ABSTRACT BOOK

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...*GLIMPSES*...

Fiber-Based Polarized and Tunable Multimode Laser

Eyal Buks, Andrew, Erna Viterbi, Department of Electrical Engineering, Technion, Haifa 32000 Israel

ABSTRACT:

Tunable multimode lasing has been recently demonstrated using an Erbium doped fiber(EDF) that is cooled down to cryogenic temperatures [Phys. Rev. Applied 19, L051001 (2023)]. Here we explore amodified laser configuration, in which a polarization filter is added. We findthat the added filter enables lasing with significantly higher degree ofpolarization (DOP). The enhanced DOP, together with the wavelength tunability,open the way for some practical applications for the multimode laser under study in the fields of quantum communication and metrology.

BIOGRAPHY:

EyalBuks, Technion
EB received the B.Sc**.** degree in mathematicsand physics from the Tel-Aviv University, and the M.Sc.andPh.D.degreesin physics from the Weizmann Institute of Science. He worked at the CaliforniaInstituteof Technology,asa postdoctoral scholar, His current research isfocused on nonlinear dynamics in classical and quantum systems.

Quantum Cone-Nano Source of Light with Dispersive Spectrum: Technology and Properties

Arturs Medvids, Lab of Semiconductor Physics, Riga Technical University.

ABSTRACT:

Nanostructures (NSs) are the most investigated object in solid-state physics, especially the Quantum confinement effect in quantum dots – 0D, quantum wires - 1D, and quantum wells – 2D systems. Twenty years ago, we showed the possibility of the formation of a new quantum system, the so-called Quantum cone (QC), on the surface of Ge crystal by laser radiation. The QC possesses unique optical properties: huge "blue shift" of photoluminescence (PL) spectrum on 1.1 eV with increased intensity more than a million times, and "red shift" of LO phonon line frequency on 6 cm-1 in Raman spectrum. The appearance of a new band in the PL spectrum of CdZnTe solid solution is explained by the exciton quantum confinement effect in QC. Irradiation of SiO_2/Si structure by Nd:YAG laser leads to the formation of nanocones which possesses a unique PL spectrum: "blue shift" on 1.2 eV, an asymmetric wide band from 1.1 eV till 2.2 eV with gradually decreases intensity in the red part of the spectrum, rainbow-like spectrum, and maximum of PL intensity increase more than million times. These properties of the system of PL spectrum are typical for graded bandgap semiconductors. This means that the quantum cone with a solid angle at the top of the cone of less than 60o is a 1D system with a gradually decreasing diameter from the base to the top of the cone. Therefore, where the cone diameter is equal to or less than Bohr's radius, an exciton quantum confinement effect takes place. These facts speak forward to the possibility of a gradual decrease in the lifetime of electron-hole pairs or excitons from the base to the top of a cone. The aim of this study is to elaborate on a nano source of light with a dispersive spectrum. The parameters of the QC as sources of light are in the spectral range of $\Delta\lambda$= 350 - 550 nm, with the linear dispersion of the quantum cone $dh/d\lambda = 0.1$. The rate of spectra change is $V_\lambda = 3\times10^{10}$ nm/s.

BIOGRAPHY:

Professor Arturs Medvids works at the Institute of Technical Physics of Riga Technical University. In 2001 and 2017, he worked as an invited professor at Shizuoka University. He was awarded the title of Honorable Guest Professor in 2009 - 2019. He has 623 publications. He has participated at the 12th International Conference on Solid Films and Surfaces, 2005, in Hamamatsu, Japan and the 1st Conference on Nanocomposites, 2009, in Kerala, India, and at the Energy Materials Nanotechnology East Meeting, 2014, in Beijing, and Keynote Speaker at the 19th Nano Congress for Next Generation, 2017, in Brussels. He got the IAAM Medal at the Conference AMWC 2018 conference in Singapore.

Secured LiFi using ML-Based Channel Detection

Prof. Hoa Le Minh and Dr Rida Zia-ul-Mustafa, Northumbria University at Newcastle, UK.

ABSTRACT:

White light LED-based general lighting hassignificantly been evolved since being invented from the original incandescent and fluorescent sources. The extensive utilisation of LEDs at home and in industry at a large scale has much attracted the dual usage of LED in both lighting and telecommunications, including Light Fidelity (LiFi). As aLiFisystem typically broadcasts the light beam signal, the eavesdropper can access to the physical channel and potentially obtain the information. In this presentation we will discuss a ML-based approach to identify communications channel, hence forming a secure communication zone for LiFi system. This will limit the eavesdropping capability of unauthorised users.

BIOGRAPHY:

Dr Hoa Le Minh is a Professor in Optical Communications at Northumbria University at Newcastle, UK.

Prior to joining Northumbria University he was a research fellow at Siemens AG, Munich, Germany and at University of Oxford, UK. His research area is optical communications, visible light communications, sensor network and photonics artificial intelligence in which he has published over 200 papers in journals and conferences. He participates in a number of European and industrial projects. He wasthe Chairman of IEEE Communications Society (ComSoc) Chapter of UK and Ireland, and currently the Treasurer of IEEE UK and Ireland Section.

First Principles Numerical Modeling of Optoelectronic and Photonic Devices

Avik Ghosh, Dept of Electrical and Computer Engineering, and Dept of Physics, University of Virginia, Charlottesville, VA 22904

ABSTRACT:

Semiconductor Device modeling, including emerging materials like magnets and 2-D materials, has now reached a great-deal of sophistication, thanks to predictive models for material bandstructures built out of Density Functional Theory (DFT) or empirical tight binding, coupled with quantum kinetic models that operate far from equilibrium transport. The Non-Equilibrium Green's Function (NEGF) formalism provides a potent way to do this. This talk will show how to extend that treatment from DC transport to 'first principles' AC conductivities of bulk and heterostructure materials, next to higher order nonlinear photogalvanic coefficients of 2-D materials that show intriguing impact of spin-momentum locking selectively coupled with chiral circular photons, and finally strongly interacting impact ionization in Avalanche Photo Diodes.

BIOGRAPHY:

Avik Ghosh, Professor.
Professor Ghosh has a 20+ year history of computational modeling of quantum transport, spanning 200+ papers and 150+ invited and keynote talks. He has won the NSF Career Award, Army Research Office Best paper award, is senior member of IEEE, site director of the NSF-MIST center, and Fellow of the UK based Institute of Physics. His group's demonstration of negative index in graphene along with Columbia University was voted by editors of Physics World as one of the top 10 discoveries of 2016.

High-Energy Yellow Lasers for Medical Applications, Based on Raman Gneration in KGW Crystals

Aleksandr Tarasov and Hong Chu, 204 Hyundai I Valley, 31 Galmachi-ro, 244 Beon-gil, Jungwon-gu, Seongnam-si, Gyeonggi-do, South Korea, 13212.

ABSTRACT:

The application of laser light with wavelengths in yellow-orange spectral range (585-600 nm) for small blood vessel surgery has the advantages, compared to the application of the light with other wavelengths. At present time only one laser model with the characteristics, required for such medical treatment can be found at the market – V-Beam, produced by Candela. This laser generates light bursts at 595 nm with maximum energy 8 J and variable burst duration in millisecond range. But this laser is based on organic dye, that`s why suffers from multiple disadvantages,inherent for dye lasers. The main disadvantage is a short operational life of the dye, which causes frequent interruptions for laser service and increases operational expenses.

In our company, Laseroptek, we are developing a completely solid-state laser with similar to V-Beam characteristics, which is free from dye laser disadvantages. This laser is based on wavelength conversion of high-energy burst-pulsed Nd: YAG laser radiation to 589 nm radiation by stimulated Raman scattering in potassium gadolinium tungstate (KGW) crystals placed inside laser resonator (Raman laser).Crystalline Raman lasers were investigated during more than 50 years, butthe vast majority of studies considered low-energy generation (some millijoules or less). In our work we produce scaling of yellow light Raman laser energy to a multi-joule level.

In this talk we will consider the characteristics of high-energy KGW Raman lasers, the impact of laser cavity configuration and pump radiation parameters on laser characteristics. The results of the study of pump radiation nonlinear absorption in KGW crystals and its influence on laser generation will be presented.

BIOGRAPHY:

Aleksandr Tarasov, principal research scientist Laseroptek.

Born in 1949. Graduated from Leningrad Electrotechnical University (LETI) in 1972, got Master`s degree with Honor. Worked at Vavilov State Optical Institute, Leningrad, USSR as a research scientist from 1972 to 1989. Received PhD degree in 1984. From 1989 to 2000 worked at the Institute of Nuclear Problems, Minsk, Belarus as a principal research scientist. Since 2002 is working at Laseroptek, South Korea, as principal research scientist. Recipient of 1982 USSR LeninskiKomsomol Prize. Member of Optica (USA) since 2009.

Dense BST-Cu_x (x = 5, 12.5, 15, 20, 30, and 40%) Ceramic Composites: Fabrication, Electrical, and Optical Properties

Mohammed Tihtih, Jamal Eldin F. M. Ibrahim, and István Kocserha, Institute of Energy, Ceramics, and Polymer Technology, University of Miskolc, Miskolc, Hungary

ABSTRACT:

Dense BST-Cu_x ceramic composites were successfully fabricated using spark plasma sintering. The AC conductivity of these materials exhibited a gradual increase with rising Cu content and temperature, shifting the dominant conduction mechanism from oxygen vacancy migration to band conduction involving trapped electrons. Below the Curie temperature (Tc), conductivity increased with temperature, whereas a decline was observed beyond 130°C, indicating a transition in electrical conduction behavior. Dielectric studies revealed that composites with 30 wt% Cu content exhibited a peak permittivity of 1.0×10^5 at 1 kHz, with Maxwell–Wagner polarization governing the low-frequency dielectric response. Optical analysis showed a tunable band gap in the semiconducting range of 3.1–2.21 eV, demonstrating the potential of these materials for optoelectronic applications. Furthermore, impedance spectroscopy confirmed the two-layer conduction model, with grain boundary resistance (Rgb) decreasing as Cu content increased. These findings contribute to the fundamental understanding of defect chemistry, thermoelectric behavior, and the role of Cu doping in BST ceramics, providing valuable insights for their integration into micro-optical electro-mechanical systems and multilayer ceramic capacitors.

BIOGRAPHY:

Mohammed Tihtih is a materials scientist specializing in advanced ceramics. He earned his PhD in Materials Science and Engineering from the University of Miskolc, Hungary, focusing on doped and Cu-composite $BaTiO_3$ materials for multilayer ceramic capacitors. He has authored over 50 peer-reviewed articles and received multiple awards, including the Best Young Scientist Award (USA, 2023) and the Young Scientist Award (Japan, 2022). His expertise includes spark plasma sintering, dielectric behavior, and microstructural analysis. He has collaborated on international projects and mentored students. His research contributes to electronic and energy applications, particularly in MLCCs and micro-optical electro-mechanical systems.

Nanoplasmonics for Laser Assisted Nuclear Fusion

Norbert Kroo, Wigner Research Center for Physics, Hungary.

ABSTRACT:

Surface plasmon polaritons are the light of the nanoworld, with a broad spectrum of special properties. These properties open the field for a high number of applications, both in the fields of low and high intensities In the present work localized plasmons (LSPP) have been resonantly excited   by ultrashort (n.10fs) , high intensity (up to n.1018 W/cm2) pulses of Ti:Sa lasers on gold nanoparticles, implanted into a transparent polymer. The laser shots created craters in the studied samples. The volume of these craters is presented as the function of the exciting laser intensity for the samples with and without resonant gold nanoparticles as well as the creation of deuterium in the nanoparticle seeded sample with Raman and LIBS spectroscopy. Preliminary data indicate significant energy production and also nuclear trasmutation (hydrogen to deuterium), clearly proving   the decisive role of the unique properties of the LSPP-s. BN seeded samples have also been studied, where the p11B reaction has been observed by Thompson parabola measurements and by detecting α particles. Data obtained by other techniques (mass spectrometry) are also presented.

BIOGRAPHY:

Past Secretary General and Vice-President of the Hungarian Academy of Sciences.

Member Scientific Council of the European Research Council, founding director Research Institute for Solid State Physics and Optics of HAS. He is Honoris Causa Professor Doctor of the Roland EotvosUniversity(H). Former president European Physical Society, member, honorary member or doctor of distinguished scientific institutions and universities. (Academia Europaea, Spanish Royal Academy, Jordanian Royal Scientific Society, European Academy of Science and Arts, Euroscience, etc). His latest decorations are: Alexander von Humboldt Research Prize(D), the Wallis E. Lamb Award for Laser Physics and Quantum Electronics(US), Commander of the Order of the Lion Award (Finland), Middle Cross with the Star (H), the Townes and Weissko pf Award(US) , Hungarian Prima Primissima Prize for Science, Honorary Member European Physical Society, Research fields: neutron physics, laser physics, quantum optics and plasmonics. He has published more than 360 scientific papers, and is the owner of 43 patents.

