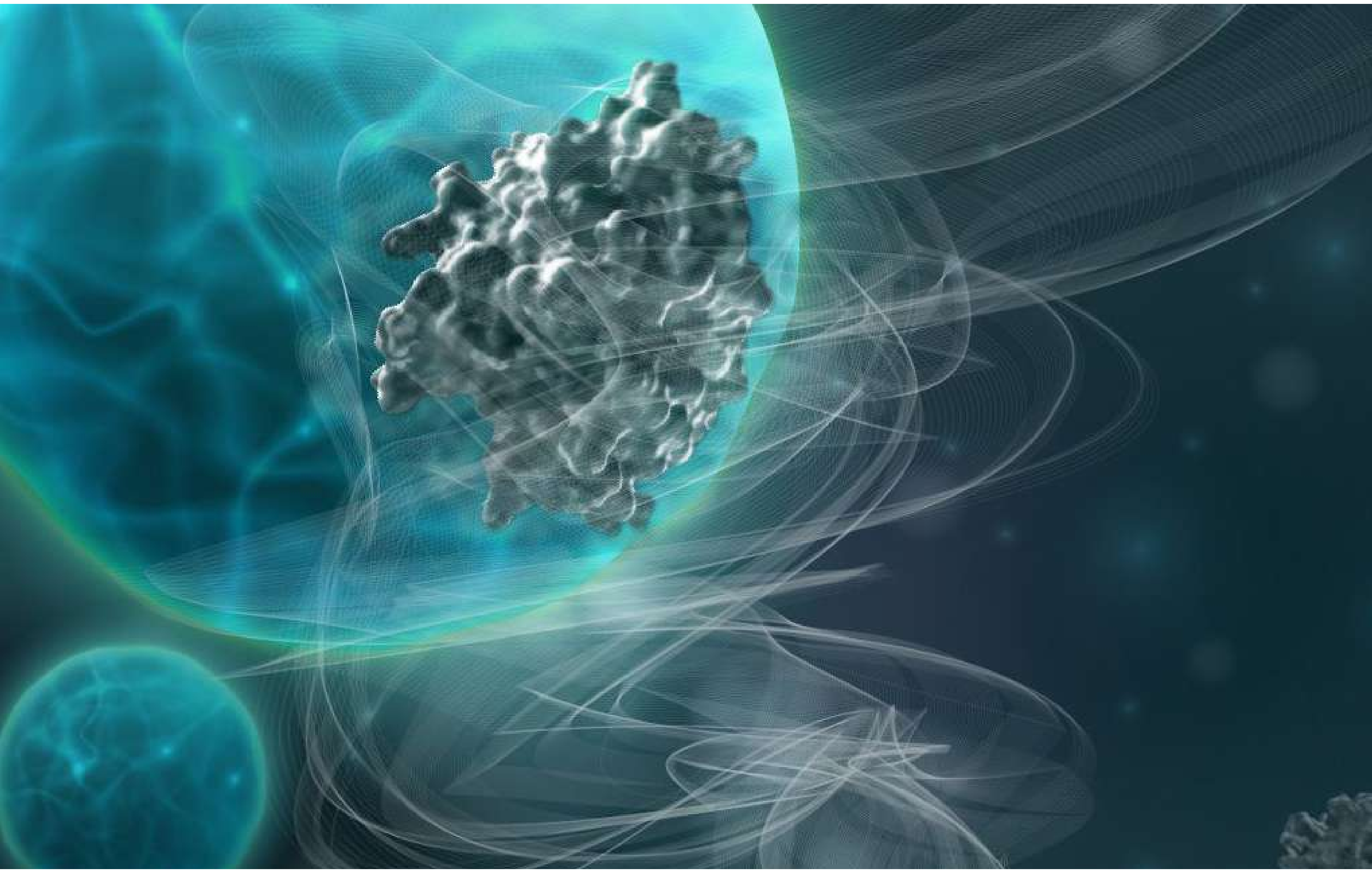
Proceedings of

5TH EDITION OF NANOTECHNOLOGY, NANOMEDICINE & OPTICS PHOTONICS HYBRID CONFERENCE

October 06-07 2022 | Paris, France



HOSTING ORGANIZATION

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Welcome Message

Linkin Science welcomes you all to the 5th EDITION OF NANOTECHNOLOGY, NANOMEDICINE & OPTICS PHOTONICS HYBRID CONFERENCE which will be hosted in Paris, France during October 06-07, 2022.

This conference is dedicated to provide a platform for high-quality information that describes the most significant and cutting-edge research in all areas of Nanotechnology, Nanomedicine and Optics Photonics applications.

Nanotechnology is rapidly expanding by playing a prominent role in many fields. This Conference is a platform to Industry, Academia, Researchers, Innovators to come together to discuss the research activities, advancements, ideas and exhibit Nano products.

The congress offers a wonderful opportunity to meet and enhance new contacts in the field of Nanotechnology & Optics Photonics, by providing mutual collaboration. It allows delegates to have issues addressed in Nanotechnology and Biophotonics global experts who are up to date with the latest developments in this particular field and provide information on new advancements and other technologies. This International conference features world renowned keynote speakers, Oral presentations, young research forum, poster presentations, workshops and career guidance sessions for students.

Regards,
Scientific Committee

Mission

Our mission is to bring the researchers on a common platform and provide opportunity for them to interact. This scientific networking helps for the betterment of science by exchanging the ideas in a broader way.

Vision

Magnifying Scientific Knowledge by Sharing the research and ideas. We believe in accelerating the possibilities of novel discoveries and enhancement in scientific research, by connecting scientific community for knowledge sharing.

Why Linkin Science

Join us to redefine and explore new research, to provide a credible source to barter ideas for scientific studies. To revolutionize the true outcome of a distinct scientific discovery and grab the attention for rare emerging technologies.

Linkin Science Conferences

Linkin Science conferences are well crafted and designed by a team of skilled experts. Our conferences are vast expanded into Medical, life sciences, health care, Engineering and other social sciences. Each conference, summit or executive briefing is tailored to the sector, topic and audience need. Our event structure varies depending on issue and market requirements featuring Keynote presentations, Oral talks, Poster presentations, Young research forum, Exhibitions, roundtables and variable formats.

Welcome to Linkin Science

Linkin Science organizes a wide range of scientific events worldwide and thus evolving to be a hub for scientists, researchers, doctors, students, industries and delegates. We are dedicated to provide high quality online Journals, Conferences, events and information, through unparalleled speaking sessions, workshops and unique face-to-face networking opportunities. This Scientific Networking creates meaningful relationships with like-minded professionals that elevate the conference experience for the participants. We value the research and other scientific prospects and works done by individuals.

We schedule different Medical, Health Care, clinical and engineering conferences to establish divergent platforms for delegates and other scientific researchers. Each conference, summit or executive briefing is tailored to the sector, topic and audience need. Our event structure varies depending on issue and market requirements. Keynote presentations delivered to all works for some content, whilst other conferences feature multiple breakout sessions, panels, roundtables and variable formats.

A team of highly skilled committee members dwell upon the trending topics of research to create a conference theme which can be used to exhibit ideas and research works among the scientific group laying the path for scientific discoveries.

KEYNOTE FORUM

DAY 1

5TH EDITION OF NANOTECHNOLOGY, NANOMEDICINE & OPTICS PHOTONICS HYBRID CONFERENCE

October 06-07 2022

Paris, France

Nanotechnology 2022

Chemical doping and stability in organic semiconductors : A tale of two charge transfer states

Bharati Neelamraju
University of Arizona, USA

Organic semiconductors (OSCs) have incredible prospects for next-generation, flexible electronic devices, including bioelectronics, opto-electronics, energy harvesting, and storage. They are flexible, biocompatible, printable, and low-cost semiconductor materials with control over chemical tailorability, giving us control over device properties. These properties expand the functionality of electronics beyond the current era of silicon, making it possible for devices such as solar windows, skin patch sensors, wearable electronics, and foldable displays. However, they have lower conductivities than their inorganic counterparts, have a complex microstructure, and are prone to degradation. Hence, to make better-performing systems, we need to understand the underlying mechanisms of doping and degradation in these systems and their intimate connection to microstructure and charge transport. We use a dopant F4TCNQ to p-type dope P3HT in the chemical doping mechanism.

The literature shows that this system either forms an integral charge transfer state (ICT), giving free charge carriers, or a partial charge transfer state (CPX), forming traps based on processing techniques, with ICT being desirable. However, using a combination of spectroscopy, x-ray scattering, and conductivity measurements, we show that these states exist simultaneously and that their existence is co-related to the local density of states of the semiconductor matrix. Using these new insights into their doping mechanisms, we then evaluate the stability of the doped P3HT-F4TCNQ system in terms of its thermal degradation mechanism in the presence of varying environmental conditions.

Biography

Bharati Neelamraju is currently a process engineer at Applied Materials working on a carbon-based PECVD process for the next generation of memory applications. She has previously worked at Micron Technologies Inc as a postdoc in their pathfinding team for high aspect ratio cryo etch processes. Her background is in physics with a Ph.D. in materials science and engineering from the University of Arizona.

Biological effects of electromagnetic waves: stimulation of cell proliferation and differentiation during regeneration as a unique property of THz impulses

László Molnár
EETRG, Balaton Limnological Research Institute Tihany, ELKH, Hungary
Institute of Biology, University of Pécs, Hungary

There is growing experimental evidence that all living things respond to electromagnetic waves. However, the published results, applying various experimental protocols and model animals, are controversial (both beneficial and disadvantageous effects of distinct electromagnetic irradiations have been reported).

Exploring the biological effects of electromagnetic irradiation requires an exact, reproducible optical background and a standardizable biological model. One of them (posterior segments regeneration of earthworms) has been developed in our laboratory. The kinetics of the segment renewing (with its biochemical, cytological, and histological backgrounds) has been elucidated under various physiological parameters. Therefore, its application in exact photobiological experiments can contribute to recognizing the effects of defined electromagnetic irradiation on living things and supports the selection of relevant parameters for medical sciences.

Earlier, we have shown that single-cycle THz pulses of 5 µJ energy, 0.30 THz mean frequency, 293 kV/cm peak electric field, and 1 kHz repetition rate has been overridden the genetically determined, endogenously mediated segment renewing capacity of our model animal (Eisenia andrei, Annelida, Oligochaeta, Lumbricidae). In contrast, THz pulses exposed worms to control specimens and have found a significantly higher number of renewing segments. The regenerated segments have had regular histological organization; no malformation has been seen in their tissues. In contrast, advanced tissue development has been recognized, e.g., in body wall epithelium and muscles, circulatory system and immune cells, and especially in the renewing ventral nerve cord ganglia. No similar effects have been seen in green or red light exposed experimental animals, and the possible heating effect of THz pulses has also been experimentally excluded. In this presentation, we show the ultrastructural and some histochemical characteristics (collagen deposition in cicatrix, dedifferentiation and redifferentiation of muscle cells, development of neurotransmitter-specific cells, and iron distribution in old and new tissues) of distinct animal tissues exposed to defined THz pulses, suggesting their possible medical application.

Biography

Dr. Molnár is a senior research fellow at Ecophysiological and Environmental Toxicological Research Group, Balaton Limnological Research Institute of Eötvös Loránd Research Network, Tihany, Hungary, and an associate professor at the Department of Comparative Anatomy and Developmental Biology, Institute of Biology Faculty of Natural Sciences, University of Pécs, Hungary. He is interested in the reparative regeneration of earthworms and its regulation with definite chemical and physical factors. He investigates the interaction of the immune and neural systems during regeneration and the effect of electromagnetic waves on tissue dedifferentiation and redifferentiation. He has been a Ph.D. supervisor of the Doctoral School of Biology and Sportbiology and the Doctoral School of Physics (University of Pécs). In the London Interdisciplinary Doctoral Programme (King's College, London, UK), he was a co-supervisor of a specific regeneration topic of a Ph.D. dissertation (Brain regeneration, an earthworm phenomenon: from molecular characterization to bioengineering a functional "brain in a dish").

Deep learning framework for clinical diagnosis - A healthcare system

Sandeep Singh Sengar*
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One of the main targets of computer vision is to interpret the content of image and video data. To interpret image content, one of the essential goals is to build a model depending on a known set of features extracted from image data. The built model is then employed to produce an inference of the unknown dataset. Medical image segmentation is a part of computer vision, and its target is to label each pixel of an object of interest in medical images. It is often a key task for clinical applications, varying from computer-aided diagnosis for lesions detection to therapy planning and guidance. Medical image segmentation helps clinicians focus on a particular disease area and extract detailed information for a more accurate diagnosis. With an end-to-end deep learning approach, Convolutional Neural Networks have shown state-of-the-art performance for automated medical image segmentation. However, it doesn't perform well in the case of complex environments. U-Net is another popular deep learning architecture, especially for biomedical imaging. It consists of a contraction and expansion path to pixel-wise predict the dataset. This model is better than previously available medical image segmentation approaches. However, again, it fails to produce promising results with 3D voxels. An incremental version of U-Net, Multiplanar U-Net, has been developed. In this talk, we will discuss a simple and thoroughly evaluated deep learning framework for the segmentation of arbitrary medical image volumes. The framework requires no human interaction, no task-specific information and is based on fixed model topology and a fixed hyperparameter set.

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ORAL PRESENTATIONS

5TH EDITION OF NANOTECHNOLOGY, NANOMEDICINE & OPTICS PHOTONICS HYBRID CONFERENCE

OCTOBER 06-07 2022
PARIS, FRANCE

Ferroelectric properties of BiFeO3 ceramics with cation substitutions at Bi-site (La3+, Eu3+) and Fe-site (Nb5+, Zr4+)

Aleksandar Radojković[1]*, Danijela Luković Golić[1], Nataša Jović-Orsini[2], Jovana Ćirković[1], Zorica Branković[1] and Goran Branković[1]

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BiFeO3 is one of the few multiferroic perovskites that exhibits magnetic and ferroelectric properties at room temperature. However, it is also distinguished by high leakage current, low remnant electric and magnetic polarization, and high electric coercive field. These features keep it away from any practical use in electronics. Therefore, many attempts have been made to improve the properties of BiFeO3 by Bi- or Fe-site doping or by both. Previous investigations suggest that doping with Nbat Fe-site can positively affect the magnetic behavior of BiFeO3 and decrease the leakage current.

In this study, various cation substitutions at Bi-site (La3+, Eu3+) and Fe-site (Nb5+, Zr4+) were examined to investigate their possible synergism and benefit for the ferroelectric properties. The role of the cations with higher valence is to suppress the formation of structural defects during synthesis, such as oxygen and bismuth vacancies. These defects are responsible for high leakage currents and, consequently, low breakdown voltages characteristic of the pure BiFeO3. On the other hand, rare earth cations at the Bi-site usually enable densification of the ceramics in a wider range of temperatures, preventing bismuth loss and forming defects and secondary phases during sintering. However, do pant concentrations above 10–15mol% may give rise to transition from polar, rhombohedral (R3c) to non-polar, orthorhombic (Pnma) symmetry.

