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OBI 2022



SLABO - Latin American
Congress of Artificial
Organs and Biomaterials





About the Event

The 7th OBI 2022 was held online (and free of charge) on December 6th and 7th, 2022. The origin of OBI Acronym comes from the Spanish “Taller de Órganos (O) Artificiales,

Biomaterialies (B) e Ingenieria (I)” workshops held in Argentina.

It was the 18th SLABO – Latin American Congress of Artificial Organs and Biomaterials. Faced with so many uncertainties, we decided to organize this event online and totally free due to the delicate moment we were experiencing, prioritizing the safety of all international travelers.

Despite we were physically apart, our minds were united and together we dreamed of an amazing near future for science.

Prof. Dr. Eduardo Bock
President of the Organizing Committee



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DEVELOPMENT AND CHARACTERIZATION OF FLEXIBLE SUBSTRATES BASED ON GELATIN FOR APPLICATION IN ORGANIC ELECTRONICS

Ana C. Merlotto^{1*}; Larissa R. Brandão¹; Cristiano Legnani²; Marina Fontes¹; Hernane S. Barud¹

*Corresponding author: E-mail address: anaclara.2626@gmail.com

Abstract: Several therapeutic interventions have been explored to obtain greater resolution of ophthalmological disorders. Substrates based on gelatin– are promising in the development of optoelectronic devices, due to their high transparency, biocompatibility, and biodegradability, it is been possible to make them conductive. In this study, flexible conductive substrates based on gelatin were obtained, aiming application in organic electronics. Films were produced with different concentrations of gelatin (FG) and most of them showed good homogeneity, flexibility, handling, optical transparency and flexibility. Gelatin film 5% (w/v) showed an average thickness of 57.8 μm and high transparency in the visible region of the electromagnetic spectrum (80%–90%). FTIR spectra showed different bands related to the chemical structure of gelatin. The FG showed no toxicity for L929 cells. Moreover, FG 5% demonstrated low values of water vapor permeability (6.72 · 10⁻⁵) and thermal stability up to 200°C. Subsequently, the FG will be crosslinked in order to reduce their solubility in water and then, thin films of indium tin oxide will be deposited on surfaces of FG films to make them conductive. Thus, it is expected to obtain an innovative eco–friendly substrate for its use in the treatment of ocular degeneration.

Keywords: Gelatin; Nanocellulose; Crosslinking Agents; Flexible Substrates; Organic Electronic.

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¹Biopolymers and Biomaterials Laboratory, University of Araraquara (UNIARA), (BioPolMat).

²Juiz de Fora Federal University (UFJF).



COMPARISON BETWEEN TWO SYNTHETIC ROUTES TO OBTAIN ZINC OXIDE NANOPARTICLES FOR BIOLOGICAL APPLICATIONS

Hulder H. Zaparoli^{1,2}; Marcela de Oliveira¹; Paulo N. L. Filho¹; Marina P. Silva¹

*Corresponding author: E-mail address: hulder.zaparoli@unesp.br

Abstract: Zinc oxide nanoparticles (ZnO–NPs) stand out due to their unique physical and chemical characteristics, becoming a fundamental technological material with broad applications. These nanomaterials can be synthesized by different routes. The chemical routes use different precursors and conditions, which allow better control of the morphology in terms of size and geometry. In this study we investigated the synthesis of ZnO–NPs by two chemically different techniques (routes): method I, based on sol–gel synthesis, and method II, based on microwave–assisted hydrothermal green synthesis. The FTIR technique was used to study the functional groups present, the XRD allowed the visualization of the structure formation of the material, and the SEM the distribution and morphology of the synthesized nanoparticles. The XRD technique showed that both methods presented crystal structures corresponding to ZnO and similar crystallite size. By FTIR and SEM, method II presented a smaller amount of chemical bonds and a greater dispersion of the nanoparticles. Therefore, both methods synthesized the ZnO–NPs, however method II was more purer and morphologically uniform compared to method I. In future work, these ZnO–NPs will be used as photosensitizers for photodynamic therapy.

Keywords: Synthesis; Nanoparticles; Zinc oxide.

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¹São Paulo State University, Faculty of Sciences, Unesp, Bauru.

²Postgraduate Program in Science and Technology of Materials – POSMAT, Unesp, Bauru.



