Universidade do Minho
Escola de Ciências

Departamento de Biologia

centre of molecular and environmental biology

INSTITUTO DE CIÊNCIA E INOVAÇÃO PARA A BIO-SUSTENTABILIDADE

Biopolymers based on renewable resources:
from synthesis to applications

(5th edition)

DEPARTMENT OF BIOLOGY / CBMA
ADVANCED COURSE

Coordination
Raul Machado
André da Costa
Margarida Casal

June 22 – July 3 , 2020

University of Minho
Department of Biology

INFORMATION

The course aims at presenting and discussing cutting edge progresses in tailor-made biopolymers – the design, the production, the present and prospective applications. Conscious of the increasing ecological awareness along with new legislation that boosted the demand for products with a high ecological image, both science and industry partners are aiming to develop biopolymers based on renewable resources to meet market needs. The course will therefore address the recent developments on biopolymers, including fibre reinforcement and the addition of novel fillers and nanofillers, as basis for the new generation of materials.

TOPICS

1. Biopolymers diversity:

- Polymers based on renewable resources
- Synthetic and biodegradable polymers
- Recombinant Protein-based polymers (rPBPs)

2. Green strategies for the production of biopolymers:

- Cell machineries for the production of polymer monomers and rPBPs
- Cleaning and reutilization of existing plastic polymers

3. Properties, processing and characterization of biopolymers:

- Toxicity and bioactivity evaluation
- Materials and material surface characterization and stability
- Processing techniques; obtention of micro and nano structures

4. Multifunctional applications:

- Biopolymers functionalization with bioactive domains: enzymes, cytokines, adhesion domains, antimicrobial peptides
- Tissue engineering matrices
- Antimicrobial materials
- Biopolymers in the food industry
- Cosmetic applications
- ...

The Advanced Course in Biopolymers based on renewable resources: from synthesis to applications (5th Edition) is organized under the scope of the project "FunBioPlas" ERA-IB-2-6/0004/2014.

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SPEAKERS

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LECTURES

MONDAY JUNE 22

10:00 AM
Raul Machado
A brief introduction to the course. Discussion about evaluation and general agenda of the course
11:00 AM
Margarida Casal
“Learning from nature: designing recombinant proteins for advanced biomaterials production”
2 PM
Raul Machado
“Silk/Elastin protein polymers as a versatile platform for the development of new “green” (bio)materials”
3:30 PM
Isabel João Silva
“Transporter engineering: a valuable tool in the bioproduction of organic acids”

TUESDAY JUNE 23

10:30 AM
André da Costa
“Biopolymers as antimicrobial materials: What is available and future perspectives”
2:30 PM
Christopher Holland
“The strength of silk is the least interesting thing about it”
4 PM
Rui Pereira
“Silk fibroin: a multifaceted material for engineering design”

WEDNESDAY JUNE 24

10 AM
Lars Berglund
“Cellulose – a nanoscale fibril important for plants and for society”
“Chitin – a cellulose analogue in the animal kingdom”
4:30 PM
Artur Ribeiro
“Keratin-based systems for hair cosmetic applications”

LECTURES

THURSDAY JUNE 25

10:30 AM
António Vicente
"Applications of biopolymers in the agrofood sector"
2:30 PM
Diana Ferreira
"Versatile Chitosan: Its potential in food packaging, drug delivery systems and multifunctional fibrous systems"
4 PM
João Bessa
"Biopolymers: from its discovery to the challenges of the future"

FRIDAY JUNE 26

10:30 AM
Senentxu Lanceros-Méndez
"Biopolymers as a new generation of smart and multifunctional materials"
2:30 PM
Marko Karkkainen
"Marine harvester from disadvantages to raw materials – Clewat Ltd. case study"

MONDAY JUNE 29

10:30 AM
Andreia Gomes
"Biointerfaces: adjusting biological assays for biomaterials validation".
2:30 PM
Mariana Oliveira
"Building functional biomaterials from renewable polymers"

TUESDAY JUNE 30

10:30 AM
Nuno Neves
"Biomaterials, Porous Scaffolds and Cells for Advanced Therapies"

THEORETICAL-PRATICAL CLASSES

TP 1 June 24 2020 2:30 PM – 4 PM	**Methodologies for the assessment of biopolymer's antimicrobial activity** **André da Costa and Diana Gomes**
TP 2 June 26 2018 4:30 PM – 5:30 PM	**Fourier Transform Infrared Spectroscopy characterization of Materials** **Rui Pereira**

CALENDAR – WEEK 1

	June 22	June 23	June 24	June 25	June 26
	Monday	Tuesday	Wednesday	Thursday	Friday
10:00-10:30	Presentation		L7 - Lars Berglund		
10:30-11:00		L4 - André da Costa		L9 - António Vicente	L12 - Senentxu Lanceros-Méndez
11:00-11:30	L1 - Margarida Casal				
11:30-12:00					
12:00-12:30	LUNCH	LUNCH			
12:30-13:00					
13:00-13:30					
13:30-14:00					
14:00-14:30	L2 - Raul Machado				
14:30-15:00		L5 - Christopher Holland	TP1 André Costa Diana Gomes - Antimicrobial testing	L10 - Diana Ferreira	L13 - Marko Karkkainen
15:00-15:30					
15:30-16:00	L3 - Isabel João				
16:00-16:30		L6 - Rui Pereira		L11 - João Bessa	
16:30-17:00			L8 - Artur Ribeiro		TP2 Rui Pereira - FTIR
17:00-17:30					

LXX - Lecture
TP – Theoretical- pratical

CALENDAR – WEEK 2

	June 29	June 30	July 1	July 2	July 3
	Monday	Tuesday	Wednesday	Thursday	Friday
10:00-10:30			Tutorials	Journal Club	Journal Club
10:30-11:00	L14 - Andreia Gomes	L16 - Nuno Neves			
11:00-11:30					
11:30-12:00					
12:00-12:30	LUNCH				
12:30-13:00					
13:00-13:30					
13:30-14:00					
14:00-14:30					
14:30-15:00	L15 - Mariana Oliveira	Tutorials	Tutorials	Journal Club	Journal Club
15:00-15:30					
15:30-16:00					
16:00-16:30					
16:30-17:00					
17:00-17:30					

LXX - Lecture
TP – Theoretical- pratical

Lecturers & Abstracts

Biopolymers based on renewable resources:
from synthesis to applications

Margarida Casal

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Biography

MARGARIDA CASAL is Full Professor of Biology of the University of Minho. She is coordinator of the doctoral program FCT in Applied and Environmental Microbiology. Assured the orientation of more than 20 postdoc researchers, 25 PhD and 24 Master students, and 44 project fellows. She is co-author of 9 patents, 8 book chapters 103 ISI publications, with h-index 33 (Researcher ID B-6386-2009).

M. Casal scientific interests are focused on protein structural-functional analysis with the goal of understanding the molecular features that allow proteins to perform work in the cell. Currently she is interested in the study of PROTEIN-BASED POLYMERS. The aim is to design, produce, characterize and develop applications for natural and recombinant Biopolymers based on the structure of silk and elastin proteins, providing an extraordinary tool to create self-structured and smart Biomaterials.

