A monolithic all-optical logic gate on InP based on a buried heterostructure integrating photonic crystals will also be produced for the first time in order to improve the degree of integration and to be used as a benchmarking action with respect to the other two technological approaches (CdTe and Si-nc).

The technical assessment of the three proposed technological approaches will be carried out by a Consultation Panel formed by several important companies (Si mass-manufacturers, equipment producers and foundries) that will provide recommendations in terms of mass-manufacturing, reliability and optical performance.

PHOLOGIC



Scheme of the nanophotonic XOR logic gate to be implemented in PHOLOGIC



PHOLOGIC addresses the inclusion of novel non-linear materials in a CMOS line to achieve mass manufacturing

PHOREMOST

Nanophotonics to realize Molecular-Scale Technologies

Project Number: 511616,
Instrument: NoE

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Web site
www.phoremost.org

Timeline
Start Date: 1 Oct. 2004
End Date: 30 Sept. 2008

Budget
Overall Cost: 20.37 million €
Funding: 4.7 million €

Project Partners
- TYNDALL NATIONAL INSTITUTE, UNIVERSITY COLLEGE CORK, IE
- LABORATORIO EUROPEO DI SPETTROSCOPIE NON LINEARI, IT
- FUNDACIO PRIVADA INSTITUT DE CIENCIES FOTONIQUES, ES
- UNIVERSITY OF EXETER, UK
- CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS, ES
- UNIVERSITY OF SOUTHAMPTON, UK
- CENTRO RICERCHE FIAT - SOCIETA CONSORTILE PER AZIONI, IT
- BILKENT UNIVERSITESI, TU
- UNIVERSITE DE DROIT, D'ECONOMIE ET DES SCIENCES D'AIX-MARSEILLE III, FR
- KOC UNIVERSITY, TR
- UNIVERSITA DEGLI STUDI DI ROMA 'LA SAPIENZA', IT
- CNRS, FR
- VILNIAUS PEDAGOGINIS UNIVERSITETAS, LT
- VALTION TEKNILLINEN TUTKIMUSKESKUS, FI
- INSTITUTE OF SOLID STATE PHYSICS OF THE RUSSIAN ACADEMY OF SCIENCES, RU
- UNIVERSITÄT HAMBURG, DE
- A.F.IOFFE PHYSICAL-TECHNICAL INSTITUTE OF RAS, RU
- INSTITUTE OF MOLECULAR AND ATOMIC PHYSICS OF THE NATIONAL ACADEMY OF SCIENCES OF BELARUS, BY
- CHALMERS TEKNISKA HOGSKOLA AB, SE
- THE WEIZMANN INSTITUTE OF SCIENCE, IL
- UNIVERSITE DE MONTPELLIER II, FR
- KUNGLIGA TEKNISKA HOEGSKOLAN, SE
- UNIVERSITAT POLITECNICA DE CATALUNYA, ES
- UNIVERSITAT POLITECNICA DE CATALUNYA, ES
- UNIVERSITY OF OXFORD, UK
- INSTITUTUL NATIONAL DE CERCETARE DEZVOLTARE PENTRU FIZICA LASERILOR, PLASMEI SI RADIATIEI, RO
- UNIVERSITÄT DORTMUND, DE
- ECOLE NORMALE SUPERIEURE CACHAN, FR
- QUEEN'S UNIVERSITY BELFAST, UK
- NANOCOMMS LIMITED, IE
- FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS, GR
- STICHTING VOOR FUNDAMENTEEL ONDERZOEK DER MATERIE, NL
- CORECOM-CONSORZIO RICERCHE ELABORAZIONE COMMUTAZIONE OTTICA MILANO, IT
- BERGISCHE UNIVERSITÄT WUPPERTAL, DE
- TECHNISCHE UNIVERSITÄT DRESDEN, DE

Vision & Aim

It is proposed to establish a Network of Excellence in the area of Nanophotonics and Molecular Photonics to address the near- and long term needs of photonic functional components. PHOREMOST builds on the critical mass existing in Europe in this emerging area, rapidly developing as a result of the concomitant progress in nanostructured materials, nanofabrication technologies, nano-scale characterisation techniques, novel concepts linking electromagnetic radiation in electronic and optical systems, recent concepts involving optical properties of non-periodic, fractal and quasi-crystal structures, as well as a better understanding of non-linear properties of molecules.

The main driving force behind nanophotonics is the expectation to access the molecular scale dispensing with electrical contacts. PHOREMOST will integrate the activities in the nanophotonics area of 34 pioneering and world- leading partners from universities, research centres and industry to:

1) overcome fragmentation;

2) ensure efficient use of resources;

3) identify future R&D opportunities;

4) guarantee the supply of suitably trained personnel;

5) anticipate future research needs;

6) ensure the excellence in research translates into applications in the life sciences, environment, infotainment and security;

7) benefit from the untapped expertise in accession and third countries and;

8) contribute to the public understanding of science.

To achieve its objectives the Network organises its long-lasting impact work, into a synergetic joint programme of activities (JPA) with integrating and spreading excellence activities. Its joint research programme (JRPs) consists of four strands: gaining functionality by incorporating nanostructures in microsystems, fabricating novel nanostructured materials and functionalising them and, finally, applying this new knowledge to photonic device realisations.

The management activities are designed to ensure a smooth and efficient running of the network, to protect the knowledge generated and to monitor the JPA.

PICASSO

Photonic integrated Components applied to secure chaos encoded optical communications systems

Project reference: 034551,
Instrument: STREP

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http://picasso.di.uoa.gr/

Timeline
Start Date: 1 Oct. 2006
End Date: 30 Sept. 2009

Budget
Overall Cost: 3.93 million €
Funding: 2.4 million €

Project Partners
- NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, GR
- FRAUNHOFER GESELLSCHAFT, DE
- UNIVERSITAT DE LES ILLES BALEARS, ES
- UNIVERSITY OF WALES, BANGOR, UK
- UNIVERSITE DE FRANCHE-COMTE, FR
- EBLANA PHOTONICS LTD, IE
- PHOENIX PHOTONICS LTD, UK
- ATTICA TELECOMMUNICATIONS S.A., GR
- UNIVERSITA DEGLI STUDI DI PAVIA, IT

Vision & Aim

The ultimate goal of PICASSO is the development of photonic components and subsystems to build chaos-based optical communication systems. Within the framework of the project, monolithic and hybrid photonic integrated circuits will be designed and developed for the realization of chaotic transmitters and receivers. Extensive security testing, verification and calibration of the chaos encoded communication system will be performed.

