LCC Finland Newsletter October 2008

Launch of DeLight and FAST-DOT

Two new projects kick off at Tampere University of Technology's ORC, and a third is extended

"Development of Low-cost Technologies for the Fabrication of High-performance Telecommunication Lasers" - DeLight

The DeLight project aims at developing advanced structures and low-cost technologies, in particular nanoimprint lithography (NIL), for the fabrication of high-performance telecommunication lasers. Surface gratings a thousand times smaller than the diameter of human hair (illustrated in Fig. 1) will be used to generate ultra-pure light, and multiple laser sections will be employed to provide direct-modulation speeds capable of sending the content of approximately 10 full DVDs per second. The surface-gratings - employed in the fabrication of distributed feedback (DFB) and distributed Bragg reflector (DBR) lasers at 1.3 and 1.55 µm - are compatible with single-sweep epitaxial growth and processing. This avoids all the fabrication complication, yield reduction, performance impairment and, ultimately, device cost increase, associated with the overgrowth applied in the conventional DFB/DBR semiconductor laser fabrication process.

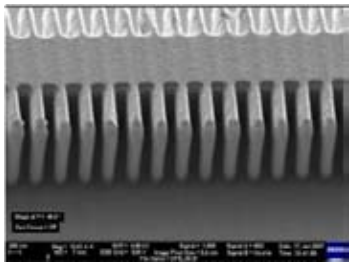

Figure 1. Laterally-corrugated ridge waveguide surface gratings with a period of 400 nm.

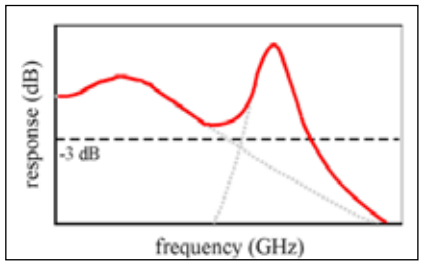

Figure 2. Electron-photon and photon-photon resonances in the direct-modulation response.

The control of high-order photon-photon resonances in multiple longitudinal section lasers will be used to extend the direct modulation bandwidth far beyond the limits currently imposed by the electron-photon resonance, as illustrated in Fig. 2.

The project has two main objectives:

1) The development of high-performance surface-grating-based DFB/DBR telecommunication lasers;

2) The development of ultra-high speed directly modulated lasers (> 28 Gb/s intermediate target and > 43 Gb/s final target) with a simplified multi-section design, which exploit high-order photonic resonances to extend the modulation bandwidth.

The project approach is to create a common technological fabrication platform for both types of lasers. The surface-oriented technology used in the project is largely independent of the underlying semiconductor structure and will be applied for the fabrication of InP- and GaAs-based edge-emitting lasers

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Letter from the Editor

Dear Readers,

A particularly active phase of research has just begun at Tampere University of Technology, and in this issue we bring you summaries of two new projects – DeLight, which aims to develop advanced structures and low-cost technologies for the fabrication of high-performance telecommunication lasers, and FAST-DOT, which focuses on the development of new ultrafast laser devices based on quantum dots. We also report on BioPulse, a project developing 3D microscale structures from biomaterials. In addition, we review the achievements of the Nanophotonics project, and highlight the research goals which will be targeted during its extension period. Futher projects will be introduced in later issues.

As always, a summary of the most exciting research and industry news topics can be found in these pages, as well as a comprehensive list of upcoming conferences and exhibitions.

Charis Reith, ORC

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(EELs) working in the 1300 and 1550 nm ranges. Although advanced materials as well as low-dimensional structures will be investigated for the active regions of the lasers, the surface-oriented technology will be directly applicable to epitaxial layer structures already developed and tested in regular Fabry-Perot telecommunication EELs.

The DeLight consortium, coordinated by the Optoelectronics Research Centre of Tampere University of Technology, comprises five other academic partners (the University of Kassel, the University of Würzburg, Politecnico di Torino, Israel Institute of Technology and Wroclaw University of Technology), one private research organization (Alcatel-Thales III-V Lab), and two SMEs (Modulight Inc. and MergeOptics GmbH). The project is funded under the Seventh Framework Programme of the European Union, (ICT-2007.3.5 Photonic components and subsystems) and will run for 3 years, starting from September 1st, 2008.

http://www.delightproject.eu/

Compact Ultrafast Laser Sources Based On Novel Quantum Dot Structures - FAST-DOT

Officially launched on June 1st 2008, the principal objective of FAST-DOT is to exploit the unique combination of ultrafast properties and key wavelengths available from quantum-dot (QD) materials to produce a new generation of compact ultrafast laser devices. Within the scope of FAST-DOT the consortium hopes to achieve the following:

- Develop QD-based laser technology to deliver compact, inexpensive, high-performance laser sources and devices, in a broad spectral range

- Provide new, affordable photonics devices and supporting knowledge to enable widespread development of biophotonics applications

- Apply the unique properties of QD-based ultrafast lasers to benefit already existing biophotonics applications

Prototypes to be developed within FAST-DOT include:

- Monolithic edge-emitting mode-locked lasers with average output power exceeding 50mW and pico- and sub-picosecond pulse duration.