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LECTURE 1 - Learning from nature: designing recombinant proteins for advanced biomaterials production

Margarida Casal
CBMA – Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/96649456731?pwd=Qm5kcDRUZzFyREpoUWxvdENkeXBwUT09

The search for advanced materials tailored for specific applications is an emerging area of research. The development of synthetic biology approaches combined with biotechnology tools for molecular and structural characterization, prompted a new change of paradigm in materials science. Nowadays it is possible to create environmentally friendly materials with new functionalities. In this lecture I will present the most recent projects we have been developing in the field of creating bioinspired protein-based materials. By seeking inspiration in the most basic elements of natural proteins we design in laboratory new biopolymers that mimic the natural counterparts. As remarkable examples we can find i) silk fibroin that exhibits a semi-crystalline structure and have been used for centuries as a reference material due to their properties of strength and resistance, and ii) elastin, found in mammalian tissues such as skin, lungs and arteries, is one of the most extraordinary natural elastic proteins. Our research group have been exploring the characteristics and properties of these biopolymers for the development of novel biomaterials by combining structural modules of silk and elastin with functional modules such as antimicrobial peptides, enzymes and cytokines.

References:

1 - Araújo, R., Silva, C., Machado, R., Casal, M., Cunha, A.M., Rodriguez-Cabello, C., Cavaco-Paulo, A. 2009. Proteolytic enzyme engineering: a tool for wool. Biomacromolecules 10, 1655-61.
2 - Bessa, P., Machado, R., Nürnberger , S., Dopler, D., Banerjee, A., Cunha, A. M., Rodríguez-Cabello, C., Redl, H., van Griensven, M., Reis, R.L., Casal, M. 2010. Thermoresponsive self-assembled elastin-based nanoparticles for delivery of BMPs. Journal of Controlled Release 142: 312–318.
3 - Machado, R., Bessa, P.C., Reis, R. L. Reis, Rodriguez-Cabello, J.C., Casal, M. 2012. Elastin-Based Nanoparticles for Delivery of Bone Morphogenetic Proteins. Methods in Molecular Biology, 906: 353-63.
4 - Collins, T., Barroca, M., Branca, F., Padrão, J., Machado, R. and Casal, M. 2014. High Level Biosynthesis of a Silk-Elastin-like Protein in E. coli. Biomacromolecules 15, 2701-8.
5 - da Costa, A., Machado, R., Ribeiro, A., Collins, T., Thiagarajan, V., Neves-Petersen, M.T., Rodríguez-Cabello, J.C., Gomes A.C., Casal, M. 2015. Development of Elastin Like Recombinamer films with antimicrobial activity. Biomacromolecules 15, 625−635.

Raul Machado

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Biography

Raul Machado is graduated in Biology, MSc in Molecular Genetics, PhD in Biology with specialization in Materials Science and Engineering, and has a post-graduation in Management. Presently, is a is Junior Researcher at the Centre of Molecular and Environmental Biology (CBMA) and at the Institute of Science and Innovation for Bio-Sustainability (IB-S), both from the University of Minho, Portugal. He is also the director of the Molecular Biotechnology Laboratory at IB-S. Since 2016, he is Invited Assistant Professor for Entrepreneurship at the School of Economics and Management, University of Minho. Since 2018, he is expert evaluator of the European Commission (Research Executive Agency). Raul Machado have been engaged in a series of National and International research projects (both as Principal Investigator and team member), is the author of several scientific articles and given more than 80 communications in scientific conferences. His research has been centred in the i) development of multifunctional bioinspired materials for biotechnological applications with special attention given to the formulation of antimicrobial materials, their processing and compounding, and ii) the formulation of active protein-based matrices and composites for the development of advanced materials, targeting sustainable and eco-friendly solutions to meet social challenges. Raul Machado is also involved in entrepreneurship activities acting as mentor, scientific advisor and business strategy consultant for several entrepreneurial projects.

LECTURE 2 - Silk/Elastin protein polymers as a versatile platform for the development of new “green” (bio)materials

Raul Machado
CBMA – Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/95713396410?pwd=NDdwS0duVi85MS8vNmFKMUNiYWpodz09

Throughout evolution nature created and refined proteins for a wide range of functions, working as structural components or as molecular motors. In this sense, the natural fibrous proteins represent the utmost case of function specialization and high performance materials. Fibrous proteins such as silk and elastin are characterized by repeating blocks of amino acid sequences that fold and hierarchically assemble into well-defined secondary structures to provide mechanical and architectural functions. These repeating sequences (minimal consensus repeats) have been used as building blocks for the development of recombinant protein polymers. As a protein is defined by a DNA sequence, recombinant technology allows the design and biosynthesis of multifunctional complex molecules with a precise control over its composition, and a production not dependent on natural or oil based resources. This allows to combine in the same polypeptide chain the properties of two or more proteins. Silk-elastin-like proteins (SELPs) are a class of genetically engineered block copolymers tailored to combine in the same molecule the structural components of silk fibroin and mammalian elastin [1]. Due to its high versatility of processing, SELP copolymers can be used for the development of several different types of materials such as (nano)fibres, free standing films, hydrogels and even composite materials. For instance, SELP fiber mats can be applied as wound dressing materials for skin regeneration applications [2], whereas SELP films have interesting properties for a wide variety of applications [3]. The formulation of composites comprising active nanofillers and recombinant protein polymers further expands the potential range of applications, opening new perspectives and paving the way for a new generation of multifunctional biocomposites.

This presentation will provide an overview of the research developed by our group in the development of SELP-based materials and composites as new materials.

References:

1 - Machado R. et al. High level expression and facile purification of recombinant silk-elastin-like polymers in auto induction shake flask cultures. AMB Express, 2013, 3:11

2 - Machado R. et al. Electrospun silk-elastin-like fibre mats for tissue engineering applications. Biomed Mater, 2013, 8:065009

3 - Machado R. et al. Exploring the Properties of Genetically Engineered Silk-Elastin-Like Protein Films. Macromol Biosci, 2015, 15(12):1698-1709

Isabel João Silva

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Biography

Isabel Soares Silva finished her PhD in 2006 in the field of Yeast Molecular Biology at Margarida Casal's lab (UMinho), being a visiting student at Andre Goffeau's lab (UCLouvain, Belgium) and George Diallinas's lab (Athens University, Greece). In her subsequent Postdoc, she specialized in the field of structure-function studies of permeases working at U Minho and Diallinas' lab. She then joined the Nephrology R&D Unit UPorto, as a research assistant, where she implemented a new research field that addressed catheter-related infections in dialysis patients, besides actively collaborating in ongoing group projects. Latter at the research Nephrology and Infectiology R&D group at INEB/I3S (UPorto) she focused on the characterisation of the Chronic Kidney Disease microbiome. At CEB research centre (UMinho) she was involved in the optimization of bacterial enzyme properties for industrial utilization. Since October 2016, and due to her strong background in Microbial Biotechnology, she was invited to work on the project EcoAgriFood as a researcher. As task leader, she is responsible for obtaining new engineered microbial cell factories with enhanced properties for carboxylic acid production.

Isabel Soares-Silva's current research is focused on the identification of novel carboxylate transporters, as well as the improvement of transporter kinetics, specificity and stability by rational site-directed mutagenesis based on 3D modelling and docking studies. By expressing selected carboxylate transporters in industrially relevant MCF she aims to enhance the tolerance to carboxylic acids, increase production yields and facilitate downstream processing. The ultimate goal of her research is to improve the efficiency of biorefineries, increase the range of currently available bio-based products and promote the circular economy in the Industrial Biotechnology sector.