The carefully selected compositions of doped BiFeO3 were synthesized by a simple hydro-evaporation method. The ceramics samples were characterized using X-ray diffraction (XRD) analysis, scanning electron microscopy (SEM), and polarization techniques, including leakage current measurements. Although the introduction of Nb5+or Zr4+decreased the leakage current, they surprisingly deteriorated the ferroelectric properties even at concentrations as low as 1 mol%. This effect was more pronounced for the samples containing Nb. On the contrary, both La3+ and Eu3+ (incorporated at the Bi-site) improved the ferroelectric properties as their concentrations increased. The La-doped samples exhibited higher remnant electric polarizations at observed electric fields. The highest remnant electric polarization of31.9 μC/cm2at 150 kV/cm was measured for Bi0.85La0.15Fe0.998Zr0.002O3, indicating the synergetic effect of La3+ and Zr4+, which is limited to very low Zr4+concentrations.

Are nano plastics toxic to plants? Early evidence and concerns

Carmelina Spanò
University of Pisa, Italy

Plastics are used in many industrial sectors and in several everyday life products. The extensive use and the poor attention to their disposal and recycling are causing the production of the massive amount of waste, with possible global contamination of environmental matrices. As known, plastics are not biodegradable and remain in the environment for long periods undergoing aging processing with fragmentation into smaller pieces, up to micro (less than 5 mm) and nano (less than 100 nm) particles dimension, the smaller fractions being of specific concern. The possible entry of these particles into the food chain through plants represents a problem to deal with to improve food safety for humans and animals. To investigate the interactions between these particles and plants, we used a multidisciplinary approach in which seeds of the model crops Allium cepa L. and Oryza sativa L. were treated with different concentrations of polystyrene nano plastics (PS-NPS), chosen as model particles, as polystyrene is among the six more used plastics, widely diffused in all the terrestrial environments including agro-ecosystems. Under short-term conditions, phytotoxicity, genotoxicity, and cytotoxicity effects were assessed during germination and the early stages of seedling growth. Thanks to our integrated approach, it was possible to highlight that PS-NPS can impair seed germination and seedling growth. They can be taken up by the root and translocated to the above-ground part of seedlings, even entering inside cells, where their presence is associated with ultrastructural damages and genotoxicity. A different concentration/localization of main oxidative stress markers has been recorded, along with the induction of an enzymatic antioxidant response. Our results suggest that damages detected could be due not only to changes in the production/diffusion of oxidative stress markers but also to a possible direct effect of PS-NPS, able to overcome plant cell barriers. Further studies under long-term conditions, with a particular focus on the edible parts of the plant, will be helpful to better clarify the impact on the environment and health of nano plastics, but their ability, even in short-term experiments, to enter inside crop plants, and possibly into the food chain is a matter of considerable concern.

Biography

Carmelina Spanò joins the University of Pisa as a researcher in the Department of Biology. She received a degree in Biological Sciences cum laude, and the Ph.D.in Agricultural Biology title. She has held many courses in plant physiology (Plant Biochemistry, Plant Biotechnology, Plant Physiology, Transgenesis in plants, and currently, Strategies of resistance in plants). Her primary research interests have been in plant response to abiotic stressors in laboratory-controlled conditions, with particular interest in studying oxidative stress and antioxidant response in plants under different physiological or stress conditions. In the last decade, her interest has turned to the study of the effects of nanomaterials on plants. In her free time, she practices tai chi and brisk walking and reads many novels, especially detective stories; she is also fond of jazz music.

Morphology and antibacterial properties of ZnO-TiO2-SiO2 Sol-gel derived coatings on stainless steel

Gundars Mezinskis[1]*, Renars Broks[2], Alise Ozolina[1], Liga Grase[1], Juta Kroiča[2] and Aigars Reinis[2]

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Biofilms are formed in different environments, on virtually any surface with sufficient moisture and nutrients, as well as hospital equipment surfaces resulting in causing biological contamination. Specific negative effects of bacteria biological pollution thanks to the growth of various bacterial resistance to antibacterial drugs are becoming a growing problem in medicine. It is concluded that antimicrobial resistance (AMR) poses a significant threat to human health worldwide [1].

We report the influence of ZnO-SiO_2-TiO_2 sol-gel dip-coatings (single and multilayer) deposited on mirror polished and stainless steel AISI 304 (SS) modified by a phosphate conversion coating. Different parameters such as particle size of sols used, coatings mechanical durability, wettability, topography, and morphology (AFM, SEM/EDS) were analyzed (Fig.1). The antibacterial effect was determined to samples with the novel dried droplet method [2] using E. coli ATCC 25922 and S. aureus ATCC 6538 strains.

Results show that phosphate SS and then sol-gel coated materials show a higher antibacterial effect than polished materials, respectively 73,0% vs. 21,3% in the case of S. aureus and 77,3% vs. 44,3% in the case of E.coli (Figure 1). Phosphated SS materials showed more than 99% antibacterial effect against E. coli and more than 95% against S. aureus.

Biography

Prof. Gundars Mezinskis is a Dr. Sc. Eng. (1981) and Dr. Habil iii. Eng. (1998) in the Faculty of Materials Science & Applied Chemistry of Riga Technical University (RTU). Leader of the Sol-Gel derived materials group of the Institute of Materials and Surface Engineering (RTU). He has authored over 110 (60 ISI publications among them) and is the author of 14 (2 EU patents among them). He led or participated in projects funded by national and European agencies and industrial companies. His research over the past 10 years has focused mainly on the development and study of coatings finding synthesis methods for material structure and material properties correlations.

Study of a new Anthracene-based polymer: From thin film characterization to fabrication of flexible yellow OLED devices

K. Papadopoulos[1]*, D. Tselekidou[1], V. Kyriazopoulos[2], S. Kassavetis[1], A. K. Andreopoulou[3], K. Andrikopoulos[3], J. K. Kallitsis[3], S. Logothetidis[1] and M. Gioti[1]

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[2]Organic Electronic Technologies P.C. (OET), Greece

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Significant efforts in academia and industry have been made towards developing bendable lighting, such as light-emitting devices on substrates that can be flexed or stretched. Organic Light Emitting Diodes (OLEDs) are the perfect candidates for such applications. Design and synthesis of advanced polymeric emitting materials with appropriate electrical and optical properties are necessary to realize stable-performance OLEDs. Mainly, yellow emissions can be applied to signaling applications, vehicle electronics, wearable electronics, etc. In this study, we focused on the characterization of a lab-scale polymer bearing bis(styryl)-anthracene moiety in film forming ability, emission characteristics, and color purity. The optical and photophysical properties of the solution-processable thin films were thoroughly studied via NIR-Vis-far UV Spectroscopic Ellipsometry (SE) and Photoluminescence (PL), respectively. In contrast, the structural characteristics were examined by Atomic Force Microscopy (AFM). Subsequently, yellow light OLED devices are fabricated by spin coating technique and characterized in terms of their electroluminescence properties and electrical characteristics. Finally, promising preliminary results are reported on flexible OLEDs using a slot die coating process.

Biography

Mr. Kyparisis Papadopoulos holds a BSc in Physics and an MSc in Nanosciences & Nanotechnology from the Aristotle University of Thessaloniki. Currently, he is a Ph.D. candidate in Physics, also at the Aristotle University of Thessaloniki. He is specialized in Sheet-to-Sheet and Roll-to-Roll printing processes of organic electronics for techniques such as slot-die coating, screen printing, and spin coating. His work is focused on the field of Printed Organic Light Emitting Diodes (OLEDs). Also, Mr. Papadopoulos participates in a national R&I project about developing a methodology and printing processes for large-scale OLED devices (project code: T1EDK-01039).

Cancer-derived Exosomes (CDE) and their role in nanomedicine

Per A. Löthman[1,2]* and Ayça Nur Demir[3]

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Exosomes are extracellular vesicles (Evs) secreted by most eukaryotic cells and participate in intercellular communication. They are present in all body fluids and they are produced actively in tumor cells, which are released and utilized to facilitate tumor growth. Exosomes carry the components proteins, DNA, mRNA, microRNA, long noncoding RNA, circular RNA, etc., which play an important role in regulating tumor growth, metastasis, and angiogenesis in the process of cancer development, and can be used as a prognostic marker and/or grading basis for tumor patients, as therapeutic targets or even as anticancer drug carrier. Their characteristics enable them to assist major cancer hallmarks of cancer growth and spread. Cancer-derived exosomal trafficking is observed in several types of liquid or solid tumors, confirming their role as cancer hallmarks.

In this contribution, we take a closer look at the roles of cancer-derived exosomes, of roughly 30–100 nm diameter, in deregulating paracrine trafficking in the tumor microenvironment and circulation. Thus, exosomes are being exploited in diagnostic biomarker development, with its potential in clinical applications as therapeutic targets utilized in exosome-based nanoparticle drug delivery strategies for cancer therapy.

Biography

Dr. Per A. Löthman obtained his Ph.D. degree from Twente University, The Netherlands, in the field of Magnetics and Self-assembly, and conducted research in Canada, France and Germany on carbon nanotubes, Graphene and related 2D nanomaterials. His research is interdisciplinary and involves sensors and sensing, 2D advanced materials, ioNanotechnology including DNA, S-layers, Viruses (archaea, bacteriophages), Biomolecular Architecture, Botany and functional surfaces. Dr. Löthman has published over 80 scientifical articles, and several book chapters and serves as a reviewer and he is on the editorial board for several journals such as Nature, Nature Materials, Journal of Bioanalytical and Analytical Chemistry, Journal of Colloid and Interface Science, Thin Solid Films, Sensors and Actuators, Microsystems Technologies, Biophysical Reviews and Letters and International Journal of Applied Mathematics and Theoretical Physics (IJAMTP). Dr. Löthman is CSO (Chief Scientifical Officer) at Foviatech GmbH in Hamburg, Germany, a young innovative high-tech company in the field of advanced materials and artificial intelligence, and a senior lecturer in "Nanomedicine, Nanopharmacy" and "Sensors and Sensing in Engineering, Biology and Medicine" (Kaiserslautern University) and "Mechatronics Systems and Design" (Hamburg University), Germany and "Interdisciplinary Manufacturing Engineering" (HTW Berlin) Germany.

Prototype fabrication of sub-millimeter sized batteries based on silicon wafer technology batteries

Robert Hahn*, Marc Ferch, Katrin Hoeppner, Sven Lueninghoener, Kai Zoschke, and Martin Schneider-Ramelow

Head of Micro Energy Group, Germany

Several emerging innovations in fields like the internet of things, medical/health, nano-robotics, and the military require extremely miniaturized batteries and special form factors. A technology was developed that combines advanced silicon wafer level packaging and micro-print and deposition processes to fabricate thousands of small batteries in parallel on a substrate. While standard lithium-ion electrode materials are used, adaptions were made for the electrolyte to reduce the vapor pressure. A key technology is wafer fabrication on glass carriers because the silicon walls of the battery housing are very thin. Deep reactive ion etching is used to fabricate the battery housing and PECVD oxide/nitride deposition to isolate the active battery materials from the silicon walls. Particular focus is on the low-temperature hermetic sealing of the batteries on wafer level since battery degradation and increased internal resistance starts at temperatures above 90°C. A combined process of polymer bonding of the battery lid and additional metallization was developed to achieve both: an assembly and packaging technology that can be performed simultaneously on thousands of micro batteries on the substrate and a robust and tight encapsulation.

The attainable energy density as a function of active materials and battery size will be shown. At battery dimensions between 1x1 … 10x10 mm2 and thickness between 200 µm and 1 mm, the overall energy density is ca. 300 Wh/l. All available electrodes for lithium-ion batteries, like graphite and lithium titanate anodes and NCA, NCM, and LFP cathodes, were qualified for micro battery fabrication. With the help of various electrode combinations, cell voltages between 1.5 and 4.0 Volts can be realized. Carbon nanotubes increase electrical conductivity and reduce the contact resistance between electrodes and current collectors. Finally, the process yield of the battery fabrication process will be discussed.

Biography

Robert Hahn received his Master's and Ph.D. in electrical engineering from the Technische Universität Dresden. He is head of the micro energy storage group of Fraunhofer IZM. He has worked for more than 20 years in batteries and microelectronic packaging. He has coordinated several national and European research projects for developing new batteries and integrated power supplies for microsystems, energy autarkic, and medical electronics. He is head of the Fraunhofer micro battery initiative MicroLIB. Dr. Hahn has filed 30 patents in micro energy systems and authored and co-authored more than 100 journal and conference publications and book chapters. He was the coordinator of the FP7 project MATFLEXEND for developing lithium-ion batteries based on nanofibers. Since 2018, he has been in charge of the micro battery prototyping line at Fraunhofer IZM, which is used to fabricate micro batteries for industrial customers.

Photophysical and electroluminescence characterization of blue emitting polymers for OLEDs

Despoina Tselekidou[1]*, Kyparisis Papadopoulos[1], Vasileios Kyriazopoulos[2], Konstantinos C. Andrikopoulos[3], Aikaterini K. Andreopoulou[3], Joannis K. Kallitsis[3], Argiris Laskarakis[1], Stergios Logothetidis[1] and Maria Gioti[1]

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[3]Department of Chemistry, University of Patras, Greece

Conjugated polymers have received increasing attention owing to their outstanding electrical and optical properties. For this reason, they are promising candidates to apply as an emissive layer in Organic light-emitting diodes (OLEDs). Recently, efficient and stable blue-emitting materials have been one of the most essential prerequisites to kick off the commercialization of OLEDs. Consequently, developing novel, high-performance, and regular blue light-emitting materials with colour purity is crucial. Specifically, the blue light-emitting materials remained a great challenge and triggered the research interest in achieving durable and high-quality light. This is due to the intrinsic wide band gaps of blue emissive materials, which generate a high charge injection barrier and unbalanced injection and transportation of charges. In this study, we focus on the photophysical characterization of one novel, lab-scale blue emissive polymer based on Carbazole derivatives compared to the commercially supplied based on Polyfluorene derivatives. The comparative study of these materials helped to evaluate their properties through the synergy of Spectroscopic Ellipsometry, Photoluminescence, and Atomic Force Microscopy techniques. Following, these blue-emitting polymers are used as an emissive layer in OLEDs. The electrical characteristics of fabricated OLED devices are investigated as well as the stability of the electroluminescence emission spectrum during the device operation. Finally, determining the optical properties in combination with the photo- and electro-emission characteristics allow us to evaluate each material's colour stability.