- Novel compact high power (>100mW) and ultra-broadband tuneable (>150nm) laser sources.

- A new generation of electrically- and optically-pumped CW and mode-locked vertical extended-cavity-surface-emitted lasers.

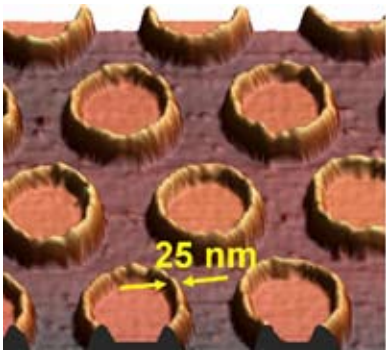


Figure 3. 25 nm imprinting resolution achieved by means of NIL. (ORC/2007)

- Ultra-compact high-power ultrashort pulse solid-state and fiber lasers based on QD SESAMs.

FAST-DOT is coordinated by the University of Dundee. The project has six commercial and eleven academic partners, including Tampere University of Technology's Optolectronics Research Centre (ORC). FAST-DOT is funded under the Seventh Framework Programme of the European Union, (Photonic Components and subsystems), and will run for 4 years.

http://www.fast-dot.eu/

Nanophotonics - Extension

This project exploits the results obtained in the Nanophotonics project, and builds on the research achievements made from 2005 to 2008 (illustrated in Fig. 3 and Fig. 4). The main results to date are:

1) Development of new semiconductor quantum structures for the mid-IR wavelength range.

2) Demonstration of a single-frequency DFB/DBR laser using a NIL-made grating that was placed outside the waveguide, in sharp contrast to the conventional buried-DBR geometry. To the best of the consortium's knowledge, this was the first laser of its type ever processed by nanoimprint lithography.

3) Testing the versatility of NIL by preparing metallic nanostructures (an array of gold nano-cones), which afforded an opportunity to refine the technology for plasmonics and non-linear optical applications.

4) Demonstration of a sub-wavelength resonant-grating which greatly enhanced non-linear interactions of optical fields.

The Nanophotonics- Extension project will focus on further refinement and commercialization of these achievements. There will be three core applications: semiconductor quantum structures, NIL, and sub-wavelength optics. The latter application will concern, in particular, optical nano-wires and fiber Bragg gratings, both representing significant business potential. Moreover, the project will focus on:

1) Development of new semiconductor quantum structures for remote sensing of environmentally hazardous gases in the mid-IR.

2) Demonstration of NIL technology in processing nanostructures for lasers and waveguides, and

3) The study of optical nano-wires and fiber Bragg gratings.

The project has two research partners and four industrial partners, and is funded by Tekes and industry through the FinNano programme for two years.

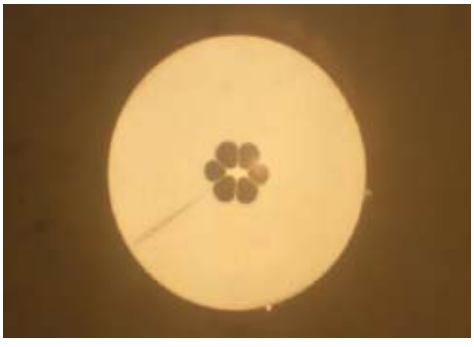


Figure 4. Micro-structured optical fiber. The diameter of the core after tapering is 20-100 nm.

3D protein structuring in the BioPulse project

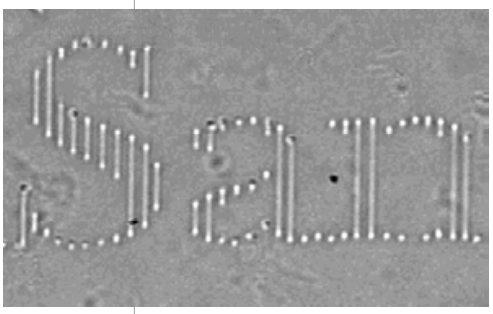
The MPP laser workstation is built over a microscope frame that allows real-time camera observation of the polymerization process. A moving XYZ platform under the objective controls the 3D structure formation.

