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Optics 2017

8th International Conference and Exhibition on

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November 15-17, 2017 | Las Vegas, USA

Workshop

Day 1-Main Hall

Douglas R McCarter, J Laser Opt Photonics 2017, 4:4 (Suppl)
DOI: 10.4172/2469-410X-C1-017

Douglas R McCarter

McCarter Machine & Technology Inc., USA

Rock wars, we can win with silicon

Present day technology does not provide detection and/or deterrence of small to medium size asteroids. Large asteroids can be seen such as 2014 The Beast which came close to the earth but interception and control is not possible. Just as important, detecting this large asteroid three months before flyby was not enough time to deter. Cities could be evacuated but the global economic damage of losing a city or country would be crippling. The Beast missed the Earth and knowing that asteroids generally travel in orbit around the sun the Beast will be back. While we wait another Large Asteroid could show up. Not to mention then 20+ nuclear blasts incurred since 2000 from small asteroids that were never detected until they hit the Earth. If a rock does not vaporize totally then that is another problem. Fortunately, the Russian Asteroid fell into a lake instead of through a crowded building. Even so over 1000 injuries and millions of dollars of damage occurred. This global bombardment of rock wars has only begun. There is no need to continue traveling through life blind and defenseless to asteroids. There is no need to rebuild if we detect and deter the asteroids. Humanity is at a crossroads with a tough decision to move forward with aggressive plan of action. Even though life would likely survive after another close extinction, we are in a today where we have advanced our knowledge of silicon optical technology to a point to where we can be proactive vs. reactive. We can study the IR signatures of the asteroids such as with the GLAST Silicon Detector, add a new array of silicon space telescopes on different orbits and space drones with silicon solar powered high energy lasers with a tested and proven material, Single Crystal Silicon optics. SPIE Solution-Build a Space Qualified Silicon System that has only submicron thermal growth, subsecond thermal equilibration low microyield, long term stability, does not creep, does not jitter, is radhard, is economical to build. The mission life will be extreme due to having 100% solar power. We can work together globally as a family of the earth with each country contributing funds and science as protective brothers and sisters. Successful detection and deterrence can lead to capture and mining. We can use what could cause harm for good by mining precious minerals. Even possibly building a rock lined road to another inhabitable planet for the future family millions of years down the road. Mankind is fundamentally a species of builders and explorers. Why stop now?

Biography

Douglas R McCarter is the Technical Integrator of McCarter Machine and Technology Inc., founded in 1981. McCarter's patented and proprietary silicon processes achievements were documented by published technical papers and over 50 oral presentations. In turn, he has won many awards, mentioned in Forbes.com, Kiplinger Letter, Entrepenuer.com, Nasa Tech Briefs, New Mexico Optics, Missile Defense Briefs Open and Classified and recognized as the current world expert in precision silicon components. He has served as Member of Editorial Staff of Advanced Optical Technology, in Munich Germany since 2012. In 2016, Dr. Babin, USA Congressman District 37 and Leader of Nasa Funding, endorsed McCarter. In addition to over 3000 hours of Technical Schools, McCarter has been directly mentored for six years by the late Frank Anthony, Bell Labs Silicon Director and past 10 years Roger Paquin, Perk and Elmer retired Materials Expert. He is one of SPIE's Inaugural 18 Senior Members, Editor Member on AOT, Advanced Optical Technology in Munich and Committee Member of OMICS Laser and Photonics.

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Scientific Tracks & Abstracts

Day 1-Main Hall

Hideyoshi Horimai, J Laser Opt Photonics 2017, 4:4 (Suppl)
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One mm-thick see-through holographic RGB illumination unit ega-rim

Hideyoshi Horimai
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In the field of the hologram, there are two big walls to disturb the development and market growth. First big wall is the holographic media production issue. Such as a photopolymer material is very useful for creating the hologram contents, however, available products and supply roots are strictly limited in the world. To make a solution to this first wall, we have started photopolymer production in Japan with an overseas photopolymer development company by the technological cooperation. Second big wall is the limitation of the expression methods for hologram contents and holographic pictures. An external light source has been mandatory for observing the sufficient quality of holographic image. To make a solution to this second wall, we proposed the brand-new illumination unit by using holographic technology. The unit thickness was only 1 mm and has a transparency; it looks like a just plane glass. In spite of this, the light can be lead from the edge of this glass and emit from the surface with certain angle. Therefore, this illumination unit can be set very close to the hologram content or hologram picture, i.e. enables to combine with them as an photo-frame. In Japanese, usually the picture pronounces /e/ or /ga/ and a frame is a rim in English. Therefore, this unit is so-called "Ega-rim". By using the Ega-rim laboratory proto-type, basic performance was proven experimentally. We hope everybody can enjoy a hologram easily by using Ega-rim and open up the hologram market worldwide.

Biography

Hideyoshi Horimai has received his PhD from The University of Tokyo. In 1998, he has invented the original holographic storage technology, so-called Collinear Holography, its disk format was approved at world first International Standard as "HVD" in 2007. His other developments were holographic 3D-image printer system, 360-degree 3D display, digital holographic microscope and holographic window for BIPV.

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Notes:

Simon Fafard, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Laser power conversion efficiencies exceeding 60%, featuring strong photon recycling, in ultra-thin GaAs n/p junctions based on high-photovoltage vertical epitaxial heterostructure architectures

Simon Fafard
Université de Sherbrooke, Canada

Optical to electrical power converting semiconductor devices are achieved with breakthrough performance using a Vertical Epitaxial HeteroStructure Architecture (VEHSA design). The devices allow achieving a near-optimum responsivity, an improved photovoltage output compared to p/n junctions with standard thicknesses and low series resistance and shunting effects yielding high fill-factor values. The ultrahigh conversion efficiencies were obtained by monolithically integrating several thin GaAs photovoltaic junctions tailored with submicron absorption thicknesses and grown in a single crystal by epitaxy. Unique experimental evidence of the significant impact of photon recycling in these photovoltaic devices has been observed. The devices exhibited a near optimum responsivity of up to 0.645A/W for tuned excitation conditions or at high optical intensities for spectral detuning values of up to ~25 nm and corresponding to an external quantum efficiency of ~94%. These devices have now available as products manufactured by Broadcom and recent progresses will be covered, including: -The highest optical to electrical efficiency ever achieved; -The highest output powers ever reported for a high-efficiency monolithic PV cell with 5.87W of converted output from a CW laser; -The highest efficiencies ever reported for any types of optical to electrical power conversion devices simultaneously combining high photovoltage and output powers (> 5W at > 7V with > 60% efficiency and > 3W at > 14V with > 60% efficiency); -The highest efficiency ever reported of 61.8% with a significantly detuned optical input; -The highest photovoltage ever reported for monolithic photovoltaic semiconductor heterostructures with measured Voc > 23V; The thinnest p/n junctions ever implemented successfully with high-performance, with ultra-thin GaAs bases as small as 24 nm.

Biography

Simon Fafard was a Co-founder & President of Broadcom which is a large public company that recently acquired Azastra and has been an innovative Canadian opto-electronic company. He has been focused on optoelectronic at uSherbrooke and at Azastra, a corporation that commercialized laser power converter products based on the new VEHSA technology. He has an h-index of 45 and is the inventor of over 30 patents. He raised over $20M of private and venture capital funding and also obtained numerous research grants. He led Cyrium to become a manufacturer of one of the highest performance multijunction III-V solar cells and led Azastra to manufacture the highest performance phototransducer products. As an entrepreneur, he cumulates over 25 years of experience in Optoelectronics and Photonics while developing and commercializing numerous devices and products in the industry at Azastra, Aton, Cyrium, Alcatel Optronics, Kymata and also in research labs at uSherbrooke, NRC and UCSB.

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Signal's envelope analysis by the mathematical statistics methods as a new approach to accurate measuring in optical metrology

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The technique of the narrowband optical signal processing by means of the joint estimation of both the informative signal's component and the speckle-noise level has appeared to become an efficient tool at solving the tasks in various fields of optics and photonics. The envelope of a signal being formed from the initially determined component under the inevitable Gaussian noise influence obeys to the Rice statistical distribution, first formulated by S. Rice in 1944 as an extension of the classical Rayleigh distribution. The Rice statistical model describes a wide range of the signal processing problems in the tasks when the output signal is composed as a sum of the sough-for initial signal and a random noise generated by many independent normally-distributed summands, what always takes place at the optical signal propagation in a medium. Recently a new concept of the so-called two-parameter analysis has been developed and mathematically substantiated providing an accurate joint estimation of both the signal and the noise values without any a-priory assumptions concerning the process. The methods of the Rician signal's two-parameter analysis, based on the mathematical statistics' principles, form the theoretical foundation for a fundamentally new approach to solving a wide variety of scientific and applied tasks, including the investigation of an optical medium's properties, the implementation of the high precision phase measurements in optical metrology systems, etc. The two-parameter analysis techniques have been tested both numerically and in physical experiments. One of the important applications of such an approach is being realized in a recently elaborated method of measuring the medium's electro-optical (EO) coefficient, based on analyzing the statistical characteristics of the modulated reflected optical wave. The two-parameter analysis of the signal's envelope has been shown to provide an efficient reconstruction of the useful, non-distorted signal component against the speckle noise background, thus ensuring the more correct evaluation of the EO coefficient than provided by the traditional linear regression technique, based upon measuring the total, noise-contaminated reflected signal. Besides, the application of the two-parameter technique significantly simplifies the experimental setup and decreases the required number of measurements. Another perspective application of the developed technique concerns the phase shift determination at quasiharmonic signals' interferometry in optical metrology.

Biography

Tatiana Yakovleva has graduated with honors from the Moscow Engineering-Physics Institute and has completed her PhD in Optics. She has been awarded by the Royal British Society Post-doctoral fellowship. The scientific interests cover the issues of nonlinear optics, wave front reversal, the light and ultrasound waves scattering in inhomogeneous medium, the mathematical methods of the Rician signals analysis, etc. In 1915, she got a degree of Doctor of Science in Physics and Mathematics. She has published more than 120 papers in reputed journals.

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Notes:

Amur Margaryan, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Time tagged time resolved single photon counting technique for quantum astronomy applications

Amur Margaryan
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A time-tagged, time-resolved single photon THz counting system, based on the recently-developed, GHz, radio-frequency photomultiplier tube (RF PMT) is considered. The detection and readout systems of the RF PMT are based on commercial multichannel plates, electron bombardment avalanche photodiodes and regular nanosecond electronics. The proposed technique is capable of detecting single photons with 1 ps resolution over virtually unlimited time spans. Over a period of around 100 ns the technique is capable of THz rates, while longer term average rates of up to GHz can be achieved. In principle, with a dedicated spiral scanning system and electron detector, the rate could be increased up to the THz level. Possible application in Quantum Astronomy is discussed.

Biography

Amur Margaryan has completed his PhD from Yerevan Physics Institute and continued studies in the field of Experimental Nuclear Physics at Yerevan Physics Institute; Serpukhov proton accelerator, Serpukhov, Moscow region; JLab, Newport News, VA, USA; MAX-lab, Lund, Sweden; GRAAL experiment at European Synchrotron Radiation Facility in Grenoble, France. He is the Leading Scientific Researcher at A I Alikhanyan National Science Laboratory (Yerevan Physics Institute). He has published more than 150 papers in reputed journals. He holds one Soviet Union and one US patent. His current research interest is in ultrafast photon detectors and optoelectronic devices.

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Notes:

Toshihiro Kasezawa, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Holographic window for solar power generation system

Toshihiro Kasezawa
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In case of building-integrated photovoltaic (BIPV), photovoltaic materials are used to replace conventional building materials. Additionally the vehicle-integrated photovoltaic (VIPV) is argued that the hybrid electric vehicles (HEV) create an opportunity for PV to serve as an energy source for the transport sector. However Conventional PV unit is Solid and Shade, it means the total construction cost becoming considerably high. Our research aims to develop high-value technology that make open up new markets and accelerate the expansion of the field of introduction of the photovoltaic power generation. We have proposed and demonstrated the brand-new see-through-window type photovoltaic generating unit by applying holographic technologies called "Holographic Window (Holo-Window)". By skillfully using phenomena such as diffraction of light, reflection and refraction, the sunlight through windowpane is captured into the glass plate. By increasing diffraction angles (reflection from hologram in this case) more than critical angle of the glass inside, the sunlight leaded to the end edge of the glass. Small-ribbon-shape low-cost solar cells placed on windowsill. While the captured light travel to the glass edge, another captured light are also combining and then light intensity can be increasing dramatically. I will introduce the basic principle of Holo-Window, including the optical configuration and requirement of hologram characteristics, the hologram fabrication technology to achieve high diffraction angle for capturing the sunlight into the glass plate and I will discuss the performance of Holo-Window experimentally.

Biography

Toshihiro Kasezawa graduated from Shizuoka University in 1984 and he managed many companies of the technical system. He is an Inventor of Holo-Window. In 2012, he applied a patent of the hologram research and development "stereoimage projection device". In 2013, he applied a patent of the hologram research and development "collecting mechanism, light of the sun electrical generator, window structure and windowpane". He won the Best Paper Award at IWH (International Workshop on Holography and Related Technologies) 2015 Okinawa and also IWH 2016 Taiwan. His article "Holographic window for solar power generation" was appeared in the Optical Review (2016).

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Notes:

Vincenzo Spagnolo, J Laser Opt Photonics 2017, 4:4 (Suppl)
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New developments in quartz enhanced photoacoustic sensors exploting custom quartz tuning forks

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Technical University of Bari, Italy

Trace gas detection has a significant impact on a wide range of applications, such as environmental or industrial monitoring or medical breath analysis. Techniques based on optical absorption offer fast responses, minimal drifts and high gas specificity. Quartz enhanced photoacoustic spectroscopy (QEPAS) is one of the most sensitive optical techniques for trace gas measurements. QEPAS exploits a quart tuning fork (QTF) as a resonant optoacoustic transducer that converts the acoustic wave into the electrical signal via the piezoelectric effect. For more than a decade since its first demonstration in 2002, all the QEPAS systems employed standard 32 KHz QTFs, similar to the ones incorporated in clock watches and smartphones. Recently, new designs for the QTFs have been proposed and implemented in QEPAS sensors, opening the way to the use of QTF overtone vibrational modes and novel micro-resonator configurations providing excellent results in terms of sensitivity. The implementation of custom QTFs also allow extending the use of QEPAS in the THz spectral range and with laser sources having poor beam profile, like fiber-amplified lasers. Here it will presented a review of recent results obtained exploiting custom QTFs in QEPAS trace-gas sensors operating in the near-IR mid-IR and THz ranges. Finally, new QEPAS approaches exploiting simultaneous excitation of the two antinodes of the QTF first overtone mode or both fundamental and first overtone mode antinodes will be reported. In particular, the latter approach leads to the first simultaneous dual-gas detection with a QEPAS sensor.

Biography

Vincenzo Spagnolo received his Phd in Physics, in 1994 from University of Bari. Since January 2004, he has been working at the Technical University of Bari, formerly as Assistant Professor of Physics and since 2015 as Associate Professor. He is the Director of the joint-research lab Polysense created by Thorlabs GmbH and Technical University of Bari. His current research interests include quantum cascade lasers, fiber optics and optoacoustic gas sensing. His research activity is documented by more than 160 Scopus publications and two filed patents. He has given more than 40 invited presentations.

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Notes:

Giorgio Pettinari, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Site-controlled quantum dots and their integration in photonic crystal nanocavities

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The fabrication of integrated quantum dot (QD)-optical microcavity systems is a requisite step for the realization of a wide range of nanophotonic experiments and applications that exploit the ability of QDs to emit non-classical light, e.g., single photons. Here, we present the possibility of creating site-controlled QDs in dilute-nitride semiconductors by spatially selective H incorporation and/or removal. In dilute nitrides (e.g., GaAsN), the formation of stable N-2H-H complexes following H incoporation removes the effects nitrogen has on the alloy properties. In particular, H binding to N atoms in GaAsN leads to an increase in the band gap energy of the GaAsN (~1.33 eV for [N]=1% at T=5 K) up to the value it has in GaAs (1.52 eV at 5 K). Therefore, by engineering the spatial H incorporation and/or removal in dilute nitides is possible to attain a spatially controlled modulation of the band gap energy in the growth plane and therefore, to tailor the carrier-confining potential down to a nm scale, resulting in the fabrication of site-controlled QDs. Clear evidence of single-photon emission is presented for QDs made either by low-energy H irradiation of lithographically prepatterned samples and by spatial H removal in a fully hydrogenated sample by using the near-field hot spot generated by a SNOM tip to locally break the N-H bonds. Also, a lithographic approach to the deterministic QD-PhC nanocavity coupling is demonstrated, resulting in a significant enhancement (inhibition) of the spontaneous emission rate for low (high) cavity mode (CM)-QD energy detuning (Purcell effect).

Biography

Giorgio Pettinari has completed his PhD in Materials Science from Sapienza University of Rome in 2008. From 2009 to 2011, he has worked as Assistant Researcher in High Field Magnet Laboratory (HFML) of Nijmegen (The Netherlands), then (2011-2013) he moved to The University of Nottingham (UK) as Marie Curie Research Fellow. Since 2013, he is a Researcher at Istitute of Photonics and Nanotechnologies (IFN-CNR) of National Research Council of Italy. He has published more than 35 peer-reviewed original papers in accademic journals, 2 invited book chapters and given more than 15 oral contributions and seminars (5 invited) at international conferences and research institutes.

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K V Madhuri, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Transition metal oxide thin film-applications

K V Madhuri
VFSTR University, India

Transition metal oxides (TMO) is an interesting group of solid materials with a wide variety of structural, optical, electrical and magnetic properties.The general formulae of transition metal oxides $M_nO_{2n\pm1}$ where M represents the transition metal. They have two dimensional vander-Waal's bonded layered structures (Ex:V_2O_5,MoO_3) or three dimensional frame work tunnel structures (Ex:WO_3, $LiCoO_2$) which lead the materials for their applications in the field of Electrochromic and Opto Electronic Devices. The combination of solid state materials science with thin film technology has significantly reduced the size of component and leads to micro electronic, micro ionic, electrochromic devices and display systems. Thin film deposition consists of three major phases. In the first phase, the material should be in the proper form to deposit. In the second stage, it was transported through the medium and in the third stage it should deposit on the substrate to form a continuous film. The films can be prepared by various physical vapour deposition techniques like thermal, electron beam, sputtering, so on and chemical vapour deposition techniques like sol-gel, spin coating, spray pyrolisis so on. Depending on the deposition parameters one can deposit amorphous, polycrystalline and nanocrystalline thin films for their effective utilisation in emerging technology. These films will be characterized for their composition, structure, morphology, vibrational and optical studies by using x-ray photo electron spectroscopy, x-ray diffraction, atomic force microscopy, infrared spectroscopy, Raman spectroscopy and UV-VIS spectroscopy.

Biography

K V Madhuri has completed her PhD from Sri Venkateswara University and Post-doctoral studies from Universite de Moncton, Canada. She is working as an Assoc. Professor/Assoc. Dean of Research and Development, in an esteemed University. She has published 17 papers in reputed international journals and has been serving as an Editorial Board Member of reputed journals. She has presented about 27 research papers in national/international conferences. In addition to this, she has delivered invited talks in reputed institutes/conferences/workshops/orientation programmes. She has recently finished a project under Young Scientist scheme by Department of Science and Technology, New Delhi, India.