Acknowledgments: This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship, and Innovation, under the call RESEARCH – CREATE – INNOVATE (project code: T1EDK-01039).

Biography

Tselekidou Despoina holds a BSc in Physics from the University of Ioannina and an MSc in Nanotechnology from the Aristotle University of Thessaloniki (AUTH). Currently, she is a Ph.D. student at the Nanotechnology Lab LTFN at the AUTH. Her research interests involve the fabrication of thin films based on solution processes and the characterization through Spectroscopic Ellipsometry, Photoluminescence, Electroluminescence, and Atomic Force Microscopy. Specifically, her research activities focus on studying the properties of fluorescent and phosphorescent emitters for application in polymer OLEDs. In parallel, she holds 3 publications in international scientific journals and has participated in several international conferences.

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ORAL PRESENTATIONS

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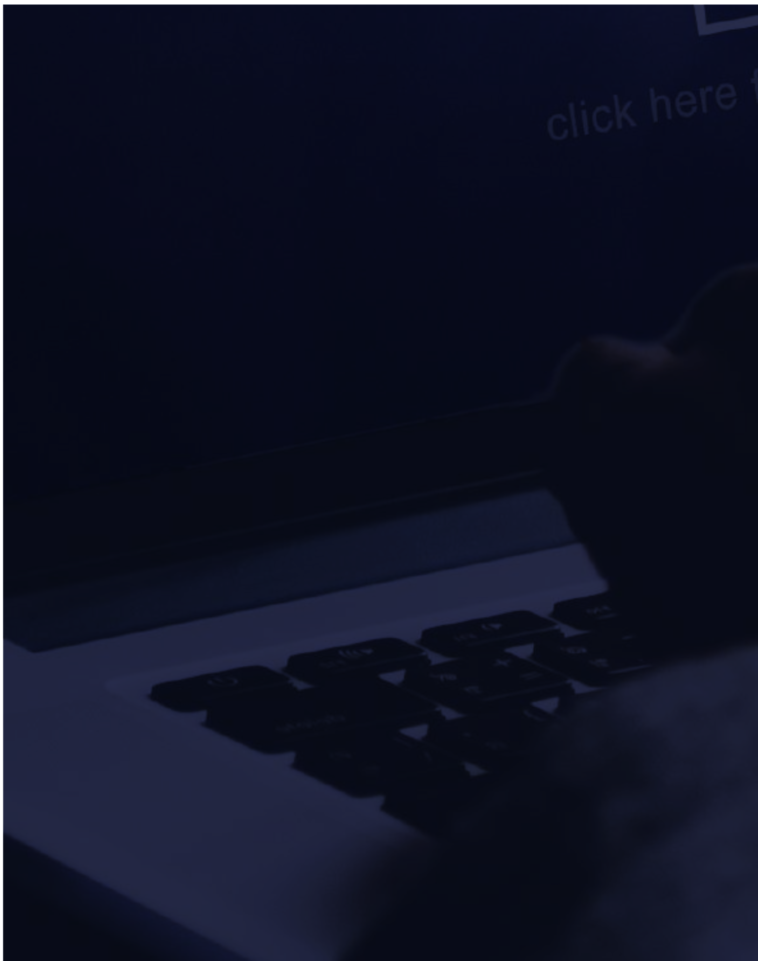

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Ultrasensitive detection of selected gases by laser absorption spectroscopy

Jacek Wojtas
Institute of Optoelectronics, Military University of Technology, Poland

Many effective methods for in-situ detection and concentration measurement of gaseous compounds have been developed so far. Nevertheless, laser absorption spectroscopy (LAS) plays a key role because it offers high sensitivity and selectivity as well as a quick response. Therefore, with the development of optoelectronic technology, LAS sensors are becoming more and more effective tools in the fight against environmental pollution and global warming, in order to control very expensive and complex technological processes in the industry, in order to support medical diagnoses and even detect and examine explosives. These sensors use the phenomenon of optical radiation absorption by the tested molecules. For this reason, they require a thorough matching of laser spectral parameters, the optical system, and the photodetector to the selected gas absorption band. The most commonly used spectral bands are the near-infrared (NIR) and medium wavelength infrared (MWIR). This is related to the price and availability of components, as well as the location of the characteristic absorption bands of many gases with a high absorption coefficient (molecular fingerprints regions). However, the use of other optical bands may also have some advantages in gas detection. For example, sensors based on the absorption of long wavelength infrared (LWIR) radiation ensure a reduction in the negative effects of interferents such as water vapor and carbon dioxide and in the side effects of Rayleigh and Mie scattering. Particular attention will be paid to Cavity Enhanced Absorption Laser Spectroscopy (CEAS).

CEAS sensors provide portability, non-invasive and high-resolution measurements in real-time, fast detection of the lowest changes in the concentration, no need to replace sensitive components and calibration, self-control and safety of use. These advantages make these sensors very useful in many applications. Their principle of operation, functionality and performance will be discussed on some examples. Generally, the results of research carried out in the field of explosive detection will be presented, but some aspects of solutions for medical diagnostics will also be shown.

Biography

Jacek Wojtas is an associate professor at the Institute of Optoelectronics, the Military University of Technology in Warsaw, Poland. Member of the IEEE Photonic Society, the Optical Society, and the Committee of Metrology and Scientific Equipment of the Polish Academy of Sciences. He has been managing the Group of Optical Signals Detection since 2015. Academic teacher and expert in optical signal detection, optoelectronic metrology and optoelectronic sensors for detecting traces of various volatile compounds. His research is focused on the use of state-of-the-art optoelectronic technology in gas sensors for environmental applications (gaseous pollution monitoring), medical diagnostics (detecting diseases biomarkers in human breath), and safety systems (explosives detection). He has been awarded many times for his scientific and didactic achievements. The author or co-author of above 240 scientific publications, an associate or guest editor in 3 JCR journals and reviewer in over 20 journals and grant agencies.

Biophotonics applied to Phlebology: Photonics Diagnosis and Treatment of all Stages of Venous Chronic Diseases. A Clinical Cases Study

Jose Maria Miguel Aguilera Cantero
President of Paraguayan Association of Laser in Medicine, Surgery and Biophotonics
UNINOVE- Nove de Julho University, Brazil

Chronic Venous Disease are spread around the worldwide, with no distinction through gender and middle age's person. The Variety and type of presentation of lesions caused by CVD are very wide, such as complications of this stages of CVD correlated with others pathologies involved same patients. The Clinical Cases Study propose a transversal analysis of cases, during the years 2020 to 2022, since the Biophotonics Diagnosis method: ThermoPhlebology, correlated with Duplex Doppler Ultrasound, to stablish the CEAP Stage of the CVD, later we decide wich Laser Treatment it's better for one by one case; Transdermal Laser vs. EVLA for each case of patients. The Follow Up of the patients was until 6 months of medical discharge data for the Laser Treatment. The CEAP STAGES (0 to 6) it still the worldwide nomenclature to describe the stage of the CVD for the UIP (Union Internationale de Phlebologié) for the Phlebology Medical Speciaty.

Influence of culture medium on the death curve of *Aggregatibacter actinomycetemcomitans* induced by Antimicrobial Blue Light (aBL)

Luciana Toledo Costa Salviatto*

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Periodontitis is a highly prevalent chronic disease affecting the teeth' supporting tissues in response to the presence of microorganisms organized in biofilms. Antimicrobial blue light (aBL) consists of the interaction of blue light with metal-free porphyrins and flavins produced endogenously by microorganisms leading to the production of highly toxic reactive oxygen species (ROS) such as singlet oxygen, leading to microbial death. This work hypothesized that different culture media could influence the formation of photosensitizers by the bacterium *Aggregatibacter actinomycetencomitans* and evaluate the potential of aBL in the death curve of this periodontopathogen. Methods: The study groups were *A. actinomycetencomitans* cultured in a BHI culture medium and *A actinomycetencomitans* cultured in blood agar. The parameters used were a LED 403 ± 15 nm with 1W of radiant power and irradiance of 588.2 mW/cm2. The irradiation times were 0, 1, 5, 10, 30, and 60 minutes. The plates were cultured for 48h in microaerophilic or anaerobic conditions with a temperature of 37°C in a bacteriological incubator, and the colonies were counted by CFU/mL. Spectroscopy and fluorescence microscopy were performed to confirm the presence of endogenous photosensitizers in the microorganisms. Results: No statistical significance was observed in the survival fraction of colonies ($p>0.05$) when the microorganism was cultivated in different culture media. Nonetheless, when the irradiance reached 1.058 J/cm2, there was a statistical and biological difference in the number of microorganisms in both culture media ($p<0.05$). The spectroscopy and fluorescence microscopy results indicated the presence of endogenous porphyrins produced by microorganisms regardless of the culture medium used.

Promising laser devices for optical communication, reliability, high-speeds and stability

Salam Nazhan*
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At present, optical communications (OC), either free space or fibers, are using laser beams as a carrier for transmission signals through communication channels. This field of study has become substantially interesting in research paper topics in the last few years. Therefore, the investigation of OC based on laser beams gives more attention than ever in the research field. Free space optical communication (FSO) is concerned with data transmission through the atmosphere from one point to another using visible or invisible light to get a network connection. Optical sources or laser sources are utilized in such communication systems; it's the key components to enable high-speed data transmission, reliability and stability of the OC system. Laser sources offer advantages in bandwidth and speed for FSO applications over traditional communications systems. Lately, the laser beam has increased the wireless capacity of 5G services and beyond for future applications. Recently, underwater OC based on laser devices has also given a broad interest in applications. Normally, FSO communication uses the wavelength range from short to long, from 700 nm to 1600 nm, because the wave optical energy that travels through the atmosphere has comparable properties at the visible and near-IR wavelengths. However, shorter and longer wavelengths of laser beams are also being considered for specific applications. The wavelengths between 780-850 nm are the most popular and widely used due to readily available and inexpensive components, which have an attenuation of less than 0.2 dB/km. The semiconductor laser diode applications employ high pump sources, like edge emitting lasers (EELs), which are the dominant and traditional source. However, EELs are too costly, requiring optical fiber coupling, which results in additional power loss. Therefore, attention has focused on vertical cavity surface emitting lasers (VCSELs) devices with potentially low manufacturing costs for various applications, including OC systems. VCSEL is a semiconductor laser with a resonant cavity vertically formed on the surfaces of the epitaxial layers. VCSELs gained a reputation as a superior technology for applications such as Gigabit Ethernet and intra-systems, FSO communications, optical fiber communications, and optical recording. Furthermore, VCSEL with external optical feedback has become a hot security topic due to its encryption capabilities and is extremely popular in wide applications in modern communication. These brief words highlight the topic and contribute to developing knowledge in a field of study.

Biography

Salam Nazhan currently works at Diyala University as an Assistant Professor in the Department of Communication, college of engineering. He received the BS and MS degrees in physics, and electronics physics from Al Mustansiriya University, Baghdad, Iraq, in 1998 and 2005, respectively, and the Ph.D. degree in optoelectronics from Northumbria University, Newcastle, the United Kingdom, in 2016. Prior to attending the Optical Communications Research Group at Northumbria University, he worked as a researcher with the optoelectronics group at Bangor University, Wales, UK, for around one year, from 2011 to 2012. His research focuses on the characterization of lasers for free-space optical communications, particularly vertical-cavity surface-emitting lasers (VCSELs) devices. He published many research papers in the top journals in the field and several conference papers. He also presented his research at several international conferences and events worldwide.

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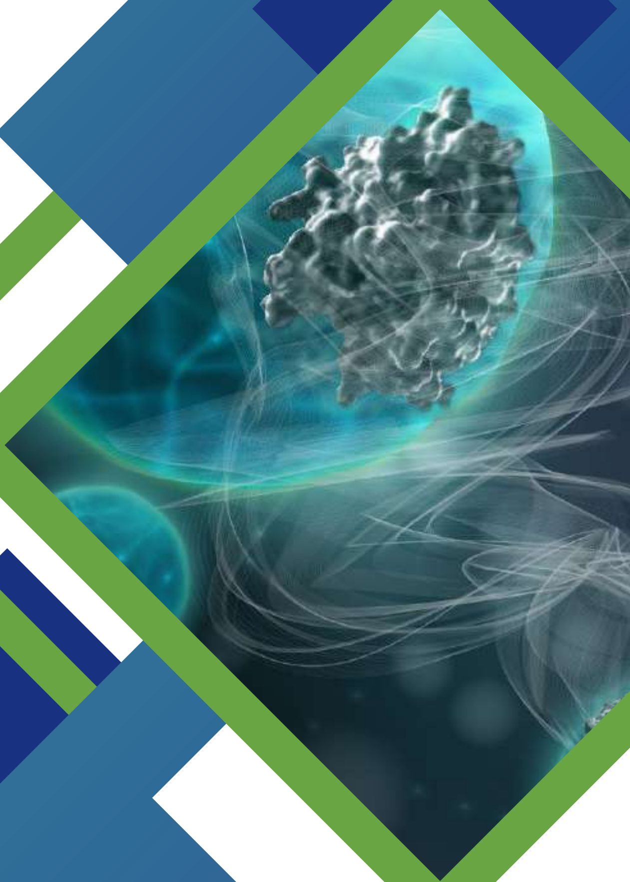

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Nanotechnology 2022

The investigation of photocatalytic properties ofNi0.8CO0.2/Zn0.4Cd0.6S/g-C3N4as a nano-photocatalyst for pollutants, degradation, and H2 generation by water splitting

Fatemeh Sousani
Sharif University of Technology, Iran

Graphitic carbon nitride (g-C_3N_4) is a promising metal-free visible-light photocatalyst due to its strong visible light response, high thermal and chemical stability, and available low-cost raw materials. This substance has gained significant attention for the degradation of pollutants and photocatalytic water splitting for H_2 production under visible light. Nevertheless, due to the relatively large band-gap, low charge-carrier mobility, and thus limited effective use of sunlight, the photocatalytic hydrogen evolution efficiency of pristine g-$C_3N_4$is still unfavorable. Several strategies, such as morphological control of g-C_3N_4, creating heterojunctions with semiconductors, and doping with other elements have improved its photocatalytic efficiency. This study's aim is to improve the photocatalytic performance of g-$C_3N_4$for degradation of pollutants and hydrogen evolution by creating $Ni_{0.8}Co_{0.2}/Zn_{0.4}Cd_{0.6}S$/g-$C_3N_4$ nano-photocatalyst that makes it more effective under visible-light irradiation. Here, $Ni_{0.8}Co_{0.2}/Zn_{0.4}Cd_{0.6}S$/g-$C_3N_4$nano-photocatalyst is produced via a facile hydrothermal and chemical reduction method. Then, the morphology, structural, optical, and photocatalytic properties of the nanohybrid were characterized by field emission scanning electron microscope (FE-SEM), X? ray diffraction (XRD), Brunauer–Emmett–Teller (BET), UV? vis diffuse reflectance absorption spectra (DRS) and photoluminescence (PL). With the formation of $Ni_{0.8}Co_{0.2}/Zn_{0.4}Cd_{0.6}S$/g-$C_3N_4$, the bandgap energy of the g-C_3N_4 decreases from 3.01 to 2.77 eV, and the absorption edge increases from 412 to 448 nm. The $Ni_{0.8}Co_{0.2}/Zn_{0.4}Cd_{0.6}S$/g-$C_3N_4$absorption edge is located between g-C_3N_4 and $Zn_{0.4}Cd_{0.6}S$ and has a stronger visible light absorption compared to g-C_3N_4 and $Ni_{0.8}Co_{0.2}/Zn_{0.4}Cd_{0.6}S$ in the range of 410 to 620 nm. The performance of the $Ni_{0.8}Co_{0.2}/Zn_{0.4}Cd_{0.6}S$/g-$C_3N_4$nano-photocatalyst in the removal of methylene blue (MB)from an aqueous solution can be used as a basis for its proper performance for water splitting and H_2 production too. Photocatalytic degradation of methylene blue in an aqueous solution was carried out under an LED lamp (100 W, 400-700 nm) illumination for 120 min. It was found that the degradation efficiency of methylene blue was 96% within this period. Thus, the $Ni_{0.8}Co_{0.2}/Zn_{0.4}Cd_{0.6}S$/g-$C_3N_4$nano-photocatalyst can act as a potential photocatalytic material for the degradation of pollutants and production of hydrogen under visible light.