Different types of transmitter/receiver pairs will be fabricated and the validity of the security assumptions will be proved experimentally. Fully functional transmitter and receiver modules will be developed at four adjacent wavelengths of the ITU grid (100 GHz spacing) in the C band of the telecommunications window operating at 2.4 and 10 Gb/s. Compatibility with the existing infrastructure will be exhaustively tested and possible interactions between chaos encoded channels and conventional neighboring channels will be investigated.

PI-OXIDE

Photonic integrated devices in activated amorphous and crystalline oxides

Project Number: 017501,
Instrument: STREP

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Web site
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Timeline
Start Date: 1 Sept. 2005
End Date: 31 Aug. 2008

Budget
Overall Cost: 2.85 million €
Funding: 1.85 million €

Project Partners
- UNIVERSITEIT TWENTE, NL
- VACOTEC SA, CH
- PHOENIX BV, NL
- EPFL, CH
- UNIVERSITÄT HAMBURG, DE
- CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS, ES

Vision & Aim

In order to satisfy the future needs in telecommunication applications relevant to the community, e.g. METRO and Access Networks, optical techniques will largely be employed. Since all kinds of passive and active functions might be required within one single photonic chip, concepts that allow for active / passive integration with low technological complexity, maybe even within the same processing step, are highly appreciated.

This project aims at providing a novel technology for telecom applications that combines the advantages of the present technologies on the same chip. It proposes a radically new mass-fabrication technique of high-refractive-index, high-heat-conductivity, amorphous and crystalline *oxide* materials, which includes nano-localized active doping. It investigates a reliable parallel processing technology for high-quality nano-scale structures in these materials in order to produce functional nano-photonic devices based on Bragg gratings, ring resonators, power splitters, amplifiers and lasers for future use in optical access networks. It includes active functionality like light generation and amplification, still missing in today's Si-based technologies.

This project is multidisciplinary, as it integrates the full range from optically active thin-film growth with the aim of mass production, the development of reliable parallel nano-structuring and nano-deposition processes, device fabrication, testing and simulation with the aim of integration of active and passive functionality on the same chip and partly within a single processing step. This project possesses the clear perspective of novel future applications especially in the telecom market. A consortium with 4 academic and 2 industrial partners from 4 European countries, all with extensive experience and international recognition but complementary skills and tasks will realize this project.

PLASMOCOM

Polymer-based Nanoplasmonic components and devices

Project reference: 034551,
Instrument: STREP

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Web site
http://www.plasmocom.org

Timeline
Start Date: 1 Sept. 2006
End Date: 31 Aug. 2009

Budget
Overall Cost: 2.08 million €
Funding: 1.85 million €

Project Partners
- THE QUEEN'S UNIVERSITY OF BELFAST, UK
- LASER ZENTRUM HANNOVER E.V., DE
- AALBORG UNIVERSITET, DK
- UNIVERSITE DE BOURGOGNE, FR
- SILIOS TECHNOLOGIES, FR

Vision & Aim

This project is aimed to develop a novel concept for micro- and nanoscale dynamic and active photonic components based on metal/polymer structures. The innovation lies in utilizing unique properties of metallic systems that allow optical and electric signals to be transmitted along the same metallic circuitry. This approach will provide a route to novel integrated micro-optical devices and components combining photonics and electronics on the same chip. The target is to establish a new technological platform and create the technology for the integratable nanophotonic components with enhanced functionality for optical signal processing, on-electronic-chip optical interconnects and optical broadband applications.

We plan to achieve this on a single material system using polymer-based guides on a metal surface to confine and manipulate surface plasmon waves on a subwavelength scale. The passive, dynamic and active photonic devices will be fabricated and their performance characterized and tested. Examples of electrically controlled nanophotonic devices (wavelength selective components, integrated power monitors and variable optical attenuators) will be demonstrated. The proposed technology has a unique potential using its intrinsic capability of carrying an optical information as well as control electronic and/or optical signals in the same circuitry without a need of separate electronic and optical circuits.

PLASMOCOM will create new critical knowledge on fabrication and performance of dynamic and active nanophotonic devices, demonstrate new devices with enhanced parameters (low fabrication cost, smaller size, enhanced dynamic and active functionality with lower electric consumption power and low intensity of control light, convergence of electronic and photonic circuitry), and will contribute to Europe's competitiveness and leadership in miniaturization of photonic components and integrated photonic circuits in order to establish it as a world market leader.

PLEAS

Plasmon enhanced photonics

Project reference: 034506,
Instrument: STREP

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Web site
http://www.eu-pleas.org/

Timeline
Start Date: 1 Sept. 2006
End Date: 31 Aug. 2009

Budget
Overall Cost: million €
Funding: 2.8 million €

Project Partners
- CENTRE SUISSE D'ELECTRONIQUE ET DE MICROTECHNIQUE SA, CH
- UNIVERSIDAD AUTONOMA DE MADRID, ES
- UNIVERSIDAD DE ZARAGOZA, ES
- OSRAM OPTO SEMICONDUCTORS GMBH, DE
- THE QUEEN'S UNIVERSITY OF BELFAST, UK
- TECHNISCHE UNIVERSITÄT DRESDEN, DE
- UNIVERSITE LOUIS PASTEUR STRASBOURG I, FR
- SAGEM DEFENSE SECURITE, FR

Vision & Aim

All photonic components need metallic or partly conductive contacts, which inherently give rise to plasmon effects when light is involved. Although such effects have often been regarded as unwanted by causing electronic damping effects and radiation losses, recent research efforts in this field have shown that by clever engineering and by understanding the physical sources for such losses, plasmonic effects have the potential to enhance photonic components. There is wealth of new plasmonic phenomena, such as enhanced transmission, optical field enhancement, and sub-wavelength focusing that has been pioneered by the European research community. This paves the way for a new generation of photonic components, such as light emitting diodes (LEDs) and photodetectors, where their performance, (e.g. external quantum efficiency, speed, and noise) is enhanced through plasmon effects.

The proposed project aims to prove the concept of plasmon enhanced photonic devices for industrial applications related to emission/ detection.