The Invention of Copper Cysteamine Illumination Many Areas

Dean and Professor, Wei Chen, School of CHIPS, Xian Jiaotong – Liverpool.

ABSTRACT:

Here we introduce a new material called Copper Cysteamine we invented for applications in cancer and infection treatment as well as applications in lighting, sensing, and water purification. Photodynamic therapy has the beauty of targeting tumors by the sensitizers themselves and the light, however, the need for light for activation has some limitations as light cannot penetrate deeply into tissue, so photodynamic therapy has been widely used for skin disease treatment but not for deep cancer treatment. Here will discuss the possible solutions for developing photodynamic therapy for deep cancer treatment some new progress in Photodynamic therapy and the invention of new sensitizers that can be activated by UV, X-ray, microwave, and ultrasound to produce reactive oxygen species for deep cancer treatment as well as immunity enhancement and the solutions by taking the advantages of the tumor environment. New ideas for the combination of photodynamic therapy and radiation to overcome radiation resistance will be discussed. In addition, the potential applications of this kind of new materials in other areas like water treatment, lighting, sensing, and plant growth will be briefly introduced.

BIOGRAPHY:

Dr. Wei Chen is currently the dean for the school of CHIPS at Xian Jiaotong-Liverpool University. He was a University Distinguished professor at the Department of Physics, UT Arlington. Currently he has published more than 360 papers in famous academic journals, presided over the compilation of two books, one monograph, and participated in the compilation of 15 book chapters. His papers have been cited more than 19600 times, and his H index is 71 and I_{10} of 280, including one paper with 814 citations. He has 22 US patents granted. Dr. Chen's scientific research work has attracted wide attention and has been reported by the American Columbia TV program. Dr. Chen received the University distinguished record of research and creative activity award in 2020. He is a Fellow of the International Association of Advanced Materials (IAAM) and a Vebleo Fellow, a Sigma Xi full member, Pencis fellow and a fellow of Royal Society of Chemistry, and he received the IAAM scientist award for his outstanding contribution in Nanotechnology, and he was elected to be a fellow for the National Academy of Inventors in 2022 and a member of the University Academy of Distinguished Scholars in 2023.

Advancements in Inorganic Hole Transport Materials for Stable and High-Performance Perovskite Solar Cells

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ABSTRACT:

While challenges in stability, scalability, and commercialization remain, the last decade has witnessed remarkable progress in the photoelectric conversion efficiency (PCE) of perovskite solar cells (PSCs). Among various developments, the evolution of inorganic hole transport materials (HTMs) has played a critical role in enhancing both performance and stability. Unlike conventional organic HTMs such as spiro-OMeTAD, inorganic alternatives—including NiO_x, CuSCN, CuI, and delafossite oxides—exhibit superior thermal and chemical stability, improved charge transport, and reduced degradation pathways. These materials have demonstrated extended operational lifetimes exceeding 1000 hours under controlled conditions.However, further research is needed to achieve long-term stability under real-world operating environments.Recent efforts in interface engineering, material optimization, and device fabrication have led to significant advancements in PSCs incorporating inorganic HTLs. In particular, delafossite-type Cu-based oxides (e.g., $CuCrO_2$, $CuGaO_2$) have gained attention due to their high hole mobility, excellent stability, and suitable band alignment with perovskite absorbers, making them promising candidates for next-generation PSCs. This study provides an overview of the evolution of inorganic HTLs in PSCs, highlighting their impact on stability and performance improvements over the years. Continued research in this area is expected to accelerate the commercialization of PSCs by addressing remaining challenges and unlocking their full potential for practical applications.

This work was supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK) ARDEB 1001 Grant No. 121F166.

BIOGRAPHY:

Assoc. Prof. Dr. S. Akin, pursued his Ph.D. in the area of perovskite solar cells. He was a visiting researcher at Prof. Michael Grätzel's laboratory at EPFL. Throughout his research career, Dr. Akin has dedicated his efforts to exploring various innovative materials for harnessing light energy. He conducts many projects supported by national and international agencies on the optimization of different layers of PSCs, and additive/interface engineering. The originality of Prof. Akin's work is truly outstanding as can be deduced from the number of awards, patents and more than 100 scientific papers published in high impact journals in the field of device physics and advanced materials including Joule, Energy & Environmental Science, Advanced Materials, Advanced Energy Materials, Advanced Functional Materials, Science Advances, Nano Energy, and so on. These papers lead to the h-index of 40, with more than 6000 citations.

Functional Polymers with Dual Porosity and Controlled Degradability

Daniel Grande , University of Strasbourg, CNRS, Institut Charles Sadron (ICS), 67034 Strasbourg, France

ABSTRACT:

Over the last decade, the preparation of doubly porous materials has particularly been relevant for the design of biocompatible scaffolds meant for biomedical applications. A hierarchical double porosity may constitute a real benefit in the area of tissue engineering as the first porosity with pore sizes higher than 100 µm may enable the seeding and development of suitable cell lines within the material, while the second porosity with pore diameters lower than 1 µm should permit to improve the nutrient and waste flow though the material when the macropores are clogged at the last stage of the cell culture. To develop robust and versatile approaches to biodegradable and/or biocompatible polymer networks with a double porosity, we have proposed novel porogen templating strategies through the use of two distinct types of porogens, namely a macroporogen in combination with a nanoporogen. To generate the macroporosity, either NaCl particles or sieved PMMA beads or Nylon® threads are extracted, while the second porosity is generally obtained through phase separation by using a porogenic solvent. Bio-based monomers arising from lignin have been synthesized to chemically mimic wood structure: syringyl methacrylate for hardwood, guaiacyl methacrylate and vanillin methacrylate for softwood. On the other hand, porous biodegradable materials have been prepared by free-radical ring-opening copolymerization of 2-methylene-1,3-dioxepane, *i.e.* a vinylic cyclic monomer, with a crosslinking agent, *i.e.* divinyladipate, and a functionalizable and biocompatible monomer. Depending on the targeted application, the functionalization of the pore surface has been assessed with different alkyne or amine-derivatized (macro)molecules. The presence of azide or chlorine moieties at the pore surface constitutes a versatile functionalization platform for the derivatization of such biporous polymers towards antibacterial activities or tissue engineering applications.

BIOGRAPHY:

Dr. Daniel Grande is the director of Charles Sadron Institute (ICS) in Strasbourg where he moved in January 2024. He previously acted as the director of the ICMPE in Thiais for the period 2020-2023. He has been serving as the president of the soft matter section of the National Council for Scientific Research since 2021. He received his Ph.D. degree in polymer chemistry from the University of Bordeaux (France) and the University of Coahuila (Mexico) in 1998, and then he spent about two years at Emory University (Atlanta, USA) as a NIH post-doctoral fellow. His research interests include the development of functional polymer materials with a broad range of porosity scales, including nanoporous materials with controlled porosity and chemical functionality derived from polymer networks and nanostructured block copolymers, doubly porous materials with nano- and macro-porosity, as well as hybrid macroporous materials based on polymer fibers and inorganic nanoparticles.

The Study of Wearable UV-Photodetectors on PET Substrates Based on TiO_2-ZnO Nanocomposite via Sol-Gel Process

Youssif S M Elzawie, Md Roslan Hashim , Mohd Mahadi Halim, Nano-Optoelectronics Research and Technology Laboratory (NOR), School of Physics, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia.

ABSTRACT:

Demand has recently been increasing for foldable, rollable, and wearable electronics as alternatives to rigid electronics. Here, we explain the fabrication and characterization of UV photodetectors devices at room temperature. The main devices consist of nanocomposite of TiO_2-ZnO on PET and nanoparticles of undoped ZnO on PET as control. The samples were produced by first preparing xerogels using the sol-gel method, then compressing them on PET substrates adhered to a buffer acrylic pressure-sensitive adhesive tape layer. The topographic images from FESEM indicated more homogeneous and smoother surface of doped sample compared to that undoped sample. The UV-Vis spectroscopy revealed the indirect band gap energies of undoped ZnO nanoparticles and TiO_2-ZnO nanocomposite samples of 3.56 eV and 3.19 eV, respectively. The I-V characteristics of the two samples as photodetectors provide the current gains and incident photon-to-current efficiency. The relationships interestingly revealed currents at zero bias. The UV photosensitivity between the two devices showed a preference for nanocomposite of TiO_2-ZnO over undoped ZnO. The findings indicated that the flexible, and wearable photodetectors fabricated at room temperature can be utilized in UV detection fields in both non and biased voltages.

BIOGRAPHY:

Youssif S M Elzawiei received his B.Sc. (Hons) in Physics from University of Benghazi-Libya in 1997 and M.Sc. in Theoretical Nuclear Physics in 2007. Currently, he is studying towards Ph.D. in the School of Physics, Universiti Sains Malaysia. His research interests focus on the fields of integrated optics for sensor applications, waveguides, numerical techniques, nonlinear optics, nanomaterial sciences, and theoretical physics.

Md Roslan. Hashim,University Professor, received his BSc (Hons) in Physics and MSc in Solid State Physics 1989 and 2003 from Universiti Sains Malaysia and PhD from University of Southampton UK 1997. He served as Deputy Vice Canselor, Sustainability and Institutional Development, USM, December 2019 to November

2022. He has taught in the School of Physics USM, in the field of Solid State Physics and Semiconductor Nanotechnology for 27 years. He was Applied Physics Program Chairman (8 years) and Engineering Physics Program Chairman (5 years). He served Oct 1999 as Visiting Researcher in University of Tohuku Japan and University of Seoul, Korea under Japanese Society of Promotion of Science. Visiting Scientist 2001 Asian Development Bank,Serpong Indonesia. Visiting researcher 2008, Univ. New South Wales Australia, visiting Scientist 2015 in Univ. di Lorraine Nancy, France,visiting Professor to King Abdul Aziz University of Science and Technology (KAUST) 2017, Arab Saudi. The current research interests are, fabrication of nanosemiconductor materials for optoelectronic, solar cells and gas sensor applications. Co-founding 2000 of Nano-Optoelectronic Lab (NOR) School of Physics, USM, with over200 international journals and graduating more than 30 MSc and PhD students. His h-index 34 dan i-index 107 (google scholar, M R Hashim) and identified as "Top 2% Researchers in the World" for 2021 and 2022.

Mohd Mahadi Halim received his BSc (Hons) in Physics from Universiti Sains Malaysia in 2007, MSc in Electronics Circuit Design & Manufacture in 2008, and PhD from the University of Dundee in 2012. He is an Associate Professor at the School of Physics, Universiti Sains Malaysia. His research focuses on solid-state physics, semiconductor devices, optoelectronics, and nanotechnology. He has published over 50 journal articles, supervised more than 12 research students, and secured eight research grants. His current work explores semiconductor nanomaterial synthesis for sensors, solar cells, and nano laser devices. With a strong academic and research background, he significantly contributes to semiconductor physics, nanotechnology, and optoelectronics.

Microfluidic Devices Fabricated by Laser Technologies for Biological Applications

M.T.Flores-Arias, Bastian Carnero, Yago Radziunas-Salinas, Photonics4Life Research Group, Applied Physics Department, Universidade de Santiago de Compostela, Spain.

ABSTRACT:

The research of this work focuses on the manufacturing and development of Organ-on- a-chip (OOC) and other microfluidic platforms employing laser technologies for conducting in vitro experiments under controlled laboratory conditions that can contribute to the development of personalized therapies. The goal is to bridge the gap between laser technology and microfluidics, offering a new fabrication approach in a field traditionally dominated by complex methods like photolithography. Additionally, the development of these platforms may help reduce the need for animal testing.

Various manufacturing techniques in microfluidics, including lithography, soft lithography, and advanced methods like pulsed laser ablation have been used throughout the year. This work presents the advantages, and the potential of techniques based on laser for fabricating different kind of microfluidics devices, particularly those that mimic organ-on-a-chip. It shows devices fabricated by techniques that involve the utilization of two different systems based on lasers: pulsed laser systems and a stereolithographic 3D printer. Manufacturing performance of internal and superficial channels is studied for different configurations. A complete characterization of the structures is carried out by optical, confocal and SEM microscopy, and EDX analysis. The biocompatibility of the manufactured devices is tested to ensure their safe use in biological and medical applications, focusing on the use of Human Umbilical Vein Endothelial Cells (HUVEC), of great interest in biological microfluidics given its sensitivity to flow conditions.

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BIOGRAPHY:

M. Teresa Flores-Arias is Professor of Optics at the Universidade de Santiago de Compostela (USC).

She is currently Head of the High Power Laser Facility (L2A2) at the USC and leader of the Photonics4Life research group at the USC. Much of her scientific activity has been focused on laser applications, microfluidics, diffractive Optics, microoptics, GRIN Optics and non-linear Optics. She is member of the Board of the committees of the Spanish Society of Optics and was member of the executive board of the European Optical Society.