Laser-induced thermotherapy as minimally invasive treatment for hepatocellular carcinoma

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Hepatocellular carcinoma (HCC) is the most common primary tumor of the liver and one of the most common malignancies worldwide. Depending on the tumor stage, there are many treatment options for HCC, such as liver transplantation, surgical resection, and locoregional treatments. These locoregional treatments are various and include Transarterial chemoembolization (TACE)as well as thermal ablation such as radiofrequency ablation (RFA), microwave ablation (MWA), and laser-induced thermotherapy (LITT).

LITT has unfortunately been less investigated compared to other thermo ablative therapies. This makes the study unique and exciting, especially due to the many examined parameters. The aim of this study was to retrospectively evaluate the MR-guided LITT in the treatment of HC according to treatment response, survival rates, and complications. This study enrolled 53 patients (12 women and 41 men; mean age: 67.5 ± 8 years) with 75 HCC lesions. All sessions were performed in analgosedation and as an outpatient procedure. The included cases were investigated the based size of tumors, ablation time, technical success, size of the post-ablation area, complete ablation, complications, local tumor progression (LTP), intrahepatic distant recurrence (IDR), overall survival (OS), and disease-free survival (DFS). Therapy response was assessed using contrast-enhanced MRI.

A total of 76 LITT sessions were performed. The mean pre-ablation axial diameter of the tumor was 2.4 ± 0.9 cm. Technical success was achieved in all sessions. The mean diameter of the ablation area was 5.3± 1.8 cm. The mean ablation time was 16.7±7.4 min. Complete ablation was achieved in 98.7% (74/75) of the treated tumors. The rates of LTP and IDR were 3.8% and 64.2%, respectively.

The 1-, 3-, and 5-year OS rates were 96.2%, 54.7%, and 30.2%, respectively. The 1-, 2-, and 3-year DFS rates were 54.7%, 30.2%, and 17%, respectively. There were no treatment-related deaths or major complications among the patients. The rate of minor complications was 7.9% (6/76). LITT is safe and effective as a local treatment for HCC, which can be performed in a short time, and as an outpatient procedure without the requirement of general anesthesia. HCC patients treated by LITT had a high OS time and a low rate of LTP.

Theranostic characterization of breast cancer treated with nanoprobes and thermal ablation therapy

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Cancer is a problem for public health, and new types of therapies have been studied. Among them, Photo thermal Therapy (PTT) has been investigated in recent years, primarily as a non-invasive cancer treatment with fewer side effects for patients. Heat energy is produced when iron or gold nanoparticles are irradiated in the near-infrared range (700-1000 nm), which can start the death process for a specific cell because tumor cells have a lower heat tolerance than normal ones. SPIONs@Au are multifunctional core-shell nanoparticles with an iron core that improve the material's chemical, physical, and optical capabilities. In this context, we investigated the synthesis and characterization of Au@SPIONs, as well as the surface functionalization with EGF-α-lipoic acid (increasing specificity for cells with EGFR overexpression) and chlorin e6 (Ce6)-cysteamine complexes, composing a theranosticnanoprobe (TP). The Confocal Fluorescence Microscopy evaluated TP internalization in the triple-negative breast cancer (TNC) cell line, which has a poor prognosis. Also, PTT was performed associated with Au@SPIONs and TP. The technique's effectiveness was determined by flow cytometry, labeling viable, apoptotic, and necrotic cells. The results, SPIONs@Au, showed a color change to red and the presence of an absorption band centered at 530 nm. The Ce6-cysteamine complex was formed efficiently, having a resonant band at 670 nm, allowing the diagnosis in biological samples via fluorescence. Internalization of the TP in the cell cytoplasm was confirmed, indicating that it might be used as a diagnostic marker. The PPT in TNC produced positive outcomes, with an apoptosis death preponderance. Aside from that, the functionalized ce6 complex permits Photodynamic Therapy to be used, broadening various uses.

Metabolic insertion of Titanium into the 3D structure of diatomaceous biosilica

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In the development of modern technologies, microorganisms, mainly unicellular algae (microalgae), are the growing inspiration due to their abundance and unique properties [1]. Microalgae can synthesise phenomenal mineral composites under natural conditions (calcium carbonate, silica) with complex hierarchic structures. The intricately ornamented silica shells known as frustules are a unique feature of diatom cells. The siliceous walls of frustules are perforated by periodic arrays of pores with diameters ranging from nano- to microscale forming openwork three-dimensional (3D) silica structures [2]. Obtaining such structures of inorganic materials is one of the main challenges in developing new materials and devices. According to published works, the diatomaceous biosilica characterized by perfectly ordered3-D structure, thermal and mechanical stability, unique optical properties, and biocompatibility [3]can be a valuable resource for applications in modern technologies for the production of optoelectronic devices, biosensors, gas sensors, catalysts, adsorbents, efficient filters, semiconductors, solar cells, templates for nanolithography, drug carriers or building material in the synthesis of bone implants [4,5].

This study's main aim was to evaluate the diatom species Pseudostaurosiratrainorii to metabolically insert soluble titanium from a culture medium into the structure of their amorphous silica cell walls by the cultivation of selected diatom species under laboratory conditions. The culture of diatom species was cultivated using Erlenmeyer flasks (3000 ml) with Guillard'sF/2 growth medium with soluble titanium concentrations ranging from 2.5 mg/l to 90 mg/l and soluble silicon concertations ranging from 1.2 mg/l to 500 mg/l. The morphological and structural features, elemental composition, structure, photoluminescence properties, and thermal stability of the obtained biosilica were examined using a set of techniques comprising scanning electron microscopy, transmission electron microscopy, photoluminescence spectroscopy, IR spectroscopy, X-ray powder diffraction, and thermogravimetry. The figure shows some of the absorbing and compelling results obtained from doping diatomaceous silica with titanium ions.

POSTER PRESENTAIONS

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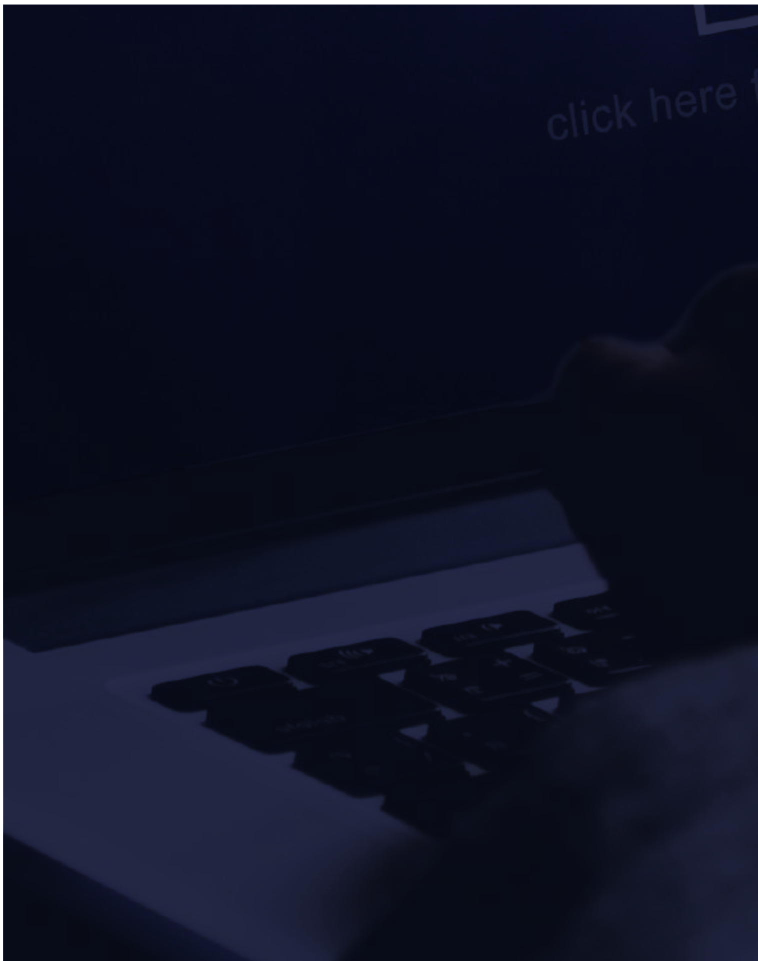

Analysis of the diagnostic potential of nanosensors in breast cancer 3D tumor

Paula Fonseca Antunes Vieira[1*], Viviane Paula dos Santos Jesus[1], Marcela Aparecida Cândido[1] and Leandro Raniero[2]

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Over expression of the Epidermal Growth Factor Receptor (EGFR) has been associated with malignancies with a worse prognosis, and the EGF protein activates its signaling pathways, which regulate cellular functions. As a result, the EGFR receptor is being investigated for a wide range of tumor diagnostics, encouraging the development of novel methods to improve quality and efficiency. Nanomaterials can recognize cancer cells by targeting certain biochemical pathways, highlighting nanomedicine's potential. Three-dimensional (3D) cell culture has arisen as an alternative to in vivo experiments for the formation of a heterogeneous microenvironment and the representativeness of the cellular mechanisms present in malignancies. Cell-cell and cell-extracellular matrix interaction is enhanced in 3D cell culture, preserving tissue shape and structure. In this regard, among the several types of 3D environment development that are conceivable, micro molded agarose allows large-scale reproducibility. In this study, breast cancer spheroids were created on micro molded agarose by the MDA-MB-468 strain. By functionalizing the EGF protein and Chlorine e6 (Ce6) in gold nanoparticles, the nanosensors were synthesized and applied to the spheroids for the detection of EGFR. The EGF protein is delivered to the EGFR receptor through active targeting, and Ce6 serves as a fluorescent flag molecule. The tumors were cultivated for 21 days after being cast in 2% agarose molds. Flow cytometry was used to detect the presence of fluorescence and the cell death pathways after the nanosensors were applied. Annexin V (AnnV) and propidium iodide (PI) staining were used to assess cell death pathways in viable (AnnV- PI-), apoptotic (AnnV+ PI-), and necrotic (AnnV+ PI+) cells. The characterization of this tissue reveal the presence of fluorescence and the absence of substantial apoptosis and necrosis deaths.

Synthesis and analysis of InP-based core/shell quantum dots using phosphine carboxamide as a novel phosphide precursor

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Quantum dots (QDs) are now the most widely used nanomaterial for optical imaging, with a broad range of colours commercially available. Indium phosphide (InP) based QDs are a prospective replacement to the II-VI family of nanoparticles (NPs), particularly the cadmium (Cd) based ones currently used in the industry. InP-based QDs maintain good photoluminescence while being non-toxic, unlocking QD's potential for clinical uses. In the past few decades, the choice of phosphide precursors in the synthesis of InP-based QDs has been restricted to tris(trimethylsilyl) phosphine and tris (dimethyl amino) phosphine. Still, both are air-sensitive and must be dissolved in stock solutions prior. This research synthesised InZnP/ZnS core/shell QDs in a one-pot reaction using a novel air-stable precursor – phosphine carboxamide –by our collaborator from the University of Oxford.

The full emission width at half maximum (FWHM) was found between 60 and 80 nm, although no attempt was made to narrow this. From TEM images, the particle diameters measured were 3.0 ± 0.1nm for the core InZnP QDs and 3.9 ± 0.2 nm for the InZnP/ZnS core/shell QDs. Its size and emission wavelengths are tuneable by adjusting the ratio of precursors and/or the reaction time. The quantum yields (QYs) for InZnP/ZnS core/shell QDs were found to be 36.28% without any shell modification, such as HF etching. By applying the polymer encapsulation nanocrystal phase transfer technique using poly (styrene-co-maleic anhydride) (PSMA, 1700 g/mol) and ethanolamine (EA), the amphiphilic polymer/QDs formed have QYs at 28.32%. It can now be dissolved in water, opening up possibilities for clinical applications.