LECTURE 3 - Transporter engineering: a valuable tool in the bioproduction of organic acids

Isabel João Silva
CBMA – Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/93973696327?pwd=RWI4K1V1Y2MzVkRNWHQwRGtrMVdvUT09

As the current model of natural resource exploitation is unsustainable, new technologies based on renewable biological sources are needed to address global problems of resource scarcity and environmental damage. Microbial cell factories are an excellent alternative for the production of biobased chemicals, and in recent years the industrial focus has gradually shifted to microorganisms as biocatalysts. Organic acids such as mono, di and tricarboxylic acids or even more complex molecules such as sugar acids, have displayed great applicability in the industry as these compounds are used as platform chemicals for polymer, food, agricultural and pharmaceutical sectors. The bioproduction of organic acids is under continuous development to increase microbial cell factory productivity, yields and range of products. One of the major bottlenecks for the efficient and cost-effective bioproduction is the export of organic acids through the microbial plasma membrane. Despite the recent effort on transporter engineering, envisaging the development and improvement of microbial cell factories, the redesigning and engineering of optimized cell membrane transporters for industrial organic acid production is still in an early stage. This is mainly due to the fact that the functional and structural characterization of membrane proteins is still a cumbersome process. In our research group, we tackle the current challenges of industrial biotechnology by applying our scientific knowledge in transporter proteins to improve product export in microbial cell factories.

André da Costa

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Biography

André da Costa graduated in Biology by the University of Porto in 2008, and obtained is MSc and PhD in Molecular and Environmental Biology in the University of Minho. Currently, is a Junior Researcher at the Centre of Molecular and Environmental Biology, University of Minho, working on the creating of functional materials functionalized with pleotropic cytokines. He was also the co-found of the spin-off company Concept Beer, Lda, for the improvement of Portuguese Craft Beer quality.

André's research focuses on the use of molecular biology tools for the creation of functional materials, especially those with antimicrobial or immunomodulatory properties. The materials created are protein-based and inspired in natural structural proteins, such as silk or elastin. He has a strong background in Microbiology, either for antimicrobial testing or by using bacteria as cell factories. Current research interests include antimicrobial materials testing; *in vitro* and *in silico* protein characterization; anti-biofilm materials; multifunctional protein-based polymers.

LECTURE 4 – Biopolymers as antimicrobial materials: What is available and future perspectives

André da Costa
CBMA – Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/98385061013?pwd=NHZ4SjBTNmg0YUpPeVRNZDNsS2tLZz09

As animals, Mankind is constantly involved in a war against pathogenic microorganisms. To win this fight and aid our immune system, we have found and created several molecules and materials with antimicrobial properties, such as the chemical antibiotics. But now, many bacterial or fungal pathogens have evolved in order to counteract antimicrobials' activity. To overcome this situation, new strategies are being developed to fight microbial infections, not only for treatment but also for prevention. Polymers, and more specifically biopolymers, have gained prominence with their versatility for several antimicrobial procedures and are already being applied in different areas such as the biomedical or agri-food sectors. In this lecture, we will discuss different themes around antimicrobial polymers, such as diversity, composition, methods of production and applications. Furthermore, it will be addressed some standard methods of antimicrobial activity characterization of these types of materials, in both processed or unprocessed forms.

References:

1 - da Costa A, Machado R, Ribeiro A, Collins T, Thiagarajan V, Neves-Petersen M T, Rodríguez-Cabello J C, Gomes A C and Casal M. (2015) Development of Elastin-Like Recombinamer Films with Antimicrobial Activity *Biomacromolecules* 16 625–35

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4 - Jain A, Duvvuri LS, Farah S, Beyth N, Domb AJ, Khan W. (2014). Antimicrobial Polymers. *Advanced Healthcare Materials*, 3(12), 1969–1985

Christopher Holland

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Biography

Dr Chris Holland is a Senior Lecturer in the department of Materials Science and Engineering at the University of Sheffield Department where he leads the Natural Materials Group (www.naturalmaterialsgroup.com). He studied Biology for his undergraduate at Oxford University and had great fun studying silk for his D.Phil in the Oxford Silk Group under the supervision of the original Spiderman, Prof. Fritz Vollrath. Today Chris' group is a collection of scientists with different backgrounds, cultures and questions surrounding how nature makes materials (from spider silk to snail slime).

In May 2018 he completed an EPSRC Early Career Fellowship (SPICE, a > £1M grant) and was the principal co-ordinator of the H2020 FET project FLIPT (a ~€4M grant, 7 partners, 1.4% success rate) which concluded in February 2020. These projects have involved integrating a range of micro/spectroscopic techniques with rheology in order to study structure development as silk proteins are exposed to controlled flow stress fields as a route towards the development of sustainable bioinspired polymers.

Currently he has a group of 10, consisting of 1x PDRA, 2 PhD Students and ~5-8 UG/PGT students. He has to date an h-index of 23 based on 50+ original articles (inc. Nature Materials x1, Advanced Materials x3, Nature Comms x2), 5 reviews, 4 book chapters, 3 Patents (founded one spin-out company) and he has given 1 plenary, 2 keynote and 20+ invited talks in the past 5 years. Outside the lab, he is an Associate Editor for ACS Biomaterials Science and Engineering and Chair of the IoM3 Natural Materials Association.

LECTURE 5 - The strength of silk is the least interesting thing about it

Christopher Holland
Department of Materials Science and Engineering, Sheffield University, Sheffield, United Kingdom
Zoom link: https://videoconf-colibri.zoom.us/j/96764991041?pwd=QURDNm1pdkNleGZkMlcyV0FIL0xvQT09

Materials manufacture and processing results in over 20% of the world's carbon emissions with Polymers accounting for approximately 5% crude oil use. Yet consumer demand for high-performance materials is forever increasing and apparently in direct contrast to parallel requirements for products that are sustainable and environmentally benign.

Here biology can contribute much to the discussion, as Nature's materials tend to be supremely energy efficient as well as recyclable. We propose silks are a unique source of inspiration for the current challenges facing the synthetic polymer industry, provided we understand how to process them correctly. This is because processing defines silk, for unlike all other biological materials they are spun, not grown. Silks are biological polymers that have evolved to be processed by controlled protein denaturation, making them ideal inspiration and a "gold standard" for comprehending and controlling the solidification/denaturation of natural materials.

This presentation will provide an overview of Nature's 400 million years of R&D into silk and our recent studies into the importance of processing in this fascinating material, especially when we consider the next generation of SynBio fibres being currently developed across the world. Finally, I will discuss silk's potential in medicine and how fundamental research is being translated into the development of implantable biomedical devices whose performance may be tuned in terms of both degradation rate and mechanical performance simply by altering the processing of the material.