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Notes:

Sebastian Roling, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Split-and-delay units for soft and hard x-ray free-electron lasers

Sebastian Roling
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In the last decade the development of free-electron lasers (FELs) which operate in the extreme ultraviolet (XUV) and soft and hard x-ray spectral region have opened this photon energy regime to new and exciting experiments, like single pulse diffractive imaging, warm dense matter dynamics, surface reactions, the ionization and dissociation dynamics of isolated atoms and molecules and many more. The duration of the FEL pulses is typically three orders of magnitude shorter than radiation from synchrotrons. These short pulses of typically a few tens of femtoseconds duration enable the investigation of dynamic processes now also in this spectral region with its chemically identifying characteristic inner shell excitations. Such studies require the presence of at least two temporally correlated light pulses. One can employ either one optical pulse from a conventional femtosecond laser and one FEL pulse or two FEL pulses. The first method has been hampered in the past by timing jitters, although with bunch arrival time measurements presently the jitter has been reduced to below 100 fs. Pump-probe experiments with x-ray pulses from the FELs alone ask for pulse splitting devices which in addition delay one pulse against the other. Such devices are usually based on an interferometric concept. The idea of splitting a light beam and recombining both parts again dates back to the very beginning of the 19th century. The concept of amplitude beam splitting was first realized in 1881 by A A Michelson in his famous interferometer. It has become a cornerstone for a large variety of fundamental experiments and instrumentation in the infrared, visible, UV and VUV spectral range. Ten years later another amplitude splitting interferometer was built independently by L Zehnder and L Mach. This instrument can also be used as wavefront splitting device. When a pulsed light source like, e.g., a synchrotron or a laser is employed, a different optical path length in the arms of the interferometer simultaneously implies a temporal delay between the pulses travelling via the different paths. It is exactly this fundamental principle which turns an interferometer into a pulse split-and-delay unit (SDU). General demands for the implementation of a SDU at free-electron laser facilities to be considered are: the coverage of a spectral range as broad as practical; an easy change of the intensity ratio in both beams; a large temporal delay; the preservation of the combined intensity through the instrument and; a low risk of damage of the optics.

Biography

Sebastian Roling has completed his PhD at the University of Münster, Germany. He works on extreme ultraviolet (XUV) and hard x-ray instrumentation for free-eletron lasers in the group of Helmut Zacharias at the University of Münster. He is author of more than 20 papers in reputed journals.

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Branislav Vlahovic et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Exciton dynamics and resonant tunneling in coupled quantum dots quantum well tunnel-injection strucutures

Branislav Vlahovic and **Igor Filikhin**
North Carolina Central University, USA

Understanding the peculiarities of tunneling processes is of key importance for the development of optoelectronic devices. We have studied tunnelin and excitonic dynamics in a hybrid InAs/GaAs dot-well, tunnel-injection structure, composed of InAs quantum dots (QDs) and an InGaAs quantum well (QW), engineered to bring the QW ground exciton state into resonance with the third QD excited state. Presented will be results of the influence of variations of geometrical parameters of the QD and QW, such as nanostructures shape, symmetry between QDs, and the effective barrier thickness between the QD and QW layers, on the electron/hole localization and spectral distributions of localized/delocalized states, and the resonant tunneling rate. Shown will be the electron wave functions of the localized and delocalized states (delocalized state is related to the tunneling) calculated for two spectral levels: E=0.345 eV and E=0.444 eV, respectively. The result will be compared with the experimental data, in which the same dot-well complwex was studued by femtosecond pump-probe reflection spectroscopy and cw photoluminescence. We will show that depending on the strength of the QW-QD coupling, resonant tunneling could strongly affects the exciton dynamics in these hybrid structures and that properties of such systems could be significantly different as compared to independent QW or QD systems.

Biography

Branislav Vlahovic is Director of the National Science Foundation Computational Center of Research Excellence, NASA University Research Center for Aerospace Device, and NSF Center Partnership for Research and Education in Materials at North Carolina Central University. In 2004, he was awarded by the Board of Governors of The University of North Carolina Oliver Max Gardner statewide award for his research and contribution to science. He has published more than 300 papers in peer-reviewed journals.

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Scientific Tracks & Abstracts

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Masashi Yamaguchi, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Broadband non-linear THz spectroscopy using gas plasma THz source

Masashi Yamaguchi
Rensselaer Polytechnic Institute, USA

THz spectroscopy has been playing a crucial role in the characterization of materials and chemical/biological sensing because of the abundance of information can be obtained through the excitations and resonant interactions in THz frequency range. Recent development of bright THz sources made it possible to explore the interaction of THz field and materials beyond the linear regime. So far, most of nonlinear THz spectroscopy has been demonstrated using solid state THz emitter in either low frequency or high frequency side of so called THz gap. This is mainly due to the bandwidth limitations of these solid state THz sources. The laser-induced gas plasma source has intense and broad bandwidth covering entire THz gap region without hindered by the phonon absorption in THz emitter itself. In this presentation, frequency resolved THz z-scan spectroscopy and two-dimensional THz spectroscopy using laser induced gas plasma source are demonstrated and discussed. Electronic and phononic contributions were resolved in broadband THz transmission spectra. The field dependence of the spectra showed the apparent existence of THz nonlinear contributions and these contributions are attributed to the combinational mode of zone boundary LA phonons. Two-dimensional THz spectroscopy in THz gap-region was demonstrated using much lower THz field (100 kV/cm) than previous reported (1MV) for higher frequency range (>20THz) in InSb. The utility of broadband nonlinear THz spectroscopy using laser-induced gas plasma provides a way to inspect and evaluate materials in more details.

Biography

Masashi Yamaguchi is currently working as an Associate Professor at the Department of Physics, Applied Physics and Astronomy, Rensselaer Polytechnic Institute. He received his PhD from Hokkaido University and performed his Post-doctoral research at University of California Riverside and Massachusetts Institute of Technology. His expertise include research in ultrafast optical, THz and acoustic spectroscopy; current interests include development of gas plasma THz radiation source and its applications to nonlinear THz spectroscopy and phonon transport in periodic nanostructures. He has over 70 publications.

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Xiaoting Jia, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Bridging nano and macro: Multimaterial multifunctional fibers

Xiaoting Jia
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Recent developments in nanomaterial synthesis and characterization have led to unprecedented material properties and device performance. On the other hand, many important applications see urgent needs for advanced material and device capabilities and require large scale production of devices in order to make a real and significant impact. A big gap exists between the advanced nanotechnology and the macro scale applications. Here, I present a unique material platform that aim to bridge the nano and macro worlds: Multimaterial multifunctional fibers. I will introduce the scalable fabrication of multimaterial fibers via thermal drawing and the application of these flexible fiber devices in neural engineering, tissue engineering, drug delivery and optical sensing. In particular, I will focus on the multimodality fibers for simultaneous optical, electrical and chemical interrogation of neural circuits *in vivo* and the applications of these fibers in a single-step optogenetic study. This technology will allow for more detailed manipulation and analysis of the neural network in deep brain regions of behaving animals than what current technologies achieved.

Biography

Xiaoting Jia is an Assistant Professor in the ECE Department at Virginia Tech. Before joining Virginia Tech, she was a Post-doc Associate in the Research Laboratory of Electronics (RLE) at MIT. She has received her PhD in Materials Science and Engineering from MIT (2011), MS in Materials Science and Engineering from SUNY-Stony Brook (2006) and BS in Materials Science from Fudan University in China (2004). She has authored and coauthored 26 papers published in premier journals including *Science, Nature Biotechnology, Nature Neuroscience, Nature Communications*, etc. Her papers have been cited for over 6000 times in total. Her work on nanomaterials was covered by several media outlets (Nanotechweb, Foresight, etc.). She was a recipient of Materials Research Society (MRS) Graduate Student Gold Medal (2010) and the Translational Fellow at the MIT Research Laboratory of Electronics (2013).

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Takashige Omatsu, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Optical parametric vortex lasers

Takashige Omatsu
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Optical vortex carrys orbital angular momentum (OAM) and donut spatial profile owing to its helical wavefront and it has been widely investigated in a various applications, such as advanced optical manipulations, chiral microfabrications, super resolution microscopes and ultrahigh-speed optical telecommunications. The afore mentioned applications desire strongly wavelength and OAM- versatility in the optical vortex sources. In general, conventional phase elements for the optical vortex generation, designed for a specified lasing frequency, are ill-suited for tunable and high power laser sources. The direct generation of optical vortex modes from a laser cavity is alternative to produce high power optical vortex modes with high quality. A nonlinear frequency extension of optical vortex sources via second or third nonlinear process also provides us to achieve sufficient wavelength versatility in optical vortex sources. In this presentation, we detail the direct generation of optical vortex modes from solid-state laser and fiber laser systems. Also, we address optical parametric vortex lasers based on optical vortex pumped optical parametric laser oscillations in combination with difference frequency generation, which enables the development of ultrabroadband tunable optical vortex laser sources in the visible, near-infrared and mid-infrared regions. Further, we discuss the fractional vortex generation beam from an optical vortex parametric oscillator based on topological charge conservation.

Biography

Takashige Omatsu has completed his PhD in the year 1992 from the University of Tokyo. He is working as professor in the Chiba University. He has published more than 130 papers in journals and has been serving as an Editorial Board Member of Optics Express and Photonics Research. He is also currently working as a Director at Large, the Optical Society (OSA). He was elected as Japan Society of Applied Physics and OSA Fellow.

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Wei Deng et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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PLGA nanocomposites loaded with verteporfin and gold nanoparticles for enhanced photodynamic therapy on cancer cells

Wei Deng, Zofia Kautzka, Wenjie Chen and **Ewa Goldys**
Macquarie University, Australia

PLGA nanocomposites were developed by incorporating a photosensitizer, verteporfin and gold nanoparticles into this polymeric matrix and utilised for enhanced photoynamic therapy on cancer cells. Both enhanced fluorescence and $^1O_2$ generation from verteporfin were observed in this new formulation under both 425 nm LED and 405 nm laser illumination. A maximum enhancement factor of 2.5 for fluorescence and 1.84 for $^1O_2$ generation was obtained when the molar ratio of gold: VP was 5:1 and excited at 425 nm, compared with PLGA doped with verteporfin alone. The experiment results could be explained by the local electric field enhancement of gold nanoparticles. Furthermore, improved therapeutic efficacy in human pancreatic cancer cells, PANC-1, was also demonstrated by using this new formulation following light exposure, indicating the utility of these nanocomposites in enhanced photodynamic therapy.

Biography

Wei Deng received her PhD degree in Chemistry with Nanotechnology background at Macquarie University, Australia in 2012. She was rewarded with a highly competitive Fellowship (Discovery Early Career Research Award) from the Australian Research Council in 2012. She is now a Research Fellow at the Centre of Excellence in Nanoscale Biophotonics, Macquarie University. Her research fields are mainly focused on biomedical applications of liposomes and polymer nanoparticles, in particular, light (or X-ray)-controlled drug/gene delivery systems in cancer treatments.

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Nano-patterned hyperbolic metamaterials for high-frequency nanowire quantum dots single photon source

Feiliang Chen, Mo Li, Qian Li, Hui Zhang, Feng Huang and **Jian Zhang**
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Plasmonic metamaterials at optical frequencies can be used to manipulate the local photonic density of states and tailor the spectrum purposefully and selectively. Here nano-patterned hyperbolic metamaterials (HMM) for high-frequency quantum dots single photon source (SPS) will be presented. Nanowire quantum dots fabricated by top-down method or selective area grown can obtain electrically driven site-controlled SPS, which is promising for integrated chip-scale SPS. However, considering the quantum confinement effect in quantum dots, the diameter of the nanowire is often less than 50 nm, which shows weak photon confinement and low spontaneous emission rate. HMM shows hyperbolic dispersion and corresponds to infinite local photonic density of states, which can be used for broadband Purcell effect radiative decay engineering. But due to the non-radiative behaviour of plasmonic modes in HMM, most of the emission photon will dissipate inside the metamaterial due to ohmic losses in planar HMM. Here we propose a nano-patterned hyperbolic metamaterials for nanowire quantum dots SPS. Combining the broadband enhancement of spontaneous emission from HMM and directional light extraction enhancement from nano-patterned scattering structures, broadband enhancements of both spontaneous emission rate and photon extraction efficiency were demonstrated over the whole visible range. Our research provides a novel idea for high-frequency and high-brightness nanowire quantum dots SPS, which has good prospect in many applications such as quantum information processing.

Biography

Feiliang Chen has completed his PhD from the University of Chinese Academy of Sciences. He is working as Assistant Researcher of Microsystem at Terahertz Research Center. His research focuses on the plasmonic photonic structures, single photon source and nanophotonic devices. He has published more than 13 papers in reputed journals and has been serving as peer reviewer for many journals. He is Member of the Optical Society of America (OSA).

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Surface plasmon polaritons in nanostructured metamaterials

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The presence of electromagnetic waves on two-dimensional interfaces has been extensively studied over the last several decades. Surface plasmonic polariton (SPP), which normally exists at the interface between a noble metal and a dielectric, is treated as the most widely investigated surface wave. SPPs have promoted new applications in many fields such as microelectronics, photovoltaics, near-field sensing, laser technology, photonics, meta-materials design, high order harmonics generation or charged particles acceleration. Recently, it has been shown that by nanostructuring the metal surface, it is possible to modify the dispersion of SPPs or excite the SPPs in a prescribed manner. Hyperbolic metamaterials, being special kind of anisotropic metamaterial with dielectric tensor elements having the mixed signs, have attracted growing attention due to their ability to support very large wave vectors. Their exotic features give rise to many intriguing applications, such as sub-wavelength imaging and hyper-lens that are infeasible with natural materials. Herein, we discovered the new kinds of surface wave on nanostructured metamaterial, crossing the light line with a substantial portion at lower frequencies lying above the free space light line. Interestingly, the propagation of such surface waves was found to be sensitive to the parameters of the materials employed in nanostructures. Furthermore, the Ferrel-Berreman modes were observed under the certain conditions, opening a gateway towards device fabrications.

Biography

Tatjana Gric is currently working as an Associate Professor at Vilnius Gediminas Technical University and a Visiting Professor at Imperial College London. Prior to becoming an Associate Professor, she was a Leading Engineer of PCB Design at AKIS technologies. Her research interests include nano optics, metamaterials and plasmonics. She has authored and co-authored over 30 journal papers, including *Optics Express* and *Journal of Optics.* Currently, she helps in organizing the International Conference of Computational Methods in Sciences and Engineering.

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Ytterbium and bismuth clusters impact on silica-based light guides optical and luminescence performances

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Yb^{3+} ions in silica are powerhouses for single mode fiber lasers yielding kilowatts CW output powers at a wavelength near one micrometer. Bismuth in silica fibers features with a wide band luminescence (from 1 to 2 microns), which is topical for applications particularly in telecom systems. There is a guide to suppose that small-size, bismuth clusters are mainly responsible for the near-infrared luminescence and lasing in Bi-doped silica. A possibility to increase concentration of active species in the core glass of the lightguide is a very important condition for obtaining effective waveguide or fiber lasers and amplifiers. Nevertheless, such increasing may yield the formation of clusters. The dynamic pattern of clustering depends on mutual solubility of oxides, host glass composition, concentration of an activator and preparation technology of the solid solution. Clustering causes quenching of the metastable state excitation responsible for lasing and adds to the optical waveguide scattering loss. In this communication, we present the results of experimental study of optical loss and luminescence performances of Yb^{3+} ions and bismuth in optical waveguides purpose made from fused and unfused silica vie the SPCVD technology. Glasses having different contents of Yb, Al, P, Bi, B and Ge additives have been studied. As the result, a relationship between spectral-luminescent properties of the samples, structure and sizes of the clusters in them have been found.

Biography

Evgeny Savelyev graduated from Lomonosov Moscow State University with a degree in Physics in 2012. He has completed his Post-graduate courses from Kotel'nikov Institute of Radio-Engineering and Electronics of RAS in 2016. The primary subject of his current research is clustering of different activators in silica-based glasses and the influence of the clusters on optical and spectral-luminescent properties of active lightguides. He has talked about the outcomes of his research at various internal and international conferences. He is the co-author of several articles recently published in the *Optical Materials Express* and *Optical Materials*.

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Notes:

S K Sekatskii, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Photon crystal–supported surface electromagnetic waves: A tool to study dynamics of receptor-ligand interactions with living bacteria and cells and to launch ultralong propagating surface plasmons

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We present a label-free biosensor based on registration of the photonic crystal (PC)-supported surface waves. s-polarized surface wave is used to detect changes in the thickness of an adsorbed layer, while p-polarized surface wave provides independent data on the liquid refraction index thus enabling the segregation of surface and volume effects. With this method we achieve mass sensitivity at the level of 0.3 pg/mm^2 and refraction index (RI) sensitivity at the level of 10^{-7} RIU/Hz$^{1/2}$. Other characteristic feature of this biosensor is large, of the order of 1 micron, surface wave penetration depth into an external media, which enables to study intermolecular interactions not only at (a few) monolayers level, but also for such large objects as bacteria, cell organells and even certain cells. We elaborated a chitosan-based protocol of surface modification of the sensor chip enabling to produce sufficiently dense and homogeneous (mono) layers of live *E. coli* bacteria and then these layers have been exploited as a generic "immobilized receptor layer" to study for the first time kinetics of adsorption of different ligands onto their (i.e. living bacteria's) surface. Other applications of our approach are the use of specially prepared PC with thin (8 nm) metal layers to support ultralong plasmon propagation in Pd (for ultrasensitive hydrogen detection) and Co (for magnetoplasmonics) and in Au in blue and UV spectral ranges. (Note that in all these cases this is meaningless to speak about plasmons without PC: the plasmon propagation length is just of the order of wavelength).

Biography

S K Sekatskii has completed his PhD from Institute of Spectroscopy, Russian Academy of Sciences, Moscow. Currently, he is working as a Senior Researcher of Ecole Polytechnique Fédérale de Lausanne, Switzerland (a permanent position). He has published around 150 papers in reputed journals.

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Laser aided shunt removals to improve conversion efficiency in high-efficiency silicon solar cells

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Interdigitated-back-contact (IBC) solar cells are the most efficient single-junction solar cell design. To date, the IBC cell with the best conversion efficiency of 26.6% has been demonstrated. IBC cell design offers a number of advantages over standard front contacted cells. It is largely in part that the IBC cell with interdigitated rear contacts offer benefits such as zero shading loss from metal fingers at the front surface, reduced grid resistance, improved front surface passivation and blue response; since the competing requirement of lateral current transport in the front emitter is removed, high rear internal reflectance owing to the presence of a thick dielectric and near full metal coverage. Utilisation of n-type material leads to reduced light-induced degradation due to the absence of the boron-oxygen complex and improved resilience to metallic impurities. In this contribution, a technique of removing shunts, associated in the development of IBC cells by laser-assisted means is presented. The laser used for the shunt removal is 532 nm diode pump solid state (DPSS) laser. The shunts are caused by residual boron (p+) diffusion within the phosphorus (n+) diffused region following the trench etch that separates the p and n regions. Photoluminescence (PL) imaging showed that apparent shunt regions were removed following this process. Analysis of IBC solar cells by dark IV characterization further confirmed that the shunt resistance was increased by about 30-fold (350 to 11500 $\Omega.cm^2$). The effective removal of shunts has increased the cell efficiency by 0.5% absolute. Carrier recombination induced by laser damage appears to be minimal since an open-circuit voltage of the IBC cells barely changes for pre- and post-laser ablation.

Biography

Ngwe Zin has earned his PhD degree from the Australian National University (ANU). He was with the ANU until 2016 undertaking the Australian Government administered Australian Renewable Energy Agency (ARENA) fellowship award. Together with the ANU PV research team, he has developed 19%, 21.5%, 22.5% and 24% efficient Interdigitated Back Contact (IBC) silicon solar cells. He then started working at the University of Central Florida recently. He also received multiple funding grants by leading or contributing to grant applications through collaboration with research institutes and industry partners. His research interests are the development of novel MEMS/NEMS structures, measurements, device fabrication, characterization, analysis and modeling in high-efficiency and passivated contact silicon solar cells.

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A G Unil Perera, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Heterojunction detectors for multi-band detection with wavelength threshold extension mechanism

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Multi-band photodetectors have received increased attention over the years due to their wide applications in civilan, commercial, medical and military sectors. The photodetectors based on III-V semiconductor heterostructures have been studied extensively for multi-band detection, covering ultra-violet (UV) to far-infrared (FIR) region. Due to material system maturity, $GaAs/Al_xGa_{1-x}As$ heterostructures provide an attractive option demonstrating photodetection covering UV-FIR range. In more recent studies, the conventional spectral threshold limit, that is, $\lambda_t=hc/\Delta$ set by the minimum energy gap Δ, has been overcome owing to a novel detection mechanism arising from the hot-carrier effect in the asymmetrical $p\text{-}GaAs/Al_xGa_{1-x}as$ heterostructures. It has been experimentally demonstrated that a detector with a conventional spectral threshold of ~3.1 µm shows an extended wavelength threshold of up to ~68 µm. In addition to the munti-band detection capability, an important advantage of the wavelength extension mechanism is a lower dark current of the dectctor, which is determined by standard Δ and is evident from close agreement of the experimentally measured dark current data to the theoretical fits based on 3D carrier drift model. Therefore, the wavelength threshold extension mechanism makes it possible to design a detector with its dark current being much lower compared to that of a detector without the extension mechanism. Based on the these studies, the of III-V semiconductor heterostructures offer potential for multi-band detection from UV to FIR by utilizing appropriate detector architectures.