The scope

The BioPulse project develops technology for forming microscale three-dimensional structures from biomaterials.

The structures can be applied e.g. for guidance of cell growth in cell cultivation inserts, implants, or stem cell differentiation.

The biomaterials, typically proteins, are processed using ultrashort, picosecond range laser pulses that initiate photochemical reactions through multiphoton absorption. The advantage of the multiphoton polymerization (MPP) process is that the reaction only occurs at the small focus point of the laser light. Therefore sub-micron 3D structures can be directly written inside the water volume where the proteins are diluted. The average power is much lower than in other laser processes where material is removed, only a few milliwatts. Therefore thermal damage to the material remains low. Also some other materials, such as ceramics and photoresists can be processed using MPP. Another application of the project is in protein crystallization studies.



3d structures
The microscope image shows about 1 micrometer wide avidin bars polymerized on a flat surface with 3 micron pitch, forming three letters.

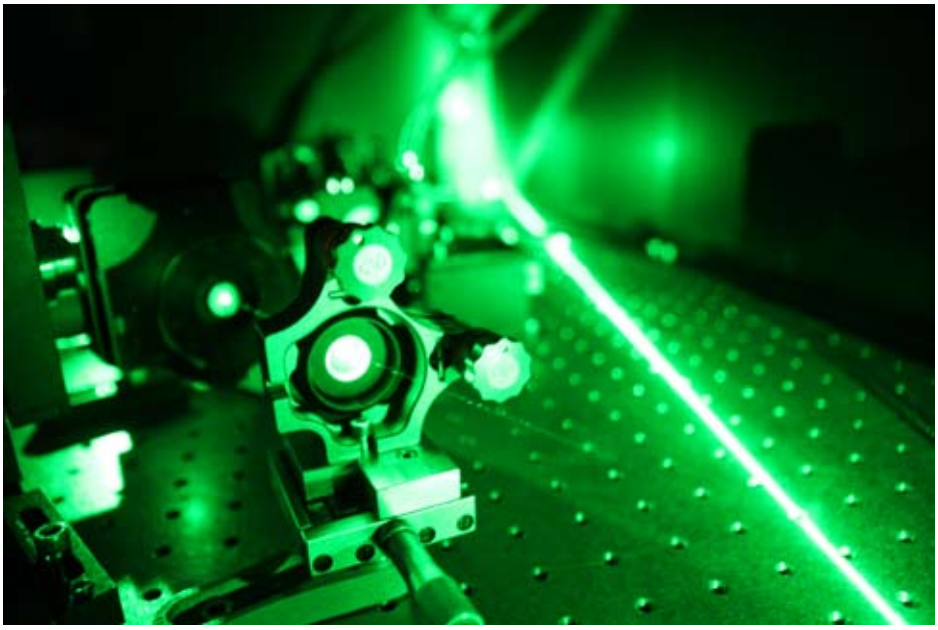
The technology

Microscale "rapid prototyping" requires cross-disciplinary R&D work in several disciplines

- biomaterials development at TUT
- fiber pulse laser development at TUT
- optics, microscopy and control software at VTT
- cell cultivation scaffold development at Scaffdex Oy
- laser processing technology at Nanofoot Finland Oy
- protein research by Macrocrystal Oy
- fiber laser technology at RefleKron Oy

Green SDL

The green semiconductor disk laser (SDL) shown here was developed at Tampere University of Technology's ORC. SDLs represent a potential low-cost, high volume solution for applications requiring sources capable of high speed modulation and/or emission in the green part of the visible spectrum, for example RGB devices. At present the so-called 'green-gap' has not been closed by conventional semiconductor devices. LCC Newsletter reported on SDL technology at ORC in the December 2007 issue, which can be found at http://lccfinland.nettisivut.fi/mp/db/file_library/x/IMG/31816/file/LCCNewsletterDecember2007.pdf



Semiconductor disk laser emitting at 520 nm.

Modulight Inc. Receive 2008 Frost & Sullivan Award

Modulight USA, Inc., San Jose, CA, and Modulight, Inc. Tampere, Finland, have received the Frost & Sullivan 2008 North American Laser Diode Emerging Company of the Year Award for their outstanding product development strategy and impressive revenue growth. Modulight has been recognized for its customer service initiatives and service type approach, coupled with its key focus on application level offering. According to Frost & Sullivan, the Award for Emerging Company of the Year is presented each year to the company that has emerged as a significant participant within its industry.