This goal can be translated into 3 distinct levels of objectives, ranging from:

- Exploratory plasmon research aimed at concepts and phenomena that can be exploited in the targeted applications.
- Investigation of specific plasmon enhanced structures for emitters and detectors, along with an investigation of the technologies to implement them.
- Achieve a proof of concept of plasmon enhanced photonics devices in 2 applications:
- Inorganic LEDs: enhancing electrical to optical energy conversion.
- Silicon photodetectors: Improving signal-to-noise ratio and increasing speed.

The project involves 6 major actors from theoretical and experimental research, as well as 2 large industrials, leaders in solid state lighting and photodetection.

POLYCOM

Plastic optical fibres with embedded active polymers for data communications

Project reference: 026365,
Instrument: STREP

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Timeline
Start Date: 1 Mai 2006
End Date: 30 April 2009

Budget
Overall Cost: 2.29 million €
Funding: 1.55 million €

Project Partners
- LUCEAT S.P.A., IT
- TECHNISCHE FACHHOCHSCHULE WILDAU, DE
- IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE, UK
- THE UNIVERSITY OF SHEFFIELD, UK
- INSTITUTO SUPERIOR TECNICO, PT

Vision & Aim

This project addresses the development of low-loss polymer optical fibres and wave-guides with integrated gain and ultra-fast optical switching functionalities. Such a class of all plastic media would allow high speed signal processing, one of the most important requirements in local area data communication systems. It would also result in higher functionality components and systems for data handling applications in new sectors, including the increasingly important automotive communication systems market (growing at 40% per annum).

The novel approach that we propose consists of doping passive host polymers with isolated chains of photoactive conjugated polymers. We have recently shown that this approach can simultaneously enhance the magnitude and spectral coverage of the optical gain (compared to that of the undiluted conjugated polymer) and also provide a new ultra-fast switching mechanism, which derives from the one-dimensional dynamics of isolated chains. We propose a multi-disciplinary strategy in order to optimise this approach and explore its suitability for incorporation into a polymer optical fibre (POF) environment.

We will prepare new materials, optimise the blending process to achieve active polymer chain isolation (including the use of copolymerisation), investigate, in detail, the photonic properties of these doped systems and develop prototype fibre and device structures. We have recently demonstrated that we can exploit the peculiar one dimensional recombination dynamics of the charge carriers in isolated conjugated polymer chains, to yield a gain switching off-on ratio of up to 100GHz in thin film geometries. Accordingly, we intend to pursuit the same objectives in light guiding systems in order to achieve switching of the signal directly inside the propagation media, avoiding the use of multi-component architectures that usually lead to reduced communication speed and coupling losses.

STABILIGHT

Novel Inorganic Nanostructured Materials with Enhanced Photoemission Activity

Project Number: 017328,
Instrument: STREP

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Timeline
Start Date: 1 Sept. 2005
End Date: 31 Aug. 2008

Budget
Overall Cost: 3.09 million €
Funding: 2.33 million €

Project Partners
- AMEPOX Sp. z o.o, PL
- NANOLYTICS GmbH, DE
- CENTRO RICERCHE FIAT, IT
- UNIVERSITY OF CAMBRIDGE, UK
- TECHNISCHE UNIVERSITÄT DRESDEN, DE
- UNIVERSITY COLLEGE CORK – TYNDALL, IE

Vision & Aim

The aim of STABILIGHT is the design and demonstration of novel nano-photonic devices based on all inorganic nanostructured materials operating at low DC voltage with enhanced photoemission activity and thermal stability to be used both in passive and active (transistor) light emitting devices.

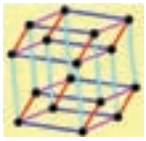
Materials and technologies involved are addressed to large consumer markets such as automotive, information displays and lighting. Specifically advanced mesoporous films and new photonic nanostructures will be demonstrated along with their application to automotive display and info panel devices.

The light emitting device developed in STABILIGHT will be characterized by an all inorganic active layer and electrodes on the same plane. The light is emitted on both sides. This device is designed to overcome the current limitations of OLED technology for automotive applications (low life-time at 80°C, very high investments, high cost because of the materials needed and relatively low yield because of the production complexity).

The active layer is characterized by a host conducting porous matrix with a network of well organized nanocavities in which are embedded luminescent semiconductor nanocrystals. The nanosized ordered cavities in the form of a mesoporous film will be grown on substrates, which can be either thin glass or nanocomposite polymeric materials with tuned bulk and surface properties with the addition of inorganic fillers (e.g. layered silicates). The porosity of the film will be tuned so as to trade off high light efficiency against reduced complexity of the device. The development of novel inorganic nanostructured materials having superior quality, reliability, sustainability and cost-effectiveness will allow an optimal incorporation into new nano-photonic devices. The proposed products and technological solutions are alternative to displays based on both organic and inorganic LEDs, which are mostly developed outside Europe.

SYNQPSK

Components for synchronous optical quadrature phase shift keying transmission



Project Number: 004631,
Instrument: STREP

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Timeline
Start Date: 1 July 2004
End Date: 31 Dec. 2007

Budget
Overall Cost: 2.37 million €
Funding: 1.7 million €

Project Partners
- CELIGHT ISRAEL LTD., IL
- PHOTLINE TECHNOLOGIES S.A., FR
- UNIVERSITÄT DUISBURG-ESSEN - STANDORT DUISBURG, DE

Vision & Aim

Synchronous quadrature phase shift keying (QPSK) transmission combined with return-to-zero (RZ) coding and polarization division multiplex is an extremely attractive modulation format for metropolitan area and long haul fiber communication. Compared to standard intensity modulation the line rate is 4 times lower, the needed number of photons per bit less than half as high, the tolerance to chromatic dispersion about 8 times better, the tolerance to polarization mode dispersion about 3 times better, and the tolerance against fiber nonlinearities, in particular cross phase modulation, is excellent. Moreover, all linear optical distortions (polarization transformations, polarization mode dispersion, chromatic dispersion) can be equalized without losses in the electrical domain. Distinct advantages exist also over all other modulation formats, including duobinary, DPSK and DQPSK.