Rui Pereira

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Biography

Rui F.P. Pereira (RP) graduated in Industrial Chemistry at the University of Coimbra (Portugal, 2005). In 2012 finished his PhD on Macromolecular Chemistry, in the University of Coimbra, presenting a thesis entitled “Interactions between metal ions and anionic surfactants”. From 2013 to Jan 2019, was a postdoctoral researcher in a collaboration between the Chemistry Center of the University of Minho (Portugal) and the Chemistry Center of the University of Trás-os-Montes e Alto Douro (Portugal). The postdoctoral work was focused on the synthesis and characterization of hybrid organic/inorganic multifunctional materials, with special focus on the use of biopolymers. Since February 2019, is a researcher in the Chemistry Center of the University of Minho. His research interests topics includes: colloids and interfaces; interactions in polyelectrolyte complexes; disordered and ordered organic-inorganic hybrid materials; biomimetism, biohybrids and biomaterials; bio-inspired superhydrophobic coatings; electrolytes derived from natural materials (proteins, polysaccharides or biomass-derived carbon dots) doped with ionic liquids; applications of natural polymers (e.g., silk-based materials) in sustainable advanced batteries, sustainable “smart windows” and medical devices. RP participated in the publication of 2 book chapters and 35 papers in international peer review journals. RP has more than 60 oral and poster communications in international conferences and participated actively in 9 research national and international projects. RP currently reviews several scientific journals such as Journal of Chemistry, Journal of Molecular Liquids, Carbohydrate Polymers, Fibers and Polymers, Biomacromolecules, ChemElectroChem, Molecules or Materials.

LECTURE 6 - Silk fibroin: a multifaceted material for engineering design

Rui Pereira
Chemistry Centre, University of Minho, Braga, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/98087744526?pwd=UjVEWWFUQjhVMWI1K053bm1LOXVMQT09

Nature provides an endless source of inspiration for building new synthetic materials. The need for solutions to respond to the ever-increasing set of technical, economic, and ecological demands of our society has urged the scientific community to seek more reliable, efficient, recyclable, environmentally friendly, and less energy-consuming materials. Natural materials combine unique features, such as sophistication, miniaturization, hybridization, complex behavior, emergence, hierarchical structure, resistance, and adaptability.

The preparation of new materials inspired by polymers of natural origin has been widely explored in recent years. The development of functional and "environmentally friendly" composites promote the use of many of the natural and renewable resources that are available to us. Polysaccharides and proteins can be immediately highlighted. Many of the biopolymers available have excellent mechanical and biological characteristics that mostly allow their use in the area of biomaterials. However, new applications in fields such as optics, electronics or energy have recently been reported.

Special attention will be given to silk fibroin (SF), a commonly available natural biopolymer produced in specialized glands of arthropods, with a long history of use in textile production and also in health care [1]. In recent years it has been demonstrated the potential of SF in new technological fields such as optics, photonics and electronics [2-4]. This new application opens the way towards the development of multifunctional optoelectronic devices, which in perspective can be made fully biocompatible and eventually bioresorbable. The incorporation of polymer electrolytes as components of various energy devices (advanced batteries, smart windows, displays and supercapacitors) offers significant advantages with respect to traditional electrolytes, including enhanced reliability and improved safety.

References

1 - R. F. P. Pereira, M. M. Silva, V. de Zea Bermudez, Macromol. Mater. Eng. 2015, 300, 1171-1198.
2 - H. Tao, D. L. Kaplan, F. G. Omenetto, Adv. Mater. 2012, 24, 2824-2837.
3 - R. F. P. Pereira, F. Sentanin, A. Pawlicka, M.C. Gonçalves, M.M. Silva, V. de Zea Bermudez, ChemElectroChem 2016, 3, 1084 – 1097
4 - R. F. P. Pereira, R. Brito-Pereira, R. Gonçalves, M. P. Silva, C. M. Costa, M. M. Silva, V. de Zea Bermudez, S. Lanceros-Méndez, ACS Appl. Mater. Interfaces 2018, 10, 5385-5394.
5 - R. F. P. Pereira, R. Gonçalves, M. Fernandes, C. M. Costa, M. M. Silva, V. de Zea Bermudez, S. Lanceros-Méndez, Adv. Sustainable Syst. 2018, 1800098.

Lars Berglund

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Biography

Lars Berglund is professor at the Royal Inst. of Technology in Stockholm, and founding director of Wallenberg Wood Science Center. He has been a visiting researcher at Stanford University, Cornell University and Kyoto University. His research interest is in nanostructured composite materials; primarily those based on cellulose and chitin. An important challenge is transparent cellulosic nanomaterials, which also can serve as load-bearing engineering materials. Professor Berglund has published more than 250 journal papers, examined more than 20 PhD's and is a member of the Royal Swedish Academy of Engineering Sciences. He holds an ERC Advanced Grant on Nanotechnologies for Transparent Wood.

LECTURE 7.1 - Cellulose – a nanoscale fibril important for plants and for society

Lars Berglund
KTH Royal Inst. of Technology, Stockholm, Sweden
Zoom link: https://videoconf-colibri.zoom.us/j/98103772254?pwd=ZnpKRmNVSFEwa2w1T3ZYdmhpZmFoUT09

In textbooks, cellulose is often presented as a polymer molecule. Although this is correct, plant organisms are making use of cellulose in the form of long, thin and very strong fibrils of nanoscale diameter. It is synthesized in the plasma membrane of plant cells, and the molecule is identical in all plants. What differs between plants is the structure and geometry of the cellulose fibril.

Cellulose is also used by man in many forms, from wood structures in buildings to thickening agents in milk shakes and as films for wound healing in biomedical applications. During the last 20 years, the nanoscale fibrils themselves (microfibrils), have been extracted from plants and used in new and interesting eco-friendly materials. We are increasingly discovering how the materials solutions evolved in nature can inspire new materials development based on ideas from biological structures.

The lecture will describe forms of cellulose in various organisms, as well as the function of cellulose in different cells. Cellulose is of great interest as an eco-friendly material, but the “eco-friendliness” depends strongly on the route from the organism to the finished cellulose product. Different examples will be provided, and concepts such as embodied energy and carbon dioxide emissions will be discussed.

LECTURE 7.2 - Chitin – a cellulose analogue in the animal kingdom

Lars Berglund
KTH Royal Inst. of Technology, Stockholm, Sweden
Zoom link: https://videoconf-colibri.zoom.us/j/98103772254?pwd=ZnpKRmNVSFEwa2w1T3ZYdmhpZmFoUT09

Chitin has many similarities to cellulose in that it is present in biological organisms as a structural component fibril with load-bearing function. The chemical repeat unit in the polymer is different from cellulose, although it is also a linear polysaccharide molecule. Whereas cellulose is embedded in amorphous polysaccharides with “glue” function, chitin fibrils are strongly associated with and bonded together with proteins.

Crustaceans have exoskeletons where chitin and proteins are combined with calcium carbonate to provide a hard and tough protective shell. Also in insects, the exoskeleton protective function relies heavily on chitin fibrils. The surface chemistry of chitin fibrils is important for the binding to proteins, and is also important for humans. The most common man-made product from chitin is chitosan, a large-scale industrial polymer with antimicrobial function.

Chitin fibrils can be disintegrated from crustaceans and insects in much the same way as cellulose fibrils. Strong films can be prepared with interesting properties. Again, the chemical structure, diameter and length of the fibril are critical factors for the physical properties of the fibrils and associated materials.

It is interesting to consider the many similarities between chitin and cellulose. For instance, in both cases the biological structures are hierarchical in nature. Large fiber-like structures in crustaceans are composed of smaller nanoscale fibrils joined by protein adhesives. Although the main reason for this may be the “bottom-up” biosynthesis process in an animal, there may also be functional advantages.