A group of researchers from Germany and Australia has for the first time used a laser **frequency comb** for wavelength calibration of an **astronomical spectrograph**. This has resulted in a calibration precision better than previously attainable using other technologies and brings astronomers one step closer to being able to measure the expansion of the universe in real time. http://optics.org/cws/article/research/35778

The first biocompatible **silicon carbide quantum dots** for fluorescence imaging have been fabricated by a team of scientists in France. The result is a major advance since all quantum dots used for imaging so far were toxic to cells. http://optics.org/cws/article/research/35800

Researchers in Canada believe that they are the first to fabricate an InP-based **quantum dot laser** that emits self-modelocked pulses at **two wavelengths** (1543 and 1571 nm) simultaneously. http://optics.org/cws/article/research/35423

Researchers in the US and Japan have devised a simple way to generate a nearly parallel beam of light from a **semiconductor laser** using a patterned metallic film which absorbs divergent light from the laser and reemits it in one direction. The technique relies on **plasmons**, and could make semiconductor lasers cheaper, smaller and more efficient. http://optics.org/cws/article/research/35299

A research group at Chalmers University of Technology has shown the potential for reliable operation of directly modulated 850 nm vertical external-cavity surface-emitting lasers **(VCSELs) at very high data rates** for future, high-capacity data communication links. http://optics.org/cws/article/research/35292

A VCSEL has been used in a **confocal laser scanning microscope** for the first time. The researchers from the UK's Strathclyde University say that their solid-state laser approach offers the convenience of wavelength tunability for optimized sample excitation in a more compact and reliable package compared with conventional gas-based systems. http://optics.org/cws/article/research/35664

An InP-based **VCSEL** engineered to emit at 2.3 μm is allowing researchers at the Technical University of Munich to measure carbon monoxide in the **parts-per-million** range. http://optics.org/cws/article/research/35544

US researchers have combined a **VCSEL** and a **photodetector array** to create a compact and highly accurate position sensor. http://optics.org/cws/article/research/35941

A team at Case Western Reserve University has made a surface-emitting distributed Bragg reflector laser that has a compression moulded gain medium and a co-extruded resonator, which could allow mass production of **polymer lasers**. http://optics.org/cws/article/research/35158

Physicists in Canada have invented a new way of testing **optical components** that could someday be used to build **quantum computers**. They claim that their technique is much simpler than conventional tests because it uses standard laser light, rather than relying on the creation of photons in special quantum states. http://optics.org/cws/article/research/36046

Researchers at ETH Zurich have detected the light absorption by a **single quantum emitter** under ambient conditions for the first time. The technique can image emitters in the "quenched" state, help directly observe single biological macromolecules without the need for fluorescence labelling and might enable applications in biology, such as sensing. http://nanotechweb.org/cws/article/tech/35550

Argon-ion lasers emitting around 490 nm have a new competitor thanks to work being carried out in France by Oxxius and researchers at the University of Paris-South. The team's laser employs **intracavity sum-frequency mixing** and emits 155 mW continuous wave at 491 nm, which it says suits biological applications such as fluorescence microscopy. http://optics.org/cws/article/research/35766

Researchers at the University of Hong Kong have found that adding an opal-like layer of fluorescent nanospheres to **blue LEDs** gives uniform white-light emission. http://optics.org/cws/article/research/35537

Replacing undoped GaN barriers in **blue LEDs** with p-type InGaN can significantly delay the onset of droop, the fall in device efficiency at higher drive currents, according to Hadis Morkoç's group at Virginia Commonwealth University. http://compoundsemiconductor.net/cws/article/news/35808

Researchers in India have succeeded in tuning the light emission properties of **zinc oxide quantum dots** – a result that could have implications for solid-state lighting and lasers, among other applications. http://nanotechweb.org/cws/article/tech/35724

Low-temperature growth of n-ZnO above the active layer is the latest approach to improve the performance of **green LEDs** and fill the "green gap". Hybrid LED epistructures featuring GaN and ZnO layers could produce higher performance green emitters than existing devices, according to a joint French-US research collaboration. http://compoundsemiconductor.net/cws/article/news/35682

A laser system emitting at 326 nm could be ideal for manipulating group three atoms such as indium, say researchers from the University of Bonn in Germany. The source looks particularly promising for **atomic nanofabrication**, an application involving the precise handling and direct deposition of atoms using laser light. http://optics.org/cws/article/research/35054

By sending laser pulses with a duration of just 5 femtoseconds through a helium cell held at high pressure, researchers from the Max-Planck Institute for Quantum Optics in Garching have created a coherent **supercontinuum** with near-uniform spectral intensity spanning the range 270 to 1000 nm. http://optics.org/cws/article/research/34972

Physicists from the Australian National University have demonstrated the first pumped **atom laser**. Their achievement marks another step on the road to a continuously operating atom laser, which should enable high-precision measurements of rotations, accelerations and magnetic fields. http://optics.org/cws/article/research/35078