So far, synchronous QPSK has not been realized because the necessary components were not available, for example lasers with line widths in the lower kHz region. For the implementation of synchronous RZ-QPSK transmission with polarization division multiplex this project aims at the realization of all necessary components which can not be found on the market: $LiNbO_3$ QPSK modulators in the transmitter, $LiNbO_3$ optical 90° hybrids, InP balanced photoreceivers - reliably co-packaged with the 90° hybrids - and SiGe/CMOS integrated electronic circuits for signal conditioning in the receiver. Standard distributed-feedback (DFB) lasers are tolerable for signal and local oscillator lasers due to a novel carrier recovery concept that requires no phase-locked loop. It is implemented in the receiver by analog-to-digital conversion and subsequent CMOS signal processing. The symbol rate is 10 Gsymbols/s, which amounts to 40 Gbit/s, plus FEC overhead. All components and contributions shall be validated in a synchronous QPSK polarization division multiplex transmission testbed.

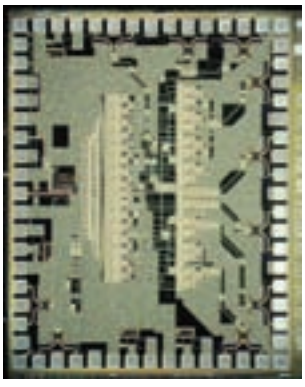

Fig. 1: Microphotograph of our ADC chip in SiGe technology.

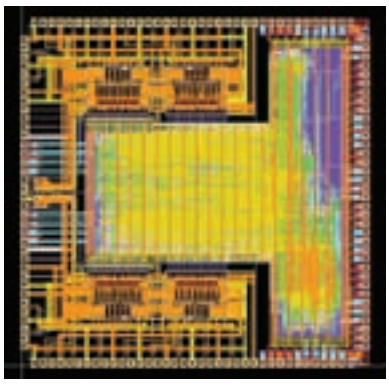

Fig. 2: Layout of Demux and DSP CMOS chip.

TERANOVA

Novel Terahertz Sensing and Imaging Systems for Biotechnology, Healthcare, Security and Process Monitoring

Project Number: 511415,
Instrument: IP

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Web site
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Timeline
Start Date: 1 Sept. 2004
End Date: 31 Aug. 2008

Budget
Overall Cost: 6.02 million €
Funding: 5.0 million €

Project Partners
- UNIVERSITY OF LEEDS, UK
- UNIVERSITY OF DURHAM, UK
- RHEINISCH WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN, DE
- ALPES LASERS, CH
- BAe SYSTEMS (OPERATIONS) LTD, UK
- TECHNICAL UNIVERSITY OF DELFT, NL
- EVOTEC TECHNOLOGIES GmbH, DE
- FEMTOLASERS PRODUKTIONS GmbH, AT
- UNIVERSITY OF NEUCHÂTEL, CH
- UNIVERSITÉ PARIS VII DENIS DIDEROT, FR
- SCUOLA NORMALE SUPERIORE, IT
- RENISHAW PLC, UK
- TERAVIEW LIMITED, UK
- THALES, FR
- TECHNISCHE UNIVERSITÄT WIEN, AT
- ALCATEL THALES III-V LAB, FR
- UNIVERSITÄT SIEGEN, DE
- DANMARKS TEKNISKE UNIVERSITET, DK

Vision & Aim

TeraNova will realise new functional components and systems for the unexploited Terahertz region of the electromagnetic spectrum lying between the millimetre wave and infrared, and in doing so, will deliver substantial benefits to the lives of its citizens. Advanced solid-state sources will be developed, including Quantum Cascade lasers and broadband sources, and sensitive detectors. These low-cost, compact, functional components will be used in sensing and imaging systems to solve specific problems identified in European biotechnology, security, healthcare, and high technology industries. By exploiting new opportunities and responding to emerging needs, we will address research challenges for 2010 and beyond in:

- Healthcare and Life Science: developing highly sensitive genetic mutation sensors, and a microscope to probestructure and function of living cells in a revolutionary way;
- Environment and Security: developing sensing systems for explosives, drugs and harmful chemicals;
- Industrial Processes: developing technologies to assess semiconductor wafers as they are manufactured.

TeraNova will strengthen the European Research Area, ensure wealth-creation via comprehensive Exploitation and Dissemination, and engage in programmes to stimulate new developments and train the future workforce.

TeraNova will integrate European capabilities, taking concepts through to Community End Users from industry, healthcare, security agencies and academia. Research and development will involve large-scale Industry, SMEs and Academics, reinforcing European strengths where it has established industrial and technology leadership. TeraNova will be organised thematically, will be governed democratically, and will have an eminent industrialist as Chair providing end-user pull.

URANUS

Ultrafast Technology for Multicolor Compact High-Power Fibre Systems

Project Number: 511406,
Instrument: STREP

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Timeline
Start Date: 1 July 2004
End Date: 30 June 2007

Budget
Overall Cost: 2.24 million €
Funding: 1.41 million €

Project Partners
- INESC PORTO, PT
- NKT RESEARCH AND INNOVATION A/S, DK
- FIANIUM-NEWOPTICS LTD, UK
- STRATOPHASE LTD, UK
- CORELASE OY, FI

Vision & Aim

Ultra-fast, high-power lasers, generating pulses of sub-picosecond durations (<10^{-12} seconds), are becoming increasingly important in application areas ranging from micro-machining to non-intrusive surgery, bio-detection and Homeland Security.

Until now, the required high-power ultrafast radiation could only be provided by bulk, solid-state lasers, which have the undesirable features of high cost, large size and poor reliability.

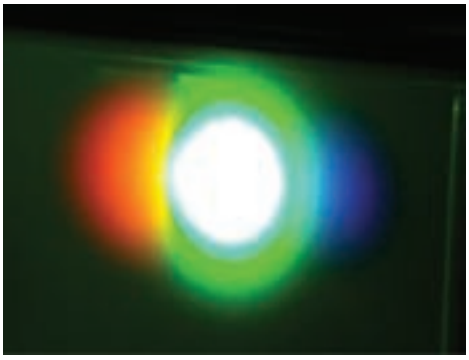
New laser sources, with improved reliability, reduced cost and reduced size will further expand the market potential for high-energy pulsed optical systems. Short-pulse fibre lasers are compact, and cost-effective, offering size and cost-reductions of up to 10 times compared to equivalent bulk-laser systems.

Tampere University of Technology (TTY) - the coordinating organization - has already demonstrated ultrashort pulse fibre lasers operating at 1.5-μm and unique picosecond system operating in the 980-1100 nm wavelength range. These systems represent a consistent starting point for the experiments in URANUS.

