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1550th Conference

3rd Annual Conference and Expo on

Biomaterials

March 05-06, 2018 | Berlin, Germany

Scientific Tracks & Abstracts

Day 1

Sessions:

Day 1 March 05, 2018

Advanced Materials | Tissue Engineering and Regenerative Medicine | Biomaterials and Nanotechnology

Session Chair
Sandra Elizabeth Rodil
Universidad Nacional Autónoma de México, México

Session CO-Chair
Je-Ken Chang
Kaohsiung Medical University, Taiwan

Session Introduction

Title: **Weight loss, corrosion resistance and biocompatibility of titanium oxide coatings on magnesium alloys**

Sandra Elizabeth Rodil, Universidad Nacional Autónoma de México, México

Title: **Hyaluronan microenvironment enhances chondrogeneic but prevents osteogenic effects of Simvastatin in adipose derived stem cells**

Je-Ken Chang, Kaohsiung Medical University, Taiwan

Title: **Preparation analysis of polymer colloid of xanthan gum-chitosan/nickel nanowires**

Hung-Bin Lee, Dayeh University, Taiwan

Title: **Metallic biomaterials in endoprosthetics: The surface microstructure of retrieved hip and knee endoprostheses**

Monika Jenko, Institute of Metals and Technology, Slovenia

Title: **Development of HA-modified hydrogel for adipose derived stem cells based articular cartilage regeneration**

Mei-Ling Ho, Kaohsiung Medical University, Taiwan

YRF: **Understanding mechanical properties of electrospun networks: Analysis, tailoring and simulation**

Alexandre Morel, Empa, Switzerland

YRF: **Fabrication of thermo-responsive surfaces with nanocone array**

Qianqian Cui, Dalian University of Technology, China

S E Rodil et al., J Biotechnol Biomater 2018, Volume 8
DOI: 10.4172/2155-952X-C1-088

Weight loss, corrosion resistance and biocompatibility of titanium oxide coatings on magnesium alloys

S E Rodil[1], **P Silva-Bermudez**[2], **J Victoria-Hernandez**[3], **S Yi3** and **D Letzig**[3]
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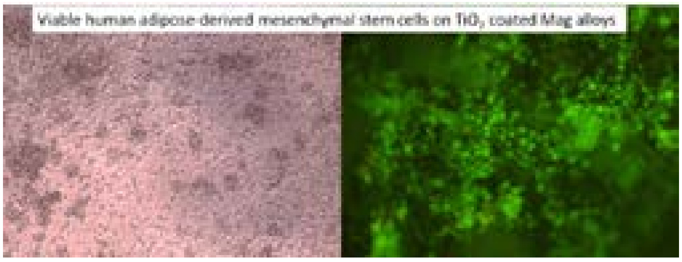
[2]Instituto Nacional de Rehabilitación, México
[3]Magnesium Innovation Centre, Germany

Titanium oxide (TiO_2) has been recognized as the active layer responsible for the good biocompatibility and osteogenic properties of the Ti-based medical alloys used for dental and orthopedic applications. Meanwhile, magnesium (Mg) and its alloys are currently widely researched for orthopedic applications, since their mechanical properties are more adequate to balance load transfer between bone and implant, but also due to its biodegradability. Extensive mechanical, *in vitro* and *in vivo* studies have been done to improve the biomedical performance of Mg alloys through alloying, processing conditions and surface modifications, including coatings deposition. The main purpose of such modifications is to extend the degradation rate of the alloy in order to match it with bone self-healing time. In this work, we are investigating the use of titanium oxide coatings deposited by physical vapor deposition techniques on high purity Mg alloys. These TiO_2 coatings have been extensively evaluated to demonstrate that independent of the substrate into which they are deposited, the coatings have the ability to promote the differentiation of mesenchymal stem cells into the osteoblast lineage, while improving the corrosion resistance of the uncoated metallic substrate and inhibiting bacterial adhesion. Here, we present the preliminary results of the corrosion resistance of the coated Mg-alloys in physiological fluids, their cell biocompatibility and weight loss kinetics.



Recent publications

1. Albrektsson T, Chrcanovic B, Jacobsson M and Wennerberg (2017) Osseointegration of implants: A biological and clinical overview. JSM Dent Surg. 2(3):1022.
2. Wei-wei Chen, Ze-xin Wang, Lei Sun and Sheng Lu (2015) Research of growth mechanism of ceramic coatings fabricated by micro-arc oxidation on magnesium alloys at high current mode. Journal of Magnesium and Alloys 3(3):253-257.
3. Phaedra Silva Bermudez, Argelia Almaguer Flores, Victor I Garcia, Rene Olivares Navarrete and Sandra E Rodil (2017) Enhancing the osteoblastic differentiation through nanoscale surface modifications. Journal of Biomedical Materials Research Part A 105(2):498-509.
4. Argelia Almaguer-Flores, Phaedra Silva-Bermudez, Rey Galicia and Sandra E Rodil (2015) Bacterial adhesion on amorphous and crystalline metal oxide coatings. Materials Science and Engineering: C 57:88-99.
5. Kannan M B and Raman R K (2009) *In vitro* degradation and mechanical integrity of calcium-containing magnesium alloys in modified-simulated body fluid. Biomaterials 29(15):2306-14.

Biography

S E Rodil has bachelor and master degrees in physics from the National Autonomous University of Mexico (UNAM) and PhD degree from the University of Cambridge, UK. Her expertise in the development of surface modifications of metallic implants in order to improve the biological response. She has been particularly interested in the development of coatings to improve the osseointegration of metallic dental and orthopedic implants, aiming to find a solution that might also decrease the cost of the implants for their use in third world countries. She is a Professor at the National Autonomous University of Mexico, where she is involved in research and the preparation of the new generation of materials research students.

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Je-Ken Chang et al., J Biotechnol Biomater 2018, Volume 8
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Hyaluronan microenvironment enhances chondrogeneic but prevents osteogenic effects of simvastatin in adipose derived stem cells

Je-Ken Chang, Shun-Cheng Wu, Chung-Hwan Chen, Jhen-Wei Chen, Che-Wei Wu, Chien-Hsueh Chen and **Mei-Ling Ho**
Kaohsiung Medical University, Taiwan

Simvastatin (Sim) is a clinically used lipid lowing agent, which has been indicated to increase bone morphogenetic protein-2 (*BMP-2*) expression. *BMP-2* has been demonstrated to play a critical role in cartilage development, and is applied to promote chondrogenic differentiation of mesenchymal stem cells (MSCs). However, *BMP-2* was also used for osteogenic differentiation of MSCs. Hyaluronan (HA) is one of the main extra cellular matrices during the early stage of chondrogenesis, and we previously found that HA microenvironment initiates and promotes chondrogenesis of adipose derived stem cells (ADSCs). In this study, we hypothesize that HA enhances the chondrogenic effect and prevents osteogenic effect of Sim on ADSCs, and this can be applied for cartilage regeneration. The ADSCs were cultured *in vitro* in HA-coating, well treated with Sim, and the *BMP-2* expression, chondrogenesis as well as osteogenesis of ADSCs were analyzed. The result showed that HA microenvironment enhances Sim-induced *BMP-2* expression and chondrogenesis of ADSCs. The real-time PCR results showed that the *BMP-2* and chondrogenic genes (*SOX-9, Collagen type II and Aggrecan*) expressions induced by Sim in ADSCs were enhanced when cultured in HA-coated well (Figure. 1). The result from sGAG synthesis of ADSCs also shows HA microenvironment enhances more pronounced sulfated glycosaminoglycan (sGAG) synthesis of ADSCs that is induced by Sim (Figure. 2). HA microenvironment also reduces osteogenic genes expressions (osteocalcin and alkaline phosphatase) and calcium deposition of ADSCs that is induced by Sim (Figure. 3). The synergic effect of HA with Sim can promote chondrogenesis and prevent osteogenesis of ADSCs, and may be applied for articular cartilage defect regeneration. This result shows the local cue on affecting chondrogenesis and osteogenesis of *BMP-2* in ADSCs induced by Sim.

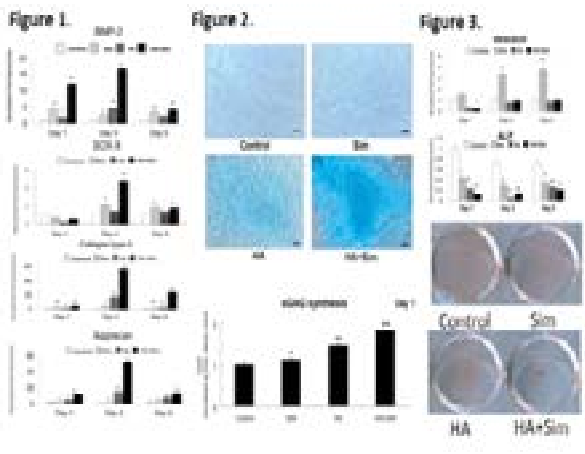

Figure 1. The mRNA expression levels of BMP-2 and chondrogenic genes of ADSCs in the Control (Non-treated), Sim (Sim treatment), HA (HA-coated well) and HA+Sim (HA-coated well with Sim treatment) groups on day 1, 3 and 5. Figure 2. Alcian blue staining of sGAG in 4 groups on day 7. Blue: Alcian blue staining. The sGAG synthesis by ADSCs in 4 groups were quantified by a DMMB assay. The sGAG synthesis normalized to the total DNA in each group is expressed as sGAG/DNA. Figure 3. The mRNA expression levels of osteogenic genes of ADSCs in 4 groups on day 1, 3 and 5. The calcium deposition by ADSCs in 4 groups on day 12. Red: Alizarin Red S staining

Recent publications

1. Wu S C, Chen C H, Wang J Y, Lin Y S, Chang J K, et al. (2018) Hyaluronan size alters chondrogenesis of adipose-derived stem cells via the CD44/ERK/SOX-9 pathway. Acta Biomater. 15(66):224-237.
2. Chuang S C, Chen C H, Fu Y C, Tai I C, Li C J, et al. (2015) Estrogen receptor mediates simvastatin-stimulated osteogenic effects in bone marrow mesenchymal stem cells. Biochemical Pharmacology 98(3):453-64.
3. Tai I C, Wang Y H, Chen C H, Chuang S C, Chang J K and Ho M L (2015) Simvastatin enhances Rho/actin/cell rigidity pathway that contributing to mesenchymal stem cells osteogenic differentiation. International Journal of Nanomedicine 10:5881–5894.
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5. Chen C H, Lin Y S, Fu Y C, Wang C K, Wu S C, et al. (2013) Electromagnetic fields enhance chondrogenesis of human adipose-derived stem cells in a chondro-genic microenvironment *in vitro*. Journal of Applied Physiology 114:647-655.