Biography

A G Unil Perera has received the BS degree in Physics (with first class honors) from the University of Colombo, Colombo, Sri Lanka and an MS and PhD degrees from the University of Pittsburgh. He is currently a Regents' Professor at the Department of Physics and Astronomy, Georgia State University, Atlanta. He is a Fellow of the IEEE, SPIE and APS. He has 8 US patents, 4 edited books, 11 invited book chapters and over 180 publications. He is also a Member of the Editorial Board for the *IEEE Journal of Electron Device Society.*

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Transparent and conductive materials for opto-electronic applications

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There has been lately numerous researches devoted to nanostructured transparent electrodes, which play a pivotal role in many modern opto-electronics devices such as solar cells or light-emitting devices. Currently, ITO (Tin-doped Indium oxide), the most commonly used material, suffers from two major drawbacks: indium scarcity and brittleness. This contribution aims at briefly reviewing the main properties of transparent electrodes (TE) as well as the challenges which we still face in terms of efficient integration in devices for several technologies. A more specific focus will be devoted to two promising TE. First, the emerging transparent electrodes based on silver nanowire (AgNW) networks, which appear as a promising substitute to ITO with excellent optical and electrical properties fulfilling the requirements for many applications including flexible devices. In addition, the fabrication of these electrodes involves low-temperature processing steps and upscaling methods, thus making them very appropriate for future use as TE for flexible devices. Their main properties, the influence of post treatments or the network density and nanowire size but as well their stability will be discussed. The second studied TCM is based on Fluor-doped Tin Oxide (FTO) which exhibits interesting opto-electronic properties. We will show that a rather promising TE can be fabricated from S:TiO_2-FTO nanocomposites which shows tuneable high haze factors from almost zero to 60% by using a simple and cost effective method. The resulting optoelectronic properties of such TE appear very well suited for its efficient integration into solar cells.

Biography

Bellet Daniel is an Assistant-Professor at Grenoble University in 1990 and is Professor at Grenoble INP since 1998. He was Junior Member at IUF (French institution to promote excellence in research) in 1999 and is now the Director of the Academic Research Community "Energies" at the Région Rhône-Alpes since 2011. His research is focused on material physics and more specifically now on transparent conductive materials. His works are two-fold aims: fundamental as well as integration of transparent electrodes in devices. He has co-authored more than 120 peer-reviewed publications or proceedings, 8 book chapters and has 28 as h-index.

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Fabrication of nanowires-based devices grown with controlled orientation

Kaddour Lekhal, Si-Young Bae, Ho-Jun Lee, Ousmane I Barry, Yagiang Liao, Shigeyoshi Usami, Yoshio Honda and **Hiroshi Amano**
Nagoya University, Japan

One-dimensional (1D) nanostructures-nanowires have shown promising potential to improve the device performance, such as high-efficiency LEDs. The growth of semiconductor nanowires was discovered for the first-time by Wagner and Ellis in 1964 through the vapor-liquid-solid (VLS) mechanism. Since then, this method has become widely used for synthesizing semiconductor nanowires. However, the growth of III-nitride nanowires with controlled orientation is challenged limited by the nature of the catalyst or the substrate used for the growth. The control of following parameters is important for large-scale integration of nanowires into practical devices: the vector (x, y) on a plane, orientation (ψ), length (L) and diameter (d). First, the growth mechanism based on nucleation theory and key issues related to the growth of III-nitride semiconductors nanowires will be presented. After that, some solution will be proposed to grow GaN nanowires with controlled orientation by using VLS approach or selective-area-growth (SAG) approach. We show that GaN nanowires grown on sapphire substrate with VLS approach can be controlled by tuning the atomic percent ratio of Au to Ni in HVPE environment. Pure Ni catalyst resulted in the growth of single-crystalline horizontal GaN nanowires, whereas mixture Au/Ni catalyst resulted in the growth of inclined nanowires with exceptional length and defect-free structure. Subsequently, we focus on the growth of GaN nanowires by SAG-MOCVD on silicon substrates; in particular we are interested to control the direction by inserting an orientation-induced buffer layer deposited by a directional sputtering before the nanowires growth. Highly ordered nanowires along the surface normal direction to parallely inclined GaN nanowires were obtained. HR-TEM and photoluminescence measurements indicated that the nanowires not only are free from structural defects (stacking faults or dislocations) but also have a good optical quality regardless of the orientation. Field effect transistors (FETs) based on horizontal nanowires have been fabricated by using conventional photolithography. The FETs exhibit reasonable electrical properties similar to other vertical nanowires, confirming the good structural quality of our nanowires. This example highlights the potential of the controlled oriented nanowires for the large-scale integration into practical devices.

Biography

Kaddour Lekhal received his PhD in Physics - Material Science from the University Blaise Pascal (France) in 2013 followed by Post-doctoral training at National Center for Scientific Research (CNRS). He is currently working as a Researcher at Amano lab., Nagoya University. His work focuses on the synthesis and characterization of nano-structures, particularly the growth of long III-V semiconductor nanowires by HVPE and MOVPE. He is deeply interested in developing new devices using long nanowires for LEDs, LDs and solar cells. He has published more than 30 papers in reputed journals.

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High precision fast line detection of alignment and coupling for optoelectronic devices

Yu Zheng[1], **Ji-an Duan**[1], **Yanbin Peng**[2] and **Bo Chen**[2]
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Optoelectronic devices are the foundation of optical fiber communication system and optical fiber sensor system. With the development of optical fiber communication, alignment and between planar optical waveguide chip (POW chip) and optical fiber array (OFA) have become the focus of many industries. In general, the alignment is performed passively and actively. During passive alignment, the two optical components may be placed according the expected desired orientation. Machine vision can be used in passive alignment to locate the position of the two optical components, then used to guide the movement of the motor stage for the alignment. Optical component edge detection is one of the key steps of machine vision in alignment. This paper has proposed a line detection algorithm based on the progressive probabilistic Hough transform (PPHT) and iteratively reweighted least squares (IRLS) algorithm for alignment between planar optical waveguide chip and optical fiber array. The experiment results show that the detection angle error is less than 0.005° and the time consumption is less than 0.5 s through the proposed algorithm. Besides, it also can accurately fit optical component edge with some non-random factors. Therefore, the proposed new algorithm has the advantages of high precision, fast computing speed and good robustness and it can successfully realize the high-precision fast line detection of optical component edge.

Biography

Yu Zheng has completed his PhD in the year 2012 from Central South University. He is the Associate Professor of Central South University. He has published more than 50 papers in reputed journals and has more than 30 patents in China. His current research interest is precision engineering, precision motion control and optoelectronic device packaging.

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In situ and *ex situ* optical characterization of nitride semiconductor crystal for advanced optical and power electronic devices

S Nitta, Z Liu, S Usami, Z Ye, K Nagamatsu, M Kushimoto, M Deki, A Tanaka, Y Honda, M Pristovsek and **H Amano**
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More compact, lighter and long lifetime mobile devices and more environmental friendly power supplies are being developed by utilizing nitride semiconductors such as AlN, GaN, InN and their alloys. Together with high-efficiency InGaN blue light emitting diodes (LEDs), high-spec and long-lifetime portable devices and general lighting will play an important role in a sustainable modern 21st century society. AlGaN/GaN high electron mobility transistors have been used in new-generation mobile communication bases, delivering more data with lower consumption. Finally, ultraviolet LEDs are widely used for curing and germicidal disinfection. The potential of nitride semiconductors is not limited to these applications, but to achieve their potential, optics can help a lot. High-quality, high-indium-content InGaN is a prerequisite for long-wavelength visible emission from green to red. However, InGaN is difficult to grow with higher indium content because of the lattice parameters and growth conditions mismatch between GaN and InN. Indium fluctuation and strain relaxation introduced by morphological degradation are substantial challenges. In order to monitor crystal properties and surface evolution during growth, we used a three-wavelength laser beam scattering *in situ* monitoring system on a horizontal metalorganic vapor phase epitaxy reactor. For electronic devices, *ex situ* emission microscopy is a powerful tool for the analysis of critical defects on vertical GaN power electronic devices. The optical emission image of a biased device reflects leakage information and allows us to identify the properties of defects.

Biography

S Nitta obtained his PhD in 2003 from Meijo University, Japan. Since then, he has been developing MOVPE equipment and high-efficiency blue and white LEDs at companies. In 2015, he joined Nagoya University as a designated Associate Professor. His research is focused on the epitaxial and bulk crystal growth of nitride semiconductors and their applications to future optical and electronic devices.

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Defect reduction of GaN nano rods on hetero-substrates: Behaviors of basal stacking faults

Si-Young Bae[1], Kaddour Lekhal[1], Yoann Robin[1], Ho-Jun Lee[1], Ousmane I Barry [1], XuYang[1], Yaqiang Liao[1], Yoshio Honda[1], Hiroshi Amano[1], Jung-Wook Min[2] and **Dong-Seon Lee[2]**
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Pulsed-mode growth in metal-organic chemical vapor deposition (MOCVD) has provided us attractive means to obtain homogeneous and elongated nano rod array in GaN epitaxy on heterosubstrates. Nowadays, ultra-elongation behaviors of pulsed-mode growth give rise to potential of growing single crystalline GaN on extremely challenging substrates such as Si(001) and amorphous substrates. Our finding in such harsh epitaxy has indicated that high quality of GaN nanorods can be achieved above the critical height (~500 nm) from the bottom of nanorods, while many structural defects are observed at the interface between the GaN nanorod and the heterolayers. Obviously, the dislocation density of epilayer is highly dependent on the lattice mismatch of the grown layers. In this presentation, we compare these structural imperfections of several hetero-substrates, e.g., sapphire, Si and amorphous quartz. Especially, we focus on the basal stacking faults (BSFs) of GaN nano rods, which were tremendously suppressed, compared to conventional epi-layers. The reduction and corresponding type of BSFs were identified by observing X-ray diffraction, thereby quantitatively proving the suppression of the crystal imperfection with selective-area growth. Moreover, to take into account the behaviors of BSFs in GaN nano rods, high-resolution transmission electron microscopy and low-temperature photoluminescence measurement were carried out. The suppression of BSFs in GaN nano rods were clearly observed by identifying defect-related luminescence peaks in the optical characterization. Therefore, the localized stain of nano architectures can provide better platform of crystal growth to overcome typical defects generated in the conventional epitaxy and finally enhance the efficiency of optoelectronic devices.

Biography

Si-Young Bae has completed his PhD from Gwangju Institute of Science and Technology (GIST) in South Korea and his Post-doctoral studies from Nagoya University, Institute of Materials and Systems for Sustainability (IMaSS) in Japan. He is currently working as a Researcher of IMaSS in Nagoya University. His research interests have been focused on crystal growth and characterization of III–N wide bandgap compound semiconductors for optoelectronic device applications. He has published more than 25 papers in reputed journals.

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Synthesis and characterization of organic mechanoluminescent materials

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Mechanoluminescence (ML) is a phenomenon where light emission is induced by a mechanical action on a solid. The ML is classified into fracto-, plastico- and elastico-MLs according to an excitation mode of the electrons. When the material structure is fractured then the electrons are excited to the higher energy levels followed by the relaxation process of electrons to lower energy levels. The energy difference is released as a light. This kind of luminescence is observed as a result of the plate force during and just earlier to earthquake. The ML was also detected by a peeling of the tape in a vacuum. We have synthesized the europium doped dibenzoylmethide triethylammonium as an organic mechanoluminescent material. The synthesis was completed at a very low temperature of 70°C by a controlled slow cooling method. The synthesized material showed a very strong mechanoluminescence at 612 nm in the visible region. In this study, the ML material has been synthesized with an addition of 1-ethenylpyrrolidin-2-one [(polyvinylpyrrolidone) (PVP)]. We have investigated effects of the ligands, EuI_2, $EuBr_2$ and $EuCl_2$ on the ML substance structure, molecular orbital electron distributions of the ligands and the ML and the photoluminescence. The ML material structure was characterized by using the nuclear magnetic resonance spectroscopy (NMR), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD) and Gaussian DFT/B_3LYP/6-31G (d,p) software. The ML properties were observed by using the multichannel spectroscope.

Biography

Kenji Murakami has completed his PhD in the year 1983 from Osaka University, Japan. He is working as a Professor in the Department of Engineering, Graduaate School of Integrated Science and Technology, Shizuoka University. He has published seven book chapters, more than 100 papers in reputed journals and has been serving as a Referee of reputed journals.

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Devki N Talwar, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Spectroscopic phonon and extended x-ray absorption fine structure measurements on 3C-SiC/Si (001) epifilms

Devki N Talwar
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Comprehensive experimental and theoretical studies are reported to assess the vibrational and structural properties of 3C-SiC/Si (001) epilayers grown by chemical vapor deposition in a vertical reactor configuration. While the phonon features are evaluated using high resolution infrared reflectance (IRR) and Raman scattering spectroscopy (RSS) the local inter-atomic structure is appraised by synchrotron radiation extended x-ray absorption fine structure (SR-EXAFS) method. Unlike others, our RSS results in the near backscattering geometry revealed markedly indistinctive longitudinal and transverse-optical phonons in 3C-SiC epifilms of thickness d<0.4 μm. The estimated average value of biaxial stress was found to be an order of magnitude smaller while the strains were two-orders of magnitude lower than the lattice misfits between 3C-SiC and Si bulk crystals. Bruggeman's effective medium theory was utilized to explain the observed atypical IRR spectra in 3C-SiC/Si (001) epifilms. High density intrinsic defects present in films and/or epilayer/substrate interface were likely to be responsible for (a) releasing misfit stress/strains, (b) triggering a typical features in IRR spectra and (c) affecting observed local structural traits in SR-EXAFS.

Biography

Devki N Talwar graduated from Allahabad University in India in 1976 with a PhD degree in Condensed Matter Physics. From 1977-80 he worked as a Visiting Scientist at the Commissariat a'l Energie Atomic, Saclay, Gif-sur-Yvette, France with M Vandevyver. While at Saclay he collaborated with theoretical /experimental group of M Balkanski, including Karel Kunc, M Zigone and G Martinez and supervised three PhD theses. In January 1980 he joined the Physics Department, University of Houston as a Visiting Professor and collaborated with P C S Ting on problems related to the electronic properties of defects in semiconductors and supervised a PhD student. From 1982-87 he was a Faculty at Texas A & M University. He joined the Physics Department at Indiana University of Pennsylvania in 1987, supervised 20 MS theses. Since 2007-2014, he has served as the Chairperson of the Physics Department.

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Juan Carlos Rendón-Angeles, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Insights of the hydrothermal synthesis of scheelite-structured powders in the $SrMoO_4$-$SrWO_4$ system: Structure and luminescence characterization

Juan Carlos Rendón-Angeles
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The present experimental work relates to a study of the hydrothermal powder processing of a functional luminescence compound. Strontium molybdate, strontium tungstate and their solid solutions were successfully prepared under hydrothermal conditions. The soft chemical method studied comprises the usage of $SrSO_4$ (celestite) ore as the precursor of Sr. Particle crystallisation occurred rapidly because of a single step reaction, which was promoted using a highly concentrated alkaline media (5 M NaOH solution) at a temperature below 200°C for 2 h under vigorous stirring at 130 rpm. In all the cases investigated, the particle crystallisation took place without the formation of secondary phases, while the ionic species representing impurities in the precursor mineral remained dissolved in the alkaline fluid. Differences in the morphology of the particles were observed when the W content varied from 25 mol% and 75 mol%. Additionally, the mechanism associated with the reaction and precipitation process investigated is discussed in detail, together with a crystalline structural characterization. Photoluminescence analyses indicate that blue and green emission responses and its intensity can be attenuated when incorporating W contents between 10 mol% and 60 mol%. Structural analysis conducted by Rietveld refinement and FT-Raman methods indicated that a localized distortion of the MO_4 tetrahedral site of the scheelite structure is produced by the disordering of the Mo and W ions resulting in the blue and green emission attenuation. Hence, these present results indicate the intermediate $SrMo_{1-X}W_XO_4$ particles have a potential to operate as a phosphorous-like light emitting material.

Biography

Juan Carlos Rendón-Angeles has received his degree of PhD in Engineering from the Faculty of Mechanical Engineering, Tohoku University Japan (1997). His early career holding a Postdoctoral position (1997-2000) at the Research Laboratory of Hydrothermal Chemistry enabled him to study the basic fundamental chemistry of the mechanisms related to hydrothermal reactions. He has joined the Department of Ceramic Engineering at CINVESTAV Saltillo Campus in 2000 and was promoted to Associate Professor in 2009-at present. He has published more than 50 papers in reputed journals and has been serving as an Reviewer of reputed journals.

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Notes:

Hao-Hsiung Lin, J Laser Opt Photonics 2017, 4:4 (Suppl)
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MBE growth of InAs nanowires on Si

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InAs nanowires grown on Si are promising and have attracted a lot of attention since its potential in applications to electronic and optoelectronic devices on Si platform have been deciphered. The small contact area of the nanowires is able to mitigate the large lattice and thermal mismatches in between InAs and Si. However, the orientation control for InAs nanowires on Si is an issue for the growth. Basically, the axial direction of InAs nanowire is along the predominate <111>B family. The non-polarity of Si further complicates the issue and allows four <111>B directions for InAs nanowires on either (001) or (111) Si substrate. To control the direction of InAs nanowires on (001) Si, we propose a two-step growth method utilizing the shadowing effect in MBE growth to grow InAs nanowires from a SiO_2/Si nanotrench structure. In the first step, we aligned the In beam with the longitudinal axis of the trench. Due to a shadowing effect resulting from one trench wall, InAs nucleated on the opposite trench end. In the second step, the growth proceeded with substrate rotation to elongate the nanowire. Because the trench was along [-110], the narrow trench width effectively blocked the growth of InAs nanowires perpendicular to the long axis of the trench. In this manner, we were able to control the growth direction. Up to 94% of the nanowires were along the desirable direction. Cross-sectional TEM was used to investigate the structural properties of the nanowires as well as the growth mechanism of nanowires and clusters in the trenches. We found that the nanowires developed from Si residue at the trench end with low misfit dislocation density. While the cluster developed at the center of the trench has high misfit dislocation density at InAs/Si interface. Details of the growth mechanism will be presented.

Biography

Hao-Hsiung Lin received his PhD degree from National Taiwan University in 1985. He has been working as a Professor with the Department of Electrical Engineering at National Taiwan University since 1992. His research interests are on the MBE growth of dilute nitrides, mid-infrared semiconductors and nano-hetero-epitaxy of compound semiconductors. He has published more than 170 papers in reputed journals. He is a Member of the Chinese Institute of Engineers and a Senior Member of IEEE.

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Notes:

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Recent progress of AlGaN-based deep-ultraviolet light-emitting diodes

Masafumi Jo and **Hideki Hirayama**
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AlGaN deep ultraviolet light-emitting diodes (DUV-LEDs) and laser diodes (LDs) are attracting a great deal of attention, since they have the potential to be used in a wide variety of applications, such as for sterilization, water purification, UV curing and in the Medical and Biochemistry fields and so on. As a result of recent developments in AlGaN DUV LEDs, high internal quantum efficiencies (IQE) of more than 60-70% have been achieved by reducing the threading dislocation density (TDD) of the AlN, by improving the crystal growth technique and/or by the introduction of AlN single crystal wafers. However, the wall-plug efficiency (WPE) of AlGaN DUV-LEDs still remains at several percent. The first target for the efficiency of AlGaN DUV-LEDs is to go beyond an efficiency of 20%, which would make them comparable to mercury lamps. In this work, we demonstrate an external quantum efficiency (EQE) of over 20% in an AlGaN DUV-LED by a significant improvement of light extraction efficiency (LEE). In order to increase LEE of DUV LEDs, we introduced a transparent p-AlGaN contact layer, a highly reflective p-type electrode and AlN template buffer fabricated on patterned sapphire substrate (PSS). By introducing transparent p-AlGaN contact layer and reflective electrode, LEE was enhanced by approximately 3 times. We also tried to increase wall plug efficiency (WPE) by reducing the applying voltage that was increased by increasing p-AlGaN contact resistance. By optimizing p-AlGaN layer structures, we have succeeded in reducing the operating voltage of DUV LED and obtained record WPE of 9.6%.