The complimentary expertise of URANUS partners (Fianium-NewOptics in ultrafast high-power fibre lasers, Stratophase in nonlinear frequency converters, NKT in photonic crystal fibres, INESC PORTO in fibre Bragg grating technology and CoreLase in high-power fibre systems) ensures a high likelihood of achieving technological break-throughs by expanding the power, operating wavelength, and pulse-width limits of cost-effective ultrafast fibre systems.

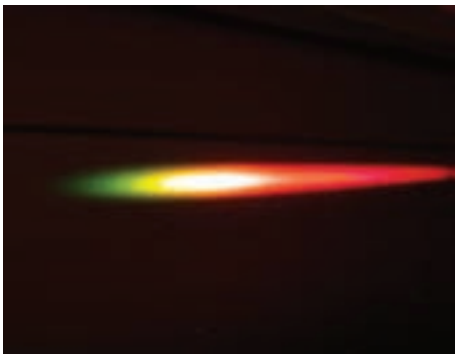
The proposed fibre systems combine a unique blend of state of the art semiconductor and micro-optics technology, advanced amplifier and photonic crystal fibres, fibre components and nonlinear materials and applications. These systems will thus be capable of providing higher average powers and comparable pulse energies and peak powers to existing solid-state laser systems but at a fraction of the cost and in a compact, robust form.

URANUS

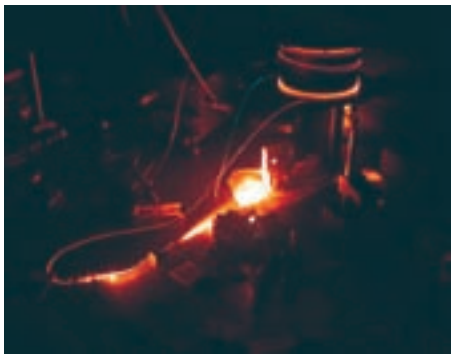


Broadband visible radiation obtained from a frequency doubled Yb fiber laser

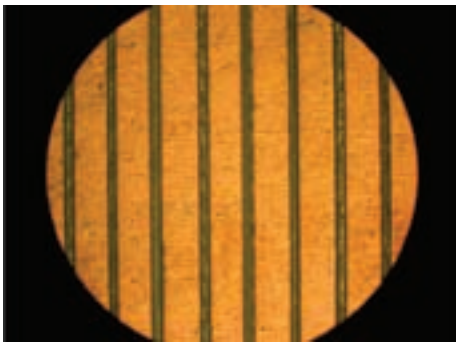
Frequency doubled Yb fiber laser



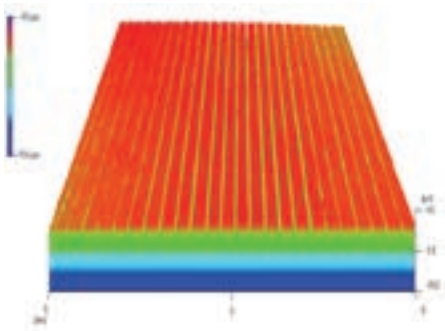
Broadband supercontinuum radiation obtained from an Yb fiber laser



Supercontinuum generator setup



Metallic film on polymer patterned with ultrashort fiber laser



Micropatterned metallic film on polymer seen by a laser profilometer

UROOF

Photonic components for ultra wideband Radio over optical fiber

Project reference: 033615
Instrument: STREP

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Timeline
Start Date: 1 July 2006
End Date: 31 Dec. 2008

Budget
Overall Cost: 3.68 million €
Funding: 2.20 million €

Project Partners
- HOLON ACADEMIC INSTITUTE OF TECHNOLOGY (HAIT), IL
- WISAIR LTD, IL
- THALES COMMUNICATIONS S.A., FR
- TES ELECTRONIC ENGINEERING GMBH, DE
- UNIVERSITY OF ESSEX, UK
- UNIVERSIDAD POLITECNICA DE VALENCIA, ES
- INESC PORTO, PT
- CENTRE FOR INTEGRATED PHOTONICS, UK
- INSTITUT NATIONAL POLYTECHNIQUE DE GRENOBLE, FR

Vision & Aim

The key goal for UROOF is to investigate building blocks for enabling the delivery of Ultra-wideband (UWB) radio signal over low-cost optical fiber. The aims are therefore to study, develop, test and implement very low cost conversion solutions for direct optical-to-UWB (O/UWB) and UWB-to-optical (UWB/O) based on innovative microwave photonic concepts. Unlike state of the art radio-over-fiber (RoF) technologies that are used in the backbone of the wireless access systems, UROOF will address the challenges of the low-cost wireless personal area networks (WPAN).

UROOF will study several approaches including: developing proof of concepts for O/UWB and UWB/O converters based on innovative optically controlled microwave converter (OCMC). A further study will address enhanced electroabsorption transceiver (EAT) to UWB applications. These converters will be integrated with the UWB radio frequency (RF) front-end and comprise the very low-cost access node for UROOF applications. Several UROOF applications will be investigated in the field trial: (i) range extension of WPAN over 1000m carrying real-world UWB signal with 480 Mb/s data rates and, (ii) very low-cost antenna distribution system (VL-DAS) for multicell WPAN applications.

We will provide detailed theoretical and practical analysis related to the design, performance, manufacturing and implementation of UROOF novel modules including: performance analysis of the different modulation schemes in UWB to determine the optimum RoF distribution configuration, evaluation of the impact of electro-optical device non-linearities (pulse chirp / chromatic dispersion) on the UROOF distribution network, device suitability studies for multiple-access architecture VL-DAS, uncooled VCSEL-based design and optical-UWB link analysis.

The UROOF partners form a highly balanced and complementary consortium, which has vast experience in the conception, design and manufacturing in both photonic components for RoF and UWB radio domains.

VERTIGO

Versatile two micron light source

Project reference: 034692,
Instrument: STREP

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http://www.2micron-laser.eu

Timeline
Start Date: 1 June 2006
End Date: 31 May 2009

Budget
Overall Cost: 3.22 million €
Funding: 1.90 million €

Project Partners
- FRAUNHOFER GESELLSCHAFT, DE
- ALCATEL THALES III-V LAB, FR
- UNIVERSITY OF STRATHCLYDE, UK
- INSTYTUT TECHNOLOGII ELEKTRONOWEJ, PL
- CABLEFREE SOLUTIONS LIMITED, UK
- LISA LASER PRODUCTS OHG, DE

Vision & Aim

The VERTIGO project is focused on the development of compact, high performance Optically-Pumped Semiconductor Disk Lasers (OPSDLs) emitting in the 2.0-2.5µm wavelength regime.