Biography

Je-Ken Chang is an Orthopedic Surgeon at the Kaohsiung Medical University. His research work focuses on Regenerative Medicine, especially Tissue Engineering of articular cartilage and bone, as well as degenerative diseases like osteoarthritis and osteoporosis. He has published his study results in journals including *Biomaterials, Acta Biomaterialia, Journal of Tissue Engineering and Regenerative Medicine and Journal of Applied Physiology.*

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Notes:

Hung-Bin Lee et al., J Biotechnol Biomater 2018, Volume 8
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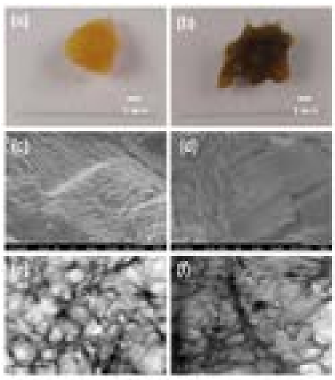
Preparation analysis of polymer colloid of xanthan gum-chitosan/nickel nanowires

Hung-Bin Lee, Yu-Teng Chang and **Kuei-Ping Liu**
Dayeh University, Taiwan

In this study, chitosan (Cs) and xanthan gum (XG) were made to react in a weight ratio of 1:1 to form a cross-linking polymer. Xanthan gum-chitosan/nanowire Ni(XG-Cs/-Ni) was prepared by the addition of nickel nanowire (NiNW) onto the XG-Cs to form the nano polymerization colloid. Field emission scanning electron microscope (FE-SEM) showed that the diameter of nickel nanowires was about 80 nm and the length was about 11 μm, with high density and high aspect ratio. The crystal planes (111) (200) and (220) [They are the growing directions of crystal planes (x,y,z)] were analyzed by X-ray diffraction (XRD). The results showed that the nanowires were fine nickel grains and had the characteristics of the crystal dislocation structure and the twin crystal structure which were observed by transmission electron microscopy (TEM). The melting points of XG-Cs/-Ni were measured by differential scanning calorimetry (DSC), they were 59.0-197.3/695.5°C. Analysis of XG-Cs/-Ni by the thermogravimetric analyzer (TGA) revealed three weight loss points.



Recent publications

1. Hung-Bin Lee and Meng Yen Wu (2017) A study on the corrosion and wear behavior of electrodeposited Ni-W-P coating. Metallurgical and Materials Transactions A 48:4667-4680.
2. Pin Han, Cheng-Mu Tsai and Hung-Bin Lee (2017) The proposed necessary and sufficient condition for spectral switches with concave reflectance of aluminum metal. Advances in Mechanical Engineering 9:1-9.
3. Hung-Bin Lee, Hsueh-Chuan Hsu, Shih-Ching Wu, Shih-Kuang Hsu, Peng-Hsiang Wang, et al. (2016) Microstructure and characteristics of calcium phosphate layers on bioactive oxide surfaces of air-sintered titanium foams after immersion in simulated body fluid. Materials 9:956-969.
4. H H Sheu, H B Lee, S Y Jian, C Y Hsu and C Y Lee (2016) Investigation on the corrosion resistance of trivalent chromium conversion passivate on electroplated Zn-Ni alloy. Surface and Coatings Technology 305:241-248.
5. H B Lee, J C Tsau and C Y Lee (2013) HER catalytic activity of electrodeposited ni-p nanowires under the influence of magnetic field. Journal of Nanomaterials 2013:9.

Biography

Dr. Lee has extensive expertise in performance improvement and innovation in metal corrosion and abrasion. His researches include innovative biomaterials reaction mode, the establishment of the nano-reaction mechanism based on the combination of biopolymer biomaterials, the applications of various researches of many scholars: the combination of improved and innovative adsorption method.

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Metallic biomaterials in endoprosthetics: The surface microstructure of retrieved hip and knee endoprostheses

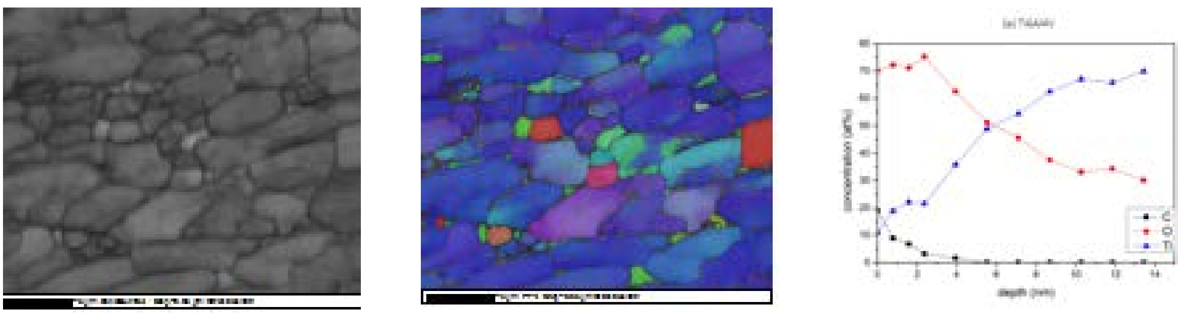
Monika Jenko[1], **Matjaž Godec**[1], **Matevž Gorenšek**[2], **Boštjan Kocjančič**[3] and **Drago Dolinar**[3]
[1]Institute of Metals and Technology, Slovenia
[2]MD-Medicina, Slovenia
[3]University Medical Centre, Slovenia

Statement of the Problem: The endoprosthetics of hip- and knee-joint replacements is currently the most common and successful methods in advanced surgery to treat degenerative joint disease for relieving pain and for correcting deformities. While these surgeries have positive outcomes, approximately 10% of the implants fail prematurely. The most common causes for revision surgeries are aseptic loosening and implant infection.

Orientation: Microstructure is a neglected factor in implant design, and a detailed microstructure characterization is required to determine the role of prematurely failed implants that determine the biological responses, such as the composition and structure of the surface oxide film, the surface contamination and the surface topography. The release of metal ions and the lack of the wear resistance of biomaterials result in implant loosening, which leads to implant failure. The release of metal nanoparticles and polyethylene debris into the soft tissue at the site of the implants is decisive for osteolysis and the implants' longevity.

Findings: The surface chemistry of Ti alloys (Ti6Al4V, Ti6Al7Nb) and the CoCrMo alloy of (retrieved and new) hip and knee endoprostheses components were studied in detail using advanced electron spectroscopy techniques FE-SEM, EDS, EBSD, AES and XPS. We will present the findings from the clinical and materials sciences point of view. All the retrieved implants were sent for sonication in Ringer's solution for cleaning and pathology analysis. Later, they were dried and stored in special sterile Wipak medical Steriking bags. All the X-ray images of implants in the patients are stored in the database of the UMC.

Conclusion & Significance: The surface chemistry results showed that thin oxide films on the Ti alloys prevent further corrosion, improve the biocompatibility, and affect the osseointegration. It is obvious that we need to keep an optimal microstructure with regards to the corrosion and mechanical properties, which can be controlled through processing parameters and be standardized in the near future.



EBSD mapping of Ti6Al4V phases, (a)band- contrast image, (b) phase-map image red Ti (hcp), green Ti -cubic (bcc), (c) AES depth profile of thin oxide film on Ti6Al4V alloy.

Recent publications

1. Jenko M, Gorenšek Matevž, Godec Matjaž, et al. (2018) Surface chemistry and microstructure of metallic biomaterials for hip and knee endoprostheses. Applied Surface Science 427:584-593.
2. Dolinar D, et al. (2018) Biomaterials in endoprosthetics, Materiali in tehnologije 52(1): 89-98,
3. Raphel J, Holodniy M, Goodman S B and Heilshorn S C (2016) Multifunctional coatings to simultaneously promote osseointegration and prevent infection of orthopaedic implants. Biomaterials 84:301-314.
4. Le D H, Goodman S B, Maloney W J and Huddleston J I (2014) Current modes of failure in TKA: infection, instability, and stiffness predominate. Clin. Orthop. Relat. Res. 472:2197-2200.
5. M Navarro, A Michiardi, O Castano and J A Planell, (2008) Biomaterials in orthopaedics. J. R. Soc. Interface 5:1137-1158.

Biography

Monika Jenko completed her PhD in Material Science at the University of Ljubljana. For 11 years she was the Director and Initiator at the Institute of Metals and Technologies (IMT) and later joined the Jožef Stefan International Postgraduate School with Advanced Metallic Materials in the frame of the Nanoscience and Nanotechnology study program. She has worked in different national and international projects in the field of Material Science, Applied Surface Science, Surface Engineering, and Nanoscience and has been very active in the field of Biocompatible Materials since the last five years. She has published several papers in reputed journals and is a member of different international working groups.

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Notes:

Mei-Ling Ho et al., J Biotechnol Biomater 2018, Volume 8
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Development of HA-modified hydrogel for adipose derived stem cells based articular cartilage regeneration

Mei-Ling Ho, Shun-Cheng Wu, Chung-Hwan Chen and **Je-Ken Chang**
Kaohsiung Medical University, Taiwan

Regenerating the damaged articular cartilage to be a functional hyaline cartilage has been a clinically unmet need. Although several current treatment methods, micro-fracture, osteo-chondral grafting and autologous chondrocytes implantation, have been used to repair the damaged cartilage, the most concerned issue is the formation of unwanted fibrous cartilage rather than hyaline cartilage in the repaired tissue. The most difficult challenge in cartilage regeneration is that the tissue mainly possesses differentiated chondrocytes to maintain extra-cellular matrix homeostasis, which lacks of *in situ* and circulatory stem cells. One of the current approaches to solve this clinically unmet need is the stem cell-based tissue engineering. Adipose-derived stem cells (ADSCs) have been thought to be beneficial for use because of easy harvest, higher yield numbers and multi-potent differentiation. To make it possible for ADSCs-based articular cartilage regeneration, the most important thing to be solved is the *in situ* chondral-induction for ADSCs. We have conducted a series of studies to develop biomaterials that can provide the extra-cellular micro-environment, including chemical and physical cues, to optimize the ADSC chondrogenesis in the repair site of articular cartilage. We found that hyaluronan (HA) enriched micro-environment can initiate and enhance ADSC chondrogenesis via CD44 mediation. On the other hand, matrix stiffness has been indicated to direct stem cell differentiation into different tissues. We further developed the chondral-induction biomaterials by ways of adjusting chemical and physical cues. We found that the modified cross-linked HA products can be optimized by tuning the HA molecular weight and matrix stiffness. Most importantly, the cartilage regeneration effect of the newly developed HA-modified hydrogel product has been confirmed in an osteo-chondral defect rabbit model (Fig.1). The findings and biomaterial development from these studies provide the important information to persuade the possibility for the future clinical use of ADSCs-based articular cartilage regeneration.

Recent publications

1. Wu S C, Chen C H, Wang J Y, Lin Y S, Chang J K, et al. (2018) Hyaluronan size alters chondrogenesis of adipose-derived stem cells via the CD44/ERK/SOX-9 pathway. Acta Biomater 15(66):224-237.
2. Teong B, Wu S C, Chang C M, Chen J W, Chen H T, et al. (2018) The stiffness of a cross-linked hyaluronan hydrogel affects its chondro-induction activity on hADSCs. J Biomed Mater Res. B 106(2):808-816.
3. Wang Y H, Rajalakshmanan E, Wang C K, Chen C H, Fu Y C, et al. (2016) PLGA-linked alendronate enhances bone repair in diaphysis defect model. J Tissue Eng Regen M. 11(9):2603-2612.
4. Fu Y C, Wang Y H, Chen C H, Wang C K, Wang G J, et al. (2015) Combination of calcium sulfate and a simvastatin-controlled release microsphere enhances bone repair in critical-sized calvarial bone defects. Int J Nanomed 10:7231-7240.
5. Wu S C, Chen C H, Chang J K, Fu Y C, Wang C K, et al. (2013) Hyaluronan initiates chondrogenesis mainly via CD44 in human adipose derived stem cells. J Appl Physiol 114(11):1610-8.