Independent optimization of the core and the shell of a **multi-quantum well nanowire laser** leads to an unprecedented level of control and tunability over these tiny sources of laser light, according to researchers in the US who see this as a step towards free-standing injection nanolasers. http://nanotechweb.org/cws/article/tech/35718

Researchers at the Ludwig-Maximilians University and Max-Planck Institute of Quantum Optics have shown that **high-dispersion mirrors** can replace prisms and gratings to produce efficient laser output from a compact source. http://optics.org/cws/article/research/35087

Intracavity frequency doubling in a continuous wave singly resonant OPO creates a high power, singlemode and widely tunable source of **blue laser light**, say researchers at ICFO in Barcelona, Spain. http://optics.org/cws/article/research/35661

Researchers from the Max Planck Institute for Quantum Optics in Garching have developed a new **FROG** retrieval method for characterizing the electric field of **attosecond pulses**. http://optics.org/cws/article/research/34903

The laser division of GSI Group has launched a £1.2 million ($2.2 million) **UK R&D project** in partnership with the LPA Group at Heriot-Watt University, PowerPhotonic and Cranfield University. HELPSYS, or High Efficiency Laser Processing Systems, aims to develop **fibre-coupled diode laser** sources with beam qualities good enough to suit a range of mainstream applications. http://optics.org/cws/article/industry/35490

A new **laser printing** technique developed at Yonsei University in Seoul can produce arbitrary patterns of **nanoparticles** over large areas using just a single laser pulse. The method, which overcomes the problems encountered in conventional laser printing, could be used to fabricate electronic devices like transistors, in a simple way. http://nanotechweb.org/cws/article/tech/35644

Researchers at the University of Cambridge in the UK have discovered that gold clusters become highly catalytic when they are 2 nm or smaller. The effect comes from the altered electronic structure of the **gold nanoparticles**, a result that could have wide-reaching implications for industry. http://nanotechweb.org/cws/article/tech/35551

A new fast and portable method to detect minute quantities of cocaine and other small molecules using **gold nanoparticles** and DNA "aptamers" has been developed by researchers in China and Singapore. http://nanotechweb.org/cws/article/tech/35903

Researchers in Hungary and Belgium have developed the most precise **nanolithography** technique ever. The method employs the tip of a scanning tunnelling microscope, to pattern tiny nanostructures (ribbons) into a graphene sheet. http://nanotechweb.org/cws/article/tech/35723

Scientists based in Korea have transfered printed **gold nanocones** on to ITO-coated glass to create a field emission display with a turn-on field of just 3.3 V/μm. Ideal for creating **displays**, the simple and low-cost approach should also benefit biological and medical applications. http://nanotechweb.org/cws/article/tech/35374

A team at the University of Rochester's Institute of Optics is using tip-enhanced near-field **optical microscopy** to resolve individual membrane proteins in liquid. The technique relies on laser-irradiated **gold nanospheres** which act as optical antennae to detect fluorescence from the protein molecules. http://nanotechweb.org/cws/article/tech/35397

A new imaging technique that allows **buried nanoscale structures** to be detected has been developed by a team of scientists from the Paul Scherrer Institute in Villigen. The method, which combines two existing microscopy techniques and employs X-rays, could be used in applications like cell biology and to image embedded semiconductor devices. http://nanotechweb.org/cws/article/tech/35113

Researchers in the US and Korea are using active **semiconductor nanowires** to light up **photonic crystal waveguides** for the first time. According to the group, its nanowire/photonic crystal arrangement represents a significant step towards all-optical processing in nanoscale integrated photonic circuits. http://optics.org/cws/article/research/35830

By combining two separate strategies to organize molecules on a surface, researchers at the University of St. Andrews have succeeded in creating a well-defined and easily modified network for use in **nanotechnology applications**, such as biosensors, catalysts and molecule-based electronics. http://nanotechweb.org/cws/article/tech/35334

A computer programme that measures the **Casimir force** between nanostructured particles has been invented by scientists in Sweden. The model might allow the Casimir force between such objects to be controlled, which will be useful for **nanomechanical devices** where the force is a source of friction. http://nanotechweb.org/cws/article/tech/35722

Researchers in Germany have devised an extremely fast way of changing the value of a **magnetic data bit** using a current of spin-polarized electrons. They claim that their technique could soon be used to create magnetic random access memories that are as fast as conventional memory chips and have storage densities that are just as high. http://nanotechweb.org/cws/article/tech/35476