ORODISPERSIBLE FILMS BASED ON HYALURONIC ACID FOR APPLICATION IN DENTISTRY

Lorena F. Piovesan¹; Hernane S. Barud²; Gustavo C. Monteiro¹; Fernanda L. Brighenti²

Abstract: The suboptimal performance of the bioavailability of oral pharmaceutical forms is one of the main challenges in developing new drug carriers for the release of drugs, especially those intended for the treatment of periodontal diseases, caries, and pulpitis. In this sense, orally disintegrating films (ODFs) are promising for this purpose, as they present rapid absorption and are easily administered, especially for pediatric and geriatric patients with limitations in the swallowing process. With consumers' growing interest in natural products, several biopolymers have been investigated for the development of new drug delivery systems, including hyaluronic acid (HA), which presents high hydrophilicity, excellent viscoelastic properties, and non-toxicity. The present work aims to develop orally disintegrating films from hyaluronic acid with different molecular weights. The free-standing films have been obtained by the casting process at 40°C. HA films are macroscopically homogeneous, flexible, and highly transparent (up to 80%), confirmed by UV-Vis measurements. TG/DTG curves showed that there are no significant changes in the thermal stability of the obtained films with different molecular weights. Thus, the use of hyaluronic acid with different molecular weights will allow for obtaining films that will be later used in dentistry.

Keywords: Hyaluronic Acid; Edible Film; Morin.

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¹Paulista State University (Unesp).

²Biopolymers and Biomaterials Laboratory (BioPolMat), University of Araraquara (UNIARA).



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DEVELOPMENT OF A HOMEMADE EXTRUDER AND FILAMENTS BASED ON BIOPOLYMERS FOR THE REGENERATIVE MEDICINE APPLICATION

R. A. Rattes¹; K. B. Rufato²; H. Barud¹

*Corresponding author: E-mail address: raphael.rattes@uniara.edu.br

Abstract: One of the major problems of the commercial extruders for developing new biopolymers filaments for 3D printer applied in regenerative medicine is the fine adjustment of the extrusion parameters, also known as setup. The complexity and the more setup time, including temperature and extrusion speed adjustment, difficult the polymer blend filament obtention, whose process requires parameter changes. To overcome these problems, we are preparing a homemade extruder for several polymer blend filament extrusions with a short time setup. The filaments are being prepared by setup the heating gradient (3 heating regions with individual adjustment), extrusion speed (fine adjustment rotation of the screw), and easy exchange of the extrusion nozzle (option of 1.5 mm, 1.75 mm e 2.0 mm). The extruder is made of stainless steel in the contact region with the material that will extrude, allowing the filament's obtention based on biopolymers. The filaments are being prepared and will be characterized by thermal analysis (TGA/DTG– DSC), Fourier Transform Infrared Spectroscopy (FTIR), mechanical properties, and Cell Viability Assay. Therefore, this work allows the easy obtention of the several polymeric blend filaments contributing to the new materials studies for regenerative medicine applications.

Keywords: Extruder; Filaments; Biopolymer; Regenerative–Medicine.

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¹Paulista State University (Unesp).

²Biopolymers and Biomaterials Laboratory (BioPolMat), University of Araraquara (UNIARA).



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USE OF MACROS IN IMAGE J FOR SURVEYING SURFACES IN OPTICAL TECHNIQUES

Giovana Araujo¹; Isac K. Fujita¹

*Corresponding author: E-mail address: araujo.giovana@aluno.ifsp.edu.br

Abstract: The Moiré phenomenon consists of the interference caused by the overlapping of two periodic structures (reticles), with the Moiré shadow technique with fringe multiplication being more sensitive than the traditional methods, in addition to reducing the effects of the difference in illumination on the surface of the object in study. For the Moiré process to take place, it is necessary that the collected images go through a process between two softwares, ImageJ and Idea, which are intended for image processing, which is why it is a time-consuming procedure. Having thus the motivation for the origin of the project, for the success it counts with the help of macro to make the process faster and more efficient. With the adversity encountered, the aim of the project was to automate the image processing necessary in the Moiré Techniques in order to obtain quick results, making the process viable in applications that require diagnostic speed. For the success of the project, tests were carried out with the ImageJ macro to optimize the process with this, the process that took 5 minutes in 1 minute was obtained and in addition to the macro, it had the support of programming in python to interconnect the programs.