Biography

Mei-Ling Ho has focused her study on Regenerative Medicine, especially Tissue Engineering of articular cartilage and bone, as well as degenerative diseases like osteoarthritis and osteoporosis, in the recent 20 years. In the field of research, she has published her study results in high ranking journals including *Biomaterials, Acta Biomaterialia, Journal of Tissue Engineering and Regenerative Medicine* and as well as *Journal of Applied Physiology*. Besides, she has also studied the stem cell biology for searching effect mechanism of drugs, nature products and physical agents, magnetic field and laser therapy. She also studied the novel gene effects on bone and cartilage by gene knock animals for searching the new drugs in future.

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Alexandre Morel, J Biotechnol Biomater 2018, Volume 8
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Understanding mechanical properties of electrospun networks: Analysis, tailoring and simulation

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Introduction: Electrospun membranes are increasingly investigated for tissue engineering application due to their structure mimicking the extracellular matrix architecture. As one important parameter, implants should mimic the mechanical properties of the host tissue in order to achieve a successful integration. E-spun fibers can be tailored in terms of diameter, mechanical properties as well as their geometrical arrangement that alters membrane porosity. However, influences of these factors on mechanical properties of the whole membrane and their interdependence are still poorly understood. This project aims to bridge the gap between microscopic single fiber and macroscopic membrane mechanical properties as well as fiber-to-fiber interaction. For this purpose, influences of fiber diameter and of fiber-to-fiber cross-linkage are investigated at different mechanical scale levels.

Methodology: Poly-(lactic acid) as a prominent biodegradable polymer is focused for fiber development. Membranes are produced with the nanospider (Elmarco), a pilot plant for industrial fiber volume production by needleless electrospinning. Mechanical behavior of isolated single fibers is measured by 3-point-bending testing by atomic force microscopy and axial tensile testing with a nanomechanical testing system. Polymer structure of fibers is assessed by different methods e.g. wide-angle x-ray scattering and selective amorphous phase dissolution. Geometrical deformation of fiber networks during uniaxial testing is investigated by in-situ scanning electron microscopy- and in-situ small-angle x-ray scattering tensile testing.

Findings: Thinner fibers have higher crystallinity level and higher molecular orientation leading to greater young's modulus. Also, higher fiber alignment during uniaxial deformation is found in membranes made out of thinner fibers. These factors lead to a stiffer response of those membranes in the direction of loading.

Outlook & Significance: Cells cultured onto mechanically tailored membranes under cyclic stretching will help to understand the performances of e-spun scaffolds for regenerative medicine application. Furthermore, we are currently developing a 3D-numerical model of membrane formation and structure informed by experimental data.

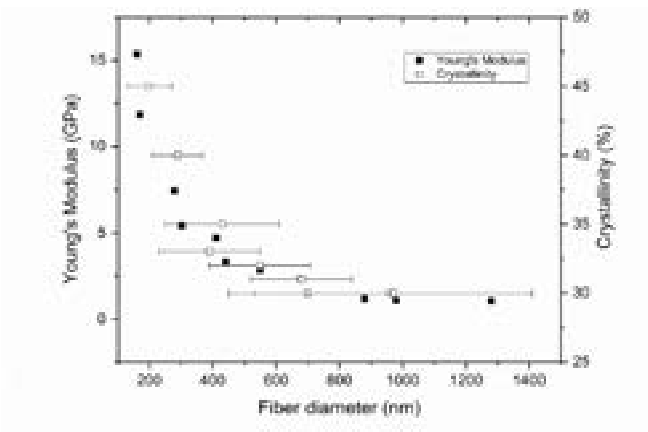

Figure: 1 Young's Modulus of single PLLA fibers in functions of its diameter and measured crystallinity of whole membranes in functions of their mean fiber diameter; both factors follow similar relationship.

Recent publications

1. Voorneveld J, Oosthuysen A et al. (2016) Dual electrospinning with sacrificial fibers for engineered porosity and enhancement of tissue ingrowth. Journal of Biomedical Materials Research Part B: Applied Biomaterials doi: 10.1002/jbm.b.33695
2. Bergström J S and Hayman D (2016) An overview of mechanical properties and material modeling of polylactide (PLA) for medical applications. Annals of Biomedical Engineering 44(2):330-340.
3. Bauer A J P, Wu Y, Liu J and Li B (2015) Visualizing the inner architecture of poly(caprolactone)-based biomaterials and its impact on performance optimization. Macromolecular Bioscience 15(11):1554-1562.
4. Yano T, Higaki Y, Tao D, et al. (2012) Orientation of poly (vinyl alcohol) nanofiber and crystallites in non-woven electrospun nanofiber mats under uniaxial stretching. Polymer 53(21):4702-4708.
5. Zhao X, Sun X, Yildirimer L, et al. (2016) Cell infiltrative hydrogel fibrous scaffolds for accelerated wound healing. Acta Biomaterialia 49:66-77.

Biography

Alexandre Morel's research interests are focused on applied tissue engineering to be highly interdisciplinary. He gained expertise in bio-microfluidics and cell culture working on the development of a cyclically-stretchable 3D-vascular network during his Master's thesis in ARTORG center in Bern (Switzerland). He worked on the development of a 3D-kidney model using bioprinting technologies during an internship at the University of Applied Sciences in Wädenswil (Switzerland). In addition to bio-microfluidics and bioprinting, expertise in electrospinning enables him to tackle tissue development with suitable solutions. During his PhD thesis, he acquired abilities to investigate mechanical aspects at different scale levels and could deepen his knowledge in mechanobiology. These new skills help to design scaffolds with appropriate mechanical properties for tissue engineering application.

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Notes:

Qianqian Cui et al., J Biotechnol Biomater 2018, Volume 8
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Fabrication of thermo-responsive surfaces with nanocone array

Qianqian Cui, Tianqing Liu, Kedong Song, Dan Ge, Shui Guan
Dalian University of Technology, China

Statement of the Problem: The bacterial adhesion to the solid surfaces and subsequent formation of biofilm are greatly harmful for the efficiency of material application and related processes. It is of important significance for protecting the environment and life health to study the formation mechanism of biofilm and the way of preventing the formation of biofilm. At present, we are working on fabricating the thermo-responsive material surfaces with nanocone array to regulate the bacterial adhesion and prevent biofilm formation, i.e. Bacterial cells are penetrated and killed by nanocone structures and thermo-responsive poly (N-isopropylacrylamide) (PNIPAAm) detaches and releases the dead cells and debrises through the change of temperature.

Method & Technology: We have prepared hexagonally packed ordered alumina inverse taper-nanopores by using one-step hard anodizing and etching peeling of high purity aluminum foils followed by multistep mild anodizing and etching pore-widening. Then adopting template-based hot embossing copies the shapes of anodic aluminum oxide template onto the polymer surfaces on which the nononipple structures can be attained. These nononipples were transformed to nanocones by chemical dissolution. According to the type of substrate materials, suitable methods of grafting thermo-responsive poly (N-isopropylacrylamide) (PNIPAAm) were chosen to obtain the thermo-responsive materials with nanocone array. For example, the glass surface and polymer surface with nanocone array were grafted with PNIPAAm by the method of ARGET-ATRP and ultraviolet irrigation, respectively.

Conclusion & Significance: Modulating the structural parameters of the thermo-responsive nanocone surfaces will realize the target of regulating bacterial adhesion, killing bacteria and releasing dead cells and their cell fragments. The material that is able to regulate bacterial adhesion and prevent biofilm formation belongs to physical environmental friendly materials, which provides new mentality for the control of bacterial adhesion and biofilm formation.

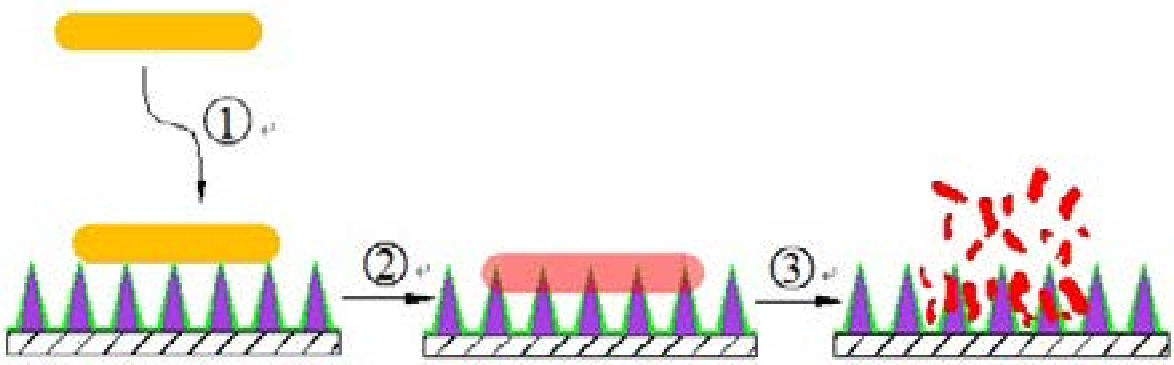

Figure 1: Schematic diagram of the dynamic evolution process of the bacteria which adhered to the temperature responsive surface with nanocone array. Green represents PNIPAAm. 1. Bacteria attach to the temperature responsive surface with nanocone structures. 2. The cell wall of bacterium is penetrated and killed by nanocone. 3. The dead cells break up into debris which is released from surface when changing temperature

Recent publications

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2. Lee W, Ji R, Gosele U and Nielsch K (2006) Fast fabrication of long-range ordered porous alumina membranes by hard anodization. Nature Materials 5:741-747.

3. Li J, Li C, Chen C and Hao Q (2012) Facile method for modulating the profiles and periods of self-ordered three-dimensional alumina taper-nanopores. ACS Applied Material & Interfaces 4:5678-5683.
4. Zhang W, Lin G, Li J and Xue H (2015) Fabrication of biomimetic polymer nanocone films with condensate micro drop self-removal function. Advanced Materials Interfaces 2: 1500238.
5. Li J, Zhu J and Gao X (2014) Bio-inspired high-performance antireflection and antifogging polymer films. Small 10:2578-2582.

Biography

Qianqian Cui is studying for doctor degree in the Faculty of Chemical, Environmental and Biological Science and Technology, Dalian University of Technology. She has been studying the subject for nearly one year. She is very interested in the research on the fabrication of materials which prevent inherently biofilm formation by physical methods. They have produced the nanocone surfaces and firmly believe that the project will contribute to the development for bioactive materials.