Biography

Masafumi Jo has received his PhD from the University of Tokyo in 2003. He is the Researcher of Quantum Optodevice Laboratory at RIKEN. He has worked on fabricating nano-structured solid-state light sources.

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Extended short wave infrared photodetectors

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Extended short wave infrared (eSWIR) photodetectors are used in night vision applications which detect reflected night glow and black body radiation. They also detect atmospheric gases which have high absorption coefficient between 2.5 and 3 μm wavelengths. Type II superlattice (T2SL) epi-structures grown on GaSb and InP substrates, with flexible cut-off wavelength ranging between 2 to 3 μm and a homogenous InPSb layer, lattice matched to a GaSb substrate, with a photoluminescence peak at 2.9 μm, are candidate technologies for eSWIR detectors. In this study, we fabricated and characterized photodetectors based on three different technologies: T2SL InAs/AlSb, T2SL InGaAs/GaAsSb and InPSb. The epi-grown layers were characterized using photoluminescence (PL) and high resolution XRD (HRXRD) tools and the photodetectors performances were measured and compared using semiconductor device parameter analyzer, Fourier transform infrared (FTIR) and Black Body tools.

Biography

Doron Cohen Elias has completed his PhD from Technion, Israel Institute of Technology. From 2012 to 2014, he was a Post-doctoral at the University of California Santa Barbara (UCSB). Since September 2014, he is a Research Scientist with the Nuclear Research Center, Soreq (Soreq NRC). He has published more than 30 publications in reputed journals and conferences.

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Room-temperature-protonation-driven optoelectronic device with water-gated thin-film-transistor structure

Takayoshi Katase[1,2,3] and **Hiromichi Ohta**[2]
[1]Tokyo Institute of Technology, Japan
[2]Hokkaido University, Japan
[3]Japan Science and Technology Agency, Japan

Using the flexible valence state of transition-metal ions in transition metal oxides (TMOs), the optoelectronic properties can be largely controlled through the electronic phase transitions. Protonation of TMOs is one of the modulation techniques because the proton in TMOs acts as shallow donors to donate an electron into TM cations, resulting in a dramatic change in the optoelectronic properties. However, the protonation needs high-temperature heating process or electrochemistry in liquid electrolyte and thus it has not been suitable for the device application. In this talk, we propose a new approach of RT-protonation of TMOs by using a solid-state thin-film-transistor-type structure with "liquid-leakage-free water", in which water is infiltrated in a nanoporous glass, as the gate insulator and demonstrate the RT-protonation-driven infrared (IR) transmittance tunable metal-insulator conversion device by using a thermochromic vanadium dioxide (VO_2) as the active channel layer. Alternative positive and negative gate-voltage applications induce the reversible protonation/deprotonation of VO_2 channel and the double-digit sheet-resistance modulation and 49% modulation of IR-transmittance were simultaneously demonstrated at RT by the metal-insulator phase conversion of VO_2 in a non-volatile manner. The present device is operable by the RT-protonation in all-solid-state structure and thus it will provide a new gateway for the development of functional optoelectronic devices.

Biography

Takayoshi Katase is currently working as an Associate Professor of Laboratory for Materials and Structures at Tokyo Institute of Technology, Japan. He obtained his BS from Tokyo Institute of Technology, Japan in 2007 and MS from Tokyo Institute of Technology, Japan in 2009 and a PhD from Tokyo Institute of Technology, Japan in 2012. In 2012, he worked as a Post-doctoral Researcher in FIRST Program, JSPS. In 2012, he worked as an Assistant Professor of Research Institute of Electronic Science, Hokkaido University, Japan. In 2016, he worked as a Researcher in PRESTO (Scientific Innovation for Energy Harvesting Technology), JST, Japan.

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Hydride vapor phase epitaxy growth of III-V nanostructures for high performance devices

Geoffrey Avit
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III-V semiconductors have a direct bandgap that can be tuned through alloy engineering and therefore appear as very interesting for solar-cells, solid-state lighting and high power applications. The performances of current devices may be increased through the use of nanostructures and nanowires which look promising for the integration of high efficiency devices. Nanowires exhibit great properties such as efficient strain relieving capability and large specific area. Growth on silicon substrates and core-shell structures can be considered as well. Still, the production of nanowire-based devices faces material challenges related to morphological, structural, optical and electrical properties which are very much linked to the synthesis process. This presentation will focus on hydride vapor phase epitaxy, which is a growth process implemented in a hot wall reactor using chloride precursors and showing unique features regarding the growth of III-V and III-nitride nanowires. For example, self-catalyzed GaAs nanowires were grown on silicon at a faster growth rate (60 $\mu m.h^{-1}$) exhibiting a constant zinc-blende crystalline phase, for the potential fabrication of GaAs-based photonic devices on Si. For III-nitride materials, InGaN nanowires demonstrating the entire composition range were grown by using a method compatible with the standard GaCl-based GaN growth process. Photoluminescence coupled with transmission electron microscopy measurements showed that these nanowires could overcome the so-called green gap and stretch the limits of solar cells efficiency. By taking advantage of the large growth rates anisotropy resulting from the use of chloride precursors, we could freely tune the shape of GaN wires on masked substrates with (sub)-micrometric apertures.

Biography

Geoffrey Avit has completed his PhD in the year 2014 from Blaise Pascal University. He is currently a Post-doctoral Reseacher at Institut Pascal (France), a leading laboratory in the field of HVPE growth of III-V nanostructures.

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Scientific Tracks & Abstracts

Day 2-Breakout

John G Ekerdt, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Study of low density sites on silicon dioxide surfaces using fluorescent probes and the role of these sites in nucleation of semiconductor and metal films

John G Ekerdt
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Characterization of low density sites on planar oxide surfaces remains a challenging task. Such sites are believed to play an important role in catalysis and particle/film nucleation, although the inability to directly observe these sites limits our understanding of these processes. We have developed a technique that enables detection of low density sites on planar surfaces using fluorescent probe molecules. Derivatives of perylene, a high quantum yield fluorophore, with various functional groups were used to titrate surface sites in vacuum. The functional group was chosen to chemically bind to the desired site and *in situ* photoluminescence (PL) measurements were used to determine the density of sites and learn about their distribution. An estimated detection limit of $<10^{10}$ sites/cm^2 is possible with this technique. We shall discuss our work using fluorescent probes to study sites on the silica surface. In particular, results of our studies of strained siloxane (density~10^{12} cm^{-2}) with perylene-3-methanamine and oxygen vacancy defect (OVD) sites (density~10^{11} cm^{-2}) with 3-vinyl perylene will be presented. Particle nucleation on oxides is suspected to involve defects that trap adatoms and form critical nuclei. Using this technique, the role strained siloxane and oxygen vacancy sites play in trapping adatoms during the nucleation of germanium and ruthenium particles on silica surfaces is examined.

Biography

John G Ekerdt earned his PhD from the Univerisity of California, Berkeley in 1979. He is currently working as the Associate Dean for Research in Engineering and the Dick Rothwell Endowed Chair in Chemical Engineering at the University of Texas at Austin. He has more than 300 refereed publications, two books and seven US patents. His current research interests focus on the surface, growth and materials chemistry of metal, dielectric and perovskite films and nanostructures by developing and understanding the reactions and chemistry that control nucleation and growth of films and nanostructures.

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Kuniharu Ijiro, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Active gap SERS with plasmonic nanostructures on hydrogels for the sensitive detection of biomacromolecules

Kuniharu Ijiro
Hokkaido University, Japan

Surface-enhanced Raman scattering (SERS) is a promising approach for the label-free detection of molecules. The morphology of metal nanostructures is a primary factor determining the magnitude of signal enhancement on Raman scattering. In general, a narrower gap can form a stronger electromagnetic field, but it makes insertion of analytes into a hot spot more difficult. This is a trade-off when using conventional SERS substrates. We have fabricated tunable plasmonic nanostructures, the gap distances of which can be controlled by the salt concentration, through the formation of gold nanoparticle self-assembled thin films on solid substrates and their transfer onto poly-acrylic acid gel. The extinction spectra shifted reversibly with volume change of the gel according to the degree of swelling. When the target molecules were injected onto this substrate as the gaps were opened (widened) and SERS was measured after the gaps were closed (narrowed), the signals became stronger than that observed without any gap control. This method can be served for the sensing of macromolecules such as proteins.

Biography

Kuniharu Ijiro received his Doctor of Engineering degree from Tokyo Institute of Technology, Japan in 1991. He worked as an Alexander von Humboldt Foundation Research Fellow at Ringsdorf's group in Johannes Gutenberg University Mainz, Germany. He is working as the Professor and concurrently the Deputy Director of the Research Institute for Electronic Science (RIES) and the Professor of the Global Institution for Collaborative Research and Education (GI-CoRE), Hokkaido University. He is interested in biomimetic self-assembly of nanomaterials and polymers to create novel functions.

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Tatsuo Shiina, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Non-diffractive beam in random media

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Beam propagation has been given strong attention in a variety of applications that is, medicine, remote sensing and information science. Especially, the beam propagation in highly scattering media, which is called random media, gathers highly emotion to control from the past to the present. In general, the multiple scattering gets rid of beam characteristics such as intensity distribution, phase front and polarization. In this study, self-converging effect of a polarized annular beam was applied in random media. The collimated annular beam of a few tens millimeters takes a few hundred meters to transform its beam shape into the non-diffractive beam in air, while this transformation was shorten only to less than a few tens centimeters in random media with a certain concentration. The generation condition of the non-diffractive beam in random media is not only the incident beam and the media characteristics, but the obserbation condition is also important. The specialized detector was installed with narrow field of view in our experiment. The detected beam has its optical characteristics of the non-diffractive beam. It has the center peak and side rings in optical axis and keeps its waveform in its propagation. Media concentration and propagation distance control the generation and the waveform of the non-difractive beam. The center peak of the non-difractive beam has the unique behavior due to the media concentration. This study indicates the generation of the non-diffractive beam in random media, its waveform structure on the isotropic multiple-scattering and the unique behavior of the alternative change of its waveform.

Biography

Tatsuo Shiina received his BE, ME and DE degrees in Electrical Engineering from Science University of Tokyo, Tokyo, Japan. He is working as an Associate Professor at Graduate School of Advanced Integration Science, Chiba University. He studies near range compact lidar for disaster prediction, portable OCT for industrial use and beam propagation in random media.

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Giedre Samuoliene, J Laser Opt Photonics 2017, 4:4 (Suppl)
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LED's for horticulture: Novel insights in plant cultivation

Giedre Samuoliene
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Advances in light technology are rapidly developing, the light-emitting diode (LED) technology as supplementary light in greenhouses, phytofactories or other closed environment growing chambers is a powerful tool for purposeful and appropriate plant cultivation. LED lighting, due to its technical possibility to control dynamic or continuous light spectrum, intensity, frequency of each component and period is useful for research applications, as well as such lighting is useful for growers, due to energy saving properties. The development of agronomic research ensures the public demand for vegetable food, feed and industry raw materials. Plant physiology is considered to be theoretical background for agronomy (crop production and horticulture). Knowledge of plant physiology patterns and management of crop photosynthetic indices by technological tools enables to control formation of productivity elements and quality of production. Moreover, response to light is not a simple linear signal transduction pathway, but it is integrated information outcome of various photoreceptors, which act through complex network of interacting signaling components. This enables to induce weak photo stress in purpose to manipulate plant antioxidant potential. Thus, such plant physiologycal researches allows to know plant functioning mechanisms, control processes of growth and development, realize potential of biological productivity. The opportunity to control processes of growth, biological productivity and nutritional quality using traditional high-pressure sodium and/or innovative light-emitting diode lighting will be presented.

Biography

Giedre Samuoliene has completed her PhD from Aleksandras Stulginskis University (Biomedical Sciences, Agronomy). She is the Chief Researcher of Laboratory of Plant Physiology and the Deputy Director for Research of Lithuanian Research Centre for Agriculture and Forestry, Institute of Horticulture and Lector at Aleksandras Stulgisnkis University. She has published 25 in ISI WoS data base journals with impact factor, 24 publications in ISI WoS data base journals without impact factor. She received National Science Award (2014, with co-authors), Silver Medal of Vytautas Magnus University (2015) and Scholarship of the Lithuanian Academy of Sciences (2012-2013).

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Dong Li, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Parity detection achieving Heisenberg limit in an SU(1,1) interferometer with coherent and squeezed vacuum input states

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One common tool for precision measurement is interferometer. Compared with the conventional SU(2) interferometer, the SU(1,1) interferometer utilizes parametric amplifiers for wave splitting and recombination. Due to parametric amplification process, SU(1,1) interferometers have a better phase sensitivity than SU(2) ones under the same condition of input states. With squeezed vacuum input, the phase measurement sensitivity of SU(1,1) interferometers can be improved. This improvement is due to noise reduction. Here, we theoretically study parity detection on an SU(1,1) interferometer with coherent mixed with squeezed vacuum input states. Parity detection counts the evenness or oddness of the photon number in one output mode. Our work shows that parity detection reaches below Heisenberg limit when the input coherent and squeezed vacuum light are mixed in roughly equal proportions with a strong parametric amplifier strength. Compared with homodyne detection, parity detection has a slightly better phase sensitivity with coherent and squeezed vacuum inputs and parity detection is more suitable than homodyne detection in some certain situations. Lastly, we also investigate the Quantum Cramer-Rao bound for SU(1,1) interferometers, showing that phase measurement sensitivity does not surpass Quantum Cramer-Rao bound even though it surpasses Heisenberg limit. Parity detection was initially proposed to applied with input N00N states and Fock states in SU(2) interferometers. Now, parity detection invades SU(1,1) interferometers.

Biography

Dong Li has completed his PhD from East China Normal University. He is the Assistant Researcher of Microsystem and Terahertz Research Center. His research interests include quantum metrology and quantum interferometry.

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Notes:

Hua Guan et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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A comparison of two $^{40}Ca^+$ single ion optical clocks at 5×10^{-17}

Hua Guan, Yao Huang and **Kelin Gao**
Chinese Academy of Sciences, China

A comparison of two optical clocks and a detailed study of the systematic frequency shifts of each $^{40}Ca^+$ single-ion optical clock were carried out in WIPM. A Ti:sapphire laser at 729 nm is frequency stabilized to an ultra-stable ultra-low thermal expansion coefcient (ULE) cavity by means of Pound-Drever-Hall method. 1 Hz linewidth and 2×10^{-15} frequency stability at 1-100 s is realized. Which is used for the probe of $^{40}Ca^+$ optical transition. After compensating for the micromotion, the two optical clocks both reach an uncertainty level of a few parts in 10^{-17}. The dominant source of uncertainty is the blackbody radiation (BBR) shift after minimizing the micromotion-induced shifts. The BBR shift is evaluated by controlling and measuring the temperature at the trap center. With a measurement over one month, the frequency difference between the two clocks is measured to be 3.2 (5.5)$\times10^{-17}$. Due to improvement of the clock laser and better control of the optical and electromagnetic feld geometry and the laboratory conditions, a fractional stability of 7×10^{-17} in 20,000 s of averaging time is achieved. The absolute frequency of the $^{40}Ca^+$ 4s $^2S_{1/2}$- 3d $^2D_{5/2}$ clock transition is measured to be 411 042 129 776 401.7 (1.1) Hz, with a fractional uncertainty of 2.7×10^{-15} using the GPS satellites as a link to the SI second.

Biography

Hua Guan has completed his PhD from Wuhan Institute of Physics and Mathematics (WIPM), The Chinese Academy of Sciences (CAS) and he visited NIST Boulder twice between 2008-2010. He is a Professor of WIPM. His major is Precision Measurement Physics. And his research interests are single-ion optical clocks and trapped ion precise spectroscopy. He has published more than 20 papers, including *Phys. Rev. Lett., Phys. Rev. A, Appl. Phys. B, Rev. Sci. Instum.* etc.

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Konstantin Lyakhov et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Intensification of boron isotopes separation by the laser field manipulation within the method of isotopes separation by selective condensation retardation in overcooled gas flow

Konstantin Lyakhov, Alexander Pechen and **Heon-Ju Lee**
Jeju National University, South Korea

Laser pulse shape manipulation can serve as an efficient tool for selective quantum level population control. In this paper it will be demonstrated parametrization of laser pulse shape, parameters variation of which can be implemented by an optical mask applied to the seed pulse. Its further amplification is provided by subsequent cell filled by CO_2 laser medium, the output laser pulse is subject to use in the method of isotopes separation by selective retardation of condensation in overcooled gas flow(SILARC), for selective excitation of all four chlorine isotopologues of $11BCl_3$ with small time delays, corresponding to respective levels population build up times. It is acheieved by that laser pulse emission spectrum has modes matching absorption lines of different chlorine isotopologues in $11BCl_3$. In order to provide the largest interaction volume of gas flow with laser beam, the latter should intersect it as many times as possible and ambient gas pressure should be maintained on the level, such that gas flow remains planar over all its extension from the nozzle outlet to the skimmer inlet. In order to save expensive laser photons, we assume, that reflectivity of mirror walls is very high and resonator condition inside irradiation cell is fulfilled. Comparison of our results for enrichment factor and product cut time evolution with one mode continuous excitation indicates that pulsed irradiation with specifically designed laser pulse shape allows to increase extractable per cycle isotope quantity significantly at the same energy expenses. Calculations were carried out at the temperature and initial laser intensity, corresponding to the maximum of isotope production over gas flow transition time across irradiation cell. Gas flow static pressure and BCl_3 molar fraction in carrier gas-argon are chosen to fixed at some small values minimize isotope scrambling.

Biography

Konsantin Lyakhov has completed his PhD from Frankfurt University. He is working as a Research Professor in Nuclear and Energy Engineering Department of Jeju National University. He has published 12 papers in SCOPUS indexed journals.

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Notes:

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Yanbo Bai, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Characterization of optically pumped semiconductor lasers in pulsed mode

Yanbo Bai
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Self-heating of optically pumped semiconductor (OPS) chip has been identified as the major limiting factor of power scaling in OPS-based lasers in continuous wave (cw) mode. In this work, characterization of OPS lasers in short pulse (100 ns) and low duty cycle (1%) regime, where self-heating is negligible, as a function of the heat sink temperature is presented. This data, combined with a rigorous thermal model, allows us to predict OPS chip performance in new cooling configurations for power scaling. Furthermore, the temperature dependent pulsed mode measurement data can be used to calibrate a temperature dependent gain model based on the 8-band kp method, taking the Auger coefficient as the fitting parameter, thus allowing for predicting the performance of new structures. The pulsed-mode testing proved to be a valuable technique to reveal the OPS chip quality independent of the thermal management and to validate the OPS gain model.

Biography

Yanbo Bai has completed his PhD from Northwestern University. His research led to develop the most efficient and most powerful quantum cascade lasers. His current role at Coherent is to develop more efficient optically pumped semiconductor lasers and explore new wavelength capabilities. He has published more than 40 papers in reputed journals, such as *Nature Photonics, Applied Physics Letters, Journal of Applied Physics*, etc.

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Novel sources and resonators for high-resolution molecular spectroscopy in the mid infrared

Simone Borri
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Molecular precision spectroscopy opens new perspectives on tests of fundamental laws of physics and fundamental constants variation. The mid infrared (IR) is a key region for molecular spectroscopy and the efforts towards the development of versatile, spectrally pure and tunable coherent sources in this region have been constantly growing in the last decade. During the last years, we have made significant efforts in the development of metrological-grade coherent sources. Here, we present our more recent work based on two different approaches, both involving frequency-stabilized mid-IR quantum cascade lasers (QCLs). The first approach is based on crystalline fluoride whispering-gallery-mode resonators. These devices have started to show their full potential for mid-IR photonics in the last two years. They demonstrated record Q-factors ($\sim10^8$ around 4.5 μm) and a further increase is expected with the improvement of materials and fabrication techniques. We successfully tested a compact apparatus for high-precision spectroscopy based on mid-IR QCLs locked to fluoride resonators. The low sensitivity of the resonator to environmental noise is one of the strengths of this approach, leading to good stability levels even over long timescales (10 kHz on 1s timescale). The second approach is based on the combination of a mid-IR QCL and a metrological-grade source based on difference frequency generation using an OP-GaP crystal. Here we take advantage of the optical reference delivered from the Italian national laboratory for metrological research (INRIM) through a stable and ever-growing fibre network. This combination allows for mW-level radiation that covers, in principle, the entire molecular fingerprint region, with linewidths at kHz level and with a phase-noise compatible with a 10^{-14} short-term instability.