The OPSDL concept combines the high efficiency and wavelength versatility of more traditional semiconductor lasers, but introduces the circular, high quality beam and resonator versatility more associated with solid-state lasers. In this project, the (AlGaIn)(AsSb) material system will be exploited to access the 2.0-2.5µm regime with a view to satisfy the demand of high performance lasers in this range.

The project combines the design and development of the laser sources with the necessary steps for specific applications implementation and eventual exploitation. The multi-partner consortium, comprising of two non-university government funded research institutes, one university research group, one industrial research laboratory, and two SMEs, has been carefully selected to accommodate all aspects of device development and its potential route to market.

We believe that these novel laser sources represent a new and versatile photonic component, suitable to serve a variety of needs expressed in the IST call. The most notable impact areas of VERTIGO technology will be in:

1) Communication: e.g. high speed, free space optical communications.

2) Environment: e.g. highly sensitive gas detection and monitoring of enviro-chemical compounds, and precise data collation for global climatic modeling, and natural disaster prediction.

3) Security: e.g. sensitive chemical and explosives sensing as homeland security measures and, stand-off turbulence detection in aviation.

4) Healthcare: e.g. sensitive non-invasive, diagnostic devices and high-throughput medical screening technologies.

The key to the success of the VERTIGO development will be to address both, the flexible, high performance nature of these novel laser sources, but also, the important issues of standardization and cost effectiveness.

VILLAGE

Versatile infrared laser source for low cost Analysis of Gas Emissions

Project reference: 034010,
Instrument: STREP

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Web site
http://www.neo.no/village/

Timeline
Start Date: 1 July 2006
End Date: 30 June 2009

Budget
Overall Cost: 2.4 million €
Funding: 1.8 million €

Project Partners
- THALES, FR
- NORSK ELEKTRO OPTIKK AS, NO
- HEINRICH-HEINE-UNIVERSITÄT DÜSSELDORF, DE
- UNIVERSITY OF SOUTHAMPTON, UK
- UNIVERSIDAD DE VALLADOLID, ES

Vision & Aim

According to recent reports, the worldwide market for spectroscopy instrumentation is expected to witness a dramatic growth during the next years, with the largest share exploiting the infrared part of the spectrum. Today, expensive high-end systems such as Fourier-Transform Infrared spectrometers still dominate this market segment. Yet, widespread greener and safer industrial processes are driving the need for more versatile or sensitive gas analyzers. Thanks to very strong and well-separated absorption peaks for most relevant species, such a prospect can be offered by direct high-resolution mid-infrared (MIR) absorption spectroscopy.

The main technical and scientific objective of VILLAGE is the development of a cost-effective widely tunable MIR laser source of high spectral purity. It will form the basis for a new generation of multi-gas analysers based on spectroscopic techniques for measurements of polluting gases generated by and emitted from industrial processes, and more specifically the gases believed to contribute to global warming.

Built on several proven trends in the field of emerging photonic components in which the partners have leading positions, this source will combine in a robust design a Thulium-doped fiber laser device including a widely tunable Bragg grating stage, a nonlinear frequency converting semiconductor crystal (Orientation-Patterned Gallium Arsenide) and a high spectral purity optical parametric oscillator (OPO) cavity.

This new OPO will be integrated into a transportable spectroscopic instrument for analysis of polluting gases and demonstration through practical tests that the system is capable of measuring the target gases at specified concentration levels (both laboratory and onsite-based). In the long term, the availability of this source is bound to also be beneficial to several growing instrumentation markets for health, security and food-related applications and the project outputs will be promoted accordingly.

WAPITI

Waferbonding and Active Passive Integration Technology and Implementation

Project Number: 004073,
Instrument: STREP

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Timeline
Start Date: 1 June 2004
End Date: 31 May 2007

Budget
Overall Cost: 2.11 million €
Funding: 1.52 million €

Project Partners
- UNIVERSITY OF CAMBRIDGE, ENGINEERING DEPARTMENT, UK
- NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, GR
- MAX PLANCK INSTITUTE OF MICROSTRUCTURE PHYSICS, DE
- INSTITUTUL NATIONAL DE CERCETARE DEZVOLTARE PENTRU MICROTEHNOLOGIE, RO
- E V GROUP E. THALLNER GMBH, AT

Vision & Aim

WAPITI`s vision is the development/realisation settlement of a novel technology and its implementation in a new mesoscopic device generation that will enable crucial miniaturisation and cost reduction. WAPITI has identified waferbonding as the ideal/appropriate technology for the realisation of optical microcircuits integrating passive photonic / active opto-electronical and active photonic driven building blocks for novel functionalities and microsystems.

WAPITI will demonstrate the potential and versatility of the technology in microring resonator building blocks in InGaAsP/InP bonded on GaAs wafers by realising ultra compact devices for MAN data rates: mainly compact bus integrated microring WDM-lasers (1) and high efficiency all-optical wavelength converters (2).

1) WDM lasers multiplexed in single mode waveguide technology (transparent bus waveguides) are a key building block for SDH/SONET and 2.5/10 GbE applications in the high volume MAN market. Attention will mainly be focussed on obtaining a small die footprint as this is the most crucial cost driving factor.

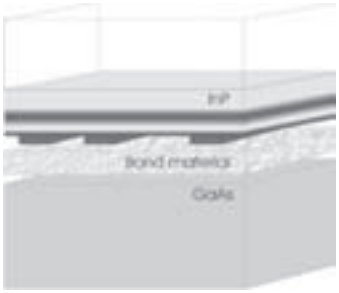

Fig. 1: Principle device set-up

2) All-optical wavelength converters are key components in future versatile optical networks. WAPITI particularly aims to realise efficient wavelength converters based on novel passive bus/active microring architectures. Furthermore, WAPITI will investigate, theoretically and experimentally, the possibility of realizing advanced functionalities (e.g. chromatic dispersion compensators, all-optical logic, optical mm wave generation) using the integrated microring structures.

Meanwhile WAPITI started with the focus on communication applications it became evident that the high potential for use in bio- /and chemo-sensing and rotation sensor applications is becoming more and more important exploiting e.g. high resolution measurements of refractive index changes.