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Notes:

Sessions:

Day 1 March 05, 2018

Polymer Biomaterials | 3D printing of Biomaterials | Biomaterials in Delivery Systems

Session Chair
Maria Helena Gil
University of Coimbra, Portugal

Session Co-Chair
Melinda Szalóki
University of Debrecen, Hungary

Session Introduction

Title: **Polymeric materials for ophthalmological applications**
Maria Helena Gil, University of Coimbra, Portugal

Title: **Investigation of 3D printable biocompatible orthodontic polymers**
Melinda Szalóki, University of Debrecen, Hungary

Title: **Development of fluorescent water-soluble hyperbranched polymers in nanomaterials and biomaterials**
Tzong-Yuan Juang, China Medical University, Taiwan

Title: **Biopolymer based films for wound dressings**
Filipa A M M Goncalves, University of Coimbra, Portugal

YRF: **b-cyclodextrin-linked chitosan/alginate compact polyelectrolyte complexes (CoPECS) as natural and functional biomaterials with intrinsic anti-inflammatory activity**
Alexandre Hardy, Université de Strasbourg, France

Video Presentation

Title: **Fabrication of porous materials**
Peng-Sheng Wei, National Sun Yat-Sen University, Taiwan

M Helena Gil et al., J Biotechnol Biomater 2018, Volume 8
DOI: 10.4172/2155-952X-C1-088

Polymeric materials for ophthalmological applications

M Helena Gil, A Jorge Guiomar, Patrícia Alves and **Filipa A M M Gonçalves**
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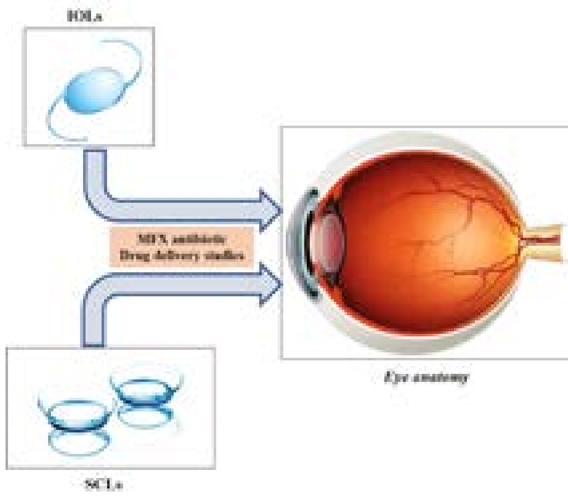
Nowadays, both synthetic and natural polymeric materials have been applied in the ophthalmologic area. In our group some work has been done on the development of intraocular lenses (IOLs) as well as on soft contact lenses (SCLs) for endophthalmitis prophylaxis in cataract surgery and implantable disks for glaucoma treatment. The use of ocular controlled drug delivery systems after ocular surgery is being used as an alternative to the usual eye drop administration. The development of SCLs based on acrylic monomers for this purpose is the subject of our more recent study. Some membranes were prepared by bulk polymerization using different monomers, such as ethylhexyl methacrylate, methyl methacrylic acid and a crosslinking agent, and were characterized physical and chemically. To increase their performance as drug delivery systems, the surface membranes were also modified by using either graft copolymerization or plasma treatment. All the copolymers were loaded with several ophthalmologic drugs and used for drug release studies.



Recent publications

1. Vieira A P, Pimenta A F, Silva D, Gil M H, Alves P, Coimbra P, Mata J L, Bozukova D, Correia T R, Correia I J, Serro A P and Guiomar A J (2017) Surface modification of an intraocular lens material by plasma-assisted grafting with 2-hydroxyethyl methacrylate (HEMA), for controlled release of moxifloxacin. European Journal of Pharmaceutics and Biopharmaceutics 120:52-62.
2. Moura M J, Brochado, J Gil, M H and Figueiredo M M (2017) *In situ* forming chitosan hydrogels: Preliminary evaluation of the *in vivo* inflammatory response. Materials Science & Engineering C-Materials for Biological Applications 75: 279-285.
3. Carreira A S, Teixeira R F A, Beirdo A, Vieira R V, Figueiredo M M and Gil M H (2017) Preparation of acrylic based microcapsules using different reaction conditions for thermo-regulating textiles production. European Polymer Journal 93:33-43.
4. Ferreira P, Alves P, Coimbra P and Gil MH (2015) Improving polymeric surfaces for biomedical applications: a review. Journal of Coatings Technology and Research 12:463-475.
5. Carreira A S, Ferreira P, Ribeiro M P, Correia T R, Coutinho P, Correia I J and Gil M H (2014) New drug-eluting lenses to be applied as bandages after keratoprosthesis implantation. International Journal of Pharmaceutics 477:218-226.

Biography

M Helena Gil is currently Professor at Chemical Engineering Department, University of Coimbra. She has a large experience in the preparation and characterization of polymeric materials to be applied in biomedical or industry fields. Research in polymer chemistry within her group includes also preparation and characterization of hydrogels, immobilization of biological compounds, biosensors and drug delivery systems. She is author or co-author of more than 200 scientific papers on international reviews and of more of 10 book chapters. M Helena Gil have supervised more than 60 MSc students and more than 20 PhD students, with 30 research fellows under the framework of several national and international projects.

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Notes:

Melinda Szaloki et al., J Biotechnol Biomater 2018, Volume 8
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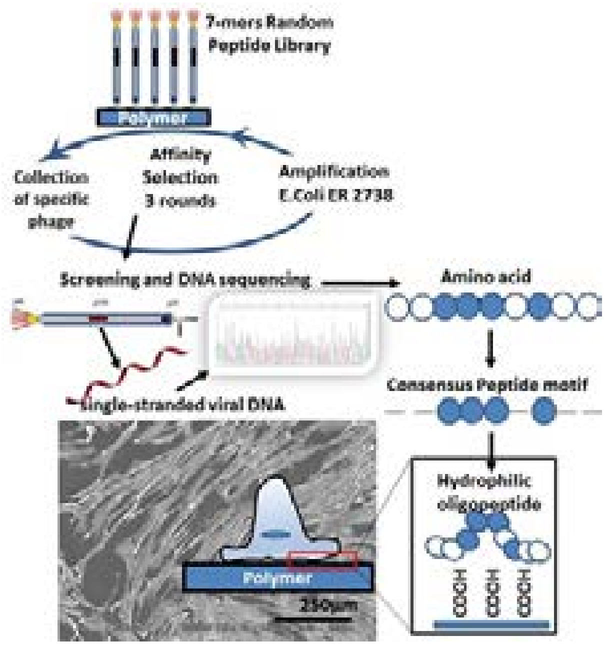
Investigation of 3D printable biocompatible orthodontic polymers

Melinda Szalóki, Ferenc Tóth, Sara Khandan, Hamid Javadi and **Csaba Hegedűs**
University of Debrecen, Hungary

Biocompatible MED620 and MED610 polymers are 3D printable materials used mainly in oral surgery and orthodontics. Researchers have reported that MED610 significantly reduced the cell numbers of keratinocytes, even in non-direct contact. The purpose of this study is to investigate the effect of different surface manipulations on cell proliferation, surface specific oligopeptides regarding MED610 and to compare to MED 620 and MED610 regarding degree of conversion (DC), polymerization shrinkage (PS) (Stratasys, USA). The MED610 and MED620 samples were printed by Objet30 OrthoDesk (Stratasys, USA) 3D printer. In cell proliferation study osteosarcoma (Saos-2) and dental pulp stem cells (DPSC) were used. The surface manipulation was done by two methods of support material removal. 7-mer oligopeptides was used to determine surface specific peptides based on New England Biolabs protocol. The PS of polymers was measured based on Archimedes' principle by an analytical balance (Adam PW 254, UK). A Nicolet 6700 Fourier Transform Infrared spectroscope (FTIR) (Thermo Electron Co. USA) in attenuated total reflectance (ATR) mode was used for DC measuring. The surface treatment has an effect on cell proliferation and surface specific oligopeptides. The PS of MED620 and MED610 photopolymers were 7.56 V/V% ± 0.12 and 8.17 V/V % ± 0.24, respectively. The DC of MED620 and MED610 samples 93.34 % ± 2.66 and 97.76 % ± 1.31, respectively. Based on the results of the study it was found that the chemical modification of polymer surface influence the numbers of the attached cells, sequence of surface specific peptides and the physical properties i.e. polymerization shrinkage and degree of conversion that can be related to the different application and composition of the 3D printable biocompatible orthodontic polymers.



Phage display on 3D printable biocompatible polymer surface

Recent publications

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2. Vodnik M, Strukelj B, Lunder M (2012) HWGMWSY, an unanticipated polystyrene binding peptide from random phage display libraries. Analytical biochemistry 424: 83-86.
3. Szaloki M, Radics T, Hegedus Cs (2016) Characterization of dental allergy associated polymer surfaces by phage display technique. Fogorvosi szemle 109: 75-80.
4. Dodziuk H (2016) Applications of 3D printing in healthcare. Polish journal of cardio-thoracic surgery 13: 283–293.
5. Walsh ME, Ostrinskaya A, Sorensen MT, Kong DS, Carr PA (2016) 3D-Printable materials for microbial liquid culture. 3D printing and additive manufacturing 3: 113-118.

Biography

Melinda Szalóki, chemist, defended her doctoral thesis with the qualification of summa cum laude in 2013. In her PhD thesis she summarized the results of her 10 years research work, the application possibilities of reactive polymer nanoparticles in dentistry. The supervisor was Prof. Csaba Hegedűs MD, LDS, PhD. Her results was published in international journals, in Colloid and Polymer Science, in Macromolecules and in Reactive and Functional Polymers. In 2013, she has won Ányos Jedlik Doctoral Candidate Scholarship in the framework of TÁMOP-4.2.4.A/2-11/1-2012-0001'National Excellence Program'. The topic of the ongoing research is the investigation the bindings of oligopeptides to poly methyl methacrylate (PMMA) surface by phage display and Fourier transformation surface plasmon resonance spectroscopy (FT-SPR). She is involved in the education activities of Dental Materials and in Student's Research Work as a supervisor. Dr. Melinda Szalóki was awarded on the IAAM 2016 (by the International Association of Advanced Materials) in Stockholm. Her research area are immediate repair of resin based composite, characterization of 3D printable dental polymers, application possibility of gold nanoparticles in dentistry and investigation of biomolecular interaction with phage display and Fourier Transformed Surface Plasmon Resonance (FT-SPR) spectroscope.

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Notes:

Tzong-Yuan Juang, J Biotechnol Biomater 2018, Volume 8
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3rd Annual Conference and Expo on

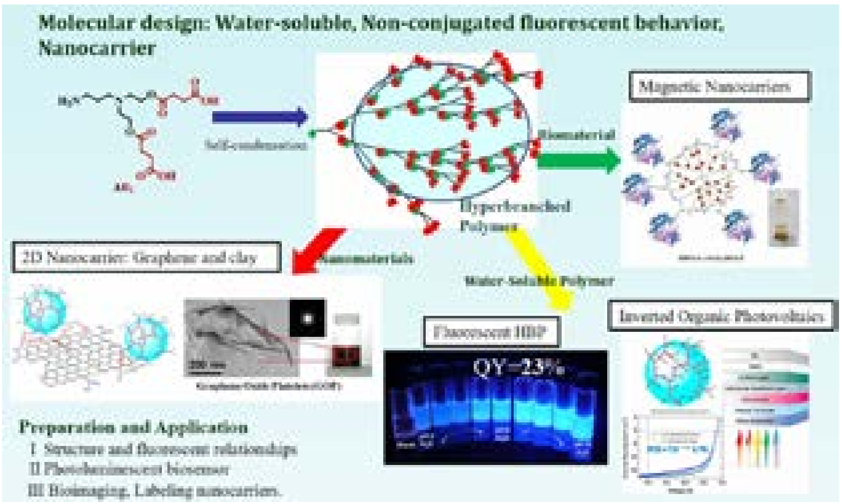
BIOMATERIALS

March 05-06, 2018 | Berlin, Germany

Development of fluorescent water-soluble hyperbranched polymers in nanomaterials and biomaterials

Tzong-Yuan Juang
China Medical University, Taiwan

In this study, we intend to used self-condensation of an AB_2 monomer to prepare fluorescent hyperbranched poly (amido acids) (HBPAAs) featuring wholly aliphatic backbones, multiple terminal CO_2H units, and many internal tertiary amino and amido moieties. Because tertiary amino groups are known to behave as fluorescent centers in dendritic structures, in this study we wish to prepared AB_2 monomer through an efficient synthetic scheme, involving blocking and deblocking processes, in high yield. Visible blue photoluminescence self-emissions would be generated from the non-conjugated HBPAAs in aqueous solution; that is, bright blue fluorescence behavior, with emission peaks at 395 nm and fluorescence QYs of up to 23%, appeared when the branching tertiary amino moieties were embedded in a self-polymerized globular confinement. These amphiphilic HBPAAs also have potential for use as tracing nanocarriers and molecular-level containers. Self-condensation of this AB_2 building block to construct water-soluble globular architectures with desired fluorescence properties appears to be a facile approach toward dendritic macromolecules with labeling-delivery applications.