She is member of several agencies of quality research projects and academical evaluation. She is co-founder of the BFlow spin-off company.

Functional and Decorative 3D Application of Bio-Polymers on Shoe Uppers

Authors: Dr. Thomas W. Schmidt1. Qinyu Yang1 and Victor Zhi Jian Fang
Author's affiliation: (1) Fujian Huafeng New Materials Co Ltd., Putian, China
(2) Softpower, Qingyuan, China

ABSTRACT:

High-solid PUD based inks were developed for functional and decorative application on top of textiles for shoe uppers. 3D effects with a distinctive haptic perception can be achieved by high-solid content and fine-tuned thixotropic properties of inks and application with a multi-layer screen printing process. Newly developed inks are now based on partly bio-based PUD binders reaching around 50 % bio-carbon within the final dried coating film. Such type of 3D screen printed uppers are now supplied to the market under the HAPTIC brand name. The new HAPTIC Bio ink formulation is attracting high attention for more sustainable athletic footwear.
HAPTIC Bio inks were adjusted in rheological properties for digital 3D printing with a specially developed digital 3D printing device. The digital application offers fast product change-over times, high 3D coating thickness and fully automated production. The new HAPTIC Bio inks will be demonstrated during World Solar Challenge, the solar car racing world championship in Australia in August 2025. TEAM Sonnenwagen, the German solar racing team will be equipped with most sustainable sneakers composed out of water-free doped dyed and 100 % recycled Polyester fabric uppers functionally decorated with HAPTIC Bio ink. The PUD Bio binder was provided by Covestro, the main sponsor of TEAM Sonnenwagen and a key partner for the HAPTIC ink development. In addition, Softpower EVA insoles with sustainable material content will be added for comfort and cushioning.

BIOGRAPHY:

Thomas Walther Schmidt, Innovation & Creation.
Thomas holds an PhD in Chemistry and Material Science of the university of Wuerzburg, Germany. After a postdoc at University of Durham in UK he started his international industrial career at adidas in China, then worked many year as Innovation Director at TIGER Coatings in Austria and since 2014 he is Director of Innovation & Creation at Fujian Huafeng New Materials Co Ltd. in China. During his scientific and industrial career he came and well known expert on coating and printing materials and technologies. He is the creator of the HAPTIC brand with enormous success in the athletic footwear industry.

The Best Method for Supramolecular Architecture – the Langmuir and Blodgett Method.Nanocomposite Chemical Sensor Applications

George R. Ivanov, University Lab Nanoscience and Nanotechnology, University of Architecture, Civil Engineering and Geodesy, blvd. Hr. Smirnenski, 1, 1064 Sofia, Bulgaria.

ABSTRACT:

Our 35 years of investigating Langmuir-Blodgett (LB) films and developing instrumentation for their research are summarised.Observations from recent conferences show that much of the early research in the LB film area is forgotten. Based on our research,we will discuss the importance of Equilibrium Spreading Pressure (ESP), the velocity of compression, waiting time at constant pressure before deposition, the presence of metal ions in the water subphase, etc. Examples of our research of different classes of substances, e.g. lipids, phospholipids, metal nanoparticles, quantum dots [1], adsorption of enzymes from the water subphase, and Metal-Organic Framework (MOF) will be presented. On a special manipulation of the deposition process, a well-developed 3D structure can be obtained (Fig. 1) thus allowing for very fast and sensitive chemical sensors.

One of the most important applications of LB films is the preparation of the sensing layer in chemical sensors. Detections in both gas and liquid environments are discussed. Results on gravimetric detection of volatile organic compounds (VOCs) by an ultra-sensitive 434 MHz Surface Acoustic Wave (SAW) two-port resonators are presented [2]. The interdigitated electrodes of the SAW resonator are used to enhance the sensitivity in Electrical Impedance Spectroscopy (EIS) detection of PFAS contaminants in water. A combination of gravimetry and electrochemistry transduction on a single device provides additional selectivity. If one of the methods gives similar results the other can still differentiate between analytes.

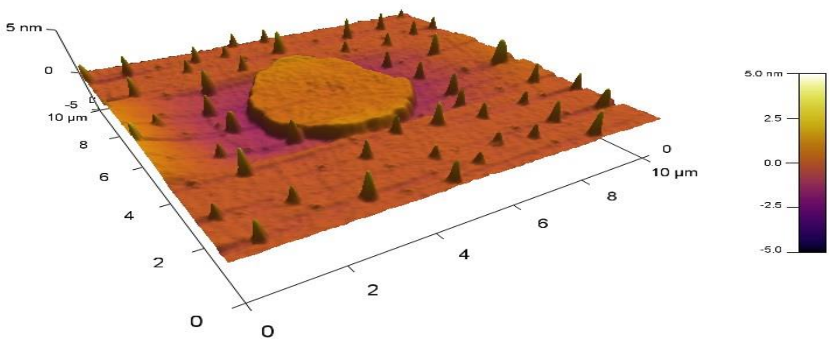

Fig. 1. Atomic Force Microscopy (AFM) of a monolayer from a fluorescently labelled phospholipid.

References:

Ivanov, G.R. et all., First Direct Gravimetric Detection of Perfluorooctane Sulfonic Acid (PFOS) Water Contaminants,: Combination with Electrical Measurements on the Same Device—Proof of Concepts Chemosensors 2024, 12, 116. https://doi.org/10.3390/chemosensors12070116 [2] I. D. Avramov and G. R. Ivanov,*Coatings* **2022**, *12*,669.

Modeling and Performance Analysis of Micro-Optical Ring-Resonator as Optical Filters with an Embedded Bragg Grating

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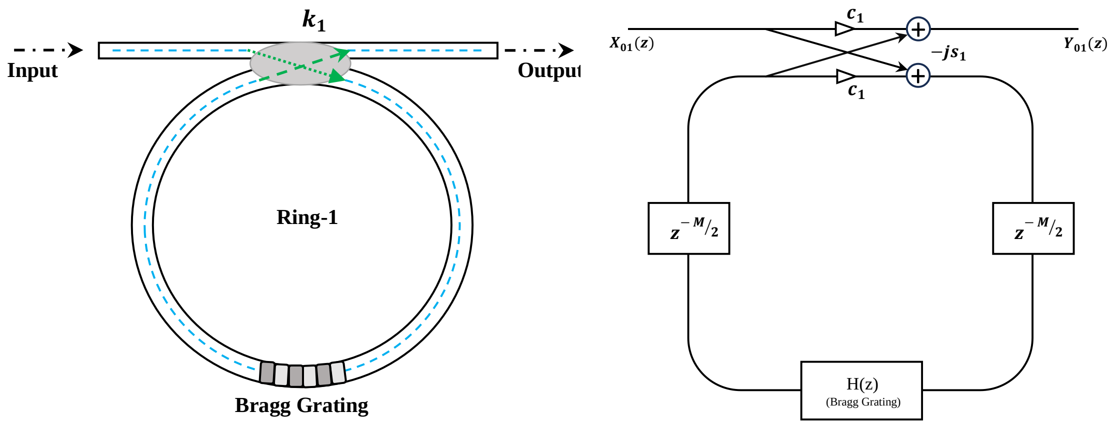
Prof. Sanjoy Mandal, Department of Electrical Engineering, Indian Institute of Technology (Indian School of Mines), Dhanbad, 826004, India.

ABSTRACT:

The performances of the asymmetrical multiple ring resonator with embedded high contrast Bragg grating (BG) as optical filter are addressed in the proposed article. The transfer functions of the proposed models are determined in the Z-domain using Mason's rule. The spectral responses are computed on MATLAB. The spectral responses of the Single Ring Resonator (SRR) and the Double Ring Resonator (DRR)are computed using MATLAB and presented in the article. The computed FSR (Free Spectral Range) for the SRR and the DRR filters are close to 0.37 THz and 0.73 THz, respectively. Therefore, the proposed micro-optical ring-resonance configurations can offer very high FSR which could be useful to accommodate large number of communication channels.

MORR (Micro Optical Ring-Resonator) Filter Designs:

1. Single Ring-Resonance (SRR) Filter



(a) (b)

Figure 1: SRR BG filter configuration (a) waveguide structure, and (b) corresponding SFG layout

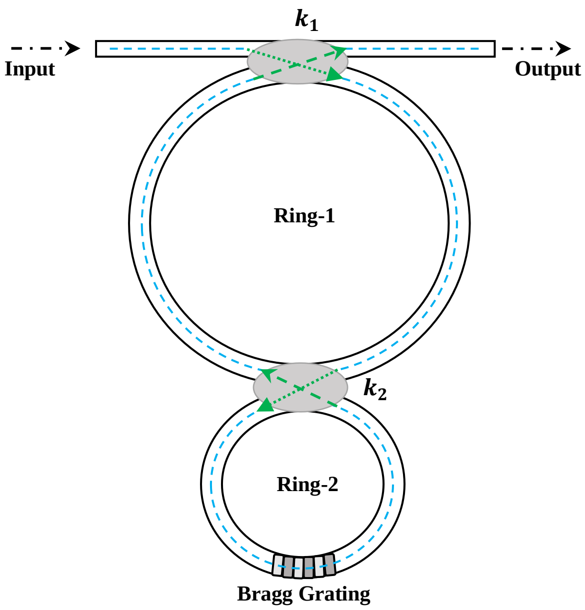
The transmission spectra of a grating-embedded SRR filter, as shown in Fig. 1, is obtained from Equation 1. Considering the SFG layout, the transfer function of the SRR filter is expressed as[1]

$$TF_{SRR} = \frac{Y_{01}(z)}{X_{01}(z)} = \left\{\frac{c_1 - \ H(z)\ \ z^{-M}}{1- \ \ c_1.H(z)\ \ z^{-M}}\right\} \quad (1)$$

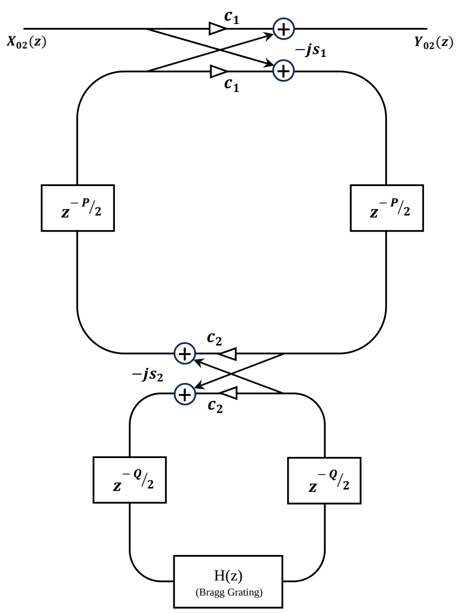
2. Double Ring-Resonance (DRR) Filter

The waveguide structure and the corresponding SFG representation of a DRR filter with grating are shown in Fig. 2 (a) and (b), respectively. The transfer function computed from the SFG is given by the expression [2]

$$TF_{DRR} = \frac{Y_{02}(z)}{X_{02}(z)} = \left\{c_1 + \frac{-s_1{}^2.c_2 z^{-P} + \ s_1{}^2\ \ H(z)\ \ z^{-(P+Q)}}{1- \ c_1.c_2\ \ z^{-P} - \ c_2 H(z)\ \ z^{-Q}\ +\ c_1 H(z) z^{-(P+Q)}}\right\} \quad (2)$$



(a)



(b)

Figure 2: DRR BG filter configuration (a) waveguide structure, and (b) corresponding SFG layout

where $c_i = \sqrt{1 - k_i}$ and $s_i = \sqrt{k_i}$ are known as the through-port and the cross-port coupling coefficients respectively, 'k' is called the power coupling ratio, $H(z)$ defines the Z-domain transmittance TF representation of the grating element, and M, P and Q are called the resonant numbers.

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[2] "Z-domain modelling and performance analysis of high contrast grating embedded micro-optical double ring-resonance flters", Optical and Quantum Electronics (2024) 56:1664, S Saha, S Mandal.

BIOGRAPHY:

Mr. Suraj Saha, Senior Research Fellow in the Department of Electrical Engineering at IIT (ISM) Dhanbad.

Mr. Suraj Saha received the B. Tech. degree in Instrumentation and Control Engineering from MAKAUT (WBUT), Kolkata, India. He received the M. Tech. degree in Instrumentation Engineering from National Institute of Technology Silchar, Silchar, India. He is currently pursuing the PhD. degree in the department of Electrical Engineering, Indian Institute of Technology (Indian School of Mines), Dhanbad, India. His research interests include optical filter designs, Bragg grating or grating embedded filters and sensors, optical ring-resonance, optical devices and communications.

Dr. Sanjoy Mandal,Professor in the Department of Electrical Engineering at IIT (ISM) Dhanbad.