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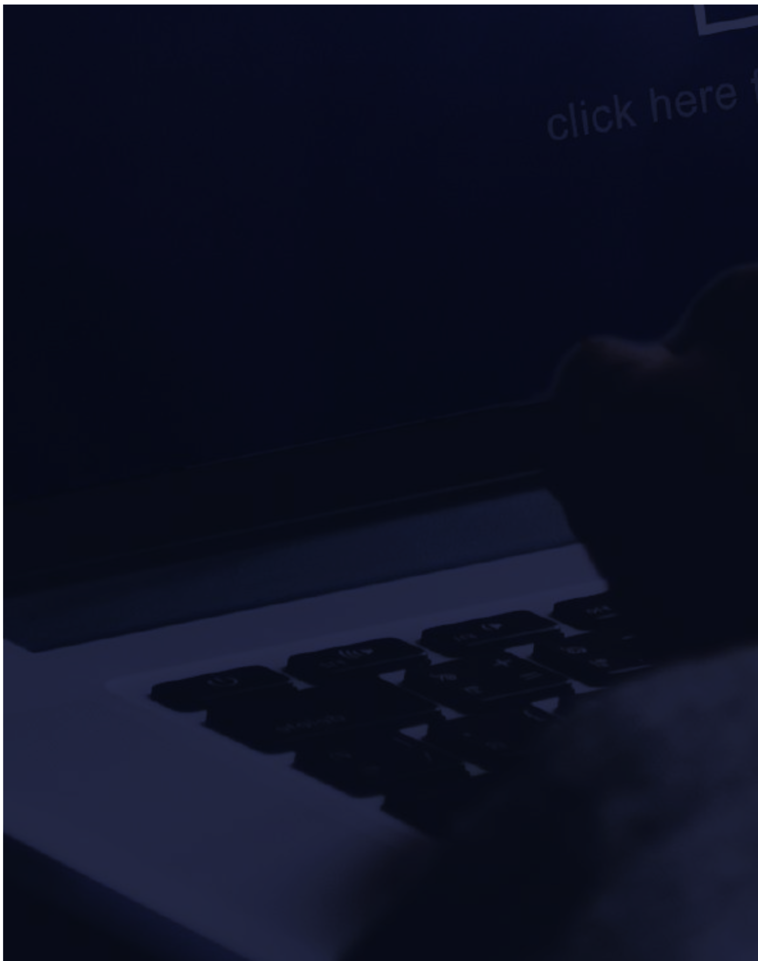

Adjuvant effect of Photobiomodulation in the treatment of incontinence-associated dermatitis in adults – A blinded randomized clinical trial

Adriana da Silva Magalhães*, Anna Carolina Ratto Tempestini Horliana, Ana Lucia Capucho Lorena Abrahão, Mitsue da Silva Hatanaka, and Sandra Kalil Bussadori

University Nove de Julho (UNINOVE), Brazil

Incontinence-associated dermatitis (IAD) is an inflammation of the skin that occurs as a result of urine or feces contact on the perineal or perigenital region in adults. Lesions are typically located in the convex regions covered by diapers. The perineal region is the most affected, bringing pain and discomfort to the patient. The prevention and treatment of IAD must essentially follow two interventions: the control of incontinence/dampness and the implementation of a structured regimen of perineal care, seeking results for restoring skin integrity. Therefore, the gold standard for treating IAD is skin hygiene, moisture control, and using a skin protector to restore skin integrity. Photobiomodulation has been used with excellent results in restoring skin integrity in acute and chronic wounds, but so far, it has not been tested for IAD. To evaluate Photobiomodulation's effect in treating incontinence-associated dermatitis in adults. A controlled, randomized, and blinded clinical study will be carried out on patients hospitalized in the Intensive Care sector, oncology, and coronary care unit of Hcor Associação Beneficente Síria. Patients who developed lesions that present erythema with intact skin and erythema with loss of continuity resulting from IAD will be included in the study. Participants will be randomly divided into 2 groups: Control group (n=39) - use of liquid protective film in spray + FBM simulation (placebo), Experimental group (n=39) - use of liquid protective film in spray + FBM. FBM will be performed with a 660 nm 100mW diode laser, 2 J per point, in 8 points, and radiant exposure of 707 J/cm2. FBM will be applied once every 24 hours for 3 days in a row. Both groups will continue with standard daily skin care and diaper changes every 3 hours. The primary endpoint was chosen for the 7-day IAD lesion cure rate study. A photographic record of the lesion area and measurements will be performed using a disposable ruler with the patient in a lithotomous position on the days of the evaluations. For the classification and characterization of the severity of IAD, the Ghent Global IAD Categorization tool will be applied. In addition, the size of the area will be analyzed using ImageJ software program. For pain assessment, the visual analog scale will be used in conscious patients and the BPS scale in patients with cognitive impairment and who are intubated. In adults with cognitive impairment, periods of confusion and dementia, the Pain Assessment in Advanced Dementia- PAINAD scale will be used, which has pain intensity from 0 to 10. All outcomes will be evaluated at baseline, at 24 hours, 3 days, and 7 days.

Evaluation of the effectiveness of antimicrobial photodynamic therapy and deproteination on permanent teeth with molar incisor hypomineralization (MIH) and the association with the longevity of restorations: Controlled blind clinical trial

Amanda Mandetta

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Molar incisor hypomineralization (MIH) is a qualitative defect of enamel development in the mineralization phase. It affects one or more first permanent molars and is often associated with permanent incisors. Patients with MIH have an increased risk of caries, hypersensitivity, and failure of restorations. The objective of this research will be to evaluate the clinical effect of antimicrobial photodynamic therapy (aPDT) on permanent teeth with HMI to promote decontamination and longevity of restorations through deproteinization. Patients aged 6 to 12 years will be randomly divided into three groups. The teeth must present carious lesions in dentin, with a post-eruptive fracture on a single surface or multiple surfaces and indicated for restorative clinical treatment. The selective chemical-mechanical removal of the caries lesion will be carried out with PapacarieTM (F&A) applied to the carious dentin and adjacent demarcated opacities for deproteinization and photodynamic therapy with the use of low power laser and 0.005% methylene blue as a photosensitizer with a pre-irradiation time of 3 minutes (GROUP 1); Selective removal of carious tissue, photodynamic therapy with the use of low-level laser and 0.005% methylene blue as photosensitizer will be performed, with a pre-irradiation time of 3 minutes and deproteinization with 5% sodium hypochlorite (GROUP 2); Selective removal of carious tissue will be performed with a dentin curette (GROUP 3). Subsequently, the teeth will be restored in the mixed technique with resin-modified glass ionomer cement, and bulk fill composite resin. The effects of photodynamic therapy on decontamination (microbiological analysis), post-treatment sensitivity (VAS and SCASS Scale), and deproteinization on restoration longevity (modified USPHS Index) will be evaluated every 3 months for 12 months. The data obtained will be subjected to descriptive statistical analysis to assess the association of categorical variables in age and gender; the Chi-square and Fisher's Exact test will be used to analyze the correlation between continuous variables, and Pearson's correlation test will be applied. ANOVA and Kruskal-Wallis will be applied for the colony forming units' microbiological results.

Comparative study of antimicrobial Photodynamic Therapy (aPDT) with and without Sodium Dodecyl Sulfate (SDS) for biofilm inactivation of Aggregatibacter actinomycetemcomitans

Ana Carolina A.C.Tortamano*, Ranato Araujo Prates, Fabiana Divina Magalães, Christiane Pavani, and Ketlyn Stefany Rost de Lima

Universidade Nove de Julho, Brazil

Aggregatibacter actinomycetemcomitans is a facultative anaerobic Gram-negative bacterium associated with periodontal disease. Antimicrobial photodynamic therapy (aPDT) aims to produce reactive oxygen species to decrease microbial infection as an adjunct intervention to mechanical periodontal treatment. It has been shown that sodium dodecyl sulfate (SDS) can improve aPDT results by increasing the formation of methylene blue (MB) monomers. This study aims to compare the behavior of aPDT mediated by methylene blue in phosphate buffered solution (PBS) and with sodium dodecyl sulfate (SDS) in the bacterial killing of A. actinomycetemcomitans. The biofilm will be grown on bovine dental samples, and aPDT will be performed on them. Microbiological evaluation, scanning electron microscopy, and verification of the formation of reactive oxygen species will be carried out.

For this, 2 groups will be created: PBS Group and SDS Group; and 6 subgroups: Control (not treated with laser or photosensitizer); FS (exposure to MB 100 µM photosensitizer for 1 min); Laser, irradiated for 5 min in the absence of FS; and three aPDT subgroups, with three exposure times of 1, 3 and 5 min of irradiation. A laser (Photon Lase III, DMC, São Carlos, Brazil) with a wavelength of 660 nm, output power of 0.1 W, well irradiation of 250 mW/cm2, and energy of 6, 18, and 30 J will be used. Corresponding to the time of 60, 180, and 300s and radiant exposure of 15, 45, and 75 J/cm2. Subsequently, microaerophiles will be cultured, counted, and converted into colony-forming units per mL for analysis and comparison.

Effect of photobiomodulation on salivary flow, immunoglobulin and PH level in individuals with xerostomia: Clinical trial controlled and randomized

AnaCarolina Barros

Horliana ACRT, Bussadori SK, dos Reis HRLR, and Motta LJ

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Saliva is directly related to oral health and homeostasis, and therefore, the occurrence of caries, periodontitis, fungal and bacterial infections can affect and compromise the population's quality of life. Changes in salivary parameters, such as decreased flow, changes in pH and composition, can lead to changes in oral health, and prevention and treatment strategies need to be studied and developed. Studies using photobiomodulation have shown promise in the improvement of some salivary parameters. The aim of this study is to compare the effect of photobiomodulation with infrared laser protocols and modified ILIB therapy on the salivary parameters of adults affected by drug xerostomia. The sample will be composed of 30 adults, with healthy teeth, between 18 and 45 years of age, who will be divided into 2 groups, with 15 participants in each group. Each group will receive a type of light. Saliva will be collected, the volume will be measured and the salivary flow determined (ml/min). Salivary IgA concentrations will be measured in all samples. Infrared laser and modified ILIB will be applied to the determined group. Total saliva at rest will be collected before, immediately, 30 minutes and 7 days after the interventions. The applications of the lights will be in the regions of the parotid glands bilaterally, as well as in the region of the submandibular and sublingual glands for the infrared laser and in the wrist for irradiation of the radial artery for the modified ILIB group. Data will be analyzed using Analysis of Variance (ANOVA) and Pearson's correlation test (= 0,05). The Statistical Package for the Social Sciences (SPSS) (IBM Corp. launched in 2012. IBM SPSS Statistics for Windows, version 21.0. Armonk, NY: IBM Corp) version 15.0 will be used for all analysis.

Treatment of the gastrocnemius muscle myofascial pain syndrome in plantar fasciitis with Photobiomodulation: A study protocol

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Plantar fasciitis is the most common cause of inferior heel pain. The etiology of plantar fasciitis is still unclear but many authors proposed that the presence of myofascial trigger points (MTrPs) within gastrocnemius muscles proximal play an important role in plantar heel pain. Myofascial pain syndrome is characterized by trigger points in the muscle. The standard treatment is inactivation of trigger points through dry needling but photobiomodulation has been widely studied in treating musculoskeletal pain, including myofascial. In this sense, this study aims to evaluate the effect of photobiomodulation in treating myofascial pain of gastrocnemius muscles in patients with plantar fasciitis. A clinical, double-blind, controlled and randomized study will be carried out. This study is in accordance with the research ethics guidelines of the University's Research Ethics Committee. About 20 patients with plantar fasciitis associated with a gastrocnemius myofascial pain will be selected at the Orthopedics and Physiatry Service of the Goias Federal University. Those selected will be divided into two groups: one that will be submitted to dry needling (with acupuncture needle size 25x30) associated with Low-Level Laser Therapy (Laser Therapy XT, DMC brand, device power of 100mW, wavelength of 785nm, energy of 1J/cm2/point, applied in 04 points per muscle, during 40 seconds, three times a week for 12 sessions) and a second group in which dry needling will be used for under the same conditions as before, associated with placebo laser Therapy group (the same device turned off).The primary outcome will be evaluated by the application of the Visual Analogue Scale. The secondary outcome will be measured by the patient's functionality, through the Foot Function Index Scale, which will be applied before and after the intervention (on the last day of intervention and 4 weeks later). The data will be statistically analyzed and the results reported.

The use of photobiomodulation in treatment of fibromyalgia

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Fibromyalgia is a syndrome that occurs with complaints of chronic, generalized musculoskeletal pain associated with typical symptoms such as fatigue, sleep disorders, and cognitive disorders without known etiology, sometimes accompanied by headaches, paresthesias, and mood disorders, among other disabled complaints. Fibromyalgia is one of the most prevalent chronic diseases and causes of functional disability in the Brazilian public health system. Photobiomodulation therapy has often been used for pain management. It is presented as a non-invasive, low-cost, safe therapy that has benefits in relation to the intensity of pain and quality of life of patients. Besides, new systemic photobiomodulation techniques have been studied recently to promote light's effects on the immune system, pain, and systemic vascular, pulmonary, or musculoskeletal clinical conditions. Based on these premises, this study aims to investigate the clinical effects of transcutaneous vascular systemic photobiomodulation (VPBM) in treating patients with fibromyalgia. Methods: it will be a clinical, unicentric, randomized, controlled, blinded trial involving 44 patients with fibromyalgia in clinical follow-up at the Primary Care Health School, Vila Maria from Universidade Nove de Julho (UNINOVE), Brazil. This study is in accordance with the research ethics guidelines of the University's Research Ethics Committee. The patients will be randomly assigned to one of two groups: an intervention VPBM group (device power 100mW, wavelength 660nm applied transcutaneously at radial artery location during 100s, totaling 10 Joules in each session, 2X per week for four weeks) or a placebo VPBM group (the same device turned off, also twice per week for four weeks). Both groups will also receive the standard treatment for fibromyalgia delivered by the rehabilitation health team of the hospital. The outcomes of pain, quality of life, and functionality will be statistically analyzed by comparing the placebo and treatment groups in pre and post-therapy moments with the Visual Analogue Scale of Pain (VAS), the Brazilian Version of the SF 36 Quality of Life Scale, and the Brazilian Version of the Fibromyalgia Impact Questionnaire (FIQ). The data will be statistically analyzed, and the results reported and discussed.

Photobiomodulation applied to the treatment of spasticity in children diagnosed with spastic infantile cerebral palsy

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Cerebral palsy syndrome implies permanent movement and posture disorders in childhood. Its etiology is related to an insult or damage to the central nervous system during the prenatal, perinatal, or postnatal period when the central nervous system has not yet fully developed. Approximately 80% of all individuals with cerebral palsy will be spastic, and this spasticity, untreated for a long time, generates anatomical and structural changes in bones, joints, muscles, tendons, and nerve junctions, with1 an impact on the quality of life, social participation, and physical function of this individual. Photobiomodulation therapy (PBM) has biological effects of tissue regeneration, reduction of the inflammatory process, and relief of pain symptoms, in addition to being feasible, safe, painless, and non-invasive. Objectives and methods: This study is a double-blinded, randomized, controlled clinical trial to evaluate the effect of photobiomodulation in reducing gastrocnemius muscle spasticity in 20 children aged between 2 and 18 years, diagnosed with lower limb spastic cerebral palsy from any etiology at least 03 months, selected at the Rehabilitation Service of the Universidade Nove de Julho Campus Vila Maria and randomized at two groups: the application of Low-Level Laser Therapy in the medial and lateral right gastrocnemius muscles (device power of 100mW, wavelength of 785nm, energy of 1J/cm(2)/point, applied in 04 points per muscle, during 40 seconds, three times a week for 12 sessions) or placebo Low-level Laser Therapy group (the same device turned off). Patients with fixed anatomic ankle deformity, malnutrition, severe gastroesophageal reflux disease and other kind of movement disorder will be excluded. Both groups will also receive the standard treatment for spasticity delivered by the rehabilitation health team of hospital. To assess the response to therapy, the primary outcomes will be evaluated by the modified Ashworth Scale, the Functional Independence Measure (WeeFIM) for children, the Visual Analogue Scale (VAS) for pain and passive and active ankle range of movement analyzed before and after the therapeutic session. The data will be statistically analyzed and the results reported and discussed. This study is in accordance with the research ethics guidelines of the University's Research Ethics Committee.