An interesting function of chitin structures is in structural color. Many insects are lacking pigments in their exoskeletons, or wings. Instead the coloring comes from microscopic chitin structures providing distinct coloration effects, without the use of any chemical pigment.

Artur Ribeiro

CEB, UMinho, Portugal
e-mail: arturibeiro@ceb.uminho.pt

Biography

Artur Ribeiro graduated in Applied Biology by the University of Minho in 2004, and obtained is PhD in Materials with Technological Interest from the University of Valladolid, Spain in 2010. Currently, is a Junior Researcher at the Centre of Biological Engineering, University of Minho.

Artur Ribeiro has a strong background in molecular biology tools for the design and expression of recombinant proteins with different functionalities for biomedical, nanotechnological and cosmetic applications. He also has experience with the interaction of cells with protein-based materials.

His current research interests are 1) Development of protein-based formulations for hair cosmetic products; 2) Hair as an analytical tool for the control of therapies and food supplementation; 3) in vitro culture of cells and screening of molecules bioactivity; 4) valorization of natural resources and 5) enzymatic biotechnology.

LECTURE 8 - Keratin-based systems for hair cosmetic applications

Artur Ribeiro
CEB - Centre of Biological Engineering, University of Minho, Braga, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/94047303345?pwd=TGNIUWZsZGNJSEdYYnZpckx3dldNdz09

The social increasing concern about the environment and the desire to have a more natural lifestyle stimulated the research on more natural compounds for hair cosmetics. Cosmetic industries are now taking into consideration the growing interests of the worlds' society in the use of responsible, sustainable and eco-friendly products. These three pillars are nowadays the main driving forces for the need of constant innovation in cosmetic science research. Protein based formulations are seen as an exceptional solution for hair cosmetics since proteins can impart several functions to the hair while protecting it, and they can be obtained from several sources using green approaches.

Keratin proteins are found in the cytoplasm of almost all differentiated eukaryote cells, being mainly known as the principal structural proteins of hair, wool and skin. The term 'keratin' includes a complex mixture of proteins, such as keratins and keratin-associated proteins.

Keratin hydrolysates are currently used in different applications: as odor-removing or deodorizing composition; included in skin-hair care cosmetic; in the enrichment of wheat straw for ruminant diets; or applied in the packaging of goods. In addition, the keratin proteins are used in the biomedical field, for wound healing, ocular and nerve regeneration and bone tissue engineering. Keratins have been also included in the development of drug delivery systems with controlled release due to keratin stability, low reactivity, and good mechanical and structural properties.

More recently, keratin obtained from human hair, was used for the development of keratin-based films and keratin-based particles. The films can be explored as hair fibers substitutes for the testing of cosmetic formulations; while the particles show great potential to be used as new hair cosmetic products for the restoration and recovery of hair properties and for the controlled release of hair perfumes.

António Vicente

CEB, University of Minho, Portugal
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Biography

Antonio Vicente graduated in Food Engineering in 1994 by the Portuguese Catholic University, in Porto, Portugal, and finished his PhD in Chemical and Biological Engineering in 1998 by the University of Minho, in Braga, Portugal. He has received his Habilitation in Chemical and Biological Engineering from the University of Minho in 2010.

From an early stage of his career he has kept a close contact with the food industry and he is involved in several research projects, both national and international, together with industrial partners either as participant or as project leader.

His main research interests are:

- micro and nanotechnology applied to Food Technology (e.g. for encapsulation/immobilization of bioactive compounds), using different structures (nano-)multilayered films and coatings, (nano)emulsions, (nano)particles and (nano)gels, all from food-grade materials
- in vitro digestion system for evaluation of the fate of foods in the GI tract
- food processing by ohmic heating/moderate electric fields (namely the study of the effects of electric currents on biomolecules and cells)
- edible films and coatings for food products (chemical, physical and functional characterization)
- bioreactor technology (including design and operation of bioreactors for the growth of microalgae and cyanobacteria)

He supervised/is currently supervising 35 PhD theses; he has also supervised/is currently supervising over 70 MSc theses and 20 post-doctoral fellows. He has published over 280 research articles in international peer-reviewed journals, 5 books, 5 patents and over 30 book chapters in international books, yielding an h-index of 56 (SCI).

He is presently Associate Professor with Habilitation, vice-Dean of the School of Engineering and Researcher of the Centre of Biological Engineering of the University of Minho, in Braga, Portugal.

LECTURE 9 - Applications of biopolymers in the agro-food sector

António Vicente
CEB - Centre of Biological Engineering, University of Minho, Braga, Portugal
Link: https://videoconf-colibri.zoom.us/j/91354587051?pwd=Q3lIcWExU2NzeUhBVmkvRkxSZ0ZlZz09

It is now widely known that nanotechnology holds promise in many areas of scientific and technological research, and it is developing at a very fast pace. It is not surprising, thus, that also in the food and agriculture areas there are very significant advances, thus leading to a justified growing attention from both academy and industry.

In particular, food scientists, technologists and engineers are dedicating their attention to nanotechnology, while searching for solutions in the various areas of their activity: from new ingredients to new processes and new packaging materials.

Particularly, the applications aimed at improving food functionality (e.g. nanoencapsulation of functional ingredients) and food packaging (e.g. nanolayered coatings or nanoencapsulated active compounds for active packaging applications) are seen as very promising. However, there are two main issues which are a concern for the application of these solutions: 1) ingredients must be food-grade and 2) safety of the consumers must be guaranteed.

This lecture will address these issues, from the use of (food-grade) biopolymers for the production of nanotechnology-based structures to a view on the actual food safety concerns regarding the use of nanomaterials in (or in contact with) foods.

Diana P. Ferreira

2C2T, University of Minho, Portugal

e-mail:

Biography

Diana P. Ferreira is presently Junior Researcher at Centre for Textile Science and Technology (2C2T) of the Minho University and Scientific Manager of the Fibrenamics Platform from Minho University. She started her Chemistry degrees at Chemistry Centre from University of Coimbra and after the master's degree, she took a fellowship position at Centro de Química Física Molecular of Instituto Superior Técnico. In 2016 she finished her PhD in Chemistry at Instituto Superior Técnico with the thesis: "Photosensitizer/biomaterial local drug delivery systems with potential application in Cancer Photodynamic Therapy".

Her research interests included surface photochemistry, synthesis and characterization of nanoparticles, characterization of organic dyes, fibers, biopolymers, drug delivery systems, cancer photodynamic therapy, multifunctional fibrous systems, CBRNe and smart materials. Present research interests are focused in using sustainable chemistry for the development of smart and innovative materials. Namely, the production of new fibers and the functionalization of natural fibres with nanoparticles and biodegradable polymers.

Diana Ferreira is author/co-author of 42 articles in peer reviewed journals, over 50 communications (including oral and posters) and 2 book chapters. Her work has been cited nearly 400 times and she has an h-index of 13. She was board of the Young Chemists group from Portuguese Chemical Society and she was for 3 years the Portuguese representative at European Young Chemists Network (EYCN).