Keywords: Móire; ImageJ; Idea; Macro.

¹Federal Institute of Education, Science and Technology of São Paulo.



USE OF MOBILE ROBOT IN NEUROREHABILITATION

Giselle Santana¹; Matheus Troiano¹; Paulo M. Aguiar¹

*Corresponding author: E-mail address: giselle.santana@aluno.ifsp.edu.br

Abstract: The integration of technology with rehabilitation practices has been growing a lot in recent decades. Several neurorehabilitation systems already make use of electronic games, gesture recognition systems and virtual reality. However, the continued use of these virtual equipment can bring some disadvantages to patients in the short and long term. High exposure to artificial blue light, emitted by electronic device screens, increases the user's risk of developing vision problems and sleep disorders. Prolonged use of virtual reality devices is also associated with side effects such as nausea, eye strain, and headaches, which can lead to tiredness and considerably impair the rehabilitation process. There are cases in which depending on the health condition of the user, is necessary a prior clinical evaluation. It should also be taken into account the reactivity of some patients to the use of digital technologies, such as some elderly, where digital or virtual interaction can prove to be a great challenge and become a barrier at the time of rehabilitation. Aiming to lead to greater interaction with the rehabilitation system, it is proposed the use of a mobile robot. The robot used is Robotino, a mobile robot with omnidirectional wheels made by FESTO, that will be controlled by the intelligent object, which here replaces the joystick commonly used in neurorehabilitation practices, and is composed of different features – load cell, accelerometer, gyroscope, myoelectric sensor – which makes it capable of monitoring the strength, movements, and myoelectric signals from the patient's motor activity. The collected data can be viewed by the physiotherapist and/or by the users themselves. To date, an intelligent object has been developed and tested, proving to be efficient for use in rehabilitation. The integration of the object with the robot is under development and once established will allow the start of clinical trials.

KEYWORDS: Neurorehabilitation; Intelligent Object; Robotino; Mioelectric Signal; Upper Limbs.

¹Biopolymers and Biomaterials Laboratory (BioPolMat), University of Araraquara (UNIARA).



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USE OF AGRO-INDUSTRIAL ORANGE PULP WASTE FOR THE PRODUCTION OF A VALUE-ADDED PRODUCT

Inácio I. Cecílio^{1*}; Marina Fontes¹; Hernane Barud¹

*Corresponding author: E-mail address: inaciozidoro123@gmail.com

Abstract: The hyaluronic acid (HA) is considered a high value-added product, showing many applications, especially in aesthetics procedures. HA has excellent viscoelasticity, high moisture retention capacity, high biocompatibility, and hygroscopic properties, in addition antioxidant and anti-inflammatory effects. The present study aims to investigate a comprehensive solution to reduce the costs and difficulties related to microbial HA. In this sense, waste orange in different percentages is used in cultivation of *Streptococcus zooepidemicus* ATCC 39920. For this, the pre-inoculum will be obtained using BHI media as conventional culture media, followed by inoculation in five different percentages of BHI: waste orange with and without yeast extract supplementation. UV-VIS spectrophotometer will be used to estimate the growth of bacterial cell population by measuring the absorbance at 600 nm. Moreover, the biomass concentration will be quantified by determination of dry weight. The purification of the HA will be carried out by ethanol precipitation method. The rheology, biological assays and physicochemical characteristics, including Infrared Spectroscopy, Thermogravimetric analysis, and mechanical properties, will also be investigated. Thus, our study has sought to develop and evaluate the alternative, low-cost culture media derived from agro-industrial orange pulp waste in production of HA microbial, aiming the optimization of microbial growth and its production cost.

Keywords: Hyaluronic acid; biopolymers; sustainability; high value-added product.

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¹Biopolymers and Biomaterials Laboratory (BioPolMat), University of Araraquara (UNIARA).