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1. Lin L L, Chi M C, Lan E G, Lin M G, Juang T Y, et al. (2017) Facile immobilization of Bacillus licheniformis γ-glutamyltranspeptidase onto graphene oxide nanosheets and its application to the biocatalytic synthesis of γ-l-glutamyl peptides. International Journal of Biological Macromolecules pii: S0141-8130(17)32915-X.
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3. Juang T Y, Hsu Y C, Jiang B H and Chen C P (2016) Highly efficient inverted organic photovoltaics containing aliphatic hyperbranched polymers as cathode modified layers. Macromolecules 49:7837.
4. Juang T Y, Kan S J, Chen Y Y, Tsai Y L, Lin M G, et al. (2014) Surface-functionalized hyperbranched poly(amido acid) magnetic nanocarriers for covalent immobilization of a bacterial γ-glutamyltranspeptidase. Molecules 19:4997.
5. Su Y A, Chen W F, Juang T Y, Ting W H, Liu T Y, et al. (2014) Honeycomb-like polymeric films from dendritic polymers presenting reactive pendent moieties. Polymer 55:1481.

Biography

Tzong-Yuan Juang is an Assistant Professor in the Department of Cosmeceutics, China Medical University, Taiwan. His research interests are focused on developing water-soluble dendritic macromolecules including dendrimers and hyperbranched macromolecules, and studying their supramolecular chemistry in solution and the relationship and applications at organic/inorganic interfaces. Potential application areas such as molecular exfoliation for 2D layered graphene and natural clay, fluorescent carrier molecules for container and drug delivery for biomedical applications.

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Notes:

Filipa A M M Goncalves et al., J Biotechnol Biomater 2018, Volume 8
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Biopolymer based films for wound dressings

Filipa A M M Goncalves, M Helena Gil, A Jorge Guiomar and **Patrícia Alves**
University of Coimbra, Portugal

In recent years, various studies have focused on producing and improving treatments for skin regeneration. Polymers are the most important components of these systems in terms of release characteristics and permeation of drugs as well as mechanical properties of the formulations of these systems. The biopolymer films have become a very popular choice since they are biodegradable and biocompatible. In our group we have developed some hydrogels based on gelatin, pectin, starch and alginate to be applied as drug delivery systems. Here we wish to report the preparation of new wound dressings based on chitosan and dicarboxylic acids from renewable sources. Membranes based on pectin and chitosan were also developed. The films were physically, chemically and biologically characterized. Finally, they were loaded with polyhexanide (PHMB) which works as an antiseptic. The hydrophilic properties were evaluated. The effects of the sterilization by gamma irradiation and by heat treatment were accessed and the effect on the final properties of the films was evaluated.

Recent publications

1. Carreira A S, Goncalves F A M M, Mendonca P V, Gil M H, Coelho J F J (2010) Temperature and pH responsive polymers based on chitosan: applications and new graft copolymerization strategies based on living radical polymerization. Carbohydrate Polymers. 80(3):618-630.
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5. Goncalves F A M M, Fonseca A C, Domingos M, Gloria A, Serra A C, Coelho J F J (2017) The potential of unsaturated polyesters in biomedicine and tissue engineering: synthesis, structure-properties relationships and additive manufacturing. Progress In Polymer Science. 68:1-34.

Biography

Filipa A M M Goncalves has her expertise in Polymer Synthesis and Characterization. She is currently finishing her PhD in the Chemical Engineering Department at University of Coimbra. She graduated from Évora University in 2007 with a degree on Chemistry and in 2010 she finished her master's degree on Industrial Polymer Applications. Her research interest is focused on the development of biodegradable and biocompatible polymer based on renewable resources. She co-authored 11 papers and her PhD is focused on the synthesis of biodegradable and biocompatible polyesters for applications in tissue engineering.

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Alexandre Hardy et al., J Biotechnol Biomater 2018, Volume 8
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b-cyclodextrin-linked chitosan/alginate compact polyelectrolyte complexes (CoPECS) as natural and functional biomaterials with intrinsic anti-inflammatory activity

Alexandre Hardy, Marcella De Giorgi, Cendrine Seguin, Anais Brion, Joseph Hemmerlé, Philippe Lavalle, Pierre Schaaf, Sylvie Fournel, Line Bourel Bonnet and **Benoît Frisch**
Université de Strasbourg, France

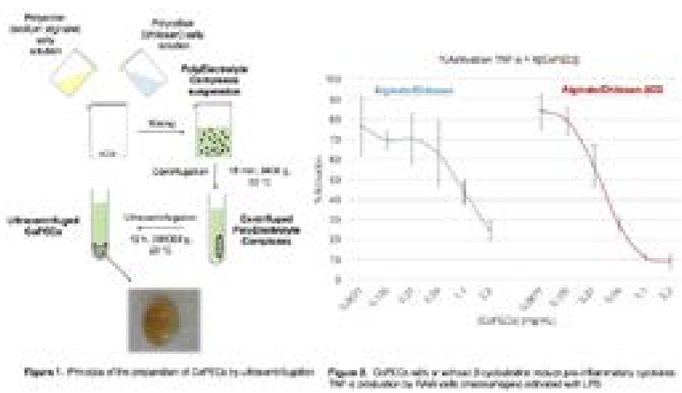
Statement of the Problem: Nowadays, the development of functional biomaterials able to contain and release drugs is of increasing interest for the treatment of various diseases and inflammation states. Synthetic Compact Polyelectrolyte Complexes (CoPECs), have shown interesting properties such as self-healing and stretching abilities or capacity to immobilize and protect enzymes. Very recently, alginate and chitosan natural polyelectrolytes, in the form of CoPECs, have been described as promising candidates for the development of high-performance biomaterials.

Purpose: The purpose of the current study is to functionalize this new natural CoPEC and to evaluate its potential as anti-inflammatory functional biomaterial. Indeed, one of its constituents, chitosan, is already known to have anti-inflammatory effects.

Methodology & Technical Orientation: Chitosan was chemically modified with b–cyclodextrin and mixed with alginate to make a final CoPEC able to trap and release drugs. The ratio between the two constituents of the material was determined by titration of the fluorescently labeled alginate. The intrinsic anti-inflammatory potential of the functionalized material, as well as its effect on cell viability, were assessed through *in vitro* assays.

Findings: Functionalized CoPEC is non-cytotoxic and causes a decrease of the production of NO and of pro-inflammatory cytokine TNF-a by macrophages previously activated with LPS. In addition, the biomaterial attenuates the differentiation of macrophages, which corroborates its anti-inflammatory action.

Conclusion & Significance: Given its anti-inflammatory efficacy and the multitude of final shapes it can take (crude material, membrane, micro- and nanoparticles), b-cyclodextrin-linked chitosan/alginate CoPEC could be used as anti-inflammatory biomaterial with the ability to deliver additional drug for combined treatment of severe chronic diseases such as Crohn's disease, arthritis or cancer.



Recent publications

1. Porcel C H and Schlenoff J B (2009) Compact polyelectrolyte complexes: saloplastic candidates for biomaterials. Biomacromolecules 10(11):2968-2975.

Notes:

2. Reisch A et al. (2012) Compact saloplastic poly(acrylic acid)/poly(allylamine) complexes: kinetic control over composition, microstructure, and mechanical properties. Advanced Functional Materials. 23(6):673-682.
3. Reisch A et al. (2014) On the benefits of rubbing salt in the cut: self-healing of saloplastic PAA/PAH compact polyelectrolyte complexes. Advanced Materials. 26(16):2547-2551.
4. Tirado P et al. (2013) Catalytic saloplastics: alkaline phosphatase immobilized and stabilized in compacted polyelectrolyte complexes. Advanced Functional Materials. 23(38):4785-4792.
5. Phoeung T et al. (2017) alginate/chitosan compact polyelectrolyte complexes (COPEC): a cell and bacterial repellent material. Chemistry of Materials. 29 (24):10418-10425. Doi:10.1021/acs.chemmater.7b03863.

Biography

Alexandre Hardy obtained his Engineering Degree in Materials from Polytech'Paris-University Pierre and Marie Curie (Paris, France) in 2015. Passionate about Biomaterials, he is currently a PhD student in the field of polymeric biomaterials in the Laboratory of Conception and Evaluation of Bioactive Molecules – Team BioVectorology, UMR 7199 CNRS/University of Strasbourg (France).

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Notes:

Fabrication of porous materials

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National Sun Yat-Sen University, Taiwan

The shape of a pore, resulting from a bubble entrapped by a solidification front, is predicted in this work. Porosity influences not only microstructure of materials, but also contemporary issues of various sciences of biology, engineering, foods, geophysics and climate change, etc. In this presentation, pore shape is determined by accounting for mass and momentum transport of solute across a self-consistent shape of the cap, as proposed previously. This work finds that there exist three different mechanisms for pore formation, depending on different directions and magnitude of solute transfer across the cap. Case 1 is subject to solute transport from the pore into surrounding liquid as a result of the cap emerged from a thin concentration boundary layer on the solidification front in the early stage. An increase in initial solute concentration in liquid decreases pore radius and times for bubble entrapment. Opposite directions of solute transport across the cap submerged into a thick concentration boundary layer along the solidification front, however, cannot result in bubble entrapment, because solute increases and decreases rapidly in late stage in Cases 2 and 3, respectively. The predicted pore shape in solid agrees with experimental data. Numerical computations of development of the pore shape associated with transport processes of fluid flow, temperature and concentration are also presented in Fig. 1.

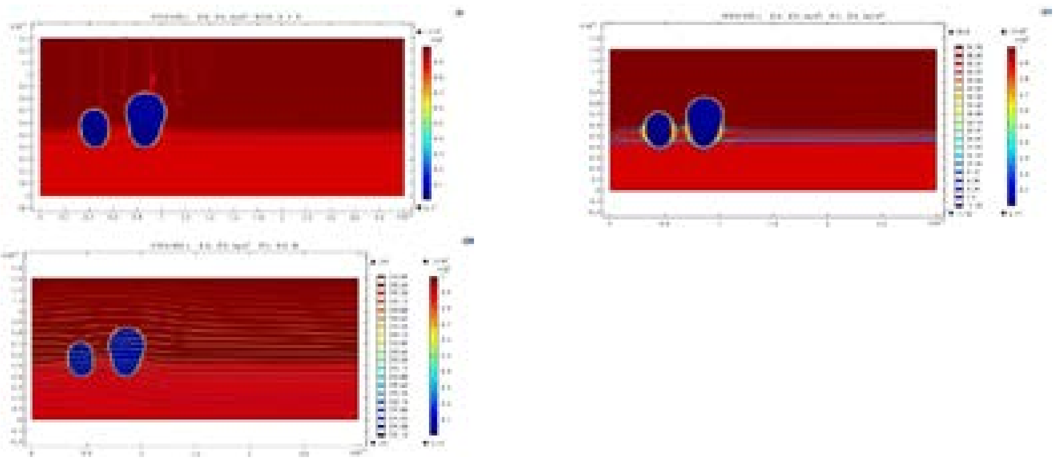

Fig. 1 Predicted pore shape, and distributions of velocity, temperature and solute concentration fields of two pores at a time of 0.0102 s in Case 1.