Prof. Sanjoy Mandal received the B.E. degree in Electrical Engineering from the B.E. College, Calcutta University (currently the Indian Institute of Engineering Science and Technology), Kolkata, India, and the M.E. and Ph.D. degrees from Jadavpur University, Kolkata. He is currently a Professor in the Department of Electrical Engineering, Indian Institute of Technology (Indian School of Mines), Dhanbad, India.

A New Way of Manufacturing Micro and Nano-Sized Silicon for Electronic and Energy-Related Devices

Shashi Paul, Emerging Technologies Research Centre, De Montfort University, The Gateway, Leicester LE1 9BH, United Kingdom.

ABSTRACT:

Silicon is widely used in electronic industries in a number of forms, for example: amorphous silicon is used in liquid-crystal display units; poly-silicon is used in Flash memory structures and photovoltaic solar cells; single crystals are used in C-MOS technologies etc. There are a few methods by which crystalline silicon is manufactured. Some of these manufacturing methods use a large amount of electricity and result in a large amount of carbon footprints. These methods also contribute to production of waste materials and greenhouse gases. My presentation will cover the various silicon production methods and the need for alternative silicon production method(s) that we are currently working on. It will cover the applications of silicon structures developed using our novel method.

BIOGRAPHY:

Shashi Paul, Professor of Nanoscience and Nanotechnology
Shashi Paul, Professor of Nanoscience and Nanotechnology, is working for the Emerging Technologies Research Centre (EMTERC) at the University of Montfort, Leicester, UK. He received his degree from the Indian Institute of Science (IISc), Bangalore (India) and previously worked at the University of Cambridge, Durham University and Rutgers University. He has an extensive experience in the field of deposition of nano-sized organic and inorganic materials in the context of their applications to electronic memory devices, thin film transistors, biological & chemical sensors and energy related devices. His particular focus is on the development of materials manufacturing processes to reduce the carbon footprint and next generation electronic devices.

Syntheses and Properties of Biomass Polymers bearing Functionality and Sustainability

Atsushi Tahara, Frontier Research Institute for Interdisciplinary Sciences (FRIS), Tohoku University.

ABSTRACT:

Since its discovery in the 1970s, the reactivity of Levoglucosenone (LGO) has been widely studied in organic chemistry, owing to its diverse functional groups that serve as linkages for polymer formation. However, most of the previous methods for synthesizing polymers from LGO lacked precise control over regio- and stereochemistry, making stereoselective polymerization from LGO a persistent challenge. Although the ketone moiety in LGO is typically reduced before polymerization, a new LGO polymer was designed, containing a C=N bond obtained by condensation with dicarboxylic dihydrazide.

Compared with a known stereoselectivity about 1,4-addition reaction to LGO (as *exo*-selective), *E* / *Z* selectivity of the hydrazine moiety have not been unknown. ^{1}H NMR measurements revealed that condensation occurred with high stereoselectivity to produce the *E*-isomer. This selectivity extended from the model compound to polymer synthesis, achieving high *E* / *Z* selectivity. The resulting polymer exhibited optical rotation, indicating its potential as a chiral polymer. In spite of these polymers showed high tolerance toward many solvents, they were degradable in water with a simple chemical treatment. The proposed approach facilitates the development of sustainable, high-performance materials that can address both environmental and industrial needs.

BIOGRAPHY:

Atsushi Tahara, assistant professor in Tohoku University.

Atsushi Tahara was born as a son of potter in Yamaguchi, Japan. In 2013, he got his degree at Tokyo Institute of Technology. After getting degree, he moved to Kyushu University, and again moved to Tohoku University in 2021. His major is organometallic chemistry, organic chemistry, and polymer chemistry.

Transforming Rice Straw into Sustainable Polymers: Advances in Lignin-Based Polyolsto Functionalise Polymers and Produced more Sustainable Adhesives for Footwear Applications

H. Pérez-Aguilar, V.M. Serrano-Martínez, M. P. Carbonell-Blasco, C. Hernández-Fernández and E. Orgilés-Calpena
INESCOP, Centre of Innovation and Technology, Pol. Ind. Campo Alto, C/ Alemania, 102, 03600, Elda, Alicante, Spain

ABSTRACT:

According to FAO, 520 million tons of rice were produced annually for food worldwide in 2022, which resulted in 650 million tons of rice straw. The most common end-of-life scenario for rice straw is incineration with the high environmental impact (950 million tons of CO2eq), thus failing to be sustainable.
Cellulose and lignin have been extracted using a low environmental impact process [1]: a steam-explosion hydrothermal process to break down the cellular wall of rice straw. At this stage, a large part of the lignin recovery near to 90% present in has been recovered for its subsequent application as lignin based-polyolin adhesives [2].
In this study, cellulose fibers have been integrated into various polymeric materials (rubber andpolyurethane (PU))to produce biomaterials, reducing the use of polymer from fossil origin [3] up to 10%, consequently decreasing the carbon footprint of the resulting biomaterials. The mechanical properties of the polymers formulateshow satisfactory results for their potential application in the footwear industry [4].
As for the lignin extracted, it has been fractionated to obtain the corresponding low molecular weight polyols [5], intended for use as an antioxidant and antimicrobial agent [6]. These lignin based-polyolhave been used to functionalize with antimicrobial activity the surface of shoe insoles to incorporate them into footwear.
In addition, the lignin based-polyols obtained from lignin have been employed in the synthesis of polyurethane bioadhesives, replacing up to 10% of fossil-based polyols [7]. The adhesion results obtained with these bioadhesivescomply requirements to use in footwear manufacturing.
In conclusion, PU adhesives with suitable adhesion propertiesfor application in the footwear sectorhave been synthesized by substituting part of the polyols derived from fossil sources with polyols from the lignin through sustainable processes. Additionally, this lignin based-polyol has been used to functionalize polymers with antimicrobial activity.

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BIOGRAPHY:

Henoc Pérez, Head of Value Recovery Line.
Henoc Pérez obtained his Chemistry Degree at the University of Alicante in 2006 and PhD in Chemical Sciences on new strategies for the synthesis of organic compounds and reactivity with polycyclic aromatic hydrocarbons in the Department of Organic Chemistry at the University of Alicante in 2010. Afterwards, he did a postdoctoral work on the improvement of bioactive compounds in foods and enhancement shelf-life in University Miguel Hernández.
Henoc is focusing his research on projects related to new and innovative methodologies for the extraction of high added-value products from animal and vegetable by-products for different industrial applications, such as biomaterials with low environmental impact, biomaterial functionalization, biostimulants for plants, retanning agents for leather or the incorporation of the bioproducts obtained in new materials.

Biopolymers in Advanced Environmental Engineering Techniques

Jaroslav Filip, Marketa Julinova, Jitka Sotolarova, Nurjahan Mahmudova, Pavlina Zizkova, Josef Osicka and Tomas Plachy
Department of Environmental Engineering Protection, Faculty of Technology, Tomas Bata University in Zlin
Centre of Polymer Systems, Tomas Bata University in Zlin

ABSTRACT:

Various living organisms produce naturally biopolymers or their precursors. They can be transformed into hydrogels with diverse applications in numerous fields, including advanced analytical techniques or water treatments. In this work, two types of biopolymers are introduced and their versatile applications in advanced environmental engineering technologies are presented. Namely, cellulose derivatives crosslinked on-site on electrode surface have been investigated as a tool for improving sensitivity of the electrode`s electrochemical determination of potentially toxic metals. It was found that hydroxyethyl cellulose and carboxymethyl cellulose could be easily crosslinked on electrodes surface using elevated temperature (110°C) and citric acid. Such modification allowed for sorption of various metal cations into the hydrogel layer and consequent electrochemical determination of these cations. Furthermore, sensitivity of the prepared electrodes was improved when low concentration of graphene oxide was integrated into hydrogel on the surface of the electrodes. It was assumed that the sorption of cations was established by a presence of cation-binding functionalities (hydroxyls, carboxyls) of hydrogels. Similar ion-catching process was observed also for hydrogels synthesized from wastefeather keratin hydrolysate.These hydrogels were synthesized using various concentrations of acrylic acid, initiator, and crosslinking agent and characterization revealed their highly porous structure, swelling ability, and biodegradability in different environments. The formation of a crosslinked network based on keratin hydrolysate and acrylic acid resulted in mechanical stability and materials with effective sorption ability.Furthermore, it was found that these hydrogels could absorb toxic metals from aqueous solutions and several types of dyes, that are also considered as serious pollutants.

BIOGRAPHY:

Jaroslav Filip, Senior lecturer and Head of the Department of Environmental Protection Engineering, Faculty of Technology, Tomas Bata University in Zlin. Author and co-author of 50+ records indexed in Scopus, research area nanotechnology and material science applied in electrochemistry and environmental engineering.

Plasmonics in 2D Materials: Fundamentals and Perspectives

YuliyV. Bludov, Nuno M.R. Peres and Mikhail I. Vasilevskiy, Centre of Physics and Department of Physics, University of Minho, Portugal.

ABSTRACT:

One of the outstanding properties of 2D materials is the ability to sustain surface polaritons–waves, which propagate along surfaces and interfaces. The surface polaritons are waves of mixed nature, where electromagnetic radiationis coupled to free charge density oscillations (plasmons), electron-holes pairs (excitons), or collective oscillations of crystal lattice (phonons), thus forming plasmon-polaritons, exciton-polaritons, and phonon-polaritons, respectively. In this talk we consider fundamental properties of different 2D materials, like graphene,transition metal dichalcogenides, hexagonal boron nitride, black phosphorus, etc. as well as main characteristics of surface polaritons, which can propagate in these 2D materials. We also consider existing and perspective practical applications of surface polaritons in 2D materials, like dielectric sensing and photodetectors.

BIOGRAPHY:

Yuliy Bludov received his PhD in physics from the A.Ya.
Usikov Institute of Radio physics and Electronics, NAS of Ukraine in 2000. After defending PhD thesis Yuliy Bludov worked at the same institute as researcher till 2005. As the next step of his career Yu. Bludov worked at Lisbon University, Portugal as postdoc. Starting from 2009 he works as a researcher at University of Minho. His principal fields of interest include theoretical investigation of plasmonics in 2D structures, as well as nonlinear dynamics.

Semiconductor Devices at Cryogenic Temperatures

Ingo Tobehn-Steinhäuser, Lukas Barthelmann, Xuemei Xu and Thomas Ortlepp
CiS For schungs institut für Mikrosensorik GmbH; Konrad-Zuse-Straße 14; D-99099 Erfurt.

ABSTRACT:

The temperature range below -196°C (liquid nitrogen) is becoming increasingly interesting both in research and in industrial applications. This is mainly due to the expected increase in the importance of hydrogen technology. This affects a wide variety of areas of industry, space travel (fuel for rockets), aviation (hydrogen-powered aircraft engines) and the road transport sector. Since the storage of liquid hydrogen is of great advantage, a temperature of -254°C is necessary for this.
This article discusses the special features of semiconductor components at cryogenic temperatures. One aspect is the provision of robust, inexpensive and precise components for temperature monitoring. The special features include the freezing-out effect and the temperature-dependent mobility of the charge carriers in doped semiconductors. The freezing-out effect is the decrease in charge carriers in the conduction band, which change to the valence band as the temperature decreases. In this context, extensive Hall measurements were carried out on samples with various doping levels.These measurements show that the freezing-out effect begins at room temperature. The measurements also suggest that below 40K other conduction mechanisms come into effect than those described in the current theories of semiconductor physics. The data generated can also be used to adapt the mobility models stored in common simulation models, as these are valid down to a minimum of 70 K (Klaassen model). This range has so far been sufficient for industrial applications.

The CiS has its own clean rooms for the production of MEMS and MOEMS. Therefore, all components used for the tests (Hall structures, diodes, semiconductor resistors, JFETs) are from our own production based on our own designs.

BIOGRAPHY:

Dr. Ingo Tobehn-Steinhäuser, Development Engineer.
The diploma and doctoral thesis were carried out at the Radiation Center of the University of Giessen in Applied Nuclear Physics. There, a source for thermal positrons was operated on a 65MeV electron linear accelerator. The work dealt with the topics of positron storage and inner-shell ionization with positrons and electrons.
The work as a development engineer at the CiS Research Institute for Microsensors has been carried out since 2008. After an initial focus of the work in the area of impedance spectroscopy, the main focus is now on temperature sensors in the range in which semiconductors can be used, i.e. from 4K to around 575K.

Bio-Corrosion Response of Sputtered Ta-Ti-Nb Thin Films

Ping-Yu Liang, Hsiu-Chang Tsai, Chen-Hsuan Lin and Jacob C. Huang Department of Materials and Optoelectronic Science, National Sun Yat-Sen University, Kaohsiung, Taiwan.