Biography

Simone Borri has completed his PhD in 2007 from University of Firenze, Italy. He is Researcher at CNR-National Institute of Optics since 2010. His main expertise is development of coherent sources and techniques for high-sensitivity and high-resolution molecular spectroscopy in the mid infrared. During his scientific activity he developed mid-IR and THz sources based on nonlinear frequency generation and worked on trace-gas sensors based on cavity-enhanced absorption spectroscopy, photoacoustic sensing, Doppler-free spectroscopy. He studied the noise properties of quantum cascade lasers and developed locking techniques for linewidth narrowing. He is author of more than 30 publications in peer-reviewed journals.

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Ramesh G Mani, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Hall coefficient sign reversal in metamaterials

Ramesh G Mani
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The Hall-effect remains broadly important nearly 140 years after its discovery. In science, the integral and fractional- quantum Hall effects have revolutionized condensed matter physics. Meanwhile, the classical Hall-effect remains a vital semiconductor characterization tool and proven contactless-sensing technology for essential applications. Recent work, see C. Kern *et al.*, Phys. Rev. Lett. 118, 016601 (2017), claims novel sign reversal of the Hall-coefficient in chain-mail-like 3D metamaterials, whereby an n-type semiconductor mimics the Hall-effect of a p-type semiconductor, see also Physics Today 70 (2), 21 (2017); Nature 544, 44 (2017). Measurement-geometry-related Hall-effect sign-inversion is known from studies of 2D or 3D- semiconductor plates including a hole with current and voltage contacts placed on the interior boundary of the hole (see R. G. Mani *et al.*, Appl. Phys. Lett. 64, 1262 (1994); Z. Phys. B 92, 335 (1993); Patents: DE 4308375C2; U.S. 5,646,527; EP 0689723B1). Studies of such "anti-hall bars" demonstrate a sign reversed Hall-effect with respect to the standard hole-less geometry. A Hall-bar including a single supplementary hole can be transformed into an "anti-hall-bar" by turning the sample inside out, which shifts the exterior boundary and contacts to the sample interior while moving the hole-boundary to the exterior. For a fixed direction of the magnetic field B, device-inversion leads to sign-reversal of the Hall-effect in "anti-hall bars" since the device-orientation becomes flipped with respect to B. Here, we discuss the relation between such sign inversion and the reported sign reversal of the Hall coefficient in metamaterials.

Biography

Ramesh G Mani obtained his PhD in Physics from the University of Maryland–College Park. He has worked at the Max-Planck-Institute for Solid State Physics in Stuttgart, Germany, University of California–Santa Barbara and Harvard University. He is presently a Faculty Member at Georgia State University in Atlanta, GA. He invented the "anti-hall bar" geometry and demonstrated dual/multiple simultaneous ordinary and quantized hall effects in a single specimen. The work served as the basis for many international patents relating to offset voltage reduction in hall sensors. He also discovered the microwave radiation-induced zero-resistance states in the two dimensional electron system.

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Notes:

Yohei Sato et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Liquid phase growth of GaSe crystal for highly efficient THz wave generation

Yohei Sato, Tadao Tanabe and **Yutaka Oyama**
Tohoku University, Japan

The applications of THz wave are expected in wide valiety of applications such as nondestructive inspection, medical science and ultra high density communication. In our laboratory, we research nondestructive inspection by using THz wave as follows: 1. Sensing of disconnection gaps covered with invisible insulator, 2. visualization of steel wire in the extradosed bridge cable and 3. qualitative and quantitative metal corrosion analysis etc. For these THz killer applications, non-linear optical gallium selenide (GaSe) is one of the most essential key materials for the highly efficient, widely frequency tunable and compact THz light source via difference frequency generation. The power of THz wave from commercially available Bridgman grown GaSe crystal is limited by the native point defects due to high temperature growth at melting point and the deviation from stoichiometric composition. In our laboratory, GaSe crystal is grown by TDM-CVP which enables extremely low growth temperature and application of Se vapor pressure for stoichiometry control. Conversion efficiency of THz wave generation at 9.41 THz using not-intentionally doped GaSe crystal grown by our TDM-CVP (1.2×10^{-6} J^{-1}) was 4 times higher than that from Bridgman-grown crystal (3.0×10^{-7} J^{-1}). In addition, we grew impurity doped GaSe crystal systematically for the first time. In low THz frequency range, transparency of GaSe crystals grown by TDM-CVP are improved by doping of amphoteric impurity (Ge) and transition metal (Ti). In the case of doping issoerectronic impurity (Te), It was confirmed to improve interlayer bonding force of GaSe crystal by doping of Te.

Biography

Yohei Sato has received a Master's degree in Material Sciences from Tohoku University in March 2017. He joined Oyama Laboratory in Sendai, Japan in 2015. Since then, he has been engaged in research of solution growth of semiconductor and THz wave generation from the grown semiconductor crystal.

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Notes:

Qi Jie Wang et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Integrated terahertz photonics and optoelectronics

Qi Jie Wang and **Guozhen Liang**
Nanyang Technological University, Singapore

Currently, terahertz (THz) optical systems are based on bulky free-space optics. This is due to the lack of a common platform onto which different THz components, e.g., source, waveguide, modulator and detector can be monolithically integrated. With the development of THz quantum cascade laser (QCL), it has been realized that the QCL chip may be such a platform for integrated THz photonics. Here, we report our recent works where the THz QCL is integrated with passive or optoelectronic components. They are: 1) integrated graphene modulator with THz QCL achieving 100% modulation depth and fast speed; 2) phase-locked THz QCL with integrated plasmonic waveguide and subwavelength antennas realizing dynamically widely tunable polarizations.

Biography

Qi Jie Wang received his PhD degree in Electrical and Electronic Engineering from Nanyang Technological University, Singapore in 2005. After completing his PhD, he joined the School of Engineering and Applied Science, Harvard University, as a Post-doctoral Researcher. In October 2009, he was assigned as a Joint Nanyang Assistant Professor at the School of Electrical and Electronic Engineering (EEE) and the School of Physical and Mathematical Sciences (SPMS). Since Feb 2015, he has been promoted to tenured Associate Professor in School of EEE and SPMS, NTU.

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Cunzhu Tong, J Laser Opt Photonics 2017, 4:4 (Suppl)
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High brightness photonic crystal semiconductor lasers

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High power diode lasers are the key elements in a wide range of applications such as pumping for solid-state lasers and fiber lasers, data transfer and material processing and the devices with high emission power and low far-field divergence are desired for many applications. Bragg reflection waveguide lasers and longitudinal photonic bandgap crystal (LPBC) lasers have been proposed to realize the high brightness diode lasers based on the PBC mechanism. In these devices, light is confined by the photonic band-gap effect in vertical direction rather than by total interface reflection (TIR) and low vertical divergence and circular beams have been demonstrated in single devices. In this paper, we introduce our recent work on the high brightness diode lasers based on the PBC waveguide with lateral microstructure. The one dimensional PBC structure demonstrated the low divergence ($<5^0$) in fast-axis, the lateral microstructure showed the evident improvement of beam quality in slow-axis. The high efficiency of directly coupled into fiber was achieved. The high-power PBC lasers were used for external-cavity spectral beam combining (SBC) and the high brightness was demonstrated.

Biography

Cunzhu Tong is working as a Professor at the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS). He received his PhD degree from CAS in 2005 and became the Professor of Hundred Talent Programs of CAS in 2010. He was the Distinguished Elite Professor of CAS and the Standing Committee Member of Chinese Society Astronautics. He has won several awards including the Outstanding Young Scientist Award of Scientific Chinese, the Excellent Award for Hundred Talents Program and the Important Achievements in China Optics in 2015. He has authored and co-authored over 80 refereed journal papers.

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Nasser Peyghambarian, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Fiber-based sources spanning UV to Mid-IR

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Phosphate, telluride and fluoride glasses allow new fiber laser frequencies. Nonlinear effects including Second Harmonic Generation (SHG), Optical Parametric Oscillators (OPO), Stimulated Raman Scattering (SRS) and Stimulated Brillouin Scattering (SBS) extend the operating wavelengths. However, some nonlinear effects including SRS in some cases are not desirable as they prevent high power operation. Our recent advances include: Demonstration of blue laser using Tm-doped fluoride glass; Demonstration of mid-infrared (mid-IR) frequency comb spanning from 7.5-11.6 µm using difference frequency generation (DFG) in a $AgGaS_2$ crystal with a compact all-fiber source based on Tm and Er-amplifiers. The power of the mid-IR signal is measured to be 1.55mW and the photon conversion efficiency is 15%. The pulse duration achieved in the mid-IR range is estimated to be around 80fs, which corresponds to 2.6 optical cycles at 9.2 µm center wavelength. The current approach allows simple power scaling by further amplification of the pump and signal pulses using established amplifier technologies. Demonstration of Er3+-doped ZBLAN fiber amplifier for Q-switched pulses at 2.79 µm is reported. Over 24 µJ pulse energy at an average output power of 1.0 W was achieved at a pump power of 9.4 W. The efficiency of this pulsed laser fiber amplifier is about 10%. Our simulation predicts that over 250 µJ pulses can be achieved with this fiber amplifier when a 120 W pump is used. Demonstration of mid-IR supercontinuum sources will also be discussed.

Biography

Nasser Peyghambarian is a Professor at the College of Optical Sciences and the Department of Materials Science and Engineering at the University of Arizona (UA), as well as the Director of the NSF Engineering Research Center for Integrated Access Networks and the UA Chair of Photonics and Lasers. He is a Fellow of the AAAS, OSA, SPIE, APS and NAI. He has over 600 publications in peer-reviewed journals and more than 700 invited talks, conference proceedings and presentations. He has authored or co-authored 28 books and book chapters and is the inventor on 38 patents.

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Notes:

Synthesis and structural characterization of the hexagonal anti-perovskite Na_2CaVO_4F

Robert L Green
Florida Polytechnic University, USA

A high-resolution neutron powder diffraction technique was used to observe and refine the structural details of the ordered hexagonal oxyfluoride Na_2CaVO_4F. Polycrystalline samples were prepared via solid-state synthesis using stoichiometric amounts of high pure starting materials. The structural changes between 25°C and 750°C revealed that the two structural subunits contained within this material exhibit different behavior when heated. There is an expansion of the face-shared FNa_4Ca_2 octahedra while the VO_4 tetrahedra due to increased thermal disorder reveal marginal bond contractions. The bond valence method is employed to compare observed and ideal bond distances and point to a structural instability at 750ºC. The Echidna high-resolution powder diffractometer located at the OPAL Research Reactor of the Australian Nuclear Science and Technology Organization (ANSTO) was used for both room temperature and temperature-dependent studies whereby diffraction data was collected using a neutron beam with a wavelength of 1.6215(1) Å using a Ge (335) monochromator. All preliminary structural information was collected using a benchtop X-ray diffractometer using Cu-Kα (1.54059 Å) over the range of 3-149° 2-theta. Both X-ray and neutron diffraction data was refined using the GSAS suite of programs.

Biography

Robert L Green has earned his BS from Morehouse College, an MS from Purdue University and his PhD from the University of South Carolina in Chemistry. For the majority of his 12 years career in higher education, he has devoted time to promoting STEM education to both K-12 teachers and students underserved communities. He is a Member of the American Chemical Society and is the Founder of the Florida Polytechnic University Chapter of the National Society of Black Engineers (NSBE).

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Technique of optical frequency comb generation from a bismuth-based harmonically mode-locked fiber laser

Yutaka Fukuchi
Tokyo University of Science, Japan

Optical frequency comb generators can offer several attractive applications such as wideband multi-wavelength lasers, ultra-short pulse generation, coherent optical waveform syntheses, ultra-fast signal processing, high resolution spectroscopy and optical frequency reference. High stability, high coherence, high efficiency, low noise, low cost, wide bandwidth and spectral flatness are commonly required for those applications. Among many potential comb sources, harmonically mode-locked fiber lasers are a popular solution owing to their abilities such as wavelength tunability, short pulse width, small timing jitter and high repetition frequency in the gigahertz region. However, since the harmonically mode-locked fiber lasers usually employ silica-based erbium-doped fibers as the gain media, the range of the wavelength tunability is limited to either the conventional wavelength band or the longer wavelength band. Furthermore, it is generally difficult for each frequency comb component generated by the harmonically mode-locked fiber lasers to have the same intensity. In this paper, we review a technique for producing a tunable and flat frequency comb from a 10 GHz bismuth-based harmonically mode-locked fiber laser. The output characteristics are as follows. The center wavelength can be tuned from 1535 nm to 1585 nm. The comb spectrum can be flatly broadened up to 2.4 nm (300 GHz) with 30 comb lines. The spectral width and the pulse width can be tuned from 0.23 nm to 2.4 nm and from 3.0 ps to 20.1 ps, respectively. Throughout the entire tuning ranges, this laser can maintain stable bit-error-free mode-locking operation within a received power deviation of 3.0 dB.

Biography

Yutaka Fukuchi received his BS and MS degrees in Electronics Engineering from Tokyo University of Science, Japan in 1998 and 2000, respectively and completed his PhD degree in Electronics Engineering from University of Tokyo, Japan in 2003. In 2003, he joined the Department of Electrical Engineering, Tokyo University of Science. Since 2009, he has been an Associate Professor in this department. From 2013 to 2014, he was a Visiting Research Fellow with the Department of Photonics Engineering, Technical University of Denmark. His research interests are nonlinear optics and their applications.

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Notes:

Taiji Sakamoto, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Randomly-coupled multi-core fiber for long-haul optical MIMO transmission system

Taiji Sakamoto
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The capacity of conventional single-mode fiber (SMF) that is widely used in the existing optical communication network is expected to be limited to around 100 Tbit/s owing to the non-linear effect of the optical fiber. Space division multiplexing technologies using multi-core fiber (MCF) or few-mode fiber have been investigated for overcoming the capacity crunch of conventional SMF. MCF has multiple cores within a cladding and multiple signals can be transmitted in parallel by using multiple cores. One important parameter for MCF is spatial density, namely the number of spatial channels per unit area, since the cladding diameter of the fiber is limited to a certain value in terms of mechanical reliability. Recently, coupled MCF which has a low core pitch value between the cores compared to the non-coupled MCF has been investigated with the aim of improving the spatial density. In this paper, we review recent progress on coupled multi-core fiber (MCF) technologies and advantages of using this type of MCF for optical MIMO transmission system. Finally we report our recent results for high spatial density randomly-coupled MCF with low modal dispersion characteristic, which is beneficial for realizing long-haul optical MIMO transmission.

Biography

Taiji Sakamoto received his BE, ME and PhD degrees in Electrical Engineering from Osaka Prefecture University, Osaka, Japan in 2004, 2006 and 2012 respectively. In 2006, he joined NTT Access Network Service Systems Laboratories, NTT, Ibaraki, Japan where he has been engaged in research on optical fiber nonlinear effects, low nonlinear optical fiber, few-mode fiber and multi-core fiber for optical MIMO transmission systems. He is a Member of the Institute of Electronics, Information and Communication Engineers.

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Notes:

Jiaren Liu et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Phase noise analysis of InAs quantum-dot mode-locked semiconductor lasers

Jiaren Liu, Zhenguo Lu, Philip Poole, Chunying Song, John Weber, Linda Mao, Pedro Barrios, Daniel Poitras and **Siegfried Janz**
National Research Council, Canada

Phase noise or linewidth of semiconductor diode lasers is vital parameter for various applications in optical sensing and coherent communication. In this talk, phase noise of individual mode in InAs quantum-dot (QD) mode-locked lasers (MLLs) made by National Research Council of Canada were investigated both theoretically and experimentally. Under optimized mode-locked conditions, the minimum linewidth of individual modes is about 0.6MHz, 0.8MHz, or 0.9MHz achieved for the repetition rate of 11GHz, 25GHz, or 34GHz respectively. For MLLs with the above channel spacing, the linewidths of 10 or more laser modes can go down to 1.0MHz at least. The relevant experimental result is consistent and fitted with the theoretical prediction which assumes zero-mean Gaussian random processes for both common mode and un-common mode phase noises. Such low phase noise MLLs will be the suitable and cost-effective candidate for multiple wavelength applications in long-haul and data-center fiber optical networks.

Biography

Jiaren Liu has completed his PhD in 1993 from Nanjing University of Science and Technology and then completed his Post-doctoral studies from Texas A&M University and University of Toronto. He is a Senior Research Officer of National Research Council of Canada and an Adjunct Professor of Concordia University. He has published 50 more papers in reputed journals and other 70 more papers in conferences and seminars.

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CFO compensation method for coherent optical OFDM system by electro-optic feedback

Sang-Rok Moon, Hun-Sik Kang, Sun Hyok Chang and **Joon Ki Lee**
Electronics and Telecommunications Research Institute, South Korea

We investigate feasibility of carrier frequency offset (CFO) compensation method using optical feedback path for coherent optical orthogonal frequency division multiplexing (CO-OFDM) system. CFO compensation is one of most important issues in OFDM system, since the CFO breakes orthogonality among OFDM subrarriers and it causes critical degradation in signal quality. In CO-OFDM, the CFO tends to be high because of laser instability. Thus wide CFO compensation range is essential. Recently proposed CFO compensation algorithms provide wide CFO estimation range. They compensate CFO after anlog-to-digital convertor (ADC). Then, CFO compensation range is limited by sampling rate of the ADC. Thus, the sampling rate should be much higher than CFO and/or data bandwidth. Because of high price of ADC, it is not affordable in practical CO-OFDM. To solve this problem, we propose a CFO compensation method having optical feedback path. The measured CFO is used to control local oscillator's wavelength for CFO compensation. Since the CFO is compensated before ADC, the compensation range is not affected by the ADC. Residual CFO can be compensated by conventional CFO compensation methods. The feasibility of the proposed method is experimentally investigated. We showed that the practical CFO compensation range can be extended to the sampling frequency range, regardless of sampling rate of ADC. Although the proposed method is based on OFDM, the proposed method works in all coherent modulation formats with minor modification.

Biography

Sang-Rok Moon has received his BS degree in Physics in 2008 and his PhD degree in Electrical Engineering in 2015 from Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea. He is working at Electronics and Telecommunications Research Institute (ETRI) from 2015. His current research interest includes, orthogonal frequency-division multiplexing (OFDM) and optical cummunisation in metropolitan/access network.

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Jair Adriano Lima Silva, J Laser Opt Photonics 2017, 4:4 (Suppl)
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The influence of constant-envelope signals in coherent-detection optical OFDM systems

Jair Adriano Lima Silva
Federal University of Espírito Santo, Brazil

The resilience towards fiber dispersion is the main attractive feature of orthogonal frequency division multiplexing (OFDM) signal processing in optical communications systems. Coherent-detection optical OFDM (CO-OFDM) posses many benefits that are critical for high data rate fiber transmission systems. It is extremely robust against chromatic and polarization mode dispersions at the same time that it improves spectral efficiency eliminating the need for a guard band between the optical carrier and the information-bearing signal. Furthermore, adaptive data rates with different subcarrier mapping levels can be supported using software-defined solutions. However, large peak-to-average power ratio (PAPR) of the inherent multicarrier signals is one of the main drawbacks in CO-OFDM systems, as it not only limits the resolution of digital-to-analog converters and power amplifiers, but also reduces the tolerance to the nonlinearities introduced by Mach-Zehnder (MZM) optical modulators and optical fibers. Several PAPR reduction techniques such as coding, tone reservation, clipping, peak windowing and partial transmit sequence, have been proposed in the literature. These distinctly techniques provide different degrees of effectiveness and tradeoffs that may include increased complexity, reduced spectral efficiency and performance degradation. Recently, we proposed a PAPR reduction scheme based on constant envelope (CE) signals to improve the tolerance towards MZM modulators and fiber nonlinearities in direct-detection optical OFDM systems. As a power efficient technique, it reduced the PAPR to 3 dB using electrical phase modulation (PM). After a successful experimental demonstration in direct-detection optical systems, this CE-OFDM technique was introduced in coherent detection systems as a suitable solution to the aforementioned problems. Unlike the approaches evaluated in the literature, the intermediate electrical constant-envelope signals of this solution were used to modulate the continuous wave laser source, employing a conventional one-branch MZM modulator. The influence of the electrical phase modulation index *h* in the performance of CE-OFDM in coherent detection optical systems was treated analytically and its range of validity examined by simulations. A compromise between *h* and subcarrier mapping was identified according to differences in sensitivity related to non-linearities inserted by the MZM. We showed that the proposed scheme outperforms conventional coherent detection OFDM systems.