Natural killer cell cytotoxicity in oral squamous cell carcinoma cell lines after photodynamic therapy

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Statement of the problem: Oral squamous cell carcinoma (OSCC) is an aggressive neoplasm with high rates of relapse. Photodynamic therapy (PDT) is a promising therapy for treating oral tumors in the early stages. However, its effectiveness is limited in the absence of T and NK (Natural Killer) cells. Thus, the objective of this study was to evaluate in vitro the cytotoxicity of NK cells after PDT.

Methodology: The OSCC cell line CA1 was incubated with 5-ALA (1 mM) and exposed to different radiant exposure to determine the sublethal PDT dose for the cytotoxicity assay. Thus, cells were divided into the following groups: Control, 5-ALA, LED, and PDT. Cellular viability was evaluated by the MTS assay. After 12h and 24h of treatment, cells from all groups were submitted to the Calcein-AM release assay using the NK92-MI cell line as effector cells in different concentrations.

Findings: Ca1 cell line viability was reduced in all radiant exposures evaluated, and the sub-lethal dose of PDT was observed with 3J/cm2. After 12h and 24h of PDT, no difference in NK92-MI cytotoxicity was noticed in all groups evaluated.

Conclusion & Significance: PDT was able to decrease OSCC cellular viability at different radiant exposures. However, it seems not to increase the cytotoxic potential of NK92-MI cells against OSCC. Further studies considering 3D models and the tumor microenvironment are needed better to understand the effects of PDT on NK92-MI cells.

Nonionic and anionic polymers affect methylene blue aggregation in formulations for antimicrobial photodynamic therapy

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Statement of the Problem: Methylene blue (MB) is a cationic phenothiazinium dye with interesting properties for application in antimicrobial photodynamic therapy (aPDT). The aggregation state directs the mechanisms of action, which means that type I or II oxidative reactions can be favored according to the medium in which MB is conveyed (1,2). The purpose of this study is to develop MB formulations associated with polymers for aPDT, considering the optimization of rheological properties and dimer-to-monomer ratio (D/M), and aims to bring improvements in clinical applicability.

Methodology & Theoretical Orientation: Hydroxypropyl methylcellulose (HPMC) and Carboxymethyl cellulose (CMC) were used, respectively, as nonionic and anionic polymers to reach a viscosity between 30 and 450 cP. The modulation of the MB aggregation state was evaluated in the presence or absence of the anionic surfactant sodium dodecyl sulfate (SDS). In triplicate, absorption spectra were recorded in a UV-Visible UV-1800 spectrophotometer (Shimadzu, Japan) from 250 to 800 nm using a 2 mm pathway cuvett Absorption values determined the D/Mues at 614 nm (dimer) and 662 nm (monomer). The D/M values underwent a logarithmic transformation and were statistically analyzed using the one-way ANOVA test, followed by the Tukey post-test, adopting α=0.05.

Findings: There was a lower D/M ratio with an increasing concentration of polymers in the absence of SDS, however with the addition of surfactant, there was a D/M reduction in formulations containing both polymers studied, with lower MB aggregation being observed in the formulation containing the anionic polymer CMC when compared to the nonionic polymer HPMC.

Conclusion & Significance: The addition of SDS to the medium in which the photosensitizer was conveyed, and the ionic charge of the polymer influenced the MB aggregation behavior. Further adjustments to this formulation will be necessary to control MB aggregation.

Effect of photobiomodulation on the salivary glands of patients with benzodiazepine-induced hyposalivation: A double-blind randomized placebo-controlled clinical study

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Depression is the most common mental illness, and antidepressants are the first line of treatment for depressed patients. This therapeutic class is inevitably associated with side effects and adverse reactions, xerostomia being a symptom that seems to be transverse to them all. Saliva performs multiple functions and plays a vital role in protecting the health of the soft and hard tissues of the oral cavity. Reductions in salivary flow are often manifested as dry mouth, which is the subjective complaint called xerostomia. Although xerostomia is the most frequent indication of reduced salivary production, it is not invariably associated with hyposalivation. The user of antidepressant drugs has a number of significant systemic and oral complications. Treatment for salivary changes remains unknown, but low-level laser therapy is effective in improving salivary flow in patients with xerostomia due to diabetes, Sjogren's syndrome, chemotherapy, and radiotherapy for head, neck, and lung cancer. This randomized controlled trial aims to evaluate oral symptoms related to salivary gland function and mucosal condition of depressed patients, as well as the effects of photobiomodulation on salivary flow. Sixty patients will be included in the protocol after signing the Informed Consent Form. They will undergo anamnesis, physical evaluation, and oral health self-perception questionnaires and symptoms related to salivary gland function and then will be divided into two groups: Photobiomodulation (PBM) (n=30); will have their larger salivary glands irradiated with Diode laser (808nm, 4J per point, the 40s) and placebo (PCB) (n=30), which will be subjected to a simulation, where the application protocol will be repeated, but with the laser off. Previous and post-treatment sialometries will be performed to compare saliva volume. Biochemical analysis will also be performed in which total protein and calcium will be measured.

Evaluation of the treatment of infectious endocarditis with aPDT and trans-thoracic irradiation in an animal model: A study protocol

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Endocarditis is an infection caused by an opportunistic bacterial that migrates to an injured endocardial. It affects 3-10/100,000 people every year, with a 30% of mortality rate. *Staphylococcus* is the most frequent and destructive microorganism that causes this disease. Usually, bacteria originate in an infection on another site. Usually, the teeth travel through the blood flow and populate damaged areas of the myocardial, such as prosthetic valves, promoting vegetation and tissue damage.

This protocol aims to evaluate the usage of antimicrobial Photodynamic Therapy with transthoracic irradiation and Methylene Blue in the treatment of Infective Endocarditis in an animal model.

The induction of endocarditis, a catheter will be introduced in the carotid artery through surgery to produce a slight injury to the myocardium. After two days, the animals will be infected with *Staphylococcus Aureus*. An echocardiogram and hemogram will be used to confirm the infection, after which the Methylene Blue will be administered diluted in drinking water one hour before the irradiation procedure. The three study groups are as follows: 1: control infected group; 2: aPDT group with a single treatment; and 3: aPDT group with 5 consecutive treatments (5 days). Each irradiation will be performed for 20 min with 800 mW LED emitting at 630 nm (342 J/cm2 at the surface of the rat's thorax). Survival fraction, as well as microbiological and imaging analysis, will be performed in all groups. With this procedure, we expect to increase the survival rate of the subjects.

Evaluation of the photodynamic effect mediated by methylene blue delivered in surfactant medium used as an adjuvant treatment to endodontic retreatment in the eradication of micro-organisms from previously filled root canals: Clinical test, randomized, controlled and double-bound

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Endodontic infection is defined as the invasion and multiplication of microorganisms in the dental pulp, responsible for pulp and periapical pathologies that occur when microbial persistence occurs in the root canal system. Among the currently known endodontic retreatment methods, manual and mechanized retreatment, associated or not, and the use of solvents and intracanal medications can be mentioned. As these techniques are similar, the level of failure in retreatment is high. In this sense, antimicrobial photodynamic therapy (aPDT) is an adjuvant in endodontic retreatment. It is a non-invasive technique that uses a photosensitizer and a light source to form reactive oxygen species that cause bacterial death. However, the main limitation of the technique is the formation of dimers that reduce the effectiveness of the therapy. On the other hand, sodium dodecyl sulfate (SDS) showed the ability to reduce this dimerization effect. Therefore, the objective of this study will be to evaluate the photodynamic effect of methylene blue delivered in SDS at 0.25% for treating patients with chronic periapical periodontitis to eradicate persistent microorganisms in previously filled root canals. The methodology will cover a sample of 30 patients with unsatisfactory endodontic treatment with chronic periapical periodontitis. These patients will initially undergo mechanized endodontic retreatment. After that, they will undergo treatment with photodynamic therapy. Patients will be randomized and divided into 03 groups, as follows: 1) mechanized endodontic retreatment (REM) and aPDT with methylene blue (n=10); 2) REM and aPDT with methylene blue in 0.25% SDS (n=10) and 3) REM with placebo irradiation (n=10). Microbial counts will evaluate microbiological results before and after treatment and clinical findings by the absence of symptoms and radiographic parameters. Data will be treated statistically for comparison between groups. As a primary outcome, a reduction in intracanal microbial load is expected.

Use of photobiomodulation on pre-dental anesthesia and its effects on anesthetic efficacy

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Phobias and the general fear of dental procedures are both prevalent worldwide, with local anesthesia being one of the most feared by patients. For this reason, several complementary therapies have emerged to reduce the pain caused by the insertion of the needle and the need for repetition. Still, so far, there is no defined protocol. Recent studies have shown that Photobiomodulation (PBM) effectively controls pain and increases local microcirculation; these effects can help local anesthetic absorption, enhancing its development and decreasing the pain of the puncture. However, further evidence is needed due to the scarcity of well-designed studies on this topic. This study will aim to evaluate the ability of PBM to reduce puncture pain and increase local anesthetic effectiveness when used as a pre-anesthetic therapy. Accordingly, 50 subjects will participate in this double-blind, randomized controlled trial. The control group will be submitted to the standard anesthetic technique. The experimental group will have an infrared laser (100mW at 808nm, 9J at a single point) applied to the place where the puncture will be performed immediately before anesthesia. The pterygomandibular technique will be conducted the same way in both groups by the same operator. The outcome assessor and the patient will be blinded to the application of PBM. The study's primary outcome will be a pain at the time of puncture, assessed using the visual analogue scale (VAS) at the time of needle insertion. Secondary outcomes will be evaluated: anxiety through the Beck questionnaire and anesthetic latency through the electric pulp test (timed until the onset of anesthetic action). Additionally, the amount of anesthetics needed to perform the procedure and the need for complementation will also be computed.

Home-based photobiomodulation in the rehabilitation of patients with chronic physical impairments: A systematic review

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Sensorimotor impairments are the main sequelae of chronic and/or degenerative disorders that affect the neuromuscular and musculoskeletal systems and require intervention and specialized care to limit disability, functional rehabilitation and improve the quality of life of these patients. Many muscular and/or neurovascular diseases, such as osteoarthritis and fibromyalgia, lymphedema, or neurological sequelae, could produce chronic impairment and/or disabilities. As a result, during long-term follow-up, intra-hospital rehabilitation treatment can determine low adherence, high costs, and mobility difficulty. Domestic treatment could reduce costs, improve satisfactory results, and improve the quality of life of the population. It is especially important because COVID-19 highlights the urgency of using the home environment for the continuity of health care. In this sense, this study is a PRISMA systematic review to discuss whether home-based photobiomodulation is a safe and effective technique in treating patients with chronic physical impairments. We are interested in evaluating the changes in symptoms, functionality, and quality of life of patients with chronic impairments using home rehabilitation with photobiomodulation therapies. Our protocol was registered on the prosperous website before data extraction by No. CDR42022326588 and followed the Prisma guidelines. Clinical trials, case reports, guidelines, and observational studies evaluating the use of PBM in patients with chronic impairments of any etiology will be analyzed, and available data about the quality of life, functionality, or degree of independence will be reported. The chosen tools for quality analysis of the included studies depend on the design of the data source. We intend to use the Cochrane risk-of-bias tool (RoB 2) for randomized trials, Cochrane Robins-I for non-randomized trials, and the CARE Tool for case reports. In addition, we will use the WALT recommendations to analyze the PBM parameters. If a minimum of two studies demonstrate population, stimulation parameters, and outcomes homogeneity, we also intend to conduct a quantitative analysis of the extracted results (meta-analysis).

Analysis of pain after endodontic instrumentation of molars in a single session associated with photobiomodulation: A randomized double-blind controlled clinical study

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Randomized clinical trials conducted in recent years have shown that photobiomodulation modulates postoperative pain in endodontic instrumentation, especially in the first days after the procedure. Although the results are promising, there is still low quality of evidence regarding the best dosimetric parameter to be applied. The aim of this double-blind randomized controlled clinical study will be to evaluate the effect of photobiomodulation (PBM) in reducing postoperative pain after conventional endodontic treatment in maxillary molars. The sample will be composed of 58 participants endodontically treated in a single session and randomly distributed in PBM Group (n=29): conventional treatment + apical photobiomodulation (808 nm, 100mW power, 3J per point, 3mm2 area, 3 points - two vestibular and palatine, total energy of 9J) and Control Group (n=29): conventional treatment + simulation of photobiomodulation. As the primary outcome of the study, postoperative pain will be evaluated 24 hours after instrumentation with a visual analog scale (VAS). The secondary outcomes will be: pain, evaluated at 4h, 8h, 12h after the procedure; pain on palpation (buccal and lingual) and pain on percussion (vertical and horizontal) which will be analyzed 24h after the procedure; the amount of analgesics needed (paracetamol); and the impact of oral health on quality of life assessed by the OHIP 14 instrument.

Effects of photobiomodulation on the prevention of the skin pressure injury in patients with a diagnosis of COVID-19: a randomized, controlled, and double blind clinical study protocol

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Introduction: The high incidence of pressure injuries (PI) is considered a serious public health problem and a negative indicator of the quality of nursing care.

Objective: This study aims to verify the preventive effects of the use of photobiomodulation (FBM) in areas more susceptible to the development of PI in patients hospitalized with COVID-19.

Methods: This is a controlled, randomized, and blind clinical study including hospitalized participants with a risk of developing PI according to the Braden scale. Participants will be randomized into 2 groups: Group 1 - Control (n=70) in which the hospital's standard operating procedures for the prevention of PI will be performed; and Group 2 - FBM (n=70) the same procedures as the group control and also FBM will be performed once a day, for 10 minutes in each of the 3 regions most commonly affected by PI, that is, sacral and calcaneal (bilaterally). The FBM will be performed using a plate with 132 LEDs of 660nm and 132 LEDs of 850nm (each LED has P=8 mW; E=4.89J, radiant exposure= 9.6 J/cm2; irradiance 16 mW /cm², 10 min). The incidence of PI will be evaluated every 48 hours after hospital admission for a period of 1 month or until hospital discharge if it occurs before this period. The time of onset of PI will also be evaluated, and the possible correlations of anthropometric data measurements and incidence of PI. The data will be statistically evaluated.