Recent publications

1. Wei P S and Chao T C (2016) The effects of drilling parameters on pore size in keyhole mode welding. ASME Journal of Manufacturing Science and Engineering 138:021008.
2. Wei P S and Chang C C (2016) Existence of universal phase diagrams for describing general pore shape resulting from an entrapped bubble during solidification. ASME Journal of Heat Transfer 138:104503.
3. Wei P S and Hsiao S Y (2016) Effects of mass transfer coefficient on pore shape in solid. International Journal of Heat and Mass Transfer 103: 931-939.
4. Wei P S and Hsiao S Y (2016) Effects of solute concentration in liquid on pore shape in solid. International Journal of Heat and Mass Transfer 103: 920-930.
5. Hsiao S Y and Wei P S (2016) Case study of terrestrial or ambient pressure effects on pore shape in solid. AIAA Journal of Thermophysics and Heat Transfer 31(4):796-804.

Biography

Peng-Sheng Wei has received his PhD in Mechanical Engineering Department at University of California, Davis, in 1984. He has been a Professor in the Department of Mechanical and Electro-Mechanical Engineering of National Sun Yat-Sen University, Kaohsiung, Taiwan, since 1989. He has contributed to advancing the understanding of and to the applications of electron and laser beam, plasma, and resistance welding through theoretical analyses coupled with verification experiments. Investigations also include studies of their thermal and fluid flow processes, and formations of the defects such as humping, rippling, spiking and porosity. He has published more than 80 journal papers, given keynote or invited speeches in international conferences more than 90 times. He is a Fellow of AWS (2007), and a Fellow of ASME (2000). He also received the Outstanding Research Achievement Awards from both the National Science Council (2004), and NSYSU (1991, 2001, and 2004), Outstanding Scholar Research Project Winner Award from National Science Council (2008), Adams Memorial Membership Award from AWS (2008), Warren F Savage Memorial Award from AWS (2012), and the William Irrgang Memorial Award from AWS (2014). He has been the Xi-Wan Chair Professor of NSYSU since 2009, and Invited as Distinguished Professor in the Beijing University of Technology, China, during 2015-2017.

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Notes:

3rd Annual Conference and Expo on

Biomaterials

March 05-06, 2018 | Berlin, Germany

Scientific Tracks & Abstracts
Day 2

Sessions:

Day 2 March 06, 2018

Dental Biomaterials | Biomaterials Applications | Properties of Biomaterials

Session Chair
Vanja Kokol
University of Maribor, Slovenia

Session Co-Chair
Jozsef Bako
University of Debrecen, Hungary

Session Introduction

Title: **Biomimetic gelatine coating for less-biodegradable and surface bioactive Mg alloys**
Vanja Kokol, University of Maribor, Slovenia

Title: **Biodegradable polymer based electrospun nanofibers for dental applications**
Jozsef Bako, University of Debrecen, Hungary

Title: **Stabilization of protein–drugs (EGF/TGF- β/Bmp-2) by photoreactive natural polymer**
Tae-il Son, Chung-Ang University, Republic of South Korea

Title: **Photoactive type I (atelo) collagen as building block of advanced wound dressings**
Giuseppe Tronci, University of Leeds, UK

Title: **Intracellular calcium ion signaling dependent on surface properties of biomaterials**
Susanne Staehlke, University of Rostock, Germany

YRF: **Multi-layer PVD coatings for longer lasting orthopaedic implants: A tribocorrosion evaluation**
Raisa Chetcuti, University of Malta, Malta

YRF: **Assessment of molecular diffusion in polyelectrolyte multilayer matrix**
David Sustr, Fraunhofer IZI-BB, Germany

YRF: **Fabrication of calcium sulfate hemihydrate coated β-tricalcium phosphate through dissolution precipitation reaction**
Eddy Eddy, Kyushu University, Japan

Vanja Kokol et al., J Biotechnol Biomater 2018, Volume 8
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Biomimetic gelatine coating for less-biodegradable and surface bioactive Mg alloys

Vanja Kokol[1], Hanuma Reddy Tiyyagura[1,2], Barbara Petovar[1], Matjaž Finšgar1, Regine Willumeit-Römer[3], Bérengère J C Luthringer[3], Mantravadi Krishna Mohan[2]
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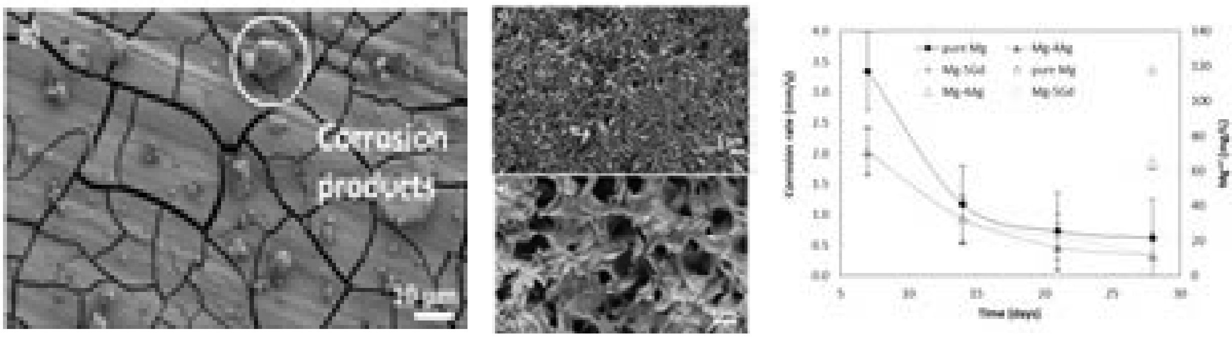
[2]Institute of Technology-Warangal, India
[3]Institute of Material Research, Germany

Magnesium (Mg) alloys have emerged as innovative orthopaedic implant materials due to their excellent degradability, which eliminates the need for a second surgery for their removal. However, rapid degradation of Mg alloys and subsequent loss of mechanical integrity before the tissue regeneration limits their application. The Mg-4Ag and Mg-5Gd binary alloys` degradation and corrosion properties were studied under *in vitro* conditions (in a simulated body fluid solution of pH 7.4 at 37°C) by using various analytical techniques and time-frame windows (up to 3 vs. 28 days), and compared with the pure (99.9 wt%) Mg alloy, before and after a biomimetic gelatin (GEL) coating via dopamine. Different kinetics and mechanisms of the alloys` degradation were identified, influencing their corrosion rates` dynamics. The EIS measurements of uncoated alloys, being performed for up to 3 days, revealed that the corrosion of all three alloys are under a kinetic-controlled mechanism, among which only pure Mg and Mg-4Ag show a repassivation ability in this time-frame. However, the corrosion rates of binary alloys were lower, reaching a value of around 0.33 mm/y and a release of 64 mg/L Mg^{2+} ions after 28 days of incubation, that was accompanied by a lower pH change (up to pH 8.3), compared to the pure Mg alloy, getting additionally reduced by GEL coating. The spectroscopic (FTIR, XRD, EDXS) and microscopic (SEM) studies revealed the formation of MgO products, as well as apatite formation on the pure Mg alloy surface, while thick and homogenous layers of differently-shaped and chemically secondary-phased $Mg(OH)_2$ products were identified on both binary alloys after 28 days. Besides, a protective interface layer between the alloy surface and SBF solution was formed on GEL-coated alloys, which further stimulates the mineralization of calcium phosphate compounds, being patterned by GEL macromolecules conformation. Among the binary alloys tested, the Mg-4Ag alloy seems to be the most appropriate biomaterial regarding the in-vitro degradation process that would lead to a suitable healing process at the implantation site, compared to the others available from the literature.



SEM images of (a) pure Mg, (c) Mg-4Ag and (e) Mg-5Gd alloys` surface with corresponding corrosion rates and Mg^{2+} ions release, after 28 days of immersion in SBF at 37±0.5˚C.

Recent publications

1. Tiyyagura H R, Gorgieva S, Fuchs-Godec R, Mohan M K and Kokol V Biomimetic gelatine coating for less-corrosive and surface bioactive AZ91 Mg alloy. J. Mater. Res. submitted revision JMR-2017-0979.
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4. Gorgieva S, Štrancar J and Kokol V (2014) Evaluation of surface/interface-related physicochemical and microstructural properties of gelatin 3D scaffolds, and their influence on fibroblast growth and morphology. J. Biomed. Mater. Res. Part A 102(11): 3986-3997.
5. Gorgieva S, Kokol V. Processing of gelatin-based cryogels with improved thermo-mechanical resistance, pore size gradient and high potential for sustainable protein-drug release. J. Biomed Mater. Res. Part A, 2015, 103(3), 1119-1130.

Biography

Assoc. Prof. Vanja Kokol PhD got a PhD in area of Textile chemistry in 2001 at University of Maribor, Faculty of Mechanical Engineering (UM-FS). She have been employed at UM-FS from 1994, currently as a research counsellor with the habilitation of Assoc. Prof.. Her research work in the last decade is oriented in modification and functionalization of fibers and biopolymers, and their processing in highly-engineered materials for different applications (from technical to biomedical). Special attention is attributed to the development of biopolymeric 2D and 3D materials with targeted and biocompatible antimicrobial activity. She is author of more than 90 papers, 3 book chapters, 3 patents, was supervisor of several (seven) doctoral and post-doctoral (five) students, and have been active in research programme Textile chemistry (from 1999) and Center of Excelence (from 2010) for advanced materials and technologies, area of Soft biomaterials. She was involved (leading or collaborating) in many national (ARRS-L2-7576, ARRS-J2-7018), bilateral (SLo-CZ, Slo-IT, SLO-IND, SLO-DE), international (E!3100 CAWAB, E!3654 BIOPOLS, EraNet Manunet NANOWEL, EraNet Matera Plus ANTIMICROB PEPTIDES, E!4956 MAGNET, EraNet MNT TABANA, EraNet MNT n-POSSCOG) and EU (H2020-PILOTS-03-2017-760601-2-NanoTexSurf, FP7-NMP-2011-SMALL-5-280519-NANOSELECT, FP7-NMP-2011-LARGE-5-280759-NANOBARRIER, Erasmus-Mundus (EMA2)-2013–2540/001–EUPHRATES, Marie Curie ToK/DEV FP6-MTKD-CT-2005-029540-POLYSURF, FP6-2004-SME-COOP-032877-ENZUP) funded research projects.

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Notes:

Jozsef Bako et al., J Biotechnol Biomater 2018, Volume 8
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Biodegradable polymer based electrospun nanofibers for dental applications

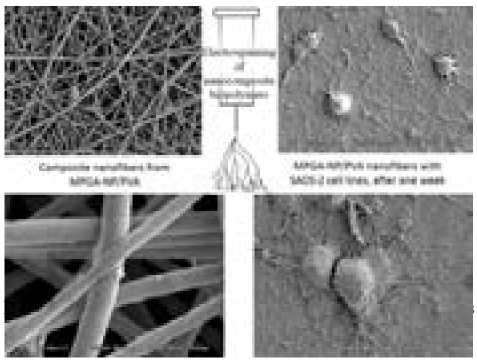
Jozsef Bako, Farkas Kerenyi, Lajos Daroczi and **Csaba Hegedus**
University of Debrecen, Hungary

Electrospinning is a versatile method for fabrication of submicron sized fibers from biopolymers, ceramics and composite materials. The dental application possibilities of these nanofibers are intensively research areas on the fields of tooth or pulp regenerations, prevention of dental caries, or drug delivery systems. Biopolymers can facilitate the elasticity of created structures, and ensure the similarities to the extracellular matrix. The tailoring of the diameters of the fibers, and pore sizes of the structures ensures the optimal conditions for the proliferation and differentiation of cells. The delivery of biological active ingredients, factors, or drugs can achieve fast and supported regeneration. Composite materials give possibly of adjusting physical, biological, or release properties. Nanofibers combined with inorganic ceramics, or polymers with nanoparticles can create functional materials for the speed up wound healing, or osseointegration processes.