Biography

Jair Adriano Lima Silva received his BS, MS and PhD degrees in Electrical Engineering from the Federal University of Esp´ rito Santo (UFES), Vitória, Brazil in 2003, 2006 and 2011 respectively. In 2012, he joined the Department of Electrical Engineering of UFES. His research interest include optical fiber communication, radio-over-fiber, orthogonal frequency division multiplexing, passive optical communication network, visible light and powerline communiactions.

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Reginaldo Barbosa Nunes, J Laser Opt Photonics 2017, 4:4 (Suppl)
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A MAC layer protocol for a bandwidth scalable OFDMA PON architecture

Reginaldo Barbosa Nunes
Federal Institute of Espírito Santo, Brazil

The need for high bandwidth networks driven by new digital services and technologies has culminated in the emergence of the new standards for passive optical networks (PONs) such as 10 Gigabit Capable PON (XGPON) recommended by the ITU-T (International Telecommunications Union - Telecommunications) and 10 Gigabit Ethernet PON (10G EPON) standardized by the IEEE (Institute of Electrical and Electronic Engineers), both provide rates up to 10 Gb/s per wavelength to the end user. More recently, the ITUT standard NGPON2 started using TWDM technology that provides rates up to 40 Gb/s, but for that, it needs to use four wavelengths. In this context, this we propose a PON architecture based on Orthogonal Frequency Division Multiple Access (OFDMA), capable to offer an efficient bandwidth control with greater flexibility and granularity in bandwidth allocation to the end users according their demand or required Quality of Service (QoS). The proposed architecture exploits the Orthogonal Frequency Division Multiplexing (OFDM) to provide transmission rates above 33 Gb/s per wavelength. The proposal considers a tree topology where each optical line terminal (OLT) is connected to at least one passive device splitter/combiner, provides multiple services for up to 32 optical network units (ONUs). Our work presents experimental results that demonstrate the feasibility of this physical infrastructure for passive optical network based on OFDM/OFDMA, suggests adaptations in the architecture and presents techniques for improving the system spectral efficiency. In addition, it also describes the main recommendations to build a medium access layer in accordance with this proposal, named BS OFDMA PON (Bandwidth Scalable OFDMA PON).

Biography

Reginaldo Barbosa Nunes has completed his PhD degree in Electrical Engineering from Federal University of Espírito Santo (2016), graduated in Electrical Engineering, Master's in Computer Science and Computer Network Specialist. He is working as a Professor of higher and technical education at the Federal Institute of Espírito Santo from 1997. He has recently published more than 15 papers in reputed journals and international conferences, has been serving as reviewer member in several international periodics.

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Jianjun Yu, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Optimization of optical modulation formats for high-speed short-reach connection

Jianjun Yu
Fudan University, China

With the popularization of data centre and other bandwidth hungry inter-connect applications, the desired capacity of short reach optical network has exponentially increased to 400 Gbit/s or even more. Recent standardization efforts for 400 G intra-data center connections specify link lengths of up to 2 km. 8×56 Gb/s or 4x100 Gb/s could enable such 400 G networks. Relative to coherent detection. Intensity modulation/direct detection (IM/DD) is a good candidate in inter-connect due to its low cost. For 56 and up to 100 Gb/s signal generation, a few modulation formats or schemes, such as pulse-amplitude-modulation (PAM4), discrete multi-tone (DMT), duobinary and chirp-managed laser (CML) are proposed and experimentally demonstrated. However, considering cost, size and power comsuption, the modulation format should be optimized for different networks to meet different requirements. In this talk, we will discuss this issue how to optimize the modulation formats for different optical networks?

Biography

Jianjun Yu has completed his PhD in the year of 1996 from Beijing Univeristy of Posts and Telecommunications. He is the Professor of Fudan University. He has published more than 600 papers in reputed journals and has been serving as an Editorial Board Member of IEEE *Photonics Journal, JLT and JOCN*.

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Improvement of optical transmission capacity by data compression and amplitude/phase/frequency 3-dimentional modulation

Dongsun Seo
Myongji University, Korea

In this talk, we discuss novel schemes that improve significantly the spectral efficiency (i.e., channel capacity) of an optical access link. Firstly, an optical orthogonal frequency division multiplexing (OFDM) signal, which is encoded by multilevel quadrature amplitude modulation (QAM), is compressed using the proposed sampling scheme sampled at a lower than conventional Nyquist rate. At the receiver, the OFDM signal is recovered by a Bayesian compressive sensing (CS) technique. We show experimentally the spectral efficiency improvement (i.e., data compression) up to <40% and <20% for 4-QAM and 16-QAM encoded OFDM waveforms, respectively. Secondly, we discuss channel capacity improvement by simultaneous modulation of amplitude, phase and frequency i.e., by combining frequency shift keying (FSK) and QAM. This 3-dimensional modulation so called NOFQAM, increases the modulation order dramatically by multiplying both the FSK and QAM orders. Unlike a conventional orthogonal FSK modulation, the FSK channels are overlapped in our non-orthogonal (NO) FSK modulation. Therefore, the NO-FSK modulation increases the channel capacity at a fixed channel bandwidth. For experimental verification, we implement a 20-km optical access link, which transmits a 64-NOFQAM signal formed by combining both 4-FSK and 16-QAM. The symbol rate and FSK channel spacing are 200 M-symbol/s and 45 MHz, respectively. Comparing to a 200 M-symbol/s 16-QAM transmission, the suggested 64-NOFQAM transmission shows negligible increase in the occupied channel bandwidth and very small power penalty less than 0.5 dB. Finally, we apply the CS based data compression technique to the 64-NOFQAM signal and show greater than 50% of data compression.

Biography

Dongsun Seo has received his PhD degree in Electrical Engineering (Optoelectronics) from the University of New Mexico in 1989. In 1990, he has joined the Faculty of Myongji University, Korea, where he is currently a Professor in the Department of Electronics. From 2002 to 2004, he was with Purdue University, as a Visiting Research Professor in the School of Electrical and Computer Engineering. He has published over 70 journal articles and over 100 conference papers. His current research interests are in the areas of optical pulse sources, ultrafast optics, high-capacity optical communications, optical processing and photonics.

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Jesse A Frantz et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Anti-reflection surface structures on optics as an alternative to thin film anti-reflection coatings

Jesse A Frantz, Lynda E Busse, Darryl A Boyd, Shyam S Bayya, Woohong Kim, Leslie B Shaw and **Jasbider S Sanghera**
US Naval Research Laboratory, USA

Anti-reflection surface structures (ARSS) are nano-scale features patterned directly into an optical surface that are designed to have low optical reflectance. They have been demonstrated to increase the transmission of an optical surface to >99.9% and are an attractive alternative to traditional thin film anti reflection (AR) coatings for several reasons. They provide AR performance over a larger spectral and angular range and unlike thin film AR coatings, they are patterned directly into the optic rather than deposited on its surface. As a result, they are not prone to delamination under thermal cycling that can occur with thin film coatings and their laser damage thresholds can be considerably higher. In this presentation, we summarize results for ARSS on a variety of optical materials including silica, germanium, magnesium aluminate spinel and a variety of laser crystals. We discuss scale-up of the technique and describe results for ARSS with dimensions as large as 33 cm. We describe a surface modification procedure that results in a superhydrophobic surface without a significant decrease in transmittance. Finally, we show results for optical performance of ARSS on silica windows following sand and rain erosion testing showing that they are suitable for use in harsh environments.

Biography

Jesse A Frantz has received his PhD in Optical Sciences in 2004 from the Optical Sciences Center at The University of Arizona. He has been working as a Research Physicist at NRL since 2004 where his research is focused on microstructured optical surfaces and novel thin film materials. He established and manages a Vacuum Deposition Cluster System Facility in NRL's Optical Sciences Division used for a variety of projects including the fabrication of advanced, multi-layer thin film devices for optical applications.

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Eugene S Smotkin, J Laser Opt Photonics 2017, 4:4 (Suppl)
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A perspective on quasi-confocal operando Raman microspectroscopy of laminated polymer composite materials

Eugene S Smotkin
Northeastern University, USA

Steady state operando confocal Raman microspectroscopy of polymer electrolyte membrane fuel cell catalytic layers is challenged by thermal damage to the catalytic layer resulting from excessive luminescence within a focal point sampling region. Experimentalists must exclude catalyst material along the optical axis path or position the axis between (parallel) the catalytic layers. We demonstrated that operando non-confocal Raman microspectroscopy of a catalytic layer yields high quality spectra elucidating changes in the membrane ion exchange site local symmetry as the fuel cell transitions from open circuit to oxygen reduction potentials. We now explain how non-confocal microscopy enables steady state layer-by-layer spectroscopic profiling with no thermal damage to "black" layers?

Biography

Eugene S Smotkin has completed his PhD from University of Texas at Austin. He is the Professor of Chemistry Northeastern University and CEO of NuVant Systems Inc., a premier electrochemical technology organization. He has published more than 80 papers in reputed journals and has 15 patents.

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Notes:

Takahiro Tsukahara, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Photo-induced flows relevant to laser-based droplet manipulations

Takahiro Tsukahara
Tokyo University of Science, Japan

Non-invasive and non-contact manipulation of micro-scale droplet in air/liquid pool, which is relevant to Medical or Biological Engineering applications and chemical processes using lab-on-chip technology, has increasingly attracted attention in the field of microfluidics. Several techniques were proposed by utilizing a local variation of interfacial tension, because the effects of interfacial phenomena are dominant in microfluidics relative to the inertia and buoyancy forces. In particular, laser-induced optical force may be used as a non-invasive and precise tool for droplet-based controls, but its force magnitude is limited on the order of a pico newton. Compared to the optical force, an optically-induced thermal Marangoni convection may provide a larger resultant force that provides the nano-newton order force. Therefore, the photothermal Marangoni convection can be a powerful technique of on-demand bubble/droplet handling in a micro-channel liquid. If allowed to change physical properties of surfactant solution liquid (e.g., azobenzene) in response to light, the cis-trans photoisomerization can be alternative non-invasive fluid manipulation without adding heat. The cis-trans photoisomerization is a property that the cis and trans isomers are reversibly changed by light of a specific wavelength such as ultraviolet light. As the isomers of different molecular structures are switched by light irradiation, physical properties such as the contact angle and interfacial tension are varied. We have performed direct numerical simulation of multi-phase flows of droplets that are accompanied by either photo-induced thermal Marangoni convection or cis-trans photoisomerization, in order to study quantitatively the force and mechanisms relevant to the laser-based droplet manipulation.

Biography

Takahiro Tsukahara has completed his PhD in the year 2007 from Tokyo University of Science. He is an Associate Professor of Department of Mechanical Engineering, Faculty of Science and Technology, Tokyo University of Science. He has published more than 37 papers in journal publications and 44 peer-reviewed proceeding papers. He has been serving as an Editorial Board Member of *Advances in Mechanical Engineering*. He has his expertise in Thermo-fluid Dynamics, especially in Turbulent Transition and Flow Instability, and Computational Fluid Dynamics.

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Notes:

Robert Claude Gauthier, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Fourier-Bessel electromagnetic mode solver (and its inversion)

Robert Claude Gauthier
Carleton University, Canada

Numerical simulations of electromagnetic phenomena provide the researcher and the component designer with a cost effective alternative to device manufacturing of prototypes. Techiques such as FDTD and FEM are commonly employed but hit up against speed and memory boundaries when structures are irregular or extend over all three coordinate axis. The talk will present a numerical technique, based on spectral analysis, which is suitable for numerical analysis of structures which present cylindrical and spherical geometries. The theoretical foundations of the numerical technique will be presented which takes its roots in Maxwell's curl coupled equations rather than the usual wave equations. The eigenvalue matrix system properties were explored and symmetry techniques utilized to reduce the matrix order and tune "mode family" computations were highlighted leading to faster computation engines. Several computation examples will be presented indicating the suitability of the technique to obtain localized states in resonators, axially propagated fields in fiber geometries and in spherical resonators. Recently, the numerical process has been inverted such that the material properties of an optical resonator and waveguide can be determined based on the user defined modal profile and propagation properties selected by the designer theoretical details and numerical examples of the inverse process will close the presentation.

Biography

Robert Claude Gauthier has completed his PhD in 1988 from Dalhousie University (Halifax, Canada). He is presently associated with the Department of Electronics at Carleton University, (Ottawa, Canada). He has published numerous papers primarily in the areas of optical fiber sensors, optical levitation and trapping, photonic crystal and photonic quasicrys. His research interest now focus on numerical studies of optical resonator properties

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Notes:

Holger Kreilkamp, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Glass optics replication in a digitalized production environment

Holger Kreilkamp
Fraunhofer-Institute for Production Technology, Germany

Digitalization, adaptivity and networked production are dominant issues for state of the art manufacturing technologies and will continue to have a substantial impact on their advancement and development. This applies especially to complex process chains, characterized by multiple and non-trivial interdependencies, such as the replicative manufacturing of optical components. Ranging from the optical design, the FEM simulation and the mold manufacturing, down to the actual molding process and the assembly of the optical system, this process chain today reveals a low level of automation as well as insufficient (data-)standards and an inadequate information flow over the different process steps. Since most of the single technologies are at the brink of technical feasibility, future components will need the ability to exploit the vast potential of interconnected and adaptive process chains. In order to promote and advance this transition in the field of replicative optics manufacturing the Fraunhofer IPT has elaborated an innovative and comprehensive data solution concept, which has been implemented within the precision glass molding process (PGM). In a specially equipped glass molding machine, tailored sensor systems are collecting multiple data concerning the molding process, such as temperature, force and pressure profiles. This information is acquired in real time and serves the purpose of immediate visualization. Beyond this, all data are fed into a superior data backbone, allowing the reconstruction of an exact digital image of the component, highly valuable to adapt downstream and upstream processes, granting a glance on what future optics production in a totally digitalized production environment will look like.

Biography

Holger Kreilkamp is Group Manager of "Optics" at Fraunhofer Institute for Production Technology IPT. He studied Mechanical Engineering specialized in Production Technology at RWTH Aachen University and received his Diploma degree in 2011. He got a second Diploma in Economics in 2012. Since then, he has worked as a Research Assistant at Fraunhofer IPT in the field of Optics Manufacturing. His research focuses on technology development for glass optics production with special interests in replicative manufacturing.

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Baptiste MOT, J Laser Opt Photonics 2017, 4:4 (Suppl)
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PILOT optical alignment

Baptiste MOT
IRAP, France

PILOT is a balloon-borne astronomy experiment designed to study the polarization of dust emission in the diffuse interstellar medium in our Galaxy at wavelengths 240 µm and 550 µm with an angular resolution of a few arc-minute. PILOT optics is composed an off-axis Gregorian type telescope and a refractive re-imager system. All optical elements, except the primary mirror, are in a cryostat cooled to 3K. We combined the optical, 3D dimensional measurement methods and thermoeslastic modeling to perform the optical alignment. I will present the system analysis, the alignment procedure, and finally the performances obtained during the second flight in March 2017.

Biography

Baptiste MOT has completed his MSD in the year 2004 from the "conservatoire national des arts et métiers". He works as a Research Engineer in an Astrophysic laboratory on several space telescopes.

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Notes:

T K Subramaniam, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Laser technology to guide rainfall to a particular region

T K Subramaniam
Sri Sairam Engineering College, India

Rain bearing clouds can be effectively guided to a specific region during monsoon or other seasons so that rainfall shall be equitably distributed without creating drought situations. Lasers sent into the lower troposphere region with power in Gigawatt ranges, sufficient to create a temperature and pressure gradient and thereby creating a low pressure area in a specific region can invite rain bearing clouds in a region opposite to the heat and pressure gradient created by laser effects, so as to bring convective rainfall during a season. Pressure gradient describes the difference in air pressure between two points in the atmosphere or on the surface of the Earth. It is vital to wind speed, because the greater the difference in pressure, the faster the wind flows (from the high to low pressure) to balance out the variation. Satellite based monitoring system of cloud formations can be an effective guide to send laser beams in a direction towards the lower troposphere to create convective rainfall into another specific region.Laser beams are an attracted means of carrying concentrated power over distance. Hence, we choose a CO_2 laser (λ=10.6 μm) whose power is not dissipated by interaction with any gas molecules and so diffraction will not take place. The beam stays coherent. Using up CO_2 gas will reduce excess carbon emissions on Earth and bring down global warming also.Thus a temperature and a pressure difference created by a CO_2 laser is enough to invite these clouds to move towards an opposite region and cause rainfall.

Biography

T K Subramaniam has completed his PhD from Banaras Hindu University, India, specializing in Laser Spectroscopy. He is presently working as Professor of Physics at Sri Sairam Engineeering College, Chennai, India, teaching Under-graduate Physics at the college level for more than 20 years and also has six years of industrial experience. He has published more than 10 research papers in international journals of repute and is a Peer-Reviewer for the *Optical Society of America* (OSA) group of journals, besides serving in the Editorial Board of other reputed journals. Recently, he has presented a research paper at Olching, Germany, in November 2016.

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Notes:

Ulrike Willer et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Quartz-enhanced photoacoustic spectroscopy with electrical co-excitation

Ulrike Willer, **Mario Mordmueller** and **Wolfgang Schade**
Clausthal University of Technology, Germany

Photoacoustic spectroscopy relies on the temporally modulated energy input into a gas via absorption and the subsequent transfer into a sound wave that is measured. This transfer of energy from vibrational into translational modes is highly dependent on collision partners and linked relaxation rates. For quartz-enhanced spectroscopy (QEPAS) a micro-tuning fork is used as a transducer instead of a conventional microphone and the modulation of the excitation laser is done at the resonant frequency of the tuning fork for signal enhancement. However, it is not only possible to drive the tuning fork into oscillation by the photoacoustically generated acoustic wave but also by applying a modulated voltage. With these two different driving forces, either applied simultaneously or subsequently, it is possible to gain more insight of the properties of the gas and the relaxation dynamics. This is especially valuable if the background gas and with it the collision partners, density, velocity of sound and relaxation rates change and a variation in signal cannot unambiguously attributed to a variation in concentration. It will be discussed how the photoacoustic interaction can be used to promote an originally electrically induced tuning fork oscillation or to fasten its fading, which enables the measurement of times rather than intensities.

Biography

Ulrike Willer has studied Physics at Christian-Albrechts University in Kiel and completed her PhD in the year 2001 at Clausthal University of Technology, Germany. She is Researcher at the Energy Research Center and Clausthal University of Technology. She has published more than 45 papers in reputed journals and has been serving as Progam Comittee Member for different scientific conferences. Her main research interest focuses on mid-infrared spectroscopy, photoacoustics and sensor design.

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Notes:

S S Bayya et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Advanced IR glass and fiber technology

S S Bayya[1], V Q Nguyen[1], W H Kim[1], L B Shaw[1], L E Busse[1], D J Gibson[1], R R Gattass[1], D Rhonehouse[1], F H Kung[2], R Thapa[3], J Frantz[1], G Villalobos[1], C Baker[1], M I Kotov[3], R E Miklos[3], C C McClain[2], I D Aggarwal[3] and **J S Sanghera[1]**
[1]Naval Research Laboratory, USA
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Chalcogenide glasses, with their high refractive indices, low phonon energy, high nonlinearity and excellent transmission in the infrared (IR) region, make them ideal for incorporation into various civilian, medical and military applications such as infrared detectors, infrared lenses, planar optics, photonic integrated circuits, lasers and other non-linear optical devices. Chalcogenide glasses have also been widely studied for use in numerous potential optical fiber applications such as fiber lasers, amplifiers, bright sources, as well as passive solid and hollow core IR fibers for laser transmission. Although stable, low-loss chalcogenide based fibers with minimum loss of <0.1 dB/m have been demonstrated, the chalcogenide based fibers suffer from absorption and scattering losses mainly caused by impurities related to hydrogen, carbon and oxygen. Great efforts have been made in reducing optical losses using improved chemical purification techniques, but further improvements are needed in both purification and fiberization technology to attain the theoretical attenuation. We have also designed and developed negative curvature, anti-resonant fibers and demonstrated record low loss in the 9.75 – 10.5 µm range. In this paper, we review our recent effort in the development of low loss chalcogenide fibers, by describing the various purification methods and their impact on the optical fiber loss and discuss the potential future outlook for these fibers.