ABSTRACT:

The successful application of biomedical implants requires materials to possess superior corrosion resistance, biocompatibility, and excellent mechanical properties. Titanium (Ti) alloys have become the preferred choice in orthopedic implant materials due to their non-toxic nature. Among these alloys, Ti-6Al-4V is highly praised for its unique high corrosion resistance and excellent biocompatibility, making it widely used in the medical field. Despite its high strength, lightweight, and overall corrosion resistance, challenges such as metal wear particle generation, potential release of aluminum ions causing neurotoxic effects, and corrosion issues due to chloride ions in the human body fluid still exist. Recently, researchers have employed sputtering technology to deposit a Ta-Ti-Nb thin film on the Si or Ti-6Al-4V substrate surface, overcoming geometric shape limitations. This film plays a crucial role in preventing reactions between the implant and simulated body fluid. Additionally, due to the relatively small proportion of the film, Young's modulus of Ti-Ta-Nb can be ignored to prevent shielding effects. This study utilizes sputtering to prepare a bioactive thin film with multiple primary elements of Ta-Ti-Nb, serving as a potential option to enhance the physical and chemical properties of Ti6Al4V. The bio-corrosion response of this Ta-Ti-Nb system is systematically explored, including the thin films with the compositions of Ta25Ti50Nb25 (Ta25), Ta34Ti33Nb33 (Ta34), Ta60Ti20Nb20 (Ta60), Ta80Ti10Nb10 (Ta80), and pure Ta (Ta100). The biocompatibility and bio-corrosion resistance of these sputtered thin films are characterized by electrochemical analysis methods. Parameters such as corrosion potential, corrosion current, and polarization resistance are evaluated to assess the bio-corrosion properties in the simulated body fluid. Higher corrosion potential and polarization resistance or lower corrosion current indicate greater corrosion resistance, helping to avoid material dysfunction after prolonged implantation. The films are also immersed in simulated body fluid for 7 days to detect passivation layers, examining the optimum oxide layer that offers the best protective effect.

BIOGRAPHY:

Ping-Yu Liang is a MS student, Hsiu-Chang Tsai and Chen-Hsuan Lin are BS undergraduate students, and Jacob C. Huang is a chair professor, all in Department of Materials and Optoelectronic Science, National Sun Yat-Sen University, Kaohsiung, Taiwan.

Effect of Boron Doping and Thermo-Mechanical Treatment on the Microstructure and Mechanical Properties of Ti65Zr7 Medium Entropy Alloy

Po-Sung Chen, Po-Yu Chen, Li-In Wang, Jason Shian-Ching Jang, Chih-Yen Chen
Institute of Materials Science and Engineering, National Central University, Taoyuan 320, Taiwan
Department of Mechanical Engineering, National Central University, Taoyuan 320
Department of Electrophysics, National Yang Ming Chiao Tung University, Hsinchu 300, Taiwan

ABSTRACT:

Due to the flexible alloy design and outstanding material properties, the medium entropy alloys (MEAs) have breakthrough the traditional alloy design concept and exhibit huge potential in future industry application. In this study, a series of lightweight Ti65Zr7Bx (B:0 ~ 0.6 at.%) MEAs have been explored to investigate the effect of boron doping on the microstructure and mechanical properties. In addition, the MEAs conducted with thermo-mechanical treatment to further enhance the material properties was also discussed. After 1000 °Chomogenization for 4 hours, the XRD results showed the boron doping makes the diffraction peaks shift to the right which due to boron possess smaller atomic radius than other elements. In addition, the characteristic peak of the TiB could be also observed. In the other hand, the EBSD observation revealed that the average grain size decreases from 74.4 µmto 52.5 µm. Meanwhile, the precipitates formed on the grain boundary were identified to be the TiB intermetallic compound by TEM characterization. On the other hand, the yield strength of as-homogenized samples increased from 1015 MPa for Ti65Zr7B0 alloy to 1158 MPa for Ti65Zr7B0.6 alloy, while the ductility reduced from 22% to 12% simultaneously. After conducted with thermo-mechanical treatment, the recrystallization ratio of Ti65Zr7Bx MEAs increased with increasing annealing temperature. Under same annealing temperature, the recrystallization behavior would be delayed with increasing boron content due to the precipitate (which halt the propagation of dislocation during recovery process. The results of mechanical test showed that the Ti65Zr7B0.6 MEA after CR70 and fast annealing at 881°C presents the optima synergy mechanical properties, with yield strength of 1382 MPa and 14.7% elongation.

Keyword: lightweight, medium-entropy alloys, boron doping, precipitate, thermo-mechanical treatment.

BIOGRAPHY:

Po-Sung Chen is a postdoctoral researcher, Po-Yu Chen is a master, Li-In Wang is a research assistant, Jason Shian-Ching Jang is a professor, all affiliatein Institute of Materials Science and Engineering, National Central University, Taoyuan 320, Taiwan. Chih-Yen Chen is an Associate professor and is affiliated in Department of Electrophysics, National Yang Ming Chiao Tung University, Hsinchu 300, Taiwan.

Enhance Mechanical Properties of CoCrNiAlTi Quinary Medium-Entropy Alloy by Boron Doping and Heat Treatment

Po-Sung Chen, Huai-Te Wu, Li-In Wang, Jason Shian-Ching Jang
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Department of Mechanical Engineering, National Central University, Taoyuan 320.

ABSTRACT:

In this research, boron elements were added in minor amounts (0.1~0.4 at.%) to the CoCrNiAlTiMEA. The alloy was arc-melted and cast into single-phase FCC alloy ingots using drop-casting. The ingots underwent homogenization heat treatment at 1000°C for 6 hours, followed by cold rolling to 80% reduction. Subsequently, the alloy plates were annealed for recrystallization at different temperatures and durations, and then analyze their mechanical properties. The experiment results showed that the optimal combination of yield strength and ductility of the recrystallized samples was achieved after annealing at 900°C for 2 hours. This annealing parameter was then used for further study on the alloys with different additions of boron doping. The alloys with different boron doping were conducted a series of thermo-mechanical treatment, such as homogenization, cold rolling, recrystallization annealing, and aging, to precipitate $L1_2$ phase. The coherent integration of $L1_2$ precipitates with the FCC matrix further enhanced the yield strength while maintaining ductility.Based on the research results and analysis of mechanical properties influenced by boron doping, it is determined that the CoCrNiAlTiMEA after cold rolled 80%,annealing 900°C for 2 hours, and aging at 750°C for 4 hours exhibits the best mechanical performance. Specifically, the alloy doped with 0.3 at.% boron can obtain an optimal mechanical property, with yield strength of 1817MPa, maximum tensile strength of 2313MPa, and ductility of 14.5%.
Keyword: medium-entropy alloys, boron doping, precipitate, thermo-mechanical treatment.

BIOGRAPHY:

Po-Sung Chen is a postdoctoral researcher, Po-Yu Chen is a master, Li-In Wang is a research assistant, Jason Shian-Ching Jang is a professor, all affiliate in Institute of Materials Science and Engineering, National Central University, Taoyuan 320, Taiwan.

Electron Beam Induced compatibilization of PLA/ PBAT Blends in Presence of Epoxidized Soybean Oil

Lena Marbach, Fraunhofer Institute for Environmental, Safety and Energy Technology, Oberhausen.

ABSTRACT:

Polylactide acid (PLA) is a biobased and biodegradable polymer with promising mechanical properties, but its brittleness limits its applications. Blending PLA with other biodegradable polymers like PBAT can enhance its properties, though poor compatibility often reduces effectiveness. This study explores electron beam-induced compatibilization as a method to improve mechanical and thermal properties of PLA/PBAT blends.PLA/PBAT films were prepared and treated with electron beams at varying doses. The effects of irradiation and reactive compatibilizers, specifically epoxidized soybean oil (ESBO), were analyzed using mechanical, chemical, and thermal characterization techniques.Electron beam treatment significantly improved compatibility, as observed in the convergence of glass transition temperatures and reduced PBAT extraction. The addition of ESBO further enhanced interfacial adhesion, reducing component migration. A remarkable increase in elongation at break from ~3% to 300% was observed, indicating superior flexibility and mechanical performance. An optimal irradiation dose was identified, where maximum molecular linking and partial crosslinking occurred, enhancing stability without excessive degradation.Electron beam treatment, combined with reactive compatibilizers, effectively enhances the mechanical and thermal properties of PLA/PBAT blends. This approach expands the applicability of PLA-based materials, making them more viable for sustainable packaging and engineering applications. Further research will optimize process parameters for industrial implementation.

BIOGRAPHY:

Lena Marbach, Research Assistant and Ph.D. student

Lena Marbach studied Bio- and Nanotechnologies before specializing in Applied Polymer Sciences. Captivated by polymer research, she pursued a Ph.D. focusing on the compatibilization of biobased polyester blends. Nearing the completion of their doctorate, their research explores electron beam-induced compatibilization to enhance mechanical and thermal properties, contributing to the advancement of sustainable polymers for industrial applications.

Microbial Upcycling of Agricultural Cabbage Waste into Phytoene Encapsulated in Poly (3-hydroxybutyrate)

Sun-Wook Jeong, Myung Won Seo, and Yong Jun Choi, School of Environmental Engineering, University of Seoul, Seoul 02504, Republic of Korea.

ABSTRACT:

With growing concerns over food shortages and climate-related environmental issues, there has been a growing interest in technologies that recycle renewable resources and add value to byproducts. Here, we report the microbial upcycling of agricultural cabbage waste (ACW) into phytoene encapsulated in poly(3-hydroxybutyrate) [P3HB] via rational metabolic engineering and fermentation. To establish a base strain, the *crtB* and *crtE* genes of *Deinococcusradiodurans* were initially overexpressed in various *Escherichia coli* strains, and the optimal phytoene-producing strain was selected. To further increase the carbon flux toward phytoene production, the mevalonate biosynthetic pathway gene cluster was introduced, resulting in phytoene production of 2.8 ± 0.6 mg/L. Finally, the P3HB biosynthetic pathway was introduced into the phytoene-producing strain to enhance its production. As a result, strain PHY4 produced 9.51 mg/L (5.6 mg/g DCW) from ACW hydrolysate at a productivity of 0.4 mg/L/h. Furthermore, the photostability of phytoene encapsulated with P3HB was more than three times higher than that of phytoene without P3HB. This is the first report on the co-production of high-value P3HB using metabolically engineered *E. coli* from ACW hydrolysate as a substrate, opening a new avenue in microbial upcycling process for phytoene production.

BIOGRAPHY:

Yong Jun Choi, Professor
He is a professor at the School of Environmental Engineering, University of Seoul. His area of research is metabolic engineering and synthetic biology focusing on biological production of value-added materials, including Bioplastics, Biofuels, and Biomaterials.

Sun-Wook Jeong, Research Professor
He is a research professor at the School of Environmental Engineering, University of Seoul. His area of research is metabolic engineering of environmental microorganisms focusing on bioconversion and biorefinery.

Myung Won Seo, Associate Professor
His research interests include production of high value-added products through biomass pyrolysis and pyrolysis of biodegradable polymers.

Steam Gasification Characteristics of Polylactic Acid (PLA) in a Fluidized Bed Reactor

Tae Won Lee, Tae Hwi An, Ui Myung Chung, Chan Young Lee, Young Kwon Park, Yong Jun Choi, and Myung Won Seo, Department of Environmental Engineering, University of Seoul

ABSTRACT:

Polylactic Acid (PLA) is a biodegradable plastic classified as a bioplastic, and its consumption has been increasing as a substitute for plastic packaging materials. However, PLA decomposition requires maintaining a high-temperature environment above 60℃ for more than six months, making short-term processing challenging. Therefore, this study evaluates the chemical recycling potential of biodegradable plastics by analyzing the fundamental characteristics of steam gasification of PLA in a fluidized bed. Gasification experiments were conducted at 700, 800, 900℃ under a steam/carbon ratio of 1. The highest yield among the product gases was CO(69.79%, 62.69%, and 58.15% at 700, 800, and 900℃ respectively), declining as the temperature increases. In contrast, H_2 yields increased with temperature (0.65%, 6.17%, and 12.94% at 700, 800, and 900℃ respectively), and tar concentration decreased with temperature (4822, 3109, and 2373 mg/m^3 at 700, 800, and 900℃ respectively). This paper can serve as fundamental data for the future chemical recycling of PLA.

BIOGRAPHY:

Myung Won Seo, associate professor at University of Seoul
He received a PhD degree in Chemical and Biomolecular Engineering at the Korea Advanced Institute of Science and Technology (KAIST) in 2011. He worked at the Clean Fuel Laboratory at the Korea Institute of Energy Research (KIER) from 2012 to 2022, concentrating on thermochemical conversion process of low-grade fuels. Currently, he is an associate professor at the department of environmental engineering and leader of waste-to-energy laboratory. His current research includes the fundamentals of chemical/environmental engineering with applications in energy and environmental processes. He has published more than 98 SCI(E) papers in peer-reviewed international/domestic journals and appointed as the World's Top 2% Scientists from Stanford/Elsevier in 2024.