The thermal stability of **magnetic nanoparticles** – crucial for making good spin-based data storage devices – can be improved by depositing a thin layer of aluminium onto the particles, say researchers at Cornell University and Hitachi in the US. http://nanotechweb.org/cws/article/tech/35424

Optical mice look set to be the latest consumer application to benefit from **GaN LEDs**, with Microsoft using this technology to displace red diode lasers. http://compoundsemiconductor.net/cws/article/news/35651

Sony has unveiled the world's brightest **red laser diode array** that it says is ideal for use in projection devices. The array developed emits a record 7.2 W of optical output at a wavelength of 635 nm. http://optics.org/cws/article/industry/35531

Researchers from Italy, France and Germany have shown that a **tabletop laser** can be used to accelerate a beam of electrons suitable for use in radiotherapy. The group, led by Antonio Giulietti of the Institute for Physical Chemistry Processes in Pisa, believes that such laser-based particle acceleration could considerably reduce the size and simplify the operation of radiotherapy facilities. http://optics.org/cws/article/research/35899

By growing **AlGaN** sideways from angled seed crystals, Hamamatsu Photonics has cut non-radiative recombination while providing a suitable bandgap for **UV lasing**. http://optics.org/cws/article/research/35343

Researchers from the University of Jena have simulated a coating that can be applied to any **solar cell** to boost the amount of light that it can trap. According to the group, the layer can be applied easily to the top of solar panels of any size and could be a step towards fabricating thinner photovoltaics. http://optics.org/cws/article/research/34959

Researchers at the University of Utah say that they can reduce manufacturing costs of compound semiconductor **solar cells** by slicing germanium substrates thinner than existing wire saws currently are able to. http://compoundsemiconductor.net/cws/article/news/35804

Researchers at the City University of Hong Kong have succeeded in producing **silicon nanowire** array photoelectrochemical **solar cells** that show more efficient light absorption per unit device and thus higher light conversion efficiency at a lower cost than conventional silicon-based cells. http://nanotechweb.org/cws/article/tech/35280

Researchers at the Fraunhofer Institute for Solar Energy Systems have developed 37.6 % efficient **triple junction photovoltaic cells** for use in highly concentrated sunlight, which they say match state-of-the-art cells under these conditions. http://compoundsemiconductor.net/cws/article/business/35015

Easy-to-make **nanostructured solar cells** have been designed by researchers at the Risø National Laboratory for Sustainable Energy, Denmark. The polymer-based devices require no vacuum or inert processing and can be prepared almost anywhere. http://nanotechweb.org/cws/article/tech/35564

Researchers at the University of Freiburg have shown that **nanostructured gold** can almost entirely suppress reflections at the substrate-to-air interface over frequencies ranging from 200 GHz to 2.2 THz in the far-infrared. http://optics.org/cws/article/research/35517

Nanodevices can be shaped using a highly focused electron beam, according to researchers at the University of Illinois at Urbana Champaign in the US who have developed a technique called **electron-beam expulsion of atoms** to etch nanoholes as small as 2.5 nm across in multiwalled carbon nanotubes and niobium nanowires. http://nanotechweb.org/cws/article/tech/35904

Researchers from Northeastern University in the US have engineered a concave **photonic crystal microlens** that they claim provides the shortest focal length ever achieved for infrared light. http://optics.org/cws/article/research/35652

A non-intensified multichannel camera system that can record image sequences at frame rates up to 200 MHz has been unveiled by a team from the US and Jordan; the researchers have established a company called Spectrum Optical Solutions to develop and market a range of **high-speed cameras**. http://optics.org/cws/article/research/35277

Researchers from the University of Victoria and the University of British Columbia have engineered a spinal disc pressure sensor based on a **fibre Bragg grating**, which is the smallest such sensor to date. http://optics.org/cws/article/research/35393

A team at ETH Zurich has increased the lateral resolution of a total internal reflection **fluorescence microscope** by 2.5 times to 92 nm using a specially designed spatial light modulator. The group says that its SLM can tune the penetration depth of light incident on the sample without the need for other optical components. http://optics.org/cws/article/research/35554

Researchers at the University of Illinois have overcome the fragile and brittle nature of **silicon** to successfully transform a 2D planar **detector** into a compact **hemispherical** shape. The team believes that its technique opens up new design avenues for advanced camera systems. http://optics.org/cws/article/research/35340

Metrology institute Physikalisch-Technische Bundesanstalt has seen a big leap in the quality of **GaAs/AlGaAs crystals** it is using to study current, thanks to an **MBE reactor** from Riber. http://compoundsemiconductor.net/cws/article/news/35797