LECTURE 10 - Versatile Chitosan: Its potential in food packaging, drug delivery systems and multifunctional fibrous systems

Diana Ferreira
2C2T - Centre for Textile Science and Technology, School of Engineering, University of Minho, Guimarães, Portugal
Fibrenamics International Platform, University of Minho, Guimarães, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/96156344337?pwd=SGZzcndSZU0rQlAxYi8wSkp4V0Z5Zz09

Over the last few years, chitosan has emerged as an attractive material for several applications due to its excellent characteristics. Chitosan is a polysaccharide derived from the deacetylation of chitin, which can be obtained from marine waste sources, namely from crustaceans' shells (shrimp, oysters, crabs, and lobsters). Besides its natural origin, this polymer presents several other interesting properties, such as biodegradability, non-toxicity, biocompatibility, low-cost, and excellent film-forming capacity 1. The obtention of chitosan from marine wastes allows the valorization of seafood waste to the manufacture of value-added products, in line with the concept of circular economy.

In the food packaging industry, minimizing the microorganisms' development and spread is crucial to prevent food deterioration, ensuring its safety. In fact, chitosan displays intrinsic antimicrobial activity against a wide range of bacteria and fungi due to its polycationic nature. It also exhibits antioxidant, anti-inflammatory, and anticancer activities, demonstrating the great applicability of this biopolymer not only for food protection and packaging but also for other fields, like biomedical applications (e.g. wound dressing systems and drug delivery systems) 2.

Besides food packaging and biomedical applications, Chitosan also exhibits strong potential to be used in the development of biopolymeric formulations for natural fibers functionalization. Chitosan can be an excellent binding and dispersive agent essential for nanoparticles dispersion and adhesion to fibers, allowing the development of multifunctional systems based on the combined effect of biopolymers and nanomaterials 3.

References:

1 - Ferreira, D. P. et al. Porphyrin dye into biopolymeric chitosan films for localized photodynamic therapy of cancer. Carbohydr. Polym. 151, 160–171 (2016).

2 - Al-Tayyar, N. A., Youssef, A. M. & Al-hindi, R. Antimicrobial food packaging based on sustainable Bio-based materials for reducing foodborne Pathogens: A review. Food Chem. 310, 125915 (2020).

3 - Costa, S. M., Ferreira, D. P., Ferreira, A., Vaz, F. & Fangueiro, R. Multifunctional Flax Fibres Based on the Combined Effect of Silver and Zinc Oxide (Ag/ZnO) Nanostructures. Nanomater. (Basel, Switzerland) 8, 1069 (2018).

João Bessa

Fibrenamics, University of Minho, Portugal
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Biography

João Bessa is a Chemical Engineer Master, since 2012, from the Faculty of Engineering of the University of Porto (FEUP), a reference educational institution in a national and international level, with a specialization in Processes and Product, where he acquired skills in the area of reaction engineering, separation processes, polymeric materials and process dynamics and control, among others. Throughout his career, he worked in some companies such Sonae Indústria de Revestimentos (SIR), the Technological Center of Textile and Clothing Industries of Portugal (CITEVE), where he had the opportunity to work in several research projects in construction, automotive, textiles and sport areas. Currently, he is a Technology Manager at Fibrenamics International Platform of University of Minho, where he has gained experience and expertise in the innovation and development of multifunctional composite materials, advanced fibrous materials, surface chemistry and physics, product engineering and processing and analysis techniques, in collaboration with reference companies.

Because of his professional career, he is the author of more than 25 scientific publications on separation processes, characterization techniques, compatibility of materials and development of advanced composite materials, and holder of 4 patents.

LECTURE 11 - Biopolymers: from its discovery to the challenges of the future

João Bessa
Fibrenamics International Platform, University of Minho, Guimarães, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/96454861664?pwd=Y1YrOHhPK2xIYVVlaU9tMThEOWZGQT09

Due to the problems of pollution and overexploitation of natural resources, trends such as sustainability and the circular economy have been awakened increase global concerns. In this way, several methodologies and technological solutions have been explored, in order to mitigate the impact of the referred problems.

In this way, it is essential that the use of materials can be designed and optimized to remain in use for as long as possible and / or their disposal generates reduces levels of environmental impact. In this context, researching in the field of biopolymers has been verified as one of the main emerging development and innovation trends. In 2018, this class of materials was represented by only 1% of the approximately 360 million tonnes of the plastic produced, but it is estimated a growth of 25% in their global production capacity until 2023.

In this presentation, it will be explained the main driving factors of this growth, the main advantages and disadvantages of biopolymers, their main market areas, methods of obtaining and some application examples, looking for the future on this type of materials.

Senentxu Lanceros-Méndez

Centro de Física, University of Minho, Portugal
BCMaterials, Bilbao, Spain
IKERBASQUE, Bilbao, Spain
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Biography

S. Lanceros-Mendez is Ikerbasque Professor and Scientific Director at BCMaterials, Basque Center for Materials, Applications and Nanostructures, Leioa, Spain and Associate Professor (on leave) at the Physics Department of the University of Minho (Portugal). He graduated in physics at the University of the Basque Country, Leioa, Spain, and obtained his Ph.D. degree at the Institute of Physics of the Julius-Maximilians-Universität Würzburg, Germany. He was Research Scholar at Montana State University, Bozeman, MT, and visiting scientist at the Pennsylvania State University, USA and University of Potsdam, among others. His work is focused in the area of polymer based smart materials for sensors and actuators, energy and biomedical applications, with over 560 publications and 12 patents in the field. He has supervised 34 PhD students and four Spin-off companies based on technologies developed from his group.

LECTURE 12 - Biopolymers as a new generation of smart and multifunctional materials

S. Lanceros-Mendez
Centro de Física, University of Minho, Braga, Portugal
BCMaterials, Basque Center for Materials, Applications and Nanostructures, UPV/EHU Science Park, Leioa, Spain
IKERBASQUE, Basque Foundation for Science, Bilbao, Spain.
Zoom link: https://videoconf-colibri.zoom.us/j/97996988506?pwd=RWV6RkNnUmdnQURpVkRNNU5ybm1SZz09

Close related to the strong evolution of the Internet of Things (IoT) and Industry 4.0 concepts, enabling new services and production paradigms, smart and multifunctional materials are a key driving force for the development of wireless, sustainable and interconnected systems. In particular, printable smart materials is an area of increasing interest due to low-cost fabrication, simple integration into devices and possibility of obtaining multifunctional materials over large and flexible areas. The impact of printable smart and multifunctional materials span from the areas of sensors and actuators, to energy generation and storage and tissue engineering applications, among others. In this scope, biopolymers are finding increasing interest to associate, to the aforementioned application areas, the necessary concepts of environmental friendly and circular economy. The present talk will summarize the main features, achievements and the challenges associated with the use of biopolymers as advanced multifunctional materials.

Marko Karkkainen

Clewat Ltd, Finland

e-mail: marko.karkkainen@clewat.com

Biography

Mr. Marko has three decades of experience in the circular economy, marketing, branding, sales, general and waste management in Europe, US, China and Asia Pacific. He has provided environmental solutions to the numbers of municipalities, industries and residential areas globally.

He holds a master's degree in Marketing from The University of South Wales, UK. Established businesses in Singapore, China, Hong. Kong, Finland and Netherlands.

Created China, Asia Pacific division. Managing growth $'0M to $'000M

Few references of waste management plans in Asia

- Bangkok Municipality
- Jakarta
- Kuala Lumpur
- Manila
- Semarang
- Jeneponto etc.