Effect of vascular photobiomodulation (ILIB) on sleep quality, relaxation and stress control: Randomized controlled clinical trial

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The quality of sleep is directly linked to the quality of human life. Laser irradiation of blood in the transcutaneous vascular technique (ILIB) is believed to decrease blood viscosity and platelet aggregation; activates superoxide dismutase; promotes increased oxygen content and stimulates microcirculation, it also stimulates increased serotonin production and cortisol reduction. Serotonin functions include sleep initiation, mood improvement, anxiety and depression. Therefore, the objective of the present project is to evaluate the effect of ILIB on salivary biomarkers related to stress and sleep through a randomized, double-blind clinical trial, in which adults between 18 and 65 years old who complain of poor sleep quality will participate. Selected participants will be divided into 2 groups, group 1 undergoing ILIB Therapy twice a week for 30 minutes and group 2 the same frequency and time of application, but with placebo equipment. Upon patient admission, both groups will fill out questionnaires on sleep quality (PSQI and Epwort) and initial saliva will be collected for analysis of Chromogranin A (CgA) and Cortisol markers. Experimental group will receive the standard treatment procedures with active equipment and the second group will receive the technique through a placebo device. At the end of 10 sessions the variables will be collected again. After the 30-day interval, a new saliva collection and application of the questionnaires will be performed for analysis of treatment response.

Use of photobiomodulation for the treatment of lymphedema after mastectomy: A randomized controlled clinical trial protocol

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Lymphedema is a complication of breast cancer treatment characterized by swelling of the upper limb. Photobiomodulation (PBM) may be an option in the treatment of lymphedema after mastectomy for breast cancer. However, the level of evidence is uncertain due to the scarcity of studies designed with equivalent parameters. The objective of this study will be to evaluate whether PBM is able to reduce lymphedema, improve manual function and improve the quality of life of patients with lymphedema after mastectomy for breast cancer. This study will be double-blind, randomized, and controlled. After mastectomy for breast cancer, participants with lymphedema will be randomized into two groups. The treatment group will use the Institution's standard protocol for lymphedema (complete decongestive therapy) plus laser treatment at wavelength 850 nm, power of 5 mW, and radiant exposure of 1.5 J/cm2. The control group will receive the Institution's standard protocol for lymphedema plus placebo laser treatment, all of both groups with 20 minutes sessions twice a week and a duration of 12 sessions. It was estimated that 57 patients should be included per group in a total of 114 participants. Demographic data, quality of life, analogue pain scale, limb perimetry, and manual function will be analyzed. Follow-up sessions will be performed four and twelve weeks after the first therapeutic session. Descriptive analyzes will consider all variables: quantitative (mean and standard deviation) and qualitative (frequencies and percentages). All statistical tests will adopt the 5% significance level. The SAS for Windows program, version 9.1, will be used. The data will be statistically analyzed, and the results reported and discussed.

Photobiomodulation treatment modulates oxidative stress formaldehyde-induced lung inflammation in rats

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Lung diseases constitute an important public health problem with high social and economic costs. Lung diseases are modulated by many factors including pollutants. Formaldehyde (FA) is ubiquitous pollutant that induces inflammations and oxidative stress in the respiratory tract. Treatments currently available are expensive and with side effects. We here investigated the role of Photobiomodulation (PBM) in the lung inflammation induced by FA exposure. Male Wistar rats were submitted to FA exposure (1% or vehicle) during 3 consecutive days and treated or not with PBM (laser, potency 30 mW, 660 nm wavelength, energy density of 12.86 J/cm2) 1 and 5 h after each FA exposure. The rats were irradiated by 3 points in the trachea and 3 points in each lung lobe in order to promote irradiation of all respiratory system. Twenty-four hours after the last FA exposure, we evaluated the generation of nitrites and hydrogen peroxide, as well as cyclooxygenases and nitric oxide enzymes. Our results showed decreased levels of oxidant enzymes and nitrites and hydrogen peroxide. Thus, PBM treatment modulates the oxidative stress in the lung tissue induced by FA.

Effects of photobiomodulation therapy on peripheral sensitivity in an experimental model of neuropathy

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Peripheral nerves are constantly targets for injuries of different origins, whether traumatic or chemical, and rarely recover without surgical intervention when they present tissue loss. These injuries are responsible for several consequences such as impaired mobility and sensitivity. During cancer treatment, whether for relief or cure, the patient may be submitted to drug treatments that may present more severe side effects, others milder or even not present, one of these adverse effects is Peripheral Neuropathy, which begins through the hands and feet and gradually ascend through the arms and legs; sometimes you can feel tingling or numbness, other times it is like a twinge or a burning sensation or even increased sensitivity to temperature.

Laser therapy, not being an invasive procedure, is very useful, although it can be mentioned the increase in nerve function, increased metabolism of neurons and increased production of myelin. Phototherapy applied transcutaneously, daily, from the first postoperative day onwards, significantly increases the increase in the rate of axon regeneration.

The effect of systemic versus local transcutaneous laser therapy on tension-type cephalea and orofacial pain in post-COVID-19 patients: A pragmatic randomized clinical trial

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Orofacial pain and tensional cephalea were symptoms commonly reported in COVID-19 patients, even after recovery, and were considered chronic pain in these cases. The pain control, in these cases, is mostly accomplished with the use of analgesic and anti-inflammatory drugs. However, there are auxiliary treatments that can reduce the amount of pharmacological intake and improve the quality of life of compromised individuals, one of them is photobiomodulation. Using lasers for treatments to control inflammation and pain is successfully performed, but the parameters and the ways of application are not yet strongly established. The aim of this research is to evaluate the effect of the application of photobiomodulation with red and infrared lasers applied locally and systemically. For this purpose, individuals who have been diagnosed with COVID-19 and have had a tension headache and/or orofacial pain for more than 3 months will be selected by convenience. The participants will be divided into two different groups: G1- photobiomodulation with red and infrared laser with local application on the pain points (808 nm and 660 nm,100 mW, 6J per point) and G2 -photobiomodulation with red laser with transcutaneous application on the radial artery (660 nm, 100mW, 30 minutes).

All participants will be treated for a period of 4 weeks, with 8 application sessions. The effects will be measured by means of blood lactate level, Brief Pain Inventory, Visual Analog Scale (VAS), and Cephalea Impact Test. The data will be collected weekly before and after the treatment, and the following tests will be applied: Analysis of variance (ANOVA), Tukey paired T-test, Kruskal□Wallis, or Wilcoxon, according to data distribution. $\alpha = 0.05$ will be considered as the level of statistical significance.

Excitation of multi resonance microwave oscillations in bulk Lithium niobate crystals in interaction with T-waves of strip structures

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Electro optical crystals of lithium niobate and other materials are widely used for the manufacture of photonic devices [1-4]. In [5], non-reciprocal properties of backscattering of waves from bulk lithium niobate crystals were investigated and a conclusion was made about the possibility of applying the results obtained when creating Doppler frequency shift simulators, ultrasonic vibration sensors for contactless diagnostics of systems in the millimeter range of microwave and information transmission by means of exposure to ultrasound crystals. Thus, determining the characteristics of bulk electro-optical crystals for the design of functional devices is an urgent task. This paper presents the results of an experimental study of the excitation of multiresonances in a module containing a volumetric lithium niobate crystal as a dielectric filling of the upper half-plane of a coplanar strip transmission line (CPL). The design of the two modules is shown in Fig. 1. Both modules have a matching wave resistance of 50 ohms in the absence of dielectric filling of the upper half-plane. The CPL is made on an FR4 dielectric. The design of the CPL has two gaps between the conductive strip and the side screens. The crystal is exposed to a linearly frequency-modulated quasi-T-wave field in the frequency range from 10 MHz to 26.5 GHz. We experimentally measured the modulus and phase of the transmission coefficient |S21(f)|, arg[S21(f)], and the modulus and phase of the return loss |S11(f)| и arg[S11(f)].

Photobiomodulation therapy reduces levels of MMPs and TNF-α, controlling tissue degradation and promoting maintenance of cartilage resistance in an experimental model of Rheumatoid Arthritis

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Rheumatoid Arthritis (RA) is a chronic inflammatory, autoimmune, systemic, and progressive disease leading to irreversible cartilage and bone destruction. In vivo and in vitro experimental studies using photobiomodulation therapy have shown positive effects on the modulation of factors that cause disease progression. This work aimed to evaluate the effects of photobiomodulation therapy in the treatment of induced Rheumatoid Arthritis (RA) in biochemical and functional aspects. Methodology: Wistar rats were used, divided into groups, CTL (control), RA (Rheumatoid Arthritis), and RA + PBM. For the induction of RA, 3 injections of the lesion-induction solution (CIA) were used on days 1, 7, and 21 days after the last induction. For groups that received PBM treatment (808 nm; 2J; 100mW), irradiation started immediately after the last induction. The strength (Fmax) and maximum deformation (Dmax) supported by the cartilage until the moment of rupture were evaluated. The gene expression of MMPs 2, 9, 13 and TNF-α was quantified. Results: the results of the evaluation of cell proliferation showed that the NT group showed a reduction in cell proliferation after 48 hours. PBM reduced the biomechanical changes caused by RA and the expression of MMPs 2, 9, 13, and TNF-α preventing disease progression. Conclusion: PBM promoted an improvement in the functional and biomechanical characteristics, reducing the impact on cartilage resistance and reducing the expression. Of MMPs. Suggesting that it is an important therapy in the treatment of rheumatoid arthritis with no known side effects.

Comparative study between photodynamic therapy with urucum + led and probiotics in halitosis reduction: A controlled clinical trial

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Halitosis is a term that defines any foul odor emanating from the oral cavity. The origin may be local or systemic. The aim of this study is to determine whether treatment with antimicrobial photodynamic therapy (aPDT) and treatment with probiotics are effective at eliminating halitosis. Fifty-two patients from 18 to 25 years old with a diagnosis of halitosis ($H_2S \geq 112$ ppb determined by gas chromatography) were randomly allocated to four groups (n=13) who received different treatments: Group 1 – treatment with teeth brushing, dental floss and tongue scraper; Group 2 – brushing, dental floss and aPDT; Group 3 – brushing, dental floss and probiotics; Group 4 – brushing, flossing, aPDT and probiotics. The results of the halimeter testing were compared before, immediately after, seven days and thirty days after treatment. The microbiological analysis of the coated tongue will be performed at these same times. The inter-group analysis was performed for each time studied individually. At the initial time, there was no significant difference between the studied groups ($p = 0.0706$, Kruskal-Wallis ANOVA), indicating that the groups were well balanced in relation to the initial condition. In the analysis of the other times after the treatments, no significant difference was observed between the groups studied ($p = 0.9581$, $p = 0.6187$ and $p = 0.9635$ for the times "immediately", "7 days" and "30 days", respectively. Kruskal -Wallis ANOVA). The analysis of the "Scraper" group showed that the time "immediately after" differs significantly from all other times ($p = 0.0006$, Friedman). The analysis of the "aPDT" group showed that the time "immediately after" differs significantly from all other times ($p = 0.0008$, Friedman). The analysis of the "Probiotic" group showed no significant difference in the times studied ($p = 0.7530$, Friedman). The analysis of the "PDT + Probiotic" group showed that the time "immediately after" differs significantly from the time "30 days" ($p = 0.0008$, Friedman). The objective of the microbiological evaluation will be to determine the effectiveness of hygiene control, aPDT and probiotics for the reduction of bacteria on the surface of the tongue.

Analysis of the action of photodynamic therapy in tissue repair of people affected by diabetic foot lesions

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Studies point to the positive response that photobiomodulation has in diabetic foot lesions. However, there is still a lack of cost analysis of this therapy, which has been growing more and more, but in the treatment of lesions. The aim of this study is to analyze the response of the action of photodynamic therapy in tissue repair of people affected by diabetic foot injuries and to identify the cost of this treatment. It will be a double blind, randomized study, patients will be divided into two groups, a control and an experiment. The research will be carried out in a Municipal Health Center (CMS) located in the west of the city of Rio de Janeiro, Brazil. As inclusion criteria, the following were listed: patients affected by neuropathic lesions of the diabetic foot, patients with good adherence to the therapeutic plan, assiduous patients in consultations, patients assisted by CAP 5.1. As an exclusion criterion, the following were listed: patients under 18 years of age; patients with wounds with etiologies that are not related to the diabetic foot, patients with ischemic diabetic foot who have an ankle-brachial index (ABI) with a value less than 0.9 or greater than 1.3. Patients with glycated hemoglobin greater than 8%. Data collection will be carried out through the medical records in order to establish the sociodemographic and clinical profile of patients affected by a diabetic foot injury and through the nursing consultation three times a week, where the patient will be submitted to the proposed treatment, being performed 10 sessions of photodynamic therapy. In all consultations, through a data collection instrument, such information will be collected to monitor the evolution of the lesions: lesion size, lesion characteristics (odor, type of exudate, type of tissue found in the wound bed, of the lesion, perilesional area and presence of biofilm and/or infection). The sample size will be 68 patients. This value was calculated to provide 95% power ($\alpha = 0.05$). Initial descriptive analyzes will be performed considering all variables measured in the study, both quantitative (mean, median and standard deviation) and qualitative (frequency and percentage).

Beam shaping with hybrid optical elements for optical communication links

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Social, economic or cultural data must be transmitted from one point to another safely and secure. The photons are excellent candidates for optical communication since they can propagate over long distances but with very low loss, due to the decoherence mechanism in free space. One can exploit many degrees of freedom of light in order to encode the information: time-bin, time-frequency, path encoding, amplitude, polarization, spatial structure - orbital angular momentum (OAM).

Large alphabets (high capacity) and high security can be achieved when the information is encoded with OAM. Optical vortices which carry OAM propagate in straight line, so in case of obstacles between the transmitter and the receiver the information transfer is affected. On the other hand, Airy beams represent accelerating beams with curved trajectory and have been a subject of great interest for self-acceleration, self-healing, non-diffraction properties and robustness in case of the atmospheric turbulence during propagation. A promising solution for optical communication to preserve the information when are present line-of-sight obstacles (between transmitter and receiver) can be considered in bendable optical vortices (AOVs). These hybrid beams encompass both functions for OAM degree of freedom (to achieve high information capacity) and curved trajectory (to avoid obstacles). In this work, the generation of curved light beams is achieved by phase profile engineering with hybrid optical elements in order to improve free space optical communication. This approach has the big advantage that passive optical elements are not influenced by temperature and permits the implementation of compact optical systems. The investigation of encoding, propagation and decoding of AOV states will be investigated for a free space optical link.