Nanoimprint lithography equipment is making more inroads into the **LED** manufacturing industry, with Swedish vendor Obducat signing a supply deal worth up to SEK 80 million ($12.6 million). The mass production order has been placed by Luxtaltek Corporation, a recently formed Taiwanese operation that has major plans to ramp photonic crystal LED fabrication. http://nanotechweb.org/cws/article/tech/35547

19 partners are working on the new, €8.5 million ($12.2 million) European project "**Helios**", led by CEA-Leti, that aims to combine compound semiconductors with silicon in a fresh attempt to merge photonics and CMOS technology. http://compoundsemiconductor.net/cws/article/news/35717

The UK government is funding a diverse range of new research projects featuring **compound semiconductor technologies**, which it hopes will help to answer the country's energy and economic challenges. Three high-profile funding announcements in August, with an overall government investment of £38 million ($67.2 million) spread across 51 projects, each featured compound-based electronics efforts. http://compoundsemiconductor.net/cws/article/news/35709

Two new high-power green lasers from **Powerlase**, the Starlase 100G and Starlase 200G, build on the company's penetration of the plasma flat panel display industry and move it towards new markets. The sources were developed for **solar-cell and hard materials processing** applications. http://optics.org/cws/article/industry/35286

Lockheed Martin has entered into a definitive agreement to acquire **Aculight**. Based in Washington state, US, Aculight is a privately held company primarily focused on providing laser-based solutions for national defence and aerospace customers. http://optics.org/cws/article/industry/35272

According to the epitaxy equipment manufacturer **Aixtron**, companies from outside the traditional LED sector are beginning to enquire about buying MOCVD reactors, which may result in a dramatic reshaping of the industry. http://compoundsemiconductor.net/cws/article/fab/35363

As **Veeco Instruments**' high-volume reactors battle it out with **Aixtron** products in the LED sector, **Spectrolab** has boosted its solar cell reputation with a multiple MOCVD system order from the US equipment supplier. http://compoundsemiconductor.net/cws/article/business/35180

French molecular beam epitaxy equipment supplier **Riber** has strengthened its market position by purchasing **Oxford Instruments Plasma Technology**'s competing tool business. http://compoundsemiconductor.net/cws/article/news/35931

A Tennessee zinc mine should position Canada's **Strategic Resource Acquisition** as the largest producer of **gallium** in the US, and among the world's top **germanium** suppliers. Both elements are used widely in compound semiconductor applications, and with increasing demand for GaAs-based RFICs and solar cells in particular, the additional supply will be welcome news for semiconductor materials companies. http://compoundsemiconductor.net/cws/article/business/35282

Taiwanese **LED** makers see sales jump 16% thanks to the Beijing Olympics and the Taiwan government's three-year plan for traffic lights, while **Win Semiconductors** is now ranked among the world's top ten GaAs suppliers. http://compoundsemiconductor.net/cws/article/business/35714

Sales of DVD recorders and players featuring **GaN-based blue lasers** are set to more than double in 2008, and may reach 12 million in 2009, says a new report from In-Stat. http://compoundsemiconductor.net/cws/article/news/35847

Upcoming Conferences and Exhibitions

16th International Workshop on Laser Ranging, 13 - 17 Oct 2008; Poznan, Poland. http://www.astro.amu.edu.pl/ILRS_Workshop_2008/

NanoEnergy 2008 and NanoRisk 2008, 21 – 23 Oct 2008, Paris, France. http://www.upperside.fr/nanoenergy2008/nanoenergy2008intro.htm
http://www.upperside.fr/nanorisk2008/nanorisk2008intro.htm

PM08 - SPIE Photomask Technology 2008, 06 - 10 Oct 2008; Monterey, California, United States.
http://spie.org/photomask.xml?WT.mc_id=RCALENDARW

Training - Photometry and Spectroradiometry, 06 - 08 Oct 2008; Teddington, United Kingdom.
http://www.npl.co.uk/server.php?show=ConWebDoc.2514

AHPSL 2008 - Applications of High Powered Semiconductor Lasers, 06 - 08 Oct 2008; San Diego, California, United States.
http://www.ahpsl-conference.com/

SEMICON Europa 2008, 07 -09 Oct 2008; Stuttgart Trade Fair Centre, Germany. http://www.semiconeuropa.org/index.htm

Good lighting with less energy: Possibilities for the future, 09 Oct 2008; Teddington, United Kingdom.
http://www.npl.co.uk/server.php?show=ConWebDoc.2858

SMMO - International Conference on Semiconductor Materials and Optics, 09 - 10 Oct 2008; Warsaw, Poland. http://www.smmo.org/

NNT'08 – The 7th International Conference on Nanoimprint and Nanoprint Technology, 13 – 15 Oct; Kyoto, Japan. http://nanoimprint.jp/nnt08/