ROBOTIC ARM INERTIAL CONTROL FOR RECREATIONAL CHILD PHYSIOTHERAPY APPLICATION

JM. Nascimento^{1*}; CS. Brito¹; EDC. Frazão¹; GAS. Mera¹; GAA. Silva¹; HGV. Melo¹

*Corresponding author: E-mail address: jean.nascimento25@etec.sp.gov.br

Abstract: According to reports from physical therapists, physiotherapy presents a painful and uninteresting process because it distances itself from the ludic, which is a natural essence of the human being, and easily attracts children when applied. In 2021, the “Robotic System for Children's Physiotherapy with Recreational Activities” project was developed, which consisted of a robotic arm to assist in the physiotherapy process of children with Cerebral Palsy. According to the conclusions of the initial project, the developed control was effective in what was proposed but not sufficient for project application in rehabilitation environments. In this way, this work presents a new control that is safer and that allows its application helping in the rehabilitation of these children. This new control allows the robotic arm to reproduce the movements of the human arm, so that the movement of the forearm, arm and hand are reproduced independently, simultaneously and in real time. Therefore, the prototype control operates reliably and robustly, achieving what was aimed at, a safer and more efficient physiotherapeutic process for users.

Keywords: Robotic Arm; Inertial Control; Recreational Physiotherapy; Inertial Measurement Unit.

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¹Robotics and Rehabilitation Laboratory – LABORE, Federal Institute of Education, Science and Technology of São Paulo, *campus* São Paulo.



OXIMETER FOR IDENTIFICATION OF HYPERTROPHIC CARDIOMYOPATHY IN CATS

J. Mendonça¹; C. Veltmeyer¹; I. Fujita¹; E. Bock¹; S. Araki¹

Abstract: Veterinary medicine represents one of the fields with the greatest possibility of exploring knowledge, this is due to the constant needs that arise. Based on this, and the contact we have with felines on a daily basis – which represent approximately 23.9 million individuals in Brazil, it was observed that domestic cats have a common heart disease, hypertrophic cardiomyopathy. This disease causes hypertrophy of the left ventricle, preventing the heart from carrying out the flow of oxygen, hormones and nutrients to the body, becoming a threat to the lives of these animals. Due to our familiarity with innovations involved in engineering, linked to our interest in the area of Bioengineering, we had the initiative to develop a prototype of a portable oximeter that determines the heart rate and oxygenation in adult domestic cats. The device was built from the assembly of an electronic circuit linked to a sensor, which by means of a C++ code, captures the essential information for a quick identification of the cat's cardiac health status and to be able to periodically monitor the results. With the help of medical and mechanical articles, it was possible to develop the prototype and obtain results with the device that show the number of beats per minute recorded (in bpm), in addition to the body's oxygenation level in %. Based on knowledge of the usual values of these parameters for cats, it is possible to compare what is presented by the device, and predetermine the real and current state of the animal's health. These results proved to be very promising, allowing people to feel more confident about the well-being of their pets. In this way, the advancement caused by the domestic oximeter for society is notorious, and the future benefits that are made available by it.

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**ALLIUM CEPA FILMS CONTAINING SIMVASTATIN AS PROMISSORY PLATFORM FOR DRUG DELIVERY SYSTEM****Lucas A. Santiago¹, Marco A.C. Borges¹, Hernane S. Barud¹****Corresponding author: E-mail address: santiago.asafe@gmail.com*

Abstract: Interest in the development of Nanocompounds with polymeric matrices has increased significantly in recent years. In this context, nanocomposites based on *Allium cepa* biopolymers containing solubilized Simvastatin and Glycerol can be used in the medical–dental area for bone tissue regeneration, due to the osteogenic action of simvastatin when applied locally, in addition to other benefits and advantages over others forms of treatment, such as promoting antioxidant and anti–inflammatory effects. The objectives of this project are based on the production, characterization and analysis of washed films of *Allium cepa* with simvastatin and glycerol by the Casting method for application in bone regeneration. The characterization of the films will consider the following parameters: film thickness, thermal analysis (TGA/DTG–DSC), Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Water Vapor Permeability (PVA), Cell Viability Assay, Spectrophotometry, Contact Angle, Degradation and Mutagenicity Assays. After passing the characterization tests, the films will be statistically analyzed. This is an innovative study whose results will serve as data to aggregate in the medical–scientific community on the subject.

Keywords: Osteogenesis; *Allium cepa*; Biopolymers; Simvastatin; Nanocomposite.

¹Biopolymers and Biomaterials Laboratory (BioPolMat), University of Araraquara (UNIARA).