Solution-Based Synthesis and Performance Evaluation of $NiCo_2O_4$ MIS Capacitors

Yusuf Atmaca, Sukru Cavdar
Gazi University, Department of Advanced Technologies, Graduate School of Natural and Applied Sciences, Ankara, Turkey, 06500 Turkey
Gazi University, Department of Physics, Faculty of Science, Ankara, Turkey, 06500 Turkey.

ABSTRACT:

This study presents the fabrication and characterization of $NiCo_2O_4$-based metal-insulator-semiconductor (MIS) capacitors processed entirely via a solution-based approach using the spin-coating technique. The structural and morphological properties of the fabricated Al/$NiCo_2O_4$/n-Si/Al thin films were analyzed using X-ray diffraction (XRD) and scanning electron microscopy (SEM). The electrical characteristics of the MIS capacitors were investigated through capacitance-voltage (C-V) and current-voltage (I-V) measurements. High-frequency (1 MHz) C-V and conductance-voltage (G-V) characteristics of the Al/$NiCo_2O_4$/p-Si/Al structure were measured within the voltage range of -5 V to +5 V. The results provide insights into the electrical performance of solution-processed $NiCo_2O_4$ thin films and their potential application in semiconductor device technology.

BIOGRAPHY:

Y. Atmaca is a Ph.D. student and holds a master's degree from Gazi University in Turkey. He is currently working as an Electro-Optical Systems Engineer at Turkish Aerospace Industry. His research focuses on electro-optical systems, Schottky diodes and photodiodes.

S. Cavdar is a faculty member at the Department of Physics, Faculty of Science, Gazi University in Turkey. His research focuses on semiconductors, nanoscience, and nanotechnology. He conducts extensive research on the properties, production processes, characterization, and applications of semiconductor materials, making significant scientific contributions in these areas.

The Industrialization and Application Technology of 5-Hydromethylfurfural

Xun You, Wei Zhang and Haitao Jin, Zhejiang Sugarenergy Technology Co., Ltd, China

ABSTRACT:

As a natural existing compound and biomass-derived platform product with rare aromatic ring structure, possessing an active aldehyde group and a hydroxymethyl group in the 2- and 5-position of the furan ring, 5-Hydromethylfurfural can be applied in the production of various value-added chemical, materials and biofuels through chemical reactions such as oxidation, hydrogenation, polymerization. However, due to the complexity of the production side reaction systerm, the industrial production of 5-Hydromethylfurfural over 1000 tons per year is still a very significante challeging task now since it was first synthesized in 1895. To be gratified, a fully mix flow continuous production technology has been successfully developed and implemented in 1000 t/a scale by Zhejiang Sugar Energy Technology Co., Ltd. and Ningbo Institute of Materials Technology and Engineer in China. The production line has been operating continuously for over a year, achieving a fructose conversion rate of 100%, with the highest molar yield of HMF reaching 94.4%, and the purity of the HMF product can reach 99.9%. On basis of this, the global production capacity of the product is set to expand rapidly. This expansion will invigorate potential downstream application markets such as FDCA, PEF, and formaldehyde-free adhesives, infusing new vitality into breakthroughs in the fields of barrier properties, strength, and heat resistance for new materials.

BIOGRAPHY:

Xun You (Josef You) holds an PhD in Organic Chemistry of the University of Science and Technology of China. After over 7 years' R&D work on the innovation of waterborne/bio-based coating technology in Fujian SKSHU Paint Co., Ltd. and Huafeng New Materials Co., Ltd. In China, he started research work on the industrialization and applications of 5-hydromethylfurfural in Zhejiang Sugarenergy Technology Co., Ltd. as R&D Director.

Non-Monochromatic Modes and Nonlinearity in Piet Hein Quantum Semiconductor Waveguides

Shahid Idrees, Muhammad Jamil[3], Jiangtao Su, A. Rasheed, Abdul Waheed, Jie Chen and Yuanyong Deng. National Astronomical Observatories, Chinese Academy of Sciences, Beijing 100012, China. University of Chinese Academy of Sciences, Beijing 100049, China Department of Physics, COMSATS University Islamabad, Lahore Campus, Lahore 54000, Pakistan. Department of Physics, Govt. College University, Faisalabad 38000, Pakistan Deep Space Exploration Laboratory. Department of Geophysics and Planetary Sciences, University of Science and Technology of China, Hefei, China

ABSTRACT:

The interplay between waveguide geometry and quantum plasma properties can lead to novel optoelectronic phenomena with potential applications in high-speed photonics and integrated optical circuits. In this study, we investigate the propagation characteristics of transverse electric (TE) and transverse magnetic (TM) modes in a semiconductor quantum plasma-filled coaxial waveguide with a Piet Hein cross-section. The unique hybrid geometry of the Piet Hein waveguide enables enhanced field confinement, reduced energy loss, and controlled modal dispersion. Through analytical and numerical methods, we unveil the non-monochromatic behavior of electromagnetic modes, revealing distinct field variations, oscillatory patterns, and nonlinear interactions. Notably, the E_z component of the TM mode exhibits minimal field concentration at the core and higher intensity in the cladding, optimizing energy transport. Additionally, the B_ρ and B_ξ components display intricate interference effects and higher-order mode contributions, opening pathways for tunable photonic devices. These insights lay the foundation for next-generation optoelectronic components, including ultrafast modulators, all-optical switches, and quantum communication systems. Our findings underscore the potential of Piet Hein semiconductor waveguides in advancing low-loss, high-performance photonic technologies.

BIOGRAPHY:

Shahid Idrees, Last year PhD student. Shahid Idrees is a Ph.D. researcher at the University of Chinese Academy of Sciences (UCAS), Beijing, China. He wins prestigious scholarship ANSO at well reputed institute UCAS. His research focuses on observational solar physics, quantum and astrophysical plasma studies, and nonlinear wave dynamics in space and semiconductor plasmas. He has investigated sunspot decay mechanisms, solar filament dynamics, and quantum hydrodynamic models for plasma waves. Before his Ph.D., he obtained masters in Plasma Physics from COMSATS University Islamabad, Lahore Campus, Pakistan where he worked on nonlinear wave interactions in quantum plasmas. His research interests span optoelectronics, magnetized plasma physics, and space weather phenomena.

Refining of Lignin into Value-added N-containing Aromatic Chemicals

Changzhi Li, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian 116023, China.

ABSTRACT:

Lignin is a complicated three-dimensional amorphous polymer consisting of methoxylated phenylpropanoid units of various types, and is relatively intractable. In view of the aromatic feature of lignin, it has the potential as renewable feedstock for the production of aromatic chemicals. Particularly, N-participated lignin depolymerization for N-containing aromatic compounds production is of great importance to expanding the boundary of biorefinery and meeting value-added biorefinery demand, which is thus highly desirable but still remains great challenge, due to the structural complexity of lignin, the incompatible catalysis for C-O cleavage and C-N formation. In this lecture, new strategies for the direct transformation of biopolymer lignin and its β-O-4 model compounds into nitrogen-containing aromatic chemicals such as benzylamines, pyrimidines, quinoxalines, quinolines and imidazopyridines with high selectivity will be presented. With our smart catalytic protocols, several important marine alkaloid meridianin derivatives, rolicyclidine skeletons, graveolinine analogues, etc. can be synthesized, emphasizing the application feasibility in pharmaceutical synthesis. The above strategies provide us an unprecedented opportunity for N-containing aromatic compounds synthesis from renewable biopolymer feedstock. The chemistry also encourages more in-depth exploration of other heterocyclic compounds production from bio-based polymers.

BIOGRAPHY:

Changzhi Li, Dalian Institute of Chemical Physics, China.
Changzhi Li is currently a professor in Dalian Institute of Chemical Physics (DICP), from where he received Ph.D. degree in 2009 under the supervision of Prof. Zongbao (kent) Zhao. Then he joined Prof. Tao Zhang's group where he was promoted to a full professor in 2019. The overarching theme of his research program is biomass catalytic conversion. He has published over 90 papers on international journals, and has applied for ca. 50 patents, of which, 38 have been authorized in China. His current research focuses on the catalytic valorisation of lignin into value-added chemicals and high-density fuels.

Quantum Dots for Green Quantum Technologies

Dieter Bimberg, Bimberg Chinese-German Center for Green Photonics" Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences and Center of NanoPhotonics, TU Berlin.

ABSTRACT:

Universal self-organization at surfaces of semiconductors grown preferentially by MOCVD leads to the formation of self-similar quantum dots (QDs). Their electronic and optical properties are close to those of atoms in a dielectric cage. All their energy levels are however only twofold degenerate [1]. The few particle states like excitons are strongly Coulomb-correlated due to the carrier localization. Their energies depend on shape and size of the dots, such that positive, zero or negative biexciton binding energies and fine-structure splitting appear [2].
Applications of single, few and millions of QDs for novel Quantum Technologies will be elucidated.
a. Single QDs can be emitters of Q-bits on demand or entangled photons for future quantum cryptography systems. In electrically pumped RCLED structures, emission of q-bits at rates beyond 1 Gbit/s were shown [3, 4].
b. Hybridization of Flash and DRAMs, bringing together the advantages of both types of memories, is the "Holy Grail" of memories and ensures future memory development after the end of Moore's law. The goal of non-volatility (i.e. storage time > 10 years) can be achieved for the storage of holes in type II (InGa)Sb QDs embedded in a (AlGa)P matrix [5].
c. The demand for higher data rates in optical networks, requires novel ultra-high bit rate, energy efficient sources. QD Lasers based on GaAs emit up to the O-band at 1.3 μm, showing record low jth and complete temperature stability up to 80°C. Passive mode-locking generates pulses in the sub-ps range at repetition rates up to 90 GHz. The hat spectrum of one single laser of several tens of closely spaced narrow lines is thus a potential pulse source for bit rates up to ≈6 TBit/s using higher order modulation formats like DQPSK [6]

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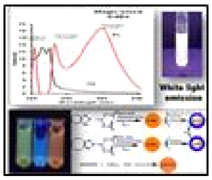
BIOGRAPHY:

Dieter H. Bimberg is the Founding Director of the Center of Nanophotonics at TU Berlin. He was chairman of the Department of Solid-State Physics at TUB from 1991 to 2012 and was holding the chair of Applied Physics until 2015. He is presently Executive Director of the Bimberg Center for Green Photonics of the Chinese Academy of Sciences at CIOMP, Changchun. His research interests include the growth and physics of nanostructures and nanophotonic devices, ultrahigh speed and energy efficient photonic devices for information systems, single/entangled photon emitters for quantum cryptography and ultimate nanoflash memories based on quantum dots. He has authored more than 1500 papers, 60 patents, and 7 books resulting in more than 56,000 citations worldwide and a Hirsch factor of 106 (@ google scholar). His honors include the Russian State Prize in Science and Technology 2001, his election to the German Academy of Sciences Leopoldina in 2004, to the Russian Academy of Sciences in 2011, to the American Academy of Engineering in 2014, to the American Academy of Inventors 2016, He was elected as Fellow of the American Physical Society, IEEE and Chinese Optical Society in 2004, 2010 and 2022, respectively. He received the Max-Born-Award and Medal 2006, awarded jointly by IoP and DPG, the William Streifer Award of the Photonics Society of IEEE in 2010, the UNESCO Nanoscience Award and Medal 2012, Heinrich-Welker-Award 2015 and Nick Holonyak jr. Award of OSA in 2018. In 2019 he received the IEEE Nishizaza Award and Medal. The University of Lancaster (UK) and the St. Petersburg Scientific University of the Russian Academy of Sciences bestowed honorary doctorates to him.

Nano-structured Metal Chalcogenides for Optoelectronics

Pawan K Khanna, Department of Applied Chemistry, Defence Institute of Advanced Technology, Pune-411025, India.

ABSTRACT:



Nanostructured metal and metal chalcogenides have found immense applications in advanced technologies such as in light-emitting diodes, solar cells, hydrogen evolution reactions, supercapacitors, field-effect transistors, sensors, photocatalysis, etc. However, their application gets limited due to the lengthy methods of synthesis requiring high temperatures, toxic solvents etc. metal nano-particles such as noble metals and or transition metals are straight forward in their synthesis as they are based on the reduction process of the cations into their zerovalent state. The only challenge associated with them is to tailor their physical and chemical properties e.g. surface plasmon resonance in copper, silver and gold nanoparticles and band-gap tuning with respect to particle size in case of chalcogenide semiconductor including that of quantum dots and magic clusters.