Polymer solutions were created for electrospinning process from Poly-vinyl-alcohol (18-88 Ph, Eur.Merc) (PVA) in 10 w/w% and 50% precrosslinked, and 50% methacrylated-poly-γ-glutamic acid nanoparticles (MPGA-NP) in 15w/w%. Irgacure 2959 1w/w% was added to the composite as photoinitiator. Nanofiber fabrication was performed by Nanospinner NS1 electrospinning device (Inovenso). The created fiber matts were phtopolymerized by Bluehase 20i (Ivoclar Vivadent) dental lamp for 60sec, and the biocompatibility properties was investigated by Saos-2.

The diameters of created MPGA/PVA nanofibers were between 82.1-149.2 nm with the average of 120.7±17.5 nm. The crosslinking of the fibers by post photopolymerization was successful, and the fibers not dissolved during the one week cell proliferating test. The good biocompatibility of the created electrospun nanofibers was proved by the presence and proliferation of Saos cells.

This nanoparticles in the nanofibers construction allow and enhance the control of different drug releases.



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Biography

Jozsef Bako is assistant lecturer on Biomaterials and Prosthetic Dentistry Department. He is graduated as a chemist, and holds PhD degree on Doctoral School of Dental sciences. He has published 16 research articles which were cited 59 times, the Hirsch index is 5. He has his expertise in nanostructured photopolymerizable polymer system fabrications and evaluations. His main research fields are the biodegradable polymer based hydrogel, nanogels and nanofibers as drug delivery systems. The research fields are connecting to scaffold creation for tissue regeneration aims by 3D printing methods and production of different inorganic/organic composites and nanofibers by electrospinning technique.

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Notes:

Tae-il Son et al., J Biotechnol Biomater 2018, Volume 8
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3rd Annual Conference and Expo on

BIOMATERIALS

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Stabilization of protein–drugs (EGF/TGF- β/Bmp-2) by photoreactive natural polymer

Tae-il Son[1], **Eun Hye Kim**[1], **Ga Dug Han**[1], **Seung Hyun Noh**[1], **Jae Won Kim**[1], **Shin Woong Kim**[1], **Tae Hoon Lee**[1], **Sung Jun Min**[1] and **Yoshihiro Ito**[2]
[1]Chung-Ang University, Republic of South Korea
[2]RIKEN, Japan

Bioactive molecules such as EGF, TGF-β, BMP-2, are very important and useful materials in medical field; regenerative medicine and pharmacy. Immobilization method is one of current researching to overcome low stability and high cost of bioactive molecules. Chemical methods have been used widely for immobilization of bioactive molecules. However, there are some of drawbacks with this method. For example, chemical method may produce potential toxic by-product, and, in case of physical method, low efficiency of immobilized bioactive material is observed. To solve these problems, recently, the immobilization by photo-immobilization has been researched widely. The advantages of photo-immobilization are 1) high selectivity of chemical reactions or processes under mild conditions (ambient temperature of also much below), 2) typically no need for added catalysts or special solvents, 3) spatially addressable effects (2D and 3D structuring possible) and 4) applicable to very small and (relatively) large scales. To use for photo-immobilization, various natural polymers, such as gelatin, chitosan, hyaluronic acid reacted by irradiation to UV or visible light can be applied for medical area to increase biocompatibility and functionality, for example, coating agent for bioinert devices like stent and implant, anti-adhesive agent, wound dressing and bio-adhesive.

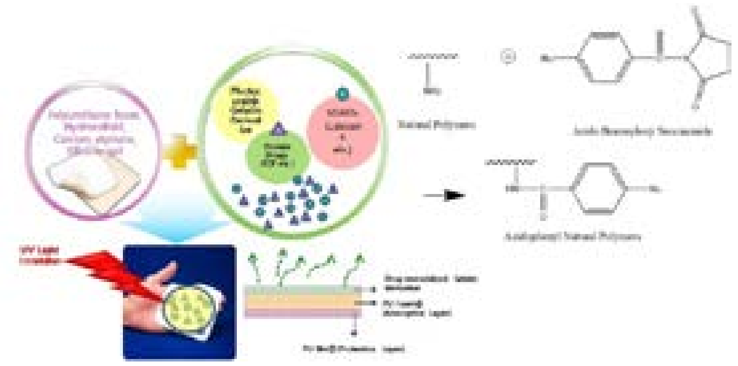

Figure: Immobilization of protein drugs

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Biography

Tae-il Son was awarded the degree of PhD by Tokyo Institute of Technology, Japan in 1989. He is a Professor in the Department of Systems Biotechnology, Chung-Ang University and a Visiting Scholar at RIKEN (2007). He has served as President of the Korean Society for Chitin and Chitosan. He is currently the Director of Biomaterial Field in the Korean Society of Industrial and Engineering Chemistry (KSIEC) in Korea. He has published more than 100 papers in reputed journals.

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Giuseppe Tronci, J Biotechnol Biomater 2018, Volume 8
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Photoactive type I (atelo) collagen as building block of advanced wound dressings

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University of Leeds, UK

The trends in diabetic occurrence and aging populations impose a heavy economic burden on healthcare providers worldwide [1]. Diabetic wounds suffer from delayed healing, and can soon become infected, chronic ulcers. If not treated timely, they can lead to gangrene, haemorrhage and lower-extremity amputations, potentially resulting in permanent disabilities and pain for patients. Advanced wound dressings have been commercialized to respond to the pressing needs of an increasing diabetic population. However, control of the wound microenvironment and matrix metalloproteinase (MMP) activity is still only partially accomplished, resulting in economically unaffordable healing times. Here, type I photoactive (atelo)collagen was synthesized and explored as a building block of factor-free advanced wound dressings with customisable macroscopic properties and integrated wound-regulating functionalities. Covalent functionalization of rat tail collagen with photoactive compounds, e.g. 4-vinylbenzyl chloride, was initially confirmed (by ^{1}H-NMR, TNBS colorimetric assay, and circular dichroism) to prompt the synthesis of UV-induced networks of collagen triple helices [2, 3]. The type and degree of collagen functionalization governed the structure-property relationships, whereby the averaged swelling ratios (*SR*: 707-1600 wt.%), bulk compressive (*Ec*: 15-129 kPa) and atomic force microscopy (AFM) elastic moduli (E_{AFM}: 16-387 kPa) could be adjusted [4]. Obtained network configurations proved key to control the activity of MMP-9 *in vitro*, with respect to a leading dressing product. This synthetic route was successfully transferred to minimally-antigenic, telopeptide-free type I collagen [5], resulting in comparable water-swollen atelocollagen networks. Preclinical investigations in a full-thickness wound model in diabetic mice proved the accelerated healing capability of this collagen system with respect to a commercial polyurethane dressing [6].

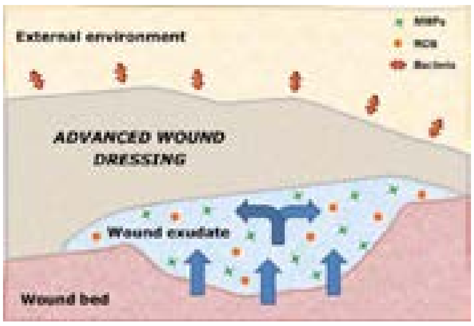

Figure 1: Design concept of an advanced wound dressing regulating wound exudate levels at the macroscopic scale, as well as pH and overexpressed MMPs and ROS at the biochemical level.

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Biography

Giuseppe Tronci is a Lecturer in Healthcare Materials at the University of Leeds with leading expertise in the chemistry of biopolymers, design of integrated biomimetic systems, and high-value manufacture of medical devices. He has established a bespoke platform for the fabrication of customised collagen materials with retained triple helix conformation and multiple integrated biofunctionalities. This work has led to the development of a University of Leeds patent-pending technology, whose applicability in wound healing has been successfully confirmed in diabetic mice.

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Notes:

Susanne Staehlke et al., J Biotechnol Biomater 2018, Volume 8
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Intracellular calcium ion signaling dependent on surface properties of biomaterials

Susanne Staehlke, Henrike Rebl, Martina Gruening and **Barbara J Nebe**
University of Rostock, Germany

The first critical courses for assessing the suitability of a new biomaterial in medicine are biofunctionality and compatibility of the biosystem at the site of its effect. Topographical as well as chemical surface properties of biomaterials have a specific impact of integration and regeneration in bone tissue. The surface stimuli can affect the cell behavior, either detrimentally or favorably. So, the osteoblasts recognize their surrounding by adhesion receptors connected intracellularly with focal adhesion complexes. The associated intracellular actin cytoskeleton is in control for cell morphology, migration as well as for the transmission of signals and forces of the surroundings into the cells. External signals from physico-chemical environments finally influence the cell function (Figure 1). However, it is unclear as to which physiological processes will be affected in detail. In the previous studies, we could find out that defined geometrical micro-pillars influenced the cell architecture and the cell function of human MG-63 osteoblasts. In addition, the mobilization of intracellular calcium ions (Ca^{2+}) after ATP stimulus was significantly impaired in cells growing on micro-pillars. It raises the question whether the mobilization of intracellular Ca^{2+}, as "second messenger", represents a sensitive parameter for *in vitro* studies of cell-biomaterial interactions. In our recent studies we examined the cell physiology and signaling on different chemical properties of biomaterials. The data indicate an increased intracellular Ca^{2+} signaling on plasma-chemically modified titanium with improved cell adhesion and spreading. The understanding of complex cellular behavior and intracellular signaling events is critical for the acceptance of new biomaterial surfaces in regenerative medicine.

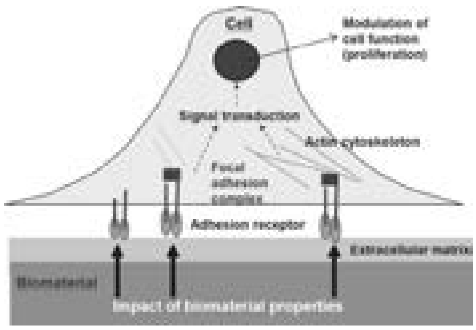

Figure 1: Scheme of the interaction of cells with biomaterials

Recent publications

1. Moerke C, Mueller P and Nebe B (2016) Attempted caveolae-meadiated phagocytosis of surface-fixed micro-pillars by human osteoblasts. Biomaterials 76:102-114.
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Biography

Susanne Staehlke earned her Diploma in Genetic and Microbiology at the University of Rostock, and went on to earn her PhD at the University Medical Center Rostock, Dept of Cell Biology, Germany, studying the interaction of human osteoblasts with defined microtopographical features of titanium-cell architecture und signaling. She is now a young researcher completing her Post-doctoral training at the University Medical Center Rostock, Dept of Cell Biology. She is a Member of the German Society for Biomaterials (DGBM) and got DGBM Poster awards in 2011 and 2013. She is skilled in western blot analysis, immunofluorescence, biomedical science, flow cytometry, cell signaling and confocal microscopy. She has published over 10 papers and has given several invited presentations at international meetings around the world (Hong Kong: ICBB 2012, Minneapolis: BioInterface 2013, Oslo: ScSB 2013, Rytro: PSBM 2016 and 17, Xian: CMCB2017, Bordeaux: FiMPART 2017).