Biography

S S Bayya received his PhD in Ceramics from Alfred University in 1992. He is a Research Scientist in the Optical Science Division at the Naval Research Laboratory (NRL) since 1994. His research interests include transparent ceramics, bulk optics and IR fibers for various optical applications. He currently heads the Optical Materials section at NRL. He has >50 publications and holds 30 patents on optical materials.

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Day 3-Breakout

A Seteikin et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Simulation of thermal reaction of biological tissues to laser-induced fluorescence and photodynamic therapy

A Seteikin and **I Krasnikov**
Amur State University, Russia

The aim of this work was to evaluate the temperature fields and the dynamics of heat conduction into the skin tissue under several laser irradiation conditions with both a pulsed ultraviolet (UV) laser (λ=337 nm) and a continuous-wave (cw) visible laser beam (λ=632.8 nm) using Monte Carlo modeling. Finite-element methodology was used for heat transfer simulation. The analysis of the results showed that heat is not localized on the surface, but is collected inside the tissue in lower skin layers. The simulation was made with the pulsed UV laser beam (used as excitation source in laser-induced fluorescence) and the cw visible laser (used in photodynamic therapy treatments), in order to study the possible thermal effects.

Biography

A Seteikin studied Physics at the Pedagogical University in Blagoveschensk. He has received his PhD in Physics in 2000. Currently, he is a Professor at the Department of Physics of the Amur State University in Blagoveschensk. His scientific background is in the field of Laser - Tissue Interaction and Biophysics. In his work, he is using experimental and computational techniques. He has national and international collaborations in Physics and Life Science research.

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Notes:

Izumi Nishidate, J Laser Opt Photonics 2017, 4:4 (Suppl)
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In vivo physiological imaging of biological tissues based on diffuse reflectance spectroscopy with an RGB camera

Izumi Nishidate
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Quantitative assessment of optical properties is important for monitoring metabolism, viability and physiological conditions of *in vivo* biological tissues. Diffuse reflectance spectra of living tissues reflects the optical absorption spectra of biological chromophores (i.e., oxygenated hemoglobin, deoxygenated hemoglobin, bilirubin, cytochrome c oxidase, and melanin) and the light scattering spectra of tissues. Diffuse reflectance spectroscopy (DRS) has been widely used for the evaluation of chromophores in living tissue. The multispectral imaging technique is a useful tool for extending DRS to the spatial mapping of the chromophores and tissue morphology. This can be simply achieved by a monochromatic charge-coupled device (CCD) camera with narrowband filters and a white light source, which has been used to investigate the physiological conditions in living tissues such as blood perfusion, oxygenation state of hemoglobin, and melanin content. In clinical conditions, simpler, more cost-effective and more portable equipment is needed. The digital red, green, blue (RGB) imaging is a promising tool for satisfying these demands for practical application. Imaging with broadband filters, as in the case of digital RGB imaging, can also probe spectral information without mechanical rotation of a filter wheel. We have developed an simple imaging technique with a digital RGB camera for *in vivo* functional imaging of biological tissues. The experimental results indicated the ability to evaluate the physiological reactions and hemodynamics in rats and humans.

Biography

Izumi Nishidate is working as an Associate Professor at the Graduate School of Bio-Applications and Systems Engineering, Tokyo University of Agriculture and Technology. His research spans the interdisciplinary fields of Biomedical Optics with particular emphasis on the development of new techniques for medical measurement, imaging and diagnosis. His major areas of activity include diffuse reflectance spectroscopy, spectral imaging, analysis of light transport in biological tissues and functional imaging of various organs. He received his PhD (2004) degree in Mechanical Systems Engineering, from Muroran Institute of Technology, Japan. He has authored/co-authored over 200 refereed journal articles, book chapters and conference/symposia proceeding articles.

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Yongsoo Lee, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Robotic irradiation of medical lasers

Yongsoo Lee
Oh & Lee Medical Robot, Inc., South Korea

Studies on laser emission made the application to human skin possible. However, even though the significance of irradiation has been recognized through adverse effects, such as post-laser burns and spotty hypopigmentation, few studies have been performed on laser irradiation. Excessive overlap of laser beams over a short period of time causes burns, while excessive overlap over a long period of time (days) results in spotty hypopigmentation, even with carefully-set emission parameters. This small fraction of adverse effects may be preventable through the use of robotic laser irradiation. Last April, in San Diego, CA, USA, a comparative study on manual and robotic irradiation was presented at the 37th Annual Conference of the American Society for Laser Medicine and Surgery. This study entitled as "Comparative Analysis of the Evenness of Laser Irradiation by a Robot vs. Human Hand: A Pilot Study of the Implication on the Effectiveness and Safety of Energy-Based Medical Devices", demonstrated that robotic irradiation was more consistent and even compared with manual irradiation at frequencies of 10 Hz and 30 Hz. Moreover, the inconsistency of manual irradiation at frequencies of 10-30 Hz was demonstrated, while the robot demonstrated no statistical inconsistency at 10-30 Hz. Truly even laser beam irradiation of three-dimensional surfaces, such as the human face requires a high degree of precision and consistency, as the curvature varies from one point to another. Studies on laser irradiation have been nearly impossible, because of the inaccuracy and inconsistency of the human hand. As inconsistency and imprecision can be overcome with robotic irradiation, new study subjects have arisen for investigation of the effects of irradiation patterns on clinical outcomes. Robotic irradiation would enable us to achieve quicker and better outcomes, as well as to prevent the adverse effects described above.

Biography

Yongsoo Lee has completed his Medical degree at Yonsei University, South Korea. He is the Co-founder and Co-CEO of Oh and Lee Medical Robot, Inc. and affiliated to Yonsei YL Laser Dermatology and Plastic Surgery in South Korea. He has published many papers in respected journals and has served as an Editorial Board Member of medical journals. He also served as the sole Editor of "*Scars and Scarring: Causes, Types and Treatment Options*," published by Nova Biomedical, New York, USA.

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Masahiro Motosuke, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Simple way of optical manipulation of particles/cells in microfluidic systems

Masahiro Motosuke
Tokyo University of Science, Japan

Optical manipulation of small objects, e.g., particle and cells, has been widely exploited as a fundamental research tool in biochemical analysis for molecules or cell screening. However, utilization of optical force relying on controlling radiation pressure to the targets basically needs fine adjustment of optics so that this technology has not been used in Point-of-Care (POC) diagnostics including advanced Lab-on-a-chip (LOAC) platform that is drastically developing fields with the aid of micro/nanofabrication. In out study, possibility of optical manipulation for particles or calls in microfluidic systems without any optical elements was investigated. Firstly, the use of scattering force was considered. This allows us to use low-evergy-density light for manipulation. Then we exploited microfabricated integrated optics which gently focused iraddiated light to targets in microchannel to promote mobility of the targets. Our approach can expand the use of optical force in simpler way toward highly functionalized POC diagnostics based on LOAC platform.

Biography

Masahiro Motosuke obtained his PhD in 2006 from Keio University. He joined the Department of Mechanical Engineering at Tokyo University of Science, and then was in Department of Micro/Nanotechnology at Technical University of Denmark. He is currently an Associate Professor of Tokyo University of Science from 2012. His research interest is on the development of biomedical optical sensing and control technology in advanced lab-on-a-chip platform, including external-field-induced liquid/particle/cell handling.

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Notes:

Albrecht Lindinger, J Laser Opt Photonics 2017, 4:4 (Suppl)
DOI: 10.4172/2469-410X-C1-017

Fluorescence anisotropy excitation by polarization-shaped laser pulses after transmission through a kagome fiber

Albrecht Lindinger
Freie Universität Berlin, Germany

Laser pulse shaping for control of photo-induced molecular processes has attained considerable success in recent years. It became most exciting when pulse shaper set-ups were employed to generate tailored pulses, which optimally drive the induced processes. Lately, polarization pulse shaping was explored to examine the vectorial character of the light field. Novel pulse shaping schemes for simultaneous phase, amplitude and polarization control were designed and a parametric subpulse encoding was developed. Thereby, the physically intuitive parameters like chirps and polarization states of subpulses can be controlled. This yields new perspectives of utilizing all properties of the light field in the pulse modulation. Currently, pulse shaping methods are increasingly used to investigate biologically relevant systems. Thereto, pulse shaping is applied to multi-photon excitated fluorescence, which enables to exploit intrapulse interference effects. In this contribution improved fluorescence contrast between dyes is reported by two-photon excitation with polarization shaped laser pulses behind a kagome fiber utilizing the anisotropy of the dye molecules. Particularly phase and polarization tailored pulses were employed for two-photon excited fluorescence of dyes in liquid behind the kagome fiber. The distortions due to the optical fiber properties were precompensated to receive predefined polarization shaped pulses at the distal end of the kagome fiber. This enabled to optimally excite one dye in one polarization direction and simultaneously the other dye in the other polarization direction. The presented method has a high potential for endoscopic applications due to the unique properties of kagome fibers for guiding ultrashort laser pulses.

Biography

Albrecht Lindinger has earned his PhD on helium droplet spectroscopy in Göttingen in the group of J-P Toennies and completed his Post-doc term in Berkeley in the group of D Neumark. He received his habilitation in the field of coherent control at the Freie Universität Berlin in the group of L Wöste and is now working as a Lecturer in the Institute of Experimental Physics at the Freie Universität Berlin. He has published 80 peer-reviewed papers in reputed journals. His main scientific interests are laser optics, coherent control, and biophotonics.

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Victor Kärcher, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Wavefront propagation simulations for a hard x-ray split-and-delay unit at the European XFEL

Victor Kärcher
University of Münster, Germany

For the High Energy Density Instrument (HED) at the European XFEL a hard x-ray split-and-delay unit (SDU) is built covering photon energies in the range between 5 keV and 24 keV. This SDU enables time-resolved x-ray pump / x-ray probe experiments as well as sequential diffractive imaging on a femtosecond to picosecond time scale. The set-up is based on wavefront splitting that has successfully been implemented at an autocorrelator at FLASH. The x-ray FEL pulses will be split by a sharp edge of a silicon mirror coated with Mo/B4C and W/B4C multilayers. Both partial beams then pass variable delay lines. For different wavelengths the angle of incidence onto the multilayer mirrors is adjusted in order to match the Bragg condition. Hence, maximum delays between +/- 1 ps at 24 keV and up to +/- 23 ps at 5 keV will be possible. In order to evaluate the influence of the device on experiments with focused hard x-ray pulses, time-dependent wave-optics simulations have been performed by means of Synchrotron Radiation Workshop (SRW) software for SASE pulses at hv = 5 keV. This software tool has recently been applied to assess the capability of the SDU to measure the temporal coherence properties of hard xray FEL-pulses. For this earlier study, diffraction at the beam splitter and a one-dimensional cut through the surface profile was taken into account. At the HED instrument, the XFEL radiation will be focused by means of compound refractive lenses (CRL) in order to perform experiments with intense, focused hard x-ray pulses. The results of these experiments severely depend on the fluence and the spatial shape of the beam that is obtained in the focal area. Therefore, in this paper the impact of wave-front distortions on the spatial intensity profile in the focus is analyzed. For this purpose, the entire optical layout of the SDU, including diffraction on the beam splitter edge and the two-dimensional surface profiles of all eight mirrors are taken into account. The XFEL radiation is simulated using the output of the time-dependent SASE code FAST. For the simulations diffraction on the beam splitter edge as well as height and slope errors of all eight mirror surfaces are taken into account. The impact of these effects on the ability to focus the beam by means of compound refractive lenses (CRL) are analyzed.

Biography

Victor Kärcher has completed his Bachelor's in Physics from the University of Münster, Germany. He works on the simulation of x-ray optics in the Group of Helmut Zacharias at the University of Münster.

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Priyalal Stephen Wijewarnasuriya, J Laser Opt Photonics 2017, 4:4 (Suppl)
DOI: 10.4172/2469-410X-C1-017

Development of high-operating long wave HGCDTE devices at army research laboratory

Priyalal Stephen Wijewarnasuriya
US Army Research Laboratory, USA

Mercury cadmium telluride (HgCdTe) alloy is of great importance in sensing radiation from the near infrared (λc ~ 1 μm) to the very long wavelength infrared (λc ~ 15 μm). Much of the HgCdTe-related research and development work is carried out for cooled operation. Intrinsic carriers play a dominant role, especially at long-wavelength (LW 8 μm to 12 μm cut-off) material near ambient temperatures due to high thermal generation of carriers. This results in low minority carrier lifetimes due to Auger recombination processes. Consequently, this low lifetime at high temperatures results in high dark currents and high noise. Cooling is one means of reducing this type of detector noise. The challenge is to design photon detectors to achieve background-limited performance (BLIP) at the highest possible operating temperature, with the greatest desire being operation close to ambient temperature. This paper present a path to achieve BLIP LW HgCdTe at twice the operating temperature of current 80K LW HgCdTe technology. High operating temperature LW devices would result in several advantages to an infrared imaging system. This technology will offer half the cool down time than the present technology for greater battle field survivability with faster first "image out" and less than half the power consumption (2 Watts vs 5 Watts). This will lead to dramatic reduction in size, weight and power resulting reduced cost (SWaP-C).

Biography

Priyalal Stephen Wijewarnasuriya received his Ph.D. in Physics from the University of Illinois at Chicago. He was a member of technical Staff at the Rockwell Scientific Center, CA and was dedicated to demonstration of novel, large-format infrared focal plane arrays for tactical and strategic military applications as well as for astronomy using HgCdTe alloy. He is currently leading the development of the next generation of infrared materials and devices at the U.S. Army Research Laboratory (ARL), Adelphi, MD. He is the Team Leader of "II-VI Materials and Devices Team". Dr. Wijewarnasuriya has authored or co-authored over 100 papers in the open technical literature, four book chapters and has presented his work at numerous national and international conferences. Currently, Dr. Wijewarnasuriya serves as a member of the organizing Committee for two international conferences in the infrared technology area.

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Morad Khosravi Eghbal et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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W-band signal propagation in a WDM-over-OCDMA system

Morad Khosravi Eghbal and **Mehdi Shadaram**
University of Texas at San Antonio, USA

In the past few years, because of the introduction of new bandwidth-demanding services and applications through mobile phone communication, demands for a higher capacity that can support execution of such services has increased substantially. An effective method to increase the capacity is to move to the higher working frequency bands (to the millimeter wave region (>30 GHz)). This region has an inherently higher capacity, plus is more secure and less occupied. However, millimeter waves when transmitted over the air are prone to atmospheric losses and are severely attenuated at a relatively short propagation distances. Thus, transmission of such signals through an optical fiber link will simultaneously preserve the security, augmented capacity and yet the propagation distance without the signals being distorted and with relatively much longer than over-the-air propagation. To add to the capacity even further, two of the well-established methods of increasing the capacity were merged in this work. First, was to increase an optical network's capacity by employing several wavelength channels to transmit optical signals in parallel. Depending on the number of wavelength channels, the capacity of the system will be multiplied. The other was optical encoding that can help to further increase the capacity of the system and accommodate more channels to be transmitted simultaneously. This method assigns different optical codes to each channel that is identical and can only be decoded individually. This work, utilizes above methods to increase the capacity of a W-band radio-over-fiber WDM-over-OCDMA system to accommodate more users per channel.

Biography

Morad Khosravi Eghbal is currently a Graduate Research Assistant and a PhD Candidate at the Photonics Research Lab at the University of Texas at San Antonio. His research focus is on the millimeter wave radio-over-fiber communication, optical coding and multi-wavelength transmission methods for 5G architecture.

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Ousmane I Barry et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Growth and characterization of homoepitaxial m-plane GaN on native bulk GaN substrates: Prospects of next-generation electronic devices

Ousmane I Barry, Kaddour Lekhal, Si-Young Bae, Ho-Jun Lee, Markus Pristovsek, Yoshio Honda and **Hiroshi Amano**
Nagoya University, Japan

Nonpolar (m–plane) nitride heterostructures-based electronic devices are, unlike their polar (c-plane) counterparts, devoid of spontaneous polarization and piezoelectric fields. This unique feature makes nonpolar nitride materials very promising candidates for normally-off enhancement mode transistors which are highly demanded in safe power switching operation and also for very stable light emitters owing to the suppression of the quantum confined Stark effect. Recent breakthroughs in the bulk GaN growth technology have made low defect m–plane GaN substrates commercially available, paving the way for higher-quality homoepitaxial GaN growth and the development of vertical devices. However, the growth of nominally on-axis homoepitaxial GaN layers by metal-organic vapor phase epitaxy (MOVPE) on these native substrates generates wavy surface reliefs characterized by three-dimensional four-sided pyramidal hillocks which are detrimental for device fabrication. In addition, a higher unintentional impurity incorporation in non-polar nitride films hinders device performance and reliability. In this talk, we present a technique to reduce the formation of pyramidal hillocks on the homoepitaxial m-GaN films. Smooth surfaces with very low density of hillocks are achieved under high V/III ratio and exclusively N_2 carrier gas. The electrical properties of m-GaN films were found to be dependent on the surface morphology. A clear improvement of the electrical properties can be observed by suppressing the hillocks. Subsequently, impurities concentrations in m-GaN films were significantly reduced with V/III optimization and pure N_2 carrier gas as confirmed by SIMS analysis. These results show good prospects for the development of next-generation electronic devices on non-polar GaN materials.

Biography

Ousmane I Barry is pursuing his final year PhD at Nagoya University (NU) in Japan. He is also a Research Assistant at NU's Institute of Materials and Systems for Sustainability (IMaSS). His research interests lie in the epitaxial growth and characterization of III-nitride compound semiconductor materials for optoelectronic and high-power device applications.

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Notes:

Mohammad A Z Al-Khateeb et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Nonlinearity compensation using optical phase conjugation in optical fiber transmission systems

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The fundamental performance limits of coherent optical transmission systems can be observed by a simple optimization between the linear noise and the nonlinear noise generated within the system. Optical Phase Conjugation (OPC) is considered to be one of the promising techniques to compensate for optical fiber's dispersion and nonlinearity that cause crosstalk between signals traveling through long-haul optical transmission systems, nonlinearity compensation can lead to significant information capacity and distance reach expansion of optical fiber transmission links. To get the full benefit from the deployment of OPC in optical transmission systems, a few considerations must be taken into account, such as: power profile symmetry, fiber's dispersion slope and Polarization Mode Dispersion (PMD). In this contribution, we will present our simplified theoretical predictions of optical fiber transmission systems performance that deploy mid-link OPC and multi-OPC and we will show that the introduction of multi-OPC in an optical transmission system will minimize the impact of uncompensated/nondeterministic signal-signal nonlinear interactions due to fiber's PMD and signal-noise interactions. We will show wide range of simulation and experimental results that validate the theoretical predictions of system's performance for various types of links: dispersion managed, dispersion unmanaged, discretely amplified systems and distributed Raman amplified systems. Also, we will present an extensive experimental study shows that the deployment of mid-link OPC can provide a significant reach improvement in asymmetric lumped optical fiber links when optimizing the span length.

Biography

Mohammad A Z Al-Khateeb has received his BSc in Communication and Software Engineering from Balqa' Applied University, Jordan. Then he received his MSc degrees in Photonics Networks Engineering, Erasmus Mundus double Master's degree, from Scuola Superiore Sant'Anna and Aston University. He is currently working towards PhD degree from Aston University under the supervision of Prof. Andrew Ellis. He is currently working across multiple projects, participated in organizing outreach activities such as LightFest (an International Year of Light event in Birmingham) and he is working on industrial contracts. He has authored/co-authored over 12 publications and he is leading the development of theoretical tools and experimental demonstrations to exhibit the benefits of Optical Phase Conjugation in optical communication systems.