Dichalcogenides of transition metals popularly termed as TMDs have captured significant attention due to their layered structure like graphene accompanied by semiconducting properties. TMDs is a class of compounds consisting of transition metals and chalcogens (S, Se, Te). The prominent members of this family are the molybdenum dichalcogenides (MoX2, X= S, Se, Te). MoO2, MoS2, MoSe2. Similarly, II-VI quantum dots and magic clusters are popular materials due to the exciting light absorption and emitting properties thereby, having excellent potential for photonic applications. White light emitting CdSe magic-sized nanoclusters can be synthesized within few minutes by microwave method as against chemical synthesis using alternate selenium source such as 1,2,3-Selenadiazoles. Green light emitting highly fluorescent hydrophilic CdTe QDs are useful for biomedical/ bio-imaging applications. Likewise, ternary metal selenides such as CuInS2 and CuInSe2 have found applicability in photonic devices such as solar cells where they are employed as light absorbing layers. They offer high conversion efficiency. Nano-CuInSe2 and sulphide can be synthesized by chemical methods using high boiling solvents. This lecture will mainly discuss strategy for synthesis of quantum dots and related chalcogenides.

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BIOGRAPHY:

Professor Pawan K Khanna completed his PhD in Organometallic Chemistry of Se & Te from IIT Bombay in 1989-90 under the guidance of Professor HB Singh. Subsequently, he went to Queens' University of Belfast and University of Wales at Swansea (UK) for his post-doctoral research in the group of Professor Christopher P Morley during 1989-1992. He was awarded the prestigious BOYSCAST fellowship of DST, govt of India during 1998-99 for his research on quantum dots to work with Professor David J Cole-Hamilton at University of Saint Andrews, Scotland (UK). He is recipient of Brainpool Int. Fellowship of Korean Govt and has been international visitor to South Korea in 2003, 2004 and in 2008-09. From 1995 till 2011 He was scientists at various grades at C-MET, Pune, a govt of India autonomous scientific institute where he handled many programmes on nanomaterials for electronics and photonics.

He moved to his current position of Senior Professor at Defence Institute of Advanced Technology (DIAT), a Deemed University of the ministry of defence, govt of India, in 2011 where he was Head of Applied Chemistry Department from 2011-2019 and was also dean of academic affairs from March 2011-March 2013 and Dean of Applied Sciences (2017-18) and Chairman of IP & Incubation (2016-2019). He has published more than 230 research papers and has 12 patents to his credit. He has guided more than 100 graduate/undergraduate students and 10 PhD and several young post-doctoral fellows as well as young scientists at his work place. Currently 04 PhD students are pursuing their research under his guidance on Nanomaterials for energy applications including quantum dots, thermoelectric materials. Nano-ink, and photocatalysis for effluent treatment.

He has completed 20 sponsored projects and was part of several national committees. He was awarded Materials Research Society of India (MRSI) medal in 2010 and was declared Researcher of the Year at DIAT/DRDO in 2014. He was elected founding president of Society for Materials Chemistry (BARC), Pune Chapter IN 2021, India. Prof. Khanna is LISTED AS TOP 2 % OF THE WORLD SCIENTISTS by researchers of Stanford University study AND By Elsevier since 2021 to date.

Bismuth based Photocatalyst For Efficient Photodegradation And CO_2 Reduction

Seema Garg, Dept of Chemistry, Amity Institute of Applied Sciences, Amity University, Noida.

ABSTRACT:

Facile synthesis of bismuth based photocatalyst that responds to visible light was fabricated through a hydrolysis reaction. pH and temperature studies of the pristine photocatalyst have been carried out, and further tested for photodegradation of organic pollutants including methyl orange (MO) dye and phenol. Carbon dioxide hydrogenation was also carried out for the same. It was confirmed that the catalyst at acidic and neutral pH formulated similar results in dye degradation. The photocatalytic ability was also observed to degrade 100 % of 20ppm MO under visible light exposure within 20 minutes of light irradiation. After observing promising results, study have been continued for higher concentrations of MO (50, 100, 200, 500 ppm). 500 ppm MO has also been photodegraded by 63%. Furthermore, this catalyst has also been tested for the photodegradation of 10 ppm phenol. As a result, bismuth titanate nanocrystals at acidic pH, has shown highest (60%) phenol degradation within 9 hours of visible light irradiation. Tests indicated that bismuth titanate nanocrystals fabricated at acidic pH and calcined at 700 degrees showcased a notable increase in CO_2 photoreduction capability, yielding CO at a rate of 673.3 µmol/g/cat and CH_4 at a rate of 70.2 µmol/g/cat, which is more efficient than other reported Bismuth titanates in the literature.

BIOGRAPHY:

Dr. Seema Garg holds doctoral degree in Chemistry from Dr. B R Ambedkar University. She started her career in 2001 as a faculty member at UPTU Engineering College and joined Amity University Noida in 2011and is currently working as a Professor, Dept of Chemistry and Head, Student Affairs, Amity Institute of Applied Sciences, Noida. She has an extensive experience of 24 years to her credit. Her research interests involve synthesizing semiconducting nanomaterial using green methods for photocatalytic applications; degradation of recalcitrant organic pollutants, hydrogen generation, CO2 reduction to provide efficient and affordable solution to the industry. She has to her credit Eighteen PATENTSout of them 6 have been granted and published more than 60research papers in refereed journals with leading publishers. She is Editorial board member of Reaction Kinetics and mechanism, Springer Journal and Associate Editor of Frontiers Journal and Guest editor of Frontiers of Material Journal. She has published 15 book chapters with leading publishers viz Springer, Elsevier and Novaand published two books with Springer on Green Photo-catalytic material and Photocatalysis for Environmental Remediation and Energy Production, they have contributions from authors of 16+ countries and next booksAdvanced Nanomaterials for Environmental & Biological Applications are under process.

Intercalated MoS2 for tunable and high-performance FETs: A Materials-First Pathway to Next-Generation Electronics

Arely Cano Martínez, Solid-State Electronics section, Electric Engineering Department, Center for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV), Mexico City, 07360, D.F., Mexico.

ABSTRACT:

Molybdenum disulfide (MoS_2), a promising layered compound from the transition metal dichalcogenides (TMDCs), has gathered attention for its tunable electronic properties. Particularly, the transition from an indirect to direct band gap, through variations in the atomic stacking sequence (S-Mo-S). To advance these properties further, the intercalation of ions, atoms and molecules at the interlayer spacing has recently emerged as a suitable strategy to minimize the Van der Waals forces and promoting the monolayer-like characteristic behavior in a multi-layer system. In this contribution, we systematically modified the interlayer spacing of MoS_2 using pyrazine and its derivatives, achieving controlled expansion and modulation of the S-Mo-S atomic stacking. This intercalation not only isolates the electronic behavior of individual layers but also significantly impacts the electron transport properties. Using Field Effect Transistors (FETs) as a platform, we evaluate and discuss the transport characteristics of these modified systems, highlighting the alteration in carrier mobility and on/off current ratios. These findings provide insights into the potential of organic molecule intercalation for advanced electronic device applications.

BIOGRAPHY:

Arely Cano, Researcher Professor.

Arely Cano is a researcher professor at CINVESTAV, Mexico specializing in 1D and 2D semiconductors. With background in Materials, Surface Science, and Superconducting Technologies, her current work focuses on semiconductors materials for advanced device applications like VTFETs and gas sensors. Committed to innovation, She aim to participate on cutting-edge projects to achieve state-of-the-art device structures, and foster collaborations to advance electronic materials and devices.

Modeling the processes of reflection and refraction of photon waves within the framework of their new wave structure.

Valentyn Nastasenko, Doctor of Technical Sciences, Professor, Kherson State Maritime Academy (Ukraine).

ABSTRACT:

The law of reflection of light was originally formulated by Euclid, approximately in 300 BC. In a strict form, the laws of reflection and refraction of light were formulated in the 19th century in the works of Fresnel based on the wave theory derived from the works of Hooke and Young. In this case, a light wave was considered as a longitudinal sinusoidal wave, similar to the vibration of a string of a musical instrument, and a photon, as a wave moving at the speed of light c, is formed in the form of a spiral (Fig. 1.a). However, an analysis of the formation of photons based on the Lorentz γ-factor showed that a photon, as an elementary particle, is compressed in the direction of motion and expands in the transverse direction, transforming into a spherical wave that moves at the speed of c (Fig. 1.b)

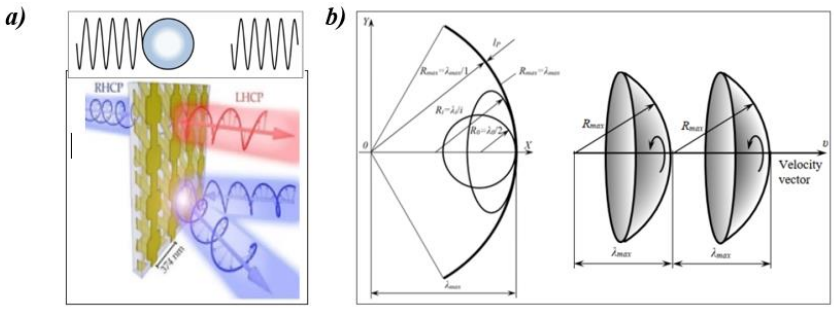

Figure 1.Traditional (a) and new (b) representation of the wave structure of a photon.

In this case, the laws of reflection and refraction of photon waves should be considered within the framework of the motion of wave fronts shown in Fig. 2, which differs from the motion of Huygens wave fronts, since photon waves have strictly finite dimensions.

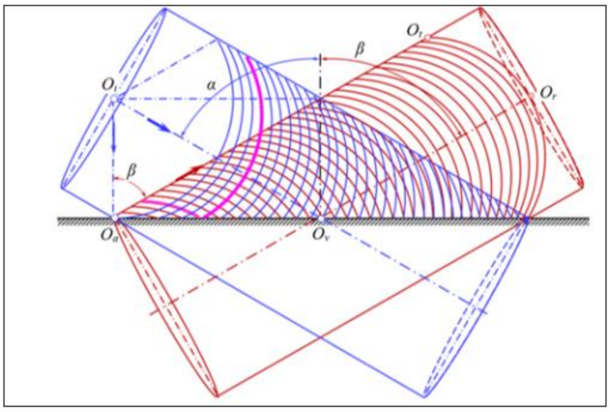

Figure 2: Model of Incidence and Reflection of the Front of a Spherical Photon Wave

In the new version, the actual reflection begins from the first point of contact of the wave with the reflection surface, which distinguishes this process from the traditional representation associated

with the midpoint of the light beam. Geometric modeling of these processes for various angles of incidence and refraction is performed.
The set of presented data indicates the need to revise the basic laws of reflection and refraction of light, which is proposed in this paper.

BIOGRAPHY:

Valentyn Nastasenko
Kherson State Maritime Academy Ukraine, faculties of ships power engineering, the department of transport technologies and mechanical engineering. Dr. of technical sciences, Professor.
A sphere of scientific interests includes quantum physics, the theory of gravitation, fundamentals of the material world and the birth of the Universe, the author of more than 100 scientific works in these spheres. https://orcid.org/0000-0002-0330-1138
Kherson, Ukraine.

Unveiling Transition Metal-Dressing Polymeric Nanodots as MRI Contrast Agents

Paulo C De Morais, Genomic Sciences and Biotechnology, Catholic University of Brasilia, Brasilia DF, Institute of Physics, University of Brasilia, Brazil.

ABSTRACT:

The present talk will discuss experimental data regarding successful fabrication of a novel Cu^{2+}-complex of nitrogen-rich polymer nanodots, with a mean diameter of about 20 nm extracted from transmission electron microscopy (TEM) micrographs and 350 nm obtained from dynamic light scattering (DLS) data. In a first step, the N-rich polymer nanodots were fabricated from N-vynil imidazole (VIm) using a one-pot hydrothermal synthesis performed at 220 ºC for 24 hour. Secondly, the as-fabricated VIm-based nanodots were used to fabricate the Cu^{2+}-doped VIm-based nanodots (Cu^{2+}@VIm) via efficient incorporation as a complex in aqueous medium. The relaxivity of the as-fabricated Cu^{2+}@Vim nanodots was explored aiming at its application as magnetic resonance imaging (MRI) contrast agent. Enhancement of the relaxivity of the Cu^{2+}@Vim nanodots ($r1 = 1.05\ mM^{-1}s^{-1}$) while compared to the relaxivity of the Cu^{2+} aqueous ion ($r1 = 0.43\ mM^{-1}s^{-1}$) will be described. MRI tests performed while labeling MCF-7 cells with Cu^{2+}@Vim nanodots show a remarkable contrast enhancement for T1-weighted imaging. Additional biomedical applications will be explored in the talk.