Companies and activities:

Clewat Oy

We bring new efficiency into the fight for saving the seas. We develop and manufacture water cleaning vessels that are able to clean up garbage and microplastics from waterways. The technology of our vessel is based on the creation and utilization of water flow.

Center of Excellence – Waste to Value/ Head of the Center

Center for Policy making, capacity building, tech research, training and education.

WasteTrade/ Sagacity Environment Pte Ltd/ Founder

We have created a marketplace that connects buyers and sellers of recyclable materials from around the world. Is a high-tech environmental protection company registered in Singapore, which devotes itself to improving city environment. Waste to Energy solutions.

LECTURE 13 - Marine harvester from disadvantages to raw materials – Clewat Ltd. Case study

Marko Karkkainen
Clewat Ltd, Kokkola, Finland
Zoom link: https://videoconf-colibri.zoom.us/j/92813560406?pwd=eDIwZEpFOW5qWEtieVYzWnBZOFg0QT09

Clewat is a Finland-based international cleantech growth company funded by the Finnish Government. Clewat makes environmental solutions based on innovative patent-pending flow-management approach. The company manufactures and operates solutions related to removal of harmful water plants and algae, marine plastic, oil and chemical spills; environmentally sustainable melting of snow and air purification.

Clewat's mission is a clean, plastic-free sea with the help of a sea cleaning vessel developed by the Chief innovator Johannes Myllykoski. Clewat's innovation is one of the most effective solutions to marine environmental problems today. Innovation is based on exploiting the flow of water, which allows high power to be achieved with a small amount of energy. The vessel collects plastic, oil and harmful vegetation with the booms at the front, where the water flow is regulated so that various debris and impurities enter the ship's conveyor and then sorted into tanks.

In the removal of water-based nuisances the company currently produces 3rd generation cleaning vessels, i.e. Clewat Cleansweep -series. That particular vessel type has been operated by Clewat in more than half-a-dozen-countries with excellent results. The Cleansweep-solution has won the Ålandsbanken Baltic Sea award for a most important innovation in 2018. Additionally, the development and piloting work has been supported by the government of Finland, and the vessels cleaning work has been commissioned by various governmental and private organizations.

Andreia Gomes

CBMA, UMinho, Portugal
e-mail: agomes@bio.uminho.pt

Biography

Andreia C. Gomes, BSc in Biology, PhD in Neurology, is an Assistant Professor in the Department of Biology at University of Minho, Portugal, since 2007, Group Leader at CBMA – Centre of Molecular and Environmental Biology and member of the Scientific Council of IB-S (Institute of Science and Innovation for Bio-Sustainability). She is co-founder of spin-off Nanodelivery-I&D em Bionanotecnologia, Lda., and frequently serves as evaluator in national and international project/scholarship grant programs.

She has co-authored 3 patents and 90 papers in international peer-reviewed journals, and supervised several Master, Doctoral and Postdoctoral students.

Her current research interests are focused on the study of the interface between nanostructured materials and cells and tissues, as to optimize biological and/or therapeutic effect with minimal toxicity risk. This implies a strong investment in collaborations with experts of other scientific areas.

LECTURE 14 - Biointerfaces: adjusting biological assays for biomaterials validation

Andreia Gomes
CBMA – Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/99133883901?pwd=aFRyaFNiRnRqeEpvUjkwb2h1alcwZz09

Current therapeutic approaches increasing rely on novel biomaterials and nanostructured systems, which must be thoroughly tested for safe use in humans. Different parameters must be assessed, in particular identification of potential toxicity issues for the human cells and tissues. Furthermore, validation of intended bioactivity often requires customization of standard methodology. An overview of different alternative methods will be given and concrete examples will be discussed. Key aspects in selecting and adjusting experimental strategies to evaluate biomaterials and nanosystems interaction with biological interfaces will be debated.

Mariana Oliveira

CICECO, UAveiro, Portugal
e-mail: mboliveira@ua.pt

Biography

Mariana B. Oliveira has a PhD in Biomedical Engineering, from the University of Minho. During her doctoral studies M. B. Oliveira focused on the optimization of biomaterials for tissue regeneration using combinatorial approaches and high-throughput screening. She currently develops her research at the COMPASS RG (CICECO – Aveiro Institute of Materials, University of Aveiro), where she has been interested in understanding relations between biomaterials' and environmental physical cues – especially architectural and mechanical features – and cellular response. M. B. Oliveira's current research interests mostly focus on the exploitation of stem cells and cell/biomaterial hybrids for tissue repair, and also to develop islet transplantation strategies.

LECTURE 15 - Building functional biomaterials from renewable polymers

Mariana B. Oliveira
CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Aveiro, Portugal
Zoom link: https://videoconf-colibri.zoom.us/j/91039620298?pwd=ZmlzRVBGdkNyeERURVJiWkY5UGVNZz09

The application of polymers extracted from renewable resources for the development of medical technologies is an opportunity to accelerate the exploitation of natural assets in eco-friendly strategies. Additionally, the extraction of biologically relevant polymers enables valorizing industrial waste, which can be integrated in cycles of sustainable technological development. A wide plethora of biopolymers has proved cytocompatible and bioactive, imparting these materials with the potential to be used as added-value elements for tissue regeneration, design of medical devices, and development of disease models and functional labware/diagnosis tools.

Advances on techniques to process biomolecules extracted from renewable sources has enabled adjusting the physical, chemical, and architectural properties of implantable devices towards optimal performance for the regeneration of specific tissues and treatment of diseases. Structures based on highly hydrated polymers, such as hydrogels, have been incorporated into (stem) cell delivery strategies. These materials have also captivated the attention of several industry and research segments, and have been incorporated as important players in the development of implantable sensors and actuators, food supplements, as well as in the pharmaceutical industry.

In this session, several applications of polymers derived from natural resources will be addressed, with focus on their ability to be processed and chemically modified to render biomaterials and devices with promising physical properties for cell fixation in tissue defects [1], as well as to integrate combined strategies aimed at tissue regeneration [2].

References:

1 - M.B. Oliveira, H.X.S. Bastos, J.F. Mano, Sequentially Moldable and Bondable Four-Dimensional Hydrogels Compatible with Cell Encapsulation, Biomacromolecules, 19 (2018) 2742-2749.

2 - D. Lopes, C. Fernandes, J.M. Nóbrega, S.G. Patrício, M.B. Oliveira, J.F. Mano, Screening of perfused combinatorial 3D microenvironments for cell culture, Acta Biomaterialia, 96 (2019) 222-236.

Nuno Neves

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e-mail: nevesi3bs@gmail.com

Biography

Nuno M. Neves is an Associate Professor with Habilitation at the Research Institute I3Bs on Biomaterials, Biodegradables and Biomimetics. This is a research unit of Excellence, directly funded by the Portuguese Foundation for Science and Technology (FCT). The I3Bs also integrates the PT Associate Laboratory ICVS/3B's being Nuno M. Neves one of the members of the Board of Directors. He is the Coordinator of the Biomaterials, Rehabilitation and Biomechanics branch of the Integrated Master Course of Biomedical Engineering of the University of Minho Erasmus Academic coordinator.

As of Jun 2020, he is the author of 193 publications listed in the Web of Science (145+ peer reviewed international papers), with h-factor of 42 and a total number of citations of over 5600 (h:45;6200 in Scopus).