Photobiomodulation therapies in the treatment of osteonecrosis: A systematic review

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Osteonecrosis is a condition resulting from a partial or complete interruption in the supply of oxygen and/or nutrients to bone tissue, resulting in tissue necrosis. It can be caused by trauma, radiation, and continued use of drugs such as the bisphosphonate class, corticosteroids, or drugs that act on bone remodeling and antiangiogenesis. The standard treatment for osteonecrosis is a conservative or extensive surgery, usually associated with antibiotic therapy. However, many patients do not improve symptoms. Therefore, other therapies are being studied, such as hyperbaric oxygen therapy and photobiomodulation, showing favorable results. Thus, this PRISMA systematic review aims to evaluate the effect of photobiomodulation therapies on the treatment of medication or radiation-induced osteonecrosis, regardless location of necrosis. In this regard, prior to data extraction, our PRISMA protocol will be sent to properly register on the PROSPERO website, including searches on PUBMED, EMBASE, LILACS, Open Gray, Proquest, and LIVIVO databases using a P.I.C.O. strategy. Clinical trials, case reports, and observational studies evaluating the use of PBM in adult patients with radiation or medication-induced osteonecrosis will be analyzed. All available data about the quality of life and all outcomes analyzed by the authors of the included studies will be reported. Moreover, all photobiomodulation protocols used by authors will be included and reported. The chosen tools for quality analysis of the included studies depend on the data design. We intend to use the Cochrane risk-of-bias tool (RoB 2) for randomized trials, Cochrane Robins-I for non-randomized trials, and the CARE Tool for case reports. In addition, we will use the LLLT/photomedicine Guideline published by Jenkins and Caroll and WALT recommendations to analyze the PBM parameters found. A qualitative descriptive analysis of the collected data is planned. Still, once the number of patients in published studies is in general limited, to come to a more accurate assertion if a minimum of two studies with the same material, same condition, therapy, and results are found, we plan to perform a quantitative synthesis (meta-analysis) of the subgroups of symptoms and quality of life outcomes.

Effect of photobiomodulation as a preventive treatment of diabetic foot: A randomized, double-blind, controlled clinical study protocol

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Diabetic foot syndrome is one of the most serious complications of diabetes mellitus and the main cause of non-traumatic lower limb amputations. Preventive measures through multidisciplinary treatment collaborate in the preservation of limbs. Diabetic foot ulcer (DFU) is associated with loss of mobility, worse quality of life (QoL), and decreased overall productivity. This research aims to evaluate the effect of photobiomodulation, as a preventive treatment of complications in patients with the diabetic foot without ulcers, compared to the control group. Therefore, 54 patients with type 2 DM between 18 and 75 years old, with signs and symptoms of PN or claudication in the absence of UPD, will participate in this study.

Participants will be randomized into two groups called G1 (self-care guidance + photobiomodulation) and G2 (self-care guidance + sham). The treatment will be performed using a boot-shaped LED device (robofoot) with light emission at wavelengths 660 and 850 nm, Durante 13 min, 5 days a week for 12 weeks. The following outcomes will be evaluated: W6MT, TBI, thermography, and mmii doppler before and after 90 days of application of FBM, initial inflammatory and metabolic profile, 30 days, and 60 days. Data collected during the research will be stored and organized in the Harvard Dataverse repository (https://dataverse.harvard.edu). And data analysis will be used Kruskal-Wallis test, followed by the student test. Comparison by Wilcoxon test, significance level of 0.05.

Evaluation of a clinical protocol of photodynamic therapy for endodontic treatment of deciduous teeth

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The aim of this study is to evaluate a dosimetric parameter for aPDT in the endodontic treatment in deciduous teeth, considering bacterial reduction, clinical and radiographic. 20 anterior deciduous teeth with a diagnosis of pulp necrosis will be selected.The teeth will be randomly divided into two groups, which will receive treatments distinct: Group 1 (G1): conventional endodontic treatment (n=10); Group 2 (G2): Treatment with aPDT (9J) using optical fiber (N=10). For aPDT it will be used as a photosensitizer methylene blue (Chimiolux®) at a concentration of 0.005%, applied inside the canal radicular with a pre-irradiation time of 3 minutes, associated with the application of the laser with wavelength of 660nm (DMC, Laser THERAPY XT), the channel will be irradiated with the equipment previously calibrated with energy of 9J and power of 100mW. For microbiological analysis, two collections of the intracanal content will be carried out with paper cones, one before and another right after the proposed treatments in both groups. The radiographic aspects will be evaluated, considering the repair process, clinically will be evaluated: presence of fistula and mobility, the evaluations will be carried out in the periods of 1 and 3 months after the treatment. The data obtained will be submitted to the Shapiro-Wilk normality test, where defined for the statistical analysis that will be used for this study, adopting a significance level of 95% (p<0.05).

The use of photobiomodulation in the management of radiotherapy side effects: Case series

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It was predicted that there would be 670,000 new cancer cases worldwide in 2020–2022. It is known that the most common treatments instituted are chemotherapy, radiotherapy, and surgery. However, these treatments have undesirable side effects such as radiodermatitis (RD). In fact, it is estimated that the prevalence of possible side effects after radiotherapy is 80 to 90%. Radiotherapy complications are associated with a negative impact on the quality of life of patients. Few supportive care measures are available for such complications. In this way, the management of these side effects has been an object of study in the literature until today. In the other side, Photobiomodulation (PBM) has an important role in wound repair and tissue regeneration as it influences the different phases of lesion resolution, including the inflammatory phase, the proliferative phase, and the remodeling phase. In this way, the objective of this study is to evaluate the application of PBMT in the treatment of patients diagnosed with acute radiodermatitis induced by radiotherapy after breast cancer treatment. This is a case series report protocol in which the data will be derived from the medical records of all breast cancer patients with RD degree 2 or 3 treated at the Laser Therapy Outpatient Clinic in a university hospital followed from September 2022 until August 2023. The data collected comes from the patient's medical record. The outcomes are the size lesion, Visual Analogic Scale (VAS) and the Radiation Therapy Oncology Group Scale (RTOG) in the pre and post-FBM therapy moments. The data will be submitted to a statistical analysis and will be discussed. Data with positive or negative results will be reported.

Treatment of Melasma with amber LED compared to tranexamic acid

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Statement of the Problem: Facial Melasma (FM) is a chronic pigmentation disorder difficult to solve. It affects women and their self-esteem. In vitro studies of photobiomodulation (PBM) with amber light showed inhibition of the tyrosinase and reduction of melanin content. The aim of this study will be to evaluate the effect of PBM with amber light in the treatment of FM compared to tranexamic acid.

Methodology: The study will be controlled, randomized and double-blind. The sample will be divided into 2 groups: One will receive amber LED and placebo topical cosmetic for home use; two will receive PBM sham and topical liposomal tranexamic acid for home use. Weekly sessions for 12 weeks and cosmetic use also for this period complete the protocol. Women aged 35 to 50 years, phototypes II to IV and who have FM will be included. The use any oral contraceptive, IUD, hormone replacement, autoimmune disease, use of photosensitive drugs or receiving facial treatments in the 3 months prior to the study will be exclusion criteria. The severity of FM will be evaluated through Melasma Area and Severity Index; epidermis pigmentation will be evaluated by corneomelametry, photographic records and the quality-of-life questionnaire (MELASQoL-BP) will also be analyzed. Assessments will be made before the start of the study, at week six, and after completion of treatment. Conclusion & Significance: This study may bring important information regarding the use of PBM in FM treatment.

Evaluation of alveolar bone preservation after early molar extraction combined with scaffold biomaterial grafting and photobiomodulation: A randomized, blinded clinical study

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The bone graft added to the dental socket immediately after tooth extraction prevents atrophy and deformity of the bone at the site of element loss, allowing for further rehabilitation with implants. Photobiomodulation is a light-based approach that accelerates bone healing; stimulates blood flow; activates osteoblasts, decreases osteoclastic activity, and improves the integration of the biomaterial with bone tissue. The goal of this study is to develop a protocol for the management and preservation of alveolar bone after the loss of first and/or second permanent molars in pre-teen and teenage subjects between 8 and 17 years, with an indication for extraction. Materials and methods: 60 patients will be randomized and randomly divided into 4 groups, n= 15: Exo (extraction), Exo+Laser (extraction and laser treatment), Exo+Biomat (extraction with biomaterial), Exo+Biomat+Laser (biomaterial extraction and grafting and laser treatment). The biomaterials will be Geistlich Bio Oss Collagen ® and Geistlich Mucograft® (Switzerland), added to the socket immediately after molar extraction. Laser groups (λ = 808 nm, power = 100 mW, radiant energy 3J per point in 3 vestibular, occlusal, and lingual/palatal points), will receive irradiation immediately after the surgery, 48 h and 10 days after surgery, in the Exo and Exo+Biomat, will use a similar laser device without emission of irradiation. Analyzes: computed tomography and intraoral scanning performed preoperatively, 3 and 6 months after surgery; to assess bone volume by measuring the height and width of the socket in each group, trabecular bone, and the interdental space of the teeth lateral to the missing element. The clinical study received approval from the ethics committee and is in the recruitment phase.

Vascular photobiomodulation on total hematological leukocytes after muscle injury in an animal model

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The local irradiation method of photobiomodulation (PBM)demonstrated positive effects in the literature when applied in an acute skeletal muscle injury stimulating the repair, with reduction of the local inflammatory infiltrate and modulation of cytokines and growth factors involved in the regenerative process. Evidence suggests that the non-invasive and transcutaneous vascular photobiomodulation (VPBM), a modified form of ILIB (Intravascular or Intravenous Laser Irradiation of Blood) irradiation, has systemic effects, with an improvement of the immune system, of a wound healing model and on the reduction of muscle injury biochemical markers. The aim of the present study was to analyze the effects of preventive or therapeutic transcutaneous VPBM on peripherical blood leukocyte count after the inducement of an acute skeletal muscle injury in rats. Wistar rats (n = 85) were divided into five experimental groups: Control; Injury; non-injured + VPBM; Previous VPBM + Injury; Injury + VPBM after. The animals' tail vein was transcutaneously irradiated using a low-level AlGaAs diode laser (780 nm, 40 mW, 0.04 cm2, 3.2 J, 80 s) and the procedure was performed in different periods, prior to or after the injury induction. Blood samples were collected at 1, 2, 5and 7 days following the cryoinjury procedure and submitted to an automatic hematology analyzer to obtain the absolute total leukocyte count. On days 1 and 7 Non-injured + VPBM group showed a decrease in leukocytes compared with the Control group. The previous VPBM group showed an increase in absolute leukocyte count on days 1, 2 and 5 in comparison with the Injury + VPBM after group. No differences were found on day 7. In conclusion, VPBM was able to increase the number of total leukocytes at 1, 2 and 5 days and the effect was more pronounced in the previous VPBM group.

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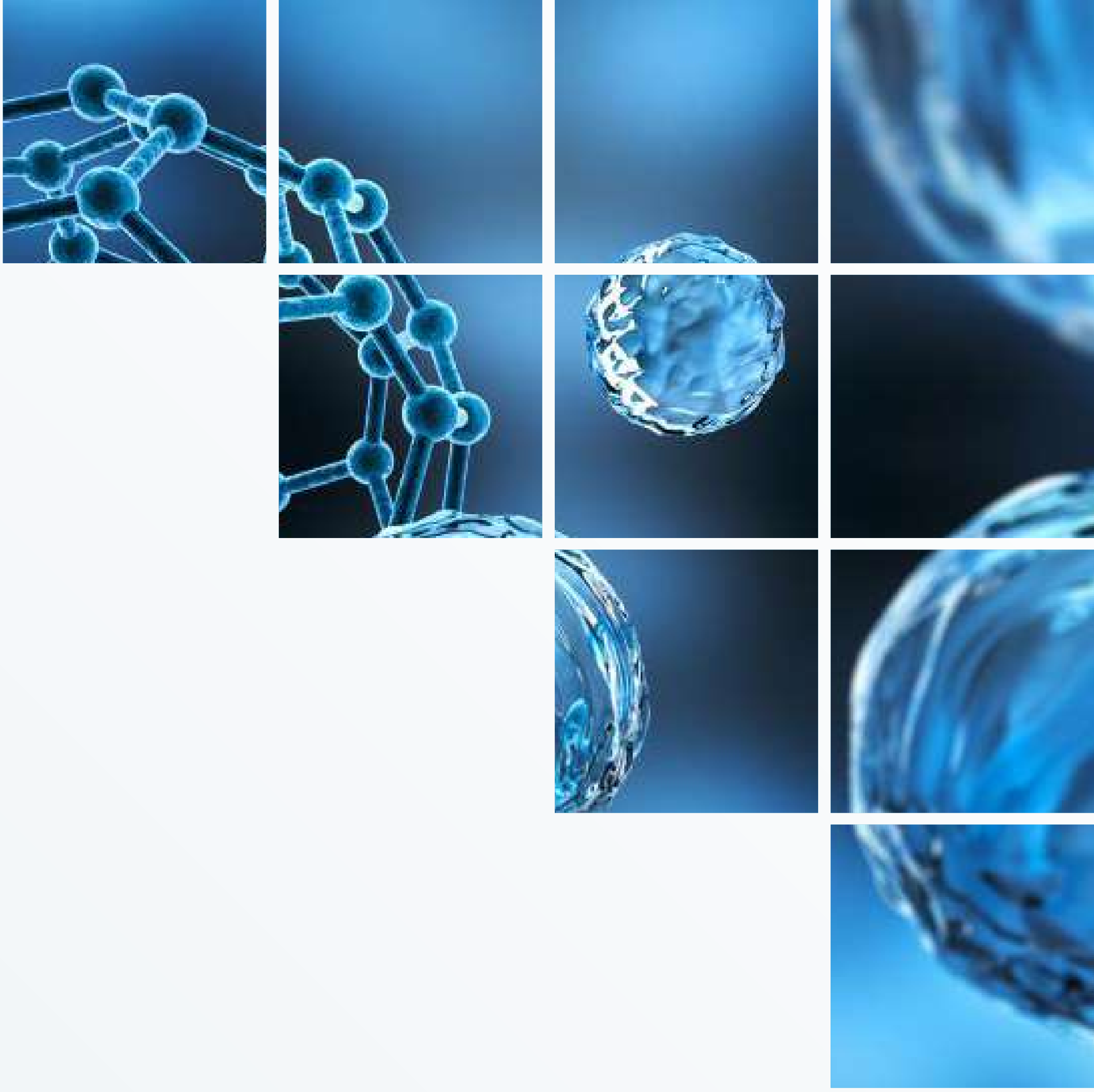

We wish to meet you

again at our upcoming conference

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