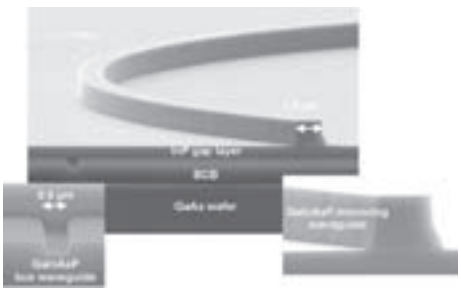

Fig. 2: Example of a fabricated passive microtring test device

WIDGAP

Wide Bandgap Semiconductors

Project Number: 015821,
Instrument: SSA

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Web site
http://www.widgap.org/

Timeline
Start Date: 16 March 2005
End Date: 15 Nov. 2006

Budget
Overall Cost: 230 000 €
Funding: 230 000 €

Project Partners
- FRAUNHOFER GESELLSCHAFT, DE
- LINKOEPINGS UNIVERSITET, SE
- CNRS, FR

Vision & Aim

Widgap will give industry, research and policymakers in Europe the tools (database, roadmap, benchmark) needed for planning a common European strategy in wide bandgap (WBG) semiconductors. WBG semiconductors can dramatically improve the energy consumption and hardware reliability of most electronic and electric devices. Their applications include high temperature electronics, solid state lighting, high power components.

Widgap is a short project that will provide a:

- database of R&D projects in Europe;
- roadmap for GaN and SiC wafers, high brightness LEDs suitable for general lighting, UV sensors, GaN and SiC transistors;
- benchmarking of Europe compared to the US and Japan;
- two workshops to present the results of the project.

The research in wide bandgap (WBG) semiconductors in Europe is currently going strong but remains extremely fragmented. Separate industrial and R&D chains exist in Germany, France, Sweden and Poland, not to mention the efforts of other countries. Although the entities know each other, no European initiative is giving coherence to the R&D. This stands in strong contrast to the US, whose concentrated efforts have led to the emergence of major commercial and academic players.

The roadmaps and benchmark will:

- accelerate the development of components based on SiC and GaN by providing a common reference point to companies throughout the supply chain;
- support policymakers in making decisions about possible research projects;
- provide the European industry with a competitive edge over the American and Japanese streamline;
- clarify potential synergies between European R&D institutions.

WISDOM

Wirespeed security domains using optical monitoring

Project reference: 033847,
Instrument: STREP

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http://www.ist-wisdom.org

Timeline
Start Date: 1 June 2006
End Date: 31 May 2009

Budget
Overall Cost: 1.91 million €
Funding: 1.14 million €

Project Partners
- CENTRE FOR INTEGRATED PHOTONICS, UK
- BRITISH TELECOMMUNICATIONS PLC, UK
- UNIVERSITY COLLEGE CORK - TYNDALL IE
- AVANEX FRANCE SA, FR
- FOUNDATION FOR RESEARCH AND TECHNOLOGY – HELLAS, GR

Vision & Aim

WISDOM is designed to develop advanced optical components necessary for photonic firewalls. This will require the development of novel optical processing modules which will be placed at the front end of the node firewall to provide the primary optical information filtering - operating at wirespeed (40 Gbit/s per channel) - which includes operations such as optical packet recognition, interrogation and manipulating data streams incorporating features of parity checking, flag status, and header recognition.

Secondary processing would then be done electronically as is currently the case, but with the benefit of a reduction in the electronic processing capacity required.

These photonic firewalls will operate using novel algorithms and protocols, to extract and process wirespeed security information in high capacity multichannel (Tb/s) networks. The algorithms will combine the functionality of optical processing with secondary electronic security approaches to introduce new layers of security analysis.

WWW.BRIGHT.EU

Wide wavelength light sources for public welfare: high BRIGHTness laser diodes for telecom, medical and environmental use

Project Number: 511722,
Instrument: IP

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http://www.bright-eu.org/bright-eu/index.htm

Timeline
Start Date: 1 July 2004
End Date: 30 Sept. 2006

Budget
Overall Cost: 6.74 million €
Funding: 4 million €

Project Partners
- THALES, FR
- ALCATEL CIT, FR
- BIOLITEC AG, DE
- OSRAM OPTO SEMICONDUCTORS GMBH and CO. OHG, DE
- THALES LASER DIODES SA, FR
- UNIVERSITY OF CAMBRIDGE, UK
- FERDINAND-BRAUN-INSTITUT IM FORSCHUNGSVERBUND BERLIN E.V., DE
- FISBA OPTIK AG, CH
- FRAUNHOFER GESELLSCHAFT, DE
- CENTRUM BADAN WYSOKOCIENIENIOWYCH POLSKIEJ AKADEMII NAUK, PL
- INSTITUT NATIONAL D'OPTIQUE, CA
- RISOE NATIONAL LABORATORY, DK
- LUNDS UNIVERSITET, SE
- CNRS, FR
- RAINBOW PHOTONICS AG, UK
- THE UNIVERSITY OF NOTTINGHAM, UK
- UNIVERSIDAD POLITECNICA DE MADRID, ES
- BAYERISCHE JULIUS-MAXIMILIANS UNIVERSITÄT WUERZBURG, DE
- FORSCHUNGSVERBUND BERLIN E.V., DE
- UNIVERSITY COLLEGE CORK - TYNDALL, IE
- INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS, GR

Vision & Aim

High brightness laser diode technology is a key enabling technology for the information society of tomorrow, especially in the fields of healthcare, telecommunication, environment, and security.

The development and achievements of the information society relies on a smart use of the information for applications such as imagery or telecommunications.

The electron and the photon are the two main information carriers, the latter having taken an increased role since the end of the seventies, when engineers demonstrated the efficiency of optical fibre transmission.

Since then, the demand for high brightness sources has increased continuously. Laser diodes already offer extraordinary compactness at a reasonable cost and now play a central role in telecommunications. However, their brightness still needs to be improved to spread their large-scale uptake across the Information Society; the main challenge is to couple more light power in smaller diameter fibres.

The WWW.BRIGHT.EU consortium proposes a long-term vision aiming at pushing the limits of the current laser diode technology towards higher brightness, and at demonstrating applications such as:

- Medical imagery for cancer therapy
- Amplifiers for telecommunication networks

The approach consists of mobilising the expertise of the main European actors of the laser diode core technology, and coupling it with highly innovative optical technologies e.g. smart cavity concepts for higher efficiency and tuneability. Industrialisation constraints will be widely addressed through packaging and reliability studies.