He is an elected member of the Board of Governors of the European Society for Artificial Organs and responsible for the Tissue Engineering Working Group of the ESAO.

LECTURE 16 - Biomaterials, Porous Scaffolds and Cells for Advanced Therapies

Nuno M. Neves
I3Bs - Research Institute on Biomaterials, Biodegradables and Biomimetics, University of Minho, Guimarães, Portugal
Zoom Link: https://videoconf-colibri.zoom.us/j/97777323285?pwd=MWNhU2tGaDhlM1RpcjBPeGF2WXd0UT09

Among the various possible embodiements of Advanced Therapies and in particular of Tissue Engineering, the use of temporary scaffolds to regenerate tissue defects is one of the key issues. The scaffolds should be specifically designed to create environments that promote tissue development and not merely to support the maintenance of communities of cells. To achieve that goal, highly functional scaffolds may combine specific morphologies and surface chemistry with the local release of bioactive agents.

This talk will review the basic concepts required for the development of natural-based biomaterials and scaffolds in combination with stem cells for advanced biomedical devices and therapies.

ZOOM LINKS

MONDAY JUNE 22

10 AM

Introduction

https://videoconf-colibri.zoom.us/j/96649456731?pwd=Qm5kcDRUZzFyREpoUWxvdENkeXBwUT09

Meeting ID: 966 4945 6731

Password: 837264

11:00 AM

Margarida Casal

https://videoconf-colibri.zoom.us/j/96649456731?pwd=Qm5kcDRUZzFyREpoUWxvdENkeXBwUT09

Meeting ID: 966 4945 6731

Password: 837264

2 PM

Raul Machado

https://videoconf-colibri.zoom.us/j/95713396410?pwd=NDdwS0duVi85MS8vNmFKMUNiYWpodz09

Meeting ID: 957 1339 6410

Password: 922884

3:30 PM

Isabel João Silva

https://videoconf-colibri.zoom.us/j/93973696327?pwd=RWI4K1V1Y2MzVkRNWHQwRGtrMVdvUT09

Meeting ID: 939 7369 6327

Password: 672131

TUESDAY JUNE 23

10:30 AM

André da Costa

https://videoconf-colibri.zoom.us/j/98385061013?pwd=NHZ4SjBTNmg0YUpPeVRNZDNsS2tLZz09

Meeting ID: 983 8506 1013

Password: 940885

2:30 PM

Christopher Holland

https://videoconf-colibri.zoom.us/j/96764991041?pwd=QURDNm1pdkNleGZkMlcyV0FlL0xvQT09

Meeting ID: 967 6499 1041

Password: 169910

4 PM

Rui Pereira

https://videoconf-colibri.zoom.us/j/98087744526?pwd=UjVEWWFUQjhVMWl1K053bm1LOXVMQT09

Meeting ID: 980 8774 4526

Password: 711991

WEDNESDAY JUNE 24

10 AM

Lars Berglund

https://videoconf-colibri.zoom.us/j/98103772254?pwd=ZnpKRmNVSFEwa2w1T3ZYdmhpZmFoUT09

Meeting ID: 981 0377 2254

Password: 401037

2:30 PM

TP1 – André da Costa and Diana Gomes

https://videoconf-colibri.zoom.us/j/95770862429?pwd=TWVVSGt1bzFGeWl6T3NSODVpbWdyQT09

Meeting ID: 957 7086 2429

Password: 853706

4:30 PM

Artur Ribeiro

https://videoconf-colibri.zoom.us/j/94047303345?pwd=TGNIUWZsZGNJSEdYYnZpckx3dldNdz09

ID da reunião: 940 4730 3345

Password: 113037

THURSDAY JUNE 24

10:30 AM

António Vicente

https://videoconf-colibri.zoom.us/j/91354587051?pwd=Q3lIcWExU2NzeUhBVmkvRkxSZ0ZlZz09

Meeting ID: 913 5458 7051

Password: 246846

2:30 PM

Diana Ferreira

https://videoconf-colibri.zoom.us/j/96156344337?pwd=SGZzcndSZU0rQlAxYi8wSkp4V0Z5Zz09

Meeting ID: 961 5634 4337

Password: 576247

4 PM

João Bessa

https://videoconf-colibri.zoom.us/j/96454861664?pwd=Y1YrOHhPK2xIYVVlaU9tMThEOWZGQT09

Meeting ID: 964 5486 1664

Password: 229386

BIOPOLYMERS BASED ON RENEWABLE RESOURCES: FROM SYNTHESIS TO APPLICATIONS

FRIDAY JUNE 26

10:30 AM

Senentxu Lanceros-Méndez

https://videoconf-colibri.zoom.us/j/97996988506?pwd=RWV6RkNnUmdnQURpVkRNNU5ybm1SZz09

Meeting ID: 979 9698 8506

Password: 947328

2:30 PM

Marko Karkkainen

https://videoconf-colibri.zoom.us/j/92813560406?pwd=eDIwZEpFOW5qWEtieVYzWnBZOFg0QT09

Meeting ID: 928 1356 0406

Password: 179057

4:30 PM

TP2 – Rui Pereira

https://videoconf-colibri.zoom.us/j/95609801712?pwd=RkhXRHZiZURTQkZHbXBjbEVQRit3QT09

Meeting ID: 956 0980 1712

Password: 230282

MONDAY JUNE 29

10:30 AM

Andreia Gomes

https://videoconf-colibri.zoom.us/j/99133883901?pwd=aFRyaFNiRnRqeEpvUjkwb2h1alcwZz09

Meeting ID: 991 3388 3901

Password: 457354

2:30 PM

Mariana Oliveira

https://videoconf-colibri.zoom.us/j/91039620298?pwd=ZmlzRVBGdkNyeERURVJiWkY5UGVNZz09

Meeting ID: 910 3962 0298

Password: 259569

TUESDAY JUNE 30

10:30 AM

Nuno Neves

https://videoconf-colibri.zoom.us/j/97777323285?pwd=MWNhU2tGaDhlM1RpcjBPeGF2WXd0UT09

Meeting ID: 977 7732 3285

Password: 308217

THURSDAY JULY 2

10 AM

Journal Club 1

https://videoconf-colibri.zoom.us/j/96203136251?pwd=NGxqSDh6U0lxMHFOdkNLajJLdlJqdz09

Meeting ID: 962 0313 6251

Password: 581852

2:30 PM

Journal Club 2

https://videoconf-colibri.zoom.us/j/95284886354?pwd=L1BrUG9nRGhRUWg3c0lkRi9MOGw0Zz09

Meeting ID: 952 8488 6354

Password: 633250

FRIDAY JULY 3

10 AM

Journal Club 3
https://videoconf-colibri.zoom.us/j/96649972136?pwd=VS93Wnd0dXNyRyttczRxd0RCemxIQT09

Meeting ID: 966 4997 2136

Password: 053381

2:30 PM

Journal Club 4

https://videoconf-colibri.zoom.us/j/92683711349?pwd=d0lRT3AwWXJxREhoYXY0R2wxWUc2QT09

Meeting ID: 926 8371 1349

Password: 357577

Universidade do Minho
Escola de Ciências

Departamento de Biologia

PROGRAMA OPERACIONAL REGIONAL DO NORTE

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