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Simeon Bogdanov, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Quantum plasmonics with nitrogen-vacancy centers in diamond

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Integrated quantum photonics imposes very stringent and often contradictory requirements on the design of integrated optical components. Plasmonic materials promise to confer novel properties to integrated quantum devices, that are not achievable with dielectric materials, such as nanoscale footprint, ultrafast operation and very strong light-matter interaction. In this talk, we will focus on the advantages of plasmonics for producing single photons. Our single-photon source is based on a nitrogen-vacancy center in diamond in a gap-plasmon cavity. It features a 200-fold speed-up in emission and a 30-fold increase in detected photon count compared to a reference source made without the plasmonic cavity. We discuss the potential of this enhancement mechanism for the engineering of tomorrow's quantum photonic systems.

Biography

Simeon Bogdanv has received his PhD from the group of Manijeh Razeghi at Northwestern University in 2014. He is currently a Post-doctoral Research Associate at Purdue University in the group of Vladimir M Shalaev. His research interests include optoelectronic devices and quantum nanophotonics. His scientific achievements include the fabrication of InAs/GaSb superlattice photodetectors operating at 10 μm with the lowest dark current and the world's brightest single-photon source based on a nitrogen-vacancy center in diamond. He is Member of the Optical Society of America and serves as Reviewer for journals such as *Optics Express, Optics Materials Express, Optics Letters* and *Nanophotonics*.

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Automatized optical quality assessment of photovoltaic modules

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Optical measurement techniques open the door to a wide variety of quality inspection tools. However, the number of customizable settings, like e.g. excitation sources or optical filters, is immense. For the quality inspection of thin film photovoltaics, we developed a Matlab based analysis tool in order to investigate as many parameters-potentially obtained by different metrology methods-as possible, in a fast and reproducible way. This tool automatically executes procedures like peak wavelength detection of luminescence spectra (an indicator for material composition), hot spot detection in IR images (an indicator for recombination losses) and many mathematical combinations of multiple images taken under varying conditions. One application of this approach was to separate the effects of material composition from the influence of the defects on the performance of a photovoltaic module. The combination of these two performance indicators showed a good correlation to the open circuit voltage of the device, proving the relevance of this analysis approach. Furthermore, the tool was capable of capturing further refinements following from hardware improvements like the combination of images taken with special IR filters. This allowed us to combine the benefits of spectral and spatial resolution, which could be used in order to selectively identify certain chemical substances and their distribution in the sample of interest. The software applies the scripted processing tasks successively on all samples of a measurement series within minutes, thus enabling high throughput inline measurements. The implemented graphical user interface (GUI) allows for a flexible and user definable handling.

Biography

Johannes Hepp has completed his MSc in Material Science from Friedrich-Alexander-University Erlangen-Nuremberg (FAU) and started working on his PhD as Reseacher at Bavarian Center for Applied Energy Research (ZAE Bayern) in February 2015. He is a Doctoral Researcher at the School of Advanced Optical Technologies Erlangen (SAOT) and has authored/coauthored three publications.

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Farzad Rezaei, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Surface modification of PET film via a large area atmospheric pressure plasma: An optical analysis of the plasma and surface characterization of the polymer film

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This research presents a comprehensive study of surface modification of polyethylene terephthalate film substrates to improve its adhesion properties using a large area atmospheric plasma. Different aspects of this study includes: analysis of the physical and chemical characteristics of the plasma as well as the substrates and evaluation of adhesion of an acrylate based hard coating onto PET substrates. PET is chemically inert to most coatings, but atmospheric plasmas can modify the surface in a manner that is compatible with high throughput manufacturing. First, optical emission spectroscopy was employed to analyze the plasma in terms of its chemical composition as well as physical characteristics such as electron temperature and density. This section estimates electron temperature of 0.2-0.4 eV and density in the order of 10^{14}-10^{15} cm^{-3} for the studied plasmas. Second, various plasma gas mixtures with helium as the seed gas mixed with fraction of oxygen and/or nitrogen (0.5-1.1 v%) were used to carry out the surface treatment of the substrates at different exposure doses between 15 to 75 J cm^{-2}. Post-treatment characterization by XPS, AFM and a goniometer show that the surface becomes enriched with oxygen, rougher and more wetting depends on the power and composition of the plasma. Lastly, standard adhesion 180° T-peel tests indicated improved adhesion after treatment.

Biography

Farzad Rezaei has graduated with a PhD in Fiber and Polymer Science from the College of Textiles at North Carolina State University. Currently, he works at the College of Textiles as a Post-doctoral Research Scholar. The focus of his research is on polymeric coatings, surface modification and plasma science.

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Marek Vostřák et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Diagnostics of laser remelting of thermally sprayed coatings using an infrared camera

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Laser remelting of thermally sprayed coatings is a promising possibility how to improve their functional properties such as wear and corrosion resistance. To achieve the optimal results and the desired depth of remelting, it requires a precise control of laser process parameters. However, any suitable control of laser remelting process by means of infrared measurement was yet not described. In this study, a high-power diode laser was used to remelt the HVOF sprayed stellite coatings. Samples with a different coating/substrate thickness ratio were utilized and by variating the process speed the different depth of remelting was achieved. The remelting process was recorded by the combination of a Long Wavelength Infrared (LWIR) and a Near Infrared (NIR) camera. The experiment was designed to find the most suitable method for diagnostics of a remelting process. The possibilities of evaluation of a temperature field in the interaction zone are presented. The width of melting pool is calculated from the evaluated temperatures and then correlated with the measured depth of remelting. The approximations of their mutual dependence show very high correspondence. It indicates that this measurement can be used for controlling of the depth of remelting, regardless of the samples dimensions.

Biography

Marek Vostřák is a PhD candidate in the field of Laser Technologies. In 2010, he has received his Master's degree in Applied Physics from the University of West Bohemia and he has been a Researcher in the New Technologies Research Centre since then. His research is focused on laser cladding and laser remelting and utilization of thermography measurement in these technologies. He is an author and co-author of numerous outcomes of applied research and some notable publications in this area, the most recent one is "Diagnostic of laser remelting of high velocity oxygen fuel sprayed stellite coatings using an infrared camera published in *Surface and Coatings Technology* volume 318 (2017): 360–364.

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Maybritt Kuehn et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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Band alignment in organic light emitting diodes – on the track of thickness dependent onset voltage shifts

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Organic light emitting diodes play an important role in our daily life, e.g. as displays in smart phones. Nevertheless these modern multilayer devices often show unexpected effects during operation. One of these phenomena - the thickness dependent onset voltage shift - is topic of this contribution. The investigations concentrate on two OLEDs that only differ in the emission layer but show an entirely different current-voltage behaviour. If the emission layer consists of the triplet host TH-A a shift in onset voltage in case of emission layer thickness variation can be observed. Using TH-B in the emission layer, an isomer to TH-A, the onset voltage remains unchanged. In a previous publication, we could show that an electric interface field is responsible for the thickness dependent onset voltage shift. The interface field is already present in the currentless case. This presentation now deals with the origin of such an interface field. Therefore the energetic alignment at the internal interfaces in the two different devices is measured by performing *in-situ* step by step interface experiments using photoelectron spectroscopy. In case of the device showing no onset voltage shift a flat band situation is measured, while in case of the other device (where there is the onset voltage shift) the formation of space charge regions is detected. A further stack modification proofs that the band bending at the hole injecting interface into the emission layer is responsible for the onset voltage shift.

Biography

Maybritt Kuehn has studied Material Science at the Technische Universitaet Darmstadt, Germany. With her diploma thesis she started to work in Jaegermann's group, completed her PhD there and continued with Post-doctoral studies. She did her PhD thesis in cooperation with the Merck KGaA, Darmstadt, Germany, at Innovationlab Heidelberg, Germany and focused on pholelectron spectroscopy. In her PhD thesis, she investigated the influence of energetic alignment at organic/organic-interfaces on the current-voltage behaviour of OLEDs.

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Hongyang Wang et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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The welding modes in Laser-arc hybrid lap welding of dissimilar metals

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The pluse laser-tungsten inert gas hybrid welding method was adopted to realize the welding dissimilar alloys process. The welding modes in the laser-arc hybrid welding lap joint were changed with the varying of laser and arc parameters, which made obviously effects on the dissimilar joints. In Ti and steel dissimilar welding lap joint with Cu interlayer, the welding mode in both of Ti and steel fusion zone were in conductive mode and the thickness of the intermetallic was limited by the accurate control of the welding heat. In Mg and Al alloys dissimilar welding lap joint with Ni interlayer, the welding mode in Mg fusion zone was in keyhole mode and Al fusion zone in conductive mode and the intermetallics was inhibited by the welding mode and interlayer. In Al and steel dissimilar welding lap joint with Cu interlayer, the welding modes in both of Al and steel fusion zone were in keyhole mode, but the thickness of the Al-Fe intermetallic was less than 10μm, which was reduced by the hybrid effect of the Cu interlayer and the welding sources. The welding mode should be changed by the character of the dissimilar metals. The formation and distribution of the intermetallic was decided by the welding sources, base metal and the welding process, which made obvious effect on the property of the joint.

Biography

Hongyang Wang received his PhD in Materials Manufacture Major from Dalian University of Technology, China. Now, he is working as an Associate Professor of Dalian University of Technology, a Deputy Director of Key Laboratory of Liaoning Province in China. He is mainly committed to lights welding and dissimilar welding process. His research has brought him more than 20 papers in reputed journals with more than 200 of SCI citation.

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Najmeh Abbasirad, J Laser Opt Photonics 2017, 4:4 (Suppl)
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Mapping surface plasmon polaritons by near-infrared dual-probe scanning near-field optical microscope

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Scanning near-field optical microscopy (SNOM) is a powerful technique to visualize optical phenomena within the near-field region of optical nanostructure. In standard aperture SNOM measurements, there is a small aperture which serves as a point-like emitter or detector of light. In dual-probe SNOM, there are two aperture tips which simultaneously illuminate and collect the light on a surface of nanostructures. In the dual-probe configuration, both illumination and collection resolution depends on the aperture size and can overcome the diffraction limit. Furthermore, the measurement signal is not influenced by background radiation stemming from an illumination laser spot. Although the dual-probe SNOM measurements have been reported for the measurement of surface plasmon polaritons (SPPs) propagation as well as local carrier dynamics in quantum wells, due to complications of dual-probe SNOM measurements, this technique is not yet a common near-field characterization method. Recently, we have introduced a fully automated and robust dual-probe SNOM technique which has facilitated the robust implementation of the measurement. In this technique, a reliable collision avoidance scheme only based on shear force interaction between two tips is employed. The fully automated dual-probe technique not only simplifies the application of dual-probe SNOM, but a low noise electronic also leads to considerably improved data acquisition. In this work, we demonstrate the capability and stability of the method by measuring SPPs propagation for near-infrared excitation. The illumination probe excited SPPs on a gold film at 1550 nm wavelength. The SPP propagation is mapped on an area around the illumination probe by raster scanning of the collection probe. A computer-controlled collision avoidance scheme prevents the collision of two probes. Therefore, the optical signal is mapped without user interference. The fully automated dual-probe SNOM could open up a new possibility to quantitatively investigate and image the optical field interaction with plasmonic and dielectric devices as well as surface wave propagation.

Biography

Najmeh Abbasirad is currently pursuing her PhD in Nano-optics group at the Institute of Applied Physics, Friedrich Schiller University Jena under supervision of Prof. Thomas Pertsch. At present her research focuses on near-field optical microscopy and developing dual-probe SNOM for characterization of optical nanostructures.

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Zanozina Ekaterina et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
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FTIR laboratory measurement of O I spectra in 0.77–12.5 μm spectral range

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Compared with the visible and ultraviolet ranges, fewer atomic and ionic lines are available in the infrared spectral region. Atlases of stellar spectra often provide only a short list of identified lines and modern laboratory-based spectral features for wavelengths longer than 1 micron are not available for most elements. In spite of the fact that oxygen is one of the most abundant elements in the universe, very few studies of their spectra in infrared region have been reported. The normal system of O I terms available in the NIST atomic spectra database was established more than a half-century ago. The present work attempts to address the above issues. We exploited the great advantages of time-resolved Fourier transform spectroscopy, such as its constant high resolution and energy throughput, to record high-resolution spectra of oxygen in a wide domain of 800-13000 cm^{-1} (0.77-12.5 μm). With the help of recent high-accuracy direct measurements of the 3p level in the UV, we performed a re-optimization of O I level energies. This re-optimization uses 146 O I lines in the infrared (including 59 lines not measured previously in the laboratory) to yield more accurate energies of levels with $n=4\text{-}7$, $l\leq6$. For some of these levels, we experimentally found fine structure splitting for the first time. The line classification was performed using relative line strengths expressed in terms of transition dipole matrix elements calculated with the help of quantum defect theory (QDT). To verify our QDT calculations of dipole transition matrix elements, we checked several QDT-calculated oscillator which strengthened against the results of other authors. The method showed the good agreement with the vast majority of the data listed in the NIST ASD.

Biography

Zanozina Ekaterina has completed her PhD from Voronezh University and State Research Center of Russian Federation Troitsk Institute For Innovation and Fusion Research. She is now a Post-doctoral Researcher in J Heyrovsky Institute of Physical Chemistry AV ČR in Prague. In the Department of Spectroscopy, she actively participates in solving problems, which mainly include the identification of infrared spectra of atoms and complex analysis of spectral data. She is the author of 11 publications in impacted journals with 37 citations. She presented her results at six international conferences focusing mainly on spectroscopic issues. Her research interests include Rydberg states of atoms and molecules; interaction of electromagnetic radiation with atoms; mathematical and computational physics; time-resolved FTIR spectroscopy and transition probabilities.

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On-chip integrated a 3D-CMOS Si photodetector array with a fiber couplers platform for remote optical fiber monitoring

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Otto-von-Guericke University of Magdeburg, Germany

A silicon-based photodetector array with on-chip integration to tiny fiber strands on a single chip is fabricated using 3D-complementary metal-oxide-semiconductor (CMOS) and microelectromechanical systems (MEMS) technology. The 3D-detector involves a vertical photoactive area as large as the fiber diameter for direct butt-coupling to the optical fiber. Novel ultra-deep trench isolation with a passivation method is carried out to overcome the leakage current as well as the surface recombination current and the dark current, which arise from the fabrication of the ultra-deep trenches. The passivation method consisting of SU-8 polymer enables to implement the deep trenches with a depth of 30μm for both the vertical photoactive area and the inter-pixel trench isolation in the CMOS process. All pixels in the linear array are held at the same applied reverse voltage, by stacking the interconnection line across the pixels. Besides, a tapered U-groove array is built on the monolithically integrated fiber couplers platform for chip-level fiber insertion. This detector shows an external quantum efficiency of 63.82%, corresponding to the photoresponsivity of 0.32A/W, at a wavelength of 631nm for 2V reverse bias. The proposed detector array integrated into a fiber bundle is very promising to apply for remote optical fiber sensing applications in harsh environments, where involve high electromagnetic fields or RF signals such as magnetic resonance imaging (MRI) or positron emission tomography (PET).

Biography

Iman Sabri Alirezaei received his MSc degree in Applied Physics from Shahid Beheshti University (SBU). He is currently doing his PhD and working as a Research Assistant in Electrical Engineering at Institute of Micro and Sensor Systems, Magdeburg University. His current research interests include CMOS-MEMS devices, micro- and nano-photonic devices, optical fiber sensors, integrated photodetectors and Lab-on-a-chip.

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Intracellular pH detection of *Brachionus plicatilis* with pMBA pH nanosensor

Nadiah Aldaleeli and **Peter Dunstan**
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An important application of Surface Enhanced Raman Scattering (SERS) is the potential of intracellular analysis based on Raman reporters attached to nanoprobes. SERS is an appropriate technique for identification of molecular species of a biological system; measuring local chemical changes at the subcellular level with high spatial and temporal resolution. Measuring pH utilising the enhanced Raman response from pMBA when it has functionalised gold nanoparticles (Au NPs) has attracted significant attentions. Thus, the application of such a system to the measurement of intracellular pH is a key aspect of current development. The importance of monitoring the intracellular pH appears in gaining a better understanding of the occurrence and progression of diseases. Herein, the sensitivity of pH nanoprobe based on pMBA functionalised 30 nm Au NPs to the pH changes of the surrounding solutions has been investigated not only with a pure stock solution of pMBA-Au but also when internalised inside *Brachionus plicatilis*. The preliminary results show that the chemical sensing of the nanoscales probe is maintained when inserted into living cells giving an evidence of the ability of such probe to monitor intracellular pH changes. The sensitivity of such nanoprobe to the pH changes inside the organism is reflected in the changes of the SERS response of the pH calibration modes at 696 cm^{-1}, 1393 cm^{-1} and 1702 cm^{-1} which shows a similar trend to the pure stock solution of pMBA-Au.

Biography

Nadiah Aldaleeli received her BE degree in Physics from the King Faisal University, Saudi Arabia, in 2003 and the Master's degree in Laser and Spectra from King Saud University in 2008 and her Master's project (Spectral diagnosis of cancer samples before and after surgery) was awarded the golden medal for the best research in that year. In 2010, she joined the Department of Physics, Aljouf University, Saudi Arabia, as a Lecturer and since 2013, have been with the Department of Physics, Education Collage, Imam Abdulrahman Bin Faisal University, Saudi Arabia, as a Lecturer as well. She is currently at Swansea University for a PhD program in the field of Nanotechnology and her research interests lie in laser diagnostics and spectroscopy.

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The MOCVD overgrowth studies of III-Nitride on Bragg grating for distributed feedback lasers

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Gallium nitride lasers, especially the single-mode distributed feedback (DFB) lasers using Bragg gratings own potential applications in communication systems due to their high-speed modulation. For the blue-violet light, the value of a period of the first-order diffraction grating is about 80 nm. This poses a big challenge when forming the high precision grating and nitride overgrowth based on it. We fabricated the fine step shape structure of first-order and 3rd order grating by nanoimprint and inductively coupled plasma (ICP) dry etching and we proceeded with an epitaxial regrowth of AlGaN layer with 6% to 12% Al content. Then we designed a series of gratings with different period, depths and duty ratios to study the influence of grating structure on nano-heteroepitaxy. And we improved the overgrowth by enhancing the growth temperature as high as 1450°C. Moreover, we observed the nucleation and growth process by step-by-step growth to study the growth mode for nitride overgrowth on grating, under the condition that the grating period was larger than the mental migration length on the surface. These samples were analyzed structurally by high-resolution transmission electron microscopy (HRTEM) and space-spectrally by cathodoluminescence (CL). The growth dynamics analysis of the nitride nano-epitaxial in this research is one of the frontier areas of nitride photoelectric devices, which is not only meaningful in semiconductor material physics, but also important for related scientific researches and applications.

Biography

Junze Li has completed his PhD from Peking University. He is working as the Research Assistant of Microsystem & Terahertz Research Center of China Academy of Engineering Physics (CAEP). He has published more than 20 papers in reputed journals.

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High quality nitride materials (AlN and AlGaN) on Si and sapphire substrates and UV-LED applications

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The growth of thick, high quality and low-stress AlN films on Si and Al_2O_3 substrates is highly desired for a number of applications like the development of micro and nanoelectromechanical system (MEMS and NEMS) technologies and particularly for fabricating AlGaN based UV-LEDs. UV-LEDs are attractive as they are applied in many areas, such as air and water sterilization, efficient white lighting, high-density optical data storage and military applications such as biological agent detection and non-line-of-sight communication. However, the development of UV-LEDs on Si substrates is highly desired for a series of reasons like the availability of cheap, large-diameter silicon wafers, the much lower device processing costs, and the possibility of monolithical integration of the UV-LEDs with Si circuitry. In addition, efficient AlGaN based deep UV-LEDs require layers and substrates which are transparent in UV light. So, it is preferable to grow the AlGaN based deep UV-LEDs active layers on Si substrates as the Si can be removed by chemical treatment to allow back illumination and avoid the generation and reabsorption of UV light by backside emission. These advantages make silicon an attractive substrate for AlGaN based UV devices. Additionally high quality AlN template on Al_2O_3 substrate still is the key layer to grow high quality AlN and high Al content AlGaN materials for DUV applications since AlN substrate price and size are not suitable for mass production.

Biography

Ilkay Demir has completed his PhD at the age of 32 years from Cumhuriyet University, Physics Department. He is the researcher of Nanophotonics Research and Application Center and Department of Nanotechnology Enginnering. He spent 1 year of his PhD at Center for Quantum Devices under supervision of Prof. Manijeh Razeghi. He has published 5 papers in reputed journals.

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