BIOGRAPHY:

Professor Paulo César De Morais (H60), PhD, was full Professor of Physics at the University of Brasilia (UnB) – Brazil up to 2013. Appointed as UnB's (Brazil) Emeritus Professor (2014);Visiting Professor at the Huazhong University of Science and Technology (HUST) – China (2012-2015); Distinguished Professor at the Anhui University (AHU) – China (2016-2019); Full Professor at the Catholic University of Brasília (CUB) – Brazil (2018); CNPq-1A Research Fellow since 2010; 2007 Master Research Prize from UnB. He held two-years (1987-1988) post-doc position with Bell Communications Research, New Jersey – USA and received his Doctoral degree in Solid State Physics (1986) from the Federal University of Minas Gerais (UFMG) – Brazil. With more than 13,000 citations, He has published about 500 papers (Web of Science), presented more than 200 international talks, and filed more than 15 patents.

Creating Materials with a Desired Refraction Coefficient and other Applications

Alexander G. Ramm, Mathematics Department, Kansas State University, USA

ABSTRACT:

It is apriori not clear if it is possible to create materials with a desired refraction coefficient. If it is possible, there are many techno- logical problems that can be solved. In this talk the author proves that it is possible to create materials with a desired refraction coeffi- cient. Moreover, he gives a concrete practical method for doing this. This method is based on an asymptotic solution of the many-body scattering problem by many small particles.

The theory of wave scattering by many small impedance particles of arbitrary shapes is developed. The basic assumptions are: $a \ll d \ll \lambda$, where a is the characteristic size of particles, d is the smallest distance between the neighboring particles, λ is the wavelength.

This theory allows one to give *a recipe for creating materials with a desired refraction coefficient.*

One can create material with negative refraction: the group veloc- ity in this material is directed opposite to the phase velocity.

One can create a material with a desired *wave focusing property*.

Quantum-mechanical scattering by many potentials with small supports is considered.

Equation is derived for the EM field in the medium in which many small impedance particles are embedded.

Similar results are obtained in [6] for heat transfer in the media in which many small particles are distributed.

The theory presented in this talk is developed in the author's monographs [1], [7], [9], [12] and in the papers [2]–[6], [8], [10], [11].

Practical realizations of this theory are discussed in [9].

In [9] the problem of creating material with a desired refraction coefficient is discussed in the case when the material is located inside a bounded closed connected surface on which the Dirichlet boundary condition is imposed.

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BIOGRAPHY:

Prof. Alexander G. Ramm is Professor of Mathematics in the Department of Mathematics at the University of Kansas since 1981. He obtained his PhD in Moscow State University, 1964 and his Dr.Sci. at the Mathematics Institute, Academy of Science, Minsk, 1972. He worked as an Instructor, Leningrad Institute of Precision Mechanics and Optics, 1962-63, Assistant Professor, Leningrad Institute of Precision Mechanics and Optics, 1964-65, and Associate Professor, Leningrad Institute of Precision Mechanics and Optics, 1965-78.

The Study of Transmission Parameters from PT-symmetric Waveguides

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ABSTRACT:

The unique non-Hermitian properties of PT-symmetric waveguides continue to inspire novel photonic device designs, particularly in optical sensing and topological photonics. The quantitative analysis of power transmission properties proves particularly critical in the development of optical switching systems. In this work, we extract the mode power transmission parameters based on the coupled mode equations and analyze the power properties of the PT-symmetric system. The two different coupled mode equations are established based on the two different orthogonality relations between the original and adjoint system. The finite-difference frequency-domain method is employedto simulate the structures. The theoretical results match well with the numerical results, which demonstrate the validity of our method. The results also reveal contrasting nonreciprocal transmission characteristics between the PT-symmetric and PT-broken phase regimes. Furthermore, the conserved quantity linked to the system's Hamiltonian invariant is derived through a new integration method in this study. The extraction of lossy and gain mode power for conserved quantities is achieved through supermode decomposition, presenting a new perspective for studying conserved quantities. Our approach systematically integrates complex mode properties and leverages orthogonality conditions to analyze power transmission properties, establishing a versatile framework applicable to diverse non-Hermitian optical systems. It will be helpful to design the various optical waveguide structures or light switching applications.

BIOGRAPHY:

Chengnian Huang, Ph.D. candidate.
Chengnian Huang was born in Wuhan, Hubei, China. She received the B.Eng. degree inelectronic science and technology from Xiamen university, China, in 2020. She is currently pursuing the Ph.D. degree in electronic science and technology with the Zhejiang University, Zhejiang, China. Her current research interests include computational electromagnetics like volume integral method and FDFD method, micro and nano-optics, and optoelectronic device simulation.

Synergistic Effects of Polyaniline and Graphene Nanoplate Hybrid Fillers on the Mechanical, Electrical, and Microwave Absorption Properties of Thermoplastic Rubber Nanocomposites

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ABSTRACT:

Conventional polymers are typically known for their insulating properties, exhibiting poor electrical conductivity and magnetic behavior. This study focuses on the fabrication of a thermoplastic natural rubber (TPNR) blend with polyaniline (PANI), reinforced with graphene nanoplatelets (GNP), using a melt blending method with an internal mixer, followed by compression molding. A control sample of TPNR/PANI, based on previous research, was formulated with an optimized PANI content of 3 wt%. The influence of GNP content (ranging from 1 to 5 wt%) on the mechanical properties (tensile, flexural, and impact strength), thermal stability , electrical conductivity, and morphology of the TPNR/PANI/GNP composites was investigated. Results indicate that the incorporation of 2 wt% GNP led to notable improvements in tensile strength (5.96 MPa), flexural strength (1.83 MPa), flexural modulus (21.68 MPa), and impact strength (4.61 kJ/m²). However, thermal analysis revealed that the addition of GNP did not significantly enhance thermal stability. In terms of electrical properties, the optimal conductivity of 2.6×10^{-9} S/cm was observed at 2 wt% GNP, representing a 23.8% increase compared to the control sample. Scanning electron microscopy (SEM) images demonstrated a well-distributed dispersion of GNP at the optimum loading, along with strong interactions between the TPNR and PANI phases. These findings suggest that TPNR/PANI blends with low GNP loading and ferrite nanoparticles can serve as novel conductive and magnetic materials. The developed hybrid thermoplastic elastomer nanocomposite exhibits promising potential for applications in electromagnetic interference (EMI) shielding and radar-absorbing materials.

BIOGRAPHY:

Professor Dr Sahrim Ahmad obtained his PhD from University of Loughborough, United Kingdom in 1988. He is an expert in the field of magnetic, nanocomposites and advanced materials. He has completed more than 60 research projects and consultancy work as a leader and co-researcher. His work on novel radar absorbing materials (RAM) subjected to transverse electromagnetic (TEM) has been successfully developed. His team managed to produce products that offered proper characteristics for handling, flexibility and lightweight, meeting requirement for various applications. He has published more than 270 papers in various journals related to polymer, composites, materials and supervised more than 63 PhD students. Dr Sahrim was former Dean of Faculty Science of Technology and Editor In Chief of Journal Sains Malaysiana (ISI/WOS). Currently he is the Fellow Academy of Science Malaysia. Fellow Academy Profeesor Malaysia and Fellow of Malaysia Solid Science Society.

Eliminating Infection in 30,000 Humans to Date: The Impact of Nanomedicine

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ABSTRACT:

This talk will discuss how we have used nanotechnology eliminate infections in over 30,000 humans to date. It will discuss how medical devices have been modified to have nanoscale surface features that repel bacteria while promoting tissue growth. Moreover, it will discuss how we are using artificial intelligence (AI) to design better biomaterials for various biomedical applications. In particular, AI is being used in implantable nano sensor design to prevent, diagnose, and treat various diseases from cancer to infection. Specifically, here, implantable sensors were designed, fabricated, and tested. Such sensors can detect the type of cell that attaches to an implant, communicate such information to a handheld device, and respond to ensure implant success. In particular, such sensors have been tested in animal studies in which sensors were inserted into the calvaria of rats, bacteria purposedly injected, and sensors used to detect bacteria presence as well as on-demand release antibiotics to eliminate infection. Further, AI has been used in such sensors to predict what types of drug delivery vehicles will be most effective for that particular patient based on prior patient health data and real time response to therapies. It is well known that due to variations in immune systems from patient to patient, patients will respond differently to the same biomaterial and drug treatment, thus, personalized or tailored treatments are necessary and can result from AI. In vitro, in vivo, and human clinical studies will be presented in which AI has already improved medicine. In this manner, this presentation presents a positive view on the implementation of AI into medicine via sensors showing how it can be used to improve disease prevention, diagnosis, and treatment.

BIOGRAPHY:

Thomas J. Webster, Professor
Thomas J. Webster's (H index: 129; Google Scholar) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995; USA) and in biomedical engineering from RPI (Ph.D., 2000; USA). He has served as a professor at Purdue (2000-2005), Brown (2005-2012), and Northeastern (2012-2021; serving as Chemical Engineering Department Chair from 2012 - 2019) Universities and has formed over a

dozen companies who have numerous FDA approved medical products currently improving human health in over 30,000 patients. His technology is also being used in commercial products to improve sustainability and renewable energy. He is currently helping those companies and serves as a professor at Brown University, Saveetha University, Hebei University of Technology, UFPI, and others. Dr. Webster has numerous awards including: 2020, World Top 2% Scientist by Citations (PLOS); 2020, SCOPUS Highly Cited Research (Top 1% Materials Science and Mixed Fields); 2021, Clarivate Top 0.1% Most Influential Researchers (Pharmacology and Toxicology); 2022, Best Materials Science Scientist by Citations (Research.com); and is a fellow of over 8 societies. Prof. Webster is a former President of the U.S. Society for Biomaterials and has over 1,350 publications to his credit with over 55,000 citations. He was recently nominated for the Nobel Prize in Chemistry. Prof. Webster also recently formed a fund to support Nigerian student research opportunities in the U.S.

Electronic Properties of $CuInS_2$ Crystals

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ABSTRACT:

Compounds I-III-VI_2 are ternary analogues of known compounds ZnS and CdS. $CuInS_2$, crystallize in a tetragonal, chalcopyrite structure with a spatial group. The elementary cell of CuInS2 contains 8 atoms. On the one hand, $CuInS_2$ crystals attract the attention of researchers due to their high birefringence and therefore they are potentially interesting as nonlinear optical materials. On the other hand, the width of the forbidden zone of $CuInS_2$ allows these crystals to be used as elements of efficient solar photoelectric converters.

In this paper, the optical properties of CuInS2 crystals are investigated experimentally by spectral ellipsometry and theoretically from first principles using the density functional theory (DFT). The real and imaginary parts of the dielectric function (Fig. 1, curves 3), the dispersion of the refractive index, extinction and absorption are determined from ellipsometry studies in the energy range of 0.7−6.5 eV. Using first-principles calculations, the partial densities of states (PDOS) projected onto atoms, the electronic band structure, the origin of energy states and the optical functions for polarizations of incident light along and perpendicular to the optical axis of the crystal are determined (Fig. 1, curves 1 and 2).

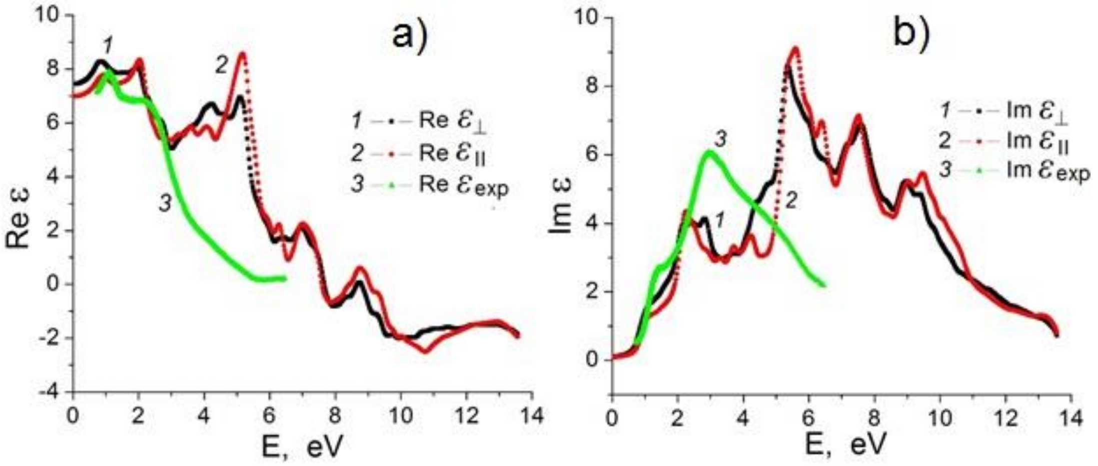

Fig. 1. Real (Re ε) (a) and imaginary (Im ε) (b) parts of the dielectric function of $CuInS_2$ (1, 2 - theory; 1 - perpendicular to the tetragonal axis c (□), 2 - along the tetragonal axis c (II), 3 - experiment).

A comparison of the results, theoretically calculated from first principles, with the experimental data of the present work, obtained by the method of spectral ellipsometry, is carried out.

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