PHOTONEX 2008, 15 – 16 Oct; Stoneleigh Exhibition Halls, Coventry, UK. http://www.photonex.org/

FiO - Frontiers in Optics: The 92nd OSA Annual Meeting and Exhibit 19 - 23 Oct 2008; Rochester, United States.
http://www.frontiersinoptics.org/

Laser Science XXIV, 19 - 23 Oct 2008; Rochester, United States. http://www.frontiersinoptics.org/

Optical Fabrication & Testing, 19 - 23 Oct 2008; Rochester, United States. http://www.osa.org/meetings/topicalmeetings/OFT/default.aspx

International Workshop on Fundamentals of Light-Matter Interaction, 20 - 22 Oct 2008; Recife, Brazil. http://www.df.ufpe.br/~lightmatter/

ICALEO 2008 - The International Congress on Applications of Lasers & Electro-Optics, 20 - 23 Oct 2008; Temecula, CA, United States.
http://www.laserinstitute.org/store/course/ICAL08

NanoEnergy Conference, 21- 23 Oct 2008; Paris, France. http://www.upperside.fr/nanoenergy2008/nanoenergy2008intro.htm

9th International Young Scientists Conference Optics and High Technology Material Science, 23 - 26 Oct 2008; Kiev, Ukraine.
http://spie.kiev.ua/ohtms/08/index.php

AOC08 - SPIE APOC Asia Pacific Optical Communications 2008, 26 - 30 Oct 2008; Hangzhou, China.
http://spie.org/apoc.xml?WT.mc_id=RCALENDARW

6th European short course on "Principles and Applications of Time-Resolved Fluorescence Spectroscopy", 27 - 31 Oct 2008; Berlin, Germany.
http://www.picoquant.com/_events.htm

XI International Workshop on Luminescence and Laser Physics, 27 - 31 Oct 2008; Irkutsk, Russia. http://optics.org/cws/event/13176

Eighth Annual LOT and JA Woollam Seminar on Ellipsometry, 28 Oct 2008; Nottingham, United Kingdom.
http://www.lot-oriel.com/site/pages_uk_en/events/events/events.php?ldn=138

Asia Optical Fiber Communications and Optoelectronic Exposition and Conference, 30 Oct - 02 Nov 2008; Shanghai, China.
http://www.aoe-expo.com/english/

Laser Florence 2008, 31 Oct - 01 Nov 2008; Florence, Italy. http://www.laserflorence.org/

TL08 - SPIE Lithography Asia 2008, 04 Nov 2008; Taipei, Taiwan. http://spie.org/lithography-asia.xml?WT.mc_id=RCALENDARW

4th International Workshop on Fiber Lasers, 05 - 06 Nov 2008; Dresden, Germany. http://www.iws.fraunhofer.de/workshop/workshop.html

INN08 - SPIE Photonics Innovation Summit 2008, 06 Nov 2008; San Francisco, CA, United States.
http://spie.org//innovation.xml?WT.mc_id=RCALENDARW

The 21st Annual Meeting of The IEEE Lasers & Electro-Optics Society, 09 -13 Nov 2008; Newport Beach, CA, United States.
http://www.ieee.org/organizations/society/leos/LEOSCONF/LEOS2008/index.html

Symposium on Semiconductor Lasers and Luminescence in Nanostructures, 12 - 14 Nov 2008; St. Petersburg, Russia.
http://www.ioffe.rssi.ru/evpti_08.html

AE08 - SPIE Asia Pacific Remote Sensing 2008, 17 - 21 Nov 2008; Moumea, New Caledonia. http://spie.org/asia-pacific-remote-sensing.xml

11th Annual Directed Energy Symposium, 17- 21 Nov 2008; Honolulu, United States. http://www.deps.org/

COMPAMED, 19 – 21 Nov 2008, Düsseldorf, Germany. http://www.compamed.de/

PHOTONICS 2008 - 9th International Conference on Fiber Optics and Photonics, 13 - 17 Dec 2008; New Delhi, India.
http://www.iitd.ac.in/events/photonics08CFP3.pdf

LiDAR 2009 - 1st International Conference on LiDAR Technology & Image Processing, 05 - 08 Jan 2009; Harbin, China.
http://www.academicinternational.org/aaic/

Laser Competence Centre Finland

covers the whole development chain, which includes the technology-oriented basic research, end users' application development, system integration, and testing of lasers.

The wide know-how of the units of the Tampere University of Technology in the separate areas of the laser technology forms the foundation of the operation of the centre. The objective is to adapt laser technologies to the needs of the industry.

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