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Notes:

Multi-layer PVD coatings for longer lasting orthopaedic implants: A tribocorrosion evaluation

Raisa Chetcuti[1], **Joseph Buhagiar**[1], **Peter A Dearnley**[2] and **Bertram Mallia1**
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[2]Boride Services Ltd, United Kingdom

Bone injuries coupled with a longer life expectancy necessitate the increased longevity of implanted biomaterials in patients suffering from bone diseases such as arthritis and osteoporosis. CoCrMo alloys have been widely employed as bearing surfaces in metal-on-metal (MoM) orthopaedic implants given their optimal mechanical properties and high corrosion resistance, as well as their relatively low wear rates and the post-operative stability. Loss of material by corrosion-wear of the hip joint and metal ion release into the blood stream are of prime concern as these can cause adverse reactions in the human body such as inflammation and bone erosion as well as loosening of the implant. This study aims to reduce the material loss at the bearing surfaces by the application of a multi-layer PVD coating on an ASTM F-1537 CoCrMo substrate. A 2.3 µm thick CrN coating was deposited on top of a 3.6 µm CoCrMo precipitate free supersaturated metastable solution of carbon, otherwise known as S-phase (S), by magnetron sputtered PVD. The coated samples designated as CrN/S, displayed a higher hardness and they retained their topography in nano-scratch tests relative to the uncoated CoCrMo substrate under the same conditions. Tribocorrosion tests for uncoated CoCrMo samples against uncoated CoCrMo counterfaces as well as for coated samples against coated counterfaces were conducted in Ringer's solution as well as in diluted Foetal calf bovine serum at 37±1 °C under reciprocating sliding conditions. Results show that under all applied potentials and in both solutions, the coated tribopairs when compared to the uncoated ones exhibited a significant decrease in material loss and excellent resistance to catastrophic failure by tribocorrosion. Figure 1 outlines the improvement exhibited by the coated samples under anodic conditions; the coated samples exhibiting a smaller wear scar and mostly polishing wear as opposed to the uncoated samples, in both solutions.

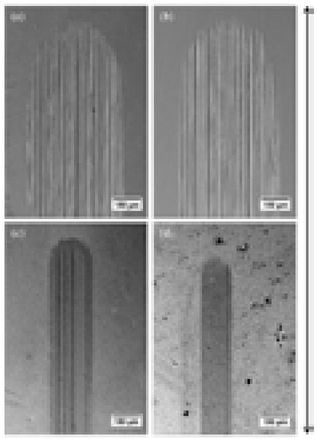

Figure 1: SEM images of the scars of (a, b) uncoated ASTM F-1537 CoCrMo samples against an uncoated ASTM F-1537 CoCrMo counterface in Ringer's solution and diluted Foetal calf bovine serum respectively, (c, d) CrN/S coated ASTM F-1537 CoCrMo samples against a CrN/S coated ASTM F-1537 CoCrMo counterface in Ringer's solution and Foetal calf bovine serum respectively, following sliding under anodic conditions. The arrow indicates the direction of sliding during tribocorrosion testing

Biography

Raisa Chetcuti earned a B.Eng (Hons.) degree in Mechanical Engineering from the University of Malta in 2016. She is currently reading for an MSc in Mechanical Engineering at the same institution. Her research interests lie in the general field of biomaterials, but in her study, she is focusing on the tribocorrosion behaviour of PVD coatings to be applied to the artificial hip joint in conditions which replicate more closely the human body environment. In 2016, she has studied two novel PVD coatings for the bearings of the artificial hip joint and she was acknowledged with the best project in the mechanical engineering stream for 2016 award by the Chamber of Engineers in Malta.

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Assessment of Molecular Diffusion in Polyelectrolyte Multilayer Matrix

David Sustr[1,2], Antonin Hlavacek[3], Claus Duschl[2] and Dmitry Volodkin[4]
[1]University of Potsdam, Germany
[2]Fraunhofer Institute for Cell Therapy and Immunology, Germany
[3]Institute of Analytical Chemistry - Czech Academy of Sciences, Czech Republic
[4]Nottingham Trent University, UK

Assessment of molecular diffusion is of high importance in fields of drug delivery systems, biomaterial development, cell biology, etc. Assessment and comprehensive analysis of the diffusivity provides a deeper understanding of the diffusion phenomenon and heterogeneity of biomaterials. This insight eventually may lead to a rational control over the diffusivity. Fluorescence recovery after photobleaching (FRAP) is commonly employed to probe molecular diffusion by analysis of the recovery of fluorescence after photobleaching of fluorescently labelled molecules. Despite FRAP being a popular method, it is hard to analyze multi-fractional molecular diffusion due to limited possibilities of approaches for analysis. Here we present a novel simulation-optimization-based approach (S-approach) that significantly broadens possibilities of the analysis. In the S-approach, possible fluorescence recovery scenarios are primarily simulated and afterwards compared with a real measurement while optimizing parameters of a model until a sufficient match is achieved. This makes it possible to reveal multi-fractional molecular diffusion. The proposed S-approach is compared with a conventional, yet advanced analytical solution based approach (A-approach) which involves fitting an analytical solution of molecular diffusion to FRAP recovery profiles. The S-approach is superior for multi-fractional analysis compared to the analytical one, however, diffusion of a single population of molecule

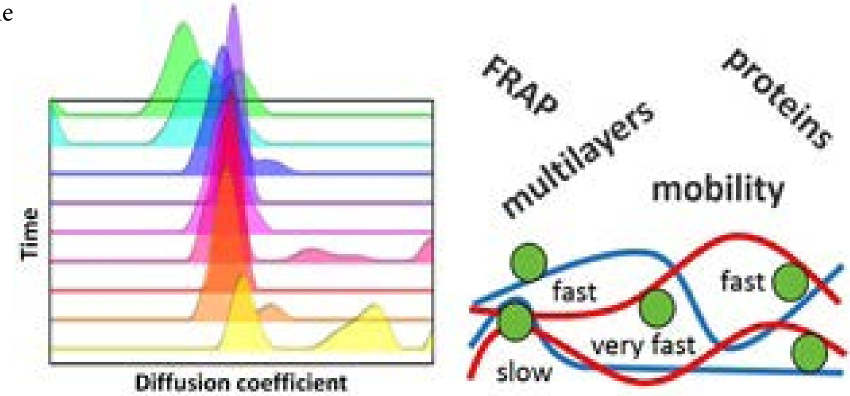

Figure 1: **Left: Distribution of diffusion coefficients of cytochrome c loaded into (HA/PLL)24 multilayers. Right: Schematics depicting various interaction states of cytochrome c in polyelectrolyte multilayer and corresponding keywords.**

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Biography

David Sustr has an expertise in polyelectrolyte multilayers, diffusion measurements, microscopy techniques and more. He gained these abilities during studies and work at Masaryk University (Czechia), University of Helsinki (Finland), University of Potsdam (Germany), and Fraunhofer IZI-BB (Germany). His motivation comes from an interest in understanding reasons of behavior and its relationships of various systems and materials.

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Notes:

Eddy Eddy et al., J Biotechnol Biomater 2018, Volume 8
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Fabrication of calcium sulfate hemihydrate coated β-tricalcium phosphate through dissolution precipitation reaction

Eddy Eddy, Akira Tsuchiya, Kanji Tsuru and **Kunio Ishikawa**
Kyushu University, Japan

Introduction: Previously, we had proposed that beta tricalcium phosphate granular cement (β-TCPGC) is useful to prevent flowing out of the β-TCP granules from the bone defect. When the β-TCP granules were mixed with acidic calcium phosphate solution, it set to form interconnected porous structure. Although it seems promising, β-TCP granules need to be mixed with the acidic calcium phosphate solution. Calcium sulfate hemihydrate (CSH) has self-setting ability by converting to calcium sulfate dihydrate (CSD) when exposed to water. Furthermore, CSD is the component of Osteoset®, which is a commercially available as a bone substitute. In this study, we fabricated CSH coated β-TCP granules through dissolution-precipitation method. This setting ability could inhibit the flowing out of the β-TCP granules from the bone defect.

Experimental Method: β-TCP granules were immersed in NaHSO4 solution for 1, 3, 5 and 7 days at 70°C. The samples were then heated at 120°C for 4 hours. β-TCPGC was prepared by mixing the granules with saline solution at a L/P ratio of 0:3 and identified by XRD and SEM. The mechanical strength of the β-TCPGC was measured as a DTS by universal testing machine. β-TCPGC was implanted in rabbit femur for 4 weeks and the percentage of newly formed bone was calculated from histological analysis.

Results: β-TCP granules immersed in NaHSO4 solution were coated by CSD and CSD became CSH after heating at 120°C for 4 hours. CSH coated β-TCP granules mixed with saline solution were set and DTS value of β-TCPGC with 75 wt.% of CSH was 0.8±0.1 MPa. The percentage of newly formed bone of β-TCPGC with 75 wt.% of CSH was 28.7±0.5%. Meanwhile, β-TCP granules without coating were 19.9±1.1%.

Conclusion: CSH coated β-TCP were successfully fabricated and formed interconnected porous structure with good mechanical strength after mixing with saline solution

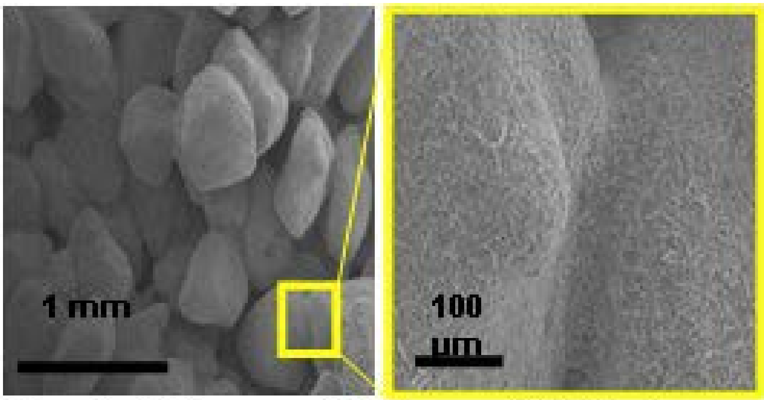

Figure 1: SEM images of CSH coated β-TCP after mixed with saline solution and formed interconnected porous structure.

Recent publications

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2. Fukuda N, Tsuru K, Mori Y and Ishikawa K (2017) Effect of citric acid on setting reaction and tissue response to β-TCP granular cement. Biomed Mater. 12(1):15027.

3. Shariff K A, Tsuru K and Ishikawa K (2017) Fabrication of dicalcium phosphate dihydrate-coated β-TCP granules and evaluation of their osteoconductivity using experimental rats. Mater Sci Eng C Mater Biol Appl. 1(75):1411-1419.
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5. Shariff K A, Tsuru K and Ishikawa K (2016) Fabrication of interconnected pore forming α-tricalcium phosphate foam granules cement. J Biomater Appl. 30(6):838-45.

Biography

Eddy Eddy is a dentist by training, graduated from Universitas Padjadjaran, Bandung, Indonesia in 2012. He continues his study as a PhD student in the Department of Biomaterials, Faculty of Dental Science in Kyushu University, Japan until present. His main research interest is the development and fabrication of artificial bone graft to fill defects in bones then afterwards replaced to new bone. He has presented his research at many international conferences.

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