TASK-ORIENTED STRATEGY IN POST-STROKE RECOVERY PROCESS

Matheus Troiano¹, Giselle Santana¹, Paulo M. Aguiar¹.

*Corresponding author: E-mail address: matheus.troiano@aluno.ifsp.edu.br

Abstract: Stroke survivors often face difficulties in rehabilitating upper limb movements, which are crucial for everyday activities such as eating, drinking, dressing, bathing, and reading. Recent studies have shown that neurorehabilitation is essential for stroke recovery and new technologies are emerging that use task-oriented processes to aid in the recovery process. Robotics devices have been developed to assist in upper limb rehabilitation, ranging from single joint movements to complex stations. This project focuses on developing a force-sensitive station and an intelligent object that can intercommunicate to aid the recovery process during occupational therapy. The intelligent object is equipped with low-cost sensors such as a gyroscope, accelerometer, microcontroller, and load cell, while the station is a sensor-based screen that simulates common daily tasks. The patient interacts with the station via the sensors and intelligent object, which collects data to help identify weaknesses or strengths specific to each patient. The goal is to reduce the need for a one-on-one therapist-patient interaction. The station structure has been built and the sensors are being implemented. The intelligent object (IO) for this purpose is already done, the next step is to integrate the intelligent object and start testing the system with both IO and Station.

Keywords: Neurorehabilitation; Intelligent object; Occupational Therapy; Stroke; Rehabilitation devices.

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¹Federal Institute of São Paulo – campus São Paulo.



PROSTHETIC HAND PREHENSION EVALUATION STRATEGY THROUGH THE USE OF SMART OBJECTS

Pedro F. Abissamra¹; Jean M. Nascimento²; Paulo M. Aguiar¹

*Corresponding author: E-mail address: abissamra.p@aluno.ifsp.edu.br

Abstract: The effective use of upper limb prosthetics, more precisely the hand ones, is related to a lot of factors such as: weight, shape, fitting and prehension posture. In between these factors, the way that the prehension is done is intimately related with the subject's learning to use the prosthetic and, therefore, to the effective success of its application as a possible substitute of the missing limb. Besides the importance of the learning process, it is little considered in the prosthetic hand development. In this work is presented the development of smart objects to be used in a quantitative and qualitative analysis of prehension. These objects work with force and torque sensors, and, according to its shape and application, provide different parameters that assist the prehension's analysis and characterization. Initial tests were done with a smart object developed. Through them, it was possible to analyze the characteristics of prehension of the used prosthetic hand, indicating that the object worked correctly and that the proposed method has possibilities of success. The use of more than one smart object was proven to be necessary to a more judicious evaluation of a prosthetic hand.

Keywords: Hand; Smart Objects; Prosthesis; Rehabilitation; Training.

¹Federal Institute of São Paulo – campus São Paulo.

²Technical State School of São Paulo.



USE OF A PORTABLE POLARISCOPE EQUIPMENT FOR PETROGRAPHY PURPOSES

Aline Tiaki Nohara¹, Eduardo G. P. Bock¹, Giovana Araújo, Isac K. Fujita¹, Rafaela S. Peres¹, Sergio Y. Araki¹

*Corresponding author: E-mail address: tiakialine@gmail.com

Abstract: Photoelasticity is a technique used to analyze stresses in birefringent materials, for success to be achieved, it is necessary to use equipment, the polariscope of transmission. To optimize the analysis, in a previous study, a portable polariscope, which can perform analyzes equivalent to the transmission polariscope, but other areas besides mechanics can be explored, such as petrography. Petrography is responsible for study, analyze and describe the rocks, which are formed by minerals and that for their identification one must carry out the analysis in the petrographic microscope, with petrographic slides, which makes it difficult to on-site identification, so the use of a portable polariscope is an alternative for verifying the rock crystals. Thus, with the objective of validating the use of the polariscope for the analysis of thin blades and patent the equipment. To carry out this study, an initial bibliographic review on photoelasticity and petrography, to understand more about each aspect and from that, comparative tests of analysis of thin sections seen from the microscope and with the portable polariscope, to validate the routine of the portable polariscope in petrography.

Keywords: Polariscope; Portable; Photoelasticity; Petrography.

¹Federal Institute of São Paulo – campus São Paulo..