International Forum of Biomedical Materials

Biomaterial Surfaces and Interfaces

Hangzhou, China

July 6-8, 2018

Organized by

Institute of Biomedical Macromolecules, Zhejiang University

MOE Key Laboratory of Macromolecular Synthesis and Functionalization

Department of Polymer Science and Engineering, Zhejiang University


IFBM
2018
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Biomaterials interfaces & Nanobiomaterials

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Topics

•Surface modification of biomaterials
•Interactions of biomaterials with cells, proteins and organisms
•Adaptive biomaterials
•Materials for tissue engineering and regenerative medicine
•Implants/medical devices based on surface modification

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General Schedule

July. 6	14:00-20:00	Registration Open *(Hotel lobby)*		
July. 7	8:30-12:00			
July. 7	14:00-14:10	Opening Ceremony *(Hall 117, Run Run Shaw Science Building*		
	14:10-15:30	*Hall 117, Run Run Shaw Science Building*		
	15:30-16:00	Coffee Break & Photo Taken		
	16:10-17:20	*Hall 117, Run Run Shaw Science Building*		
	18:00	Dinner		
July. 8	8:30-10:00	*Hall 117,Run Run Shaw Science Building*	*Hall 211,Run Run Shaw Science Building*	*Hall 212,Run Run Shaw Science Building*
	10:00-10:20	Coffee Break & Poster Session		
	10:20-11:55	*Hall 117,Run Run Shaw Science Building*	*Hall 211,Run Run Shaw Science Building*	*Hall 212,Run Run Shaw Science Building*
	12:00-14:00	Lunch		
	14:00-15:30	*Hall 117,Run Run Shaw Science Building*	*Hall 211,Run Run Shaw Science Building*	*Hall 212,Run Run Shaw Science Building*
	15:30-15:50	Coffee Break & Poster Session		
	15:50-17:25	*Hall 117,Run Run Shaw Science Building*	*Hall 211,Run Run Shaw Science Building*	*Hall 212,Run Run Shaw Science Building*
	17:25-17:40	Closing Ceremony *(Hall 117, 1rd floor)*		
	18:00	Dinner		

July 6	**14:00-20:00**	***Registration Open (Hotel lobby)***
July 7	**8:30-12:00**	
July 7	**14:00-14:10**	**Opening ceremony** ***Hall 117, Run Run Shaw Science Building***
		Chair: Yilin Cao
	14:10-14:50	**Controlling protein-surface interactions in blood-material contact: towards a fibrinolytic surface** **John L. Brash** (Plenary) McMaster University, Canada
	14:50-15:30	**Biometals for orthopaedic applications: Coating or no coating?** **Ling Qin** (Plenary) The Chinese University of Hong Kong, Hong Kong SAR, China
	15:30-16:00	**Coffee break/Photo taken**
		Chair: John L. Brash
	16:10-16:40	**Cartilage Engineering – From Bench to Bed-side** **Yilin Cao** (Plenary) Shanghai Jiaotong University, China
	16:40-17:20	**Carbonized Polymer Dots: Syntheses, Structures & Properties** **Bai Yang** (Plenary) Jilin University, China
	18:00	**Dinner**

	Concurrent I: *(Hall 117, Run Run Shaw Science Building)*	Concurrent II : *(Hall 211, Run Run Shaw Science Building)*	Concurrent III: *(Hall 212, Run Run Shaw Science Building)*
	Chair: Wenxin Wang	**Chair: Hongjun Wang**	**Chair: Min Wang**
8:30-8:55	**Tumor Acidity