This project is intended to be the first phase of 24 months a more long-term and ambitious project; this first phase will allow on one hand the full assessment of a few targeted applications corresponding to strong market needs such as photodynamic therapy, on the other hand the development of core technologies for which the applications would be fully assessed in the second phase.

WWW.BRIGHTER.EU

World Wide Welfare: high BRIGHTnes semiconducter lasERs for gEneric Use

Project reference: 035266,
Instrument: IP

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Web site
http://www.ist-brighter.eu/

Timeline
Start Date: 1 Oct. 2006
End Date: 30 Sept. 2009

Budget
Overall Cost: 16.26 million €
Funding: 9.7 million €

Project Partners
- ALCATEL THALES III-V LAB, FR
- BIOLITEC AG, DE
- LUNDS UNIVERSITET, SE
- INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS, GR
- FORSKNINGSCENTER RISOE, DK
- OSRAM OPTO SEMICONDUCTORS GMBH, DE
- UNIVERSITY OF CAMBRIDGE, UK
- KEOPSYS SA, FR
- ALCATEL CIT, FR
- INSTITUT NATIONAL D'OPTIQUE - NATIONAL OPTICS INSTITUTE, CA
- BAYERISCHE JULIUS-MAXIMILIANS UNIVERSITÄT WUERZBURG, DE
- FISBA OPTIK AG, CH
- RAINBOW PHOTONICS AG, CH
- THALES SA, FR
- UNIVERSIDAD POLITECNICA DE MADRID, ES
- FORSCHUNGSVERBUND BERLIN E.V. - FBH, DE
- FRAUNHOFER GESELLSCHAFT, DE
- INSTYTUT WYSOKICH CISNIEN PAN (UNIPRESS), PL
- UNIVERSITÄT KASSEL, DE
- CNRS, FR
- FORSCHUNGSVERBUND BERLIN E.V. - MBI
- UNIVERSITY COLLEGE CORK - TYNDALL, IE
- THE UNIVERSITY OF NOTTINGHAM, UK

Vision & Aim

High brightness laser diode technology is a key enabling technology for the modern information society, especially in the fields of healthcare, telecommunications, infotainment, environment, and security.

Laser diodes offer high output power, compactness, robustness, and mass production capabilities. However their use in the above mentioned domains is often limited by the difficulty to reach satisfactory performances on power and beam quality simultaneously. The term 'high brightness' sources indicates exactly the capability of a high power laser diode to provide high beam quality.

The brightness governs directly the performance of systems, such as the transmission span of an optical data link, the reliability of a diagnosis in fluorescence imaging of cancer, or the resolution of a laser projection display. Therefore, the need for high brightness laser diodes in these applications is currently strongly increasing.

The WWW.BRIGHTER.EU consortium proposes a long-term vision aiming at pushing the limits of the current laser diode technology towards higher brightness, and at demonstrating applications such as:

- Laser sources for medical imagery for cancer diagnosis and intelligent therapy;
- Optical amplifiers for telecommunication networks;
- Compact source for projection display.

The approach consists of mobilising the expertise of the core European players of the laser diode technology, and combining it with original optical technologies e.g. smart cavity concepts for higher efficiency and tunability. Leading European research centres and manufacturers participate in order to deploy the developed technology in new applications. Industrialisation constraints will be widely addressed through packaging and reliability studies. The consortium includes major companies and SMEs that will exploit the developed technology commercially. WWW.BRIGHTER.EU therefore increases and strengthens existing European momentum within the laser diode industry and the Information Society.

ZODIAC

Zero Order Dimension based Industrial components Applied to teleCommunications

Project Number: 017140,
Instrument: IP

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http://zodiac.if.pwr.wroc.pl/zodiac_new/

Timeline
Start Date: 1 May 2005
End Date: 30 April 2008

Budget
Overall Cost: 8.78 million €
Funding: 4.99 million €

Project Partners
- POLITECHNIKA WROCLAWSKA, PL
- NL NANOSEMICONDUCTOR GMBH, DE
- EPFL, CH
- BOOKHAM TECHNOLOGY PLC, UK
- BAYERISCHE JULIUS-MAXIMILIANS UNIVERSITÄT WUERZBURG, DE
- NANOPLUS NANOSYSTEMS AND TECHNOLOGIES GMBH, DE
- CNRS, FR
- INSTITUTION FOR RESEARCH AND EDUCATION SAINT-PETERSBURG PHYSICO-TECHNICAL CENTRE FOR RESEARCH AND EDUCATION OF THE RUSSIAN ACADEMY OF SCIENCES, RU
- UNIVERSITY COLLEGE CORK - TYNDALL, IE

Vision & Aim

Self assembled semiconductor quantum dots (QDs) constitute a class of nanoscale materials which provide fundamental advantages compared to the currently dominating 2D quantum wells: first, the zero dimensional dots suppresses temperature effects on laser threshold and efficiency and results also in a strongly reduced back reflection sensitivity. Secondly, QDs provide new degrees of freedom regarding the monolithic combination of materials. Both features are expected to allow the fabrication of compact, colourless and isolator free telecom laser modules, providing important cost advantages in a highly competitive international market.

The 8 partners of the consortium include leading European semiconductor laser manufacturers and system providers which team up with expert SMEs and academic institutions in an integrated effort to push quantum dot materials at a manufacturable level.

Although some promising features of QD lasers have already been demonstrated, there are several important material challenges to be resolved including

- realization of device grade QDs on InP;
- nanoengineering InGaAs QD properties on GaAs and InP specifically for high speed directly modulated lasers, widely tuneable lasers and semiconductor amplifiers, with specifications clearly exceeding currently available QW based devices performance;
- realization of device grade 1.55 µm emitting QDs on GaAs;
- development of injection structures for 40 Gbit/s directly modulated QD lasers;
- exploration of new QD based concepts, based on e.g. the Pockel's effect;
- detailed investigations QD device reliability according to telecom standards.

At the end of the project the consortium envisages to have reached a qualitatively new level of control in the fabrication of self assembled semiconductor nanostructures. The industrial partners of the project see this as a decisive step for a wide commercial exploitation of QD lasers which will greatly enhance their competitiveness.

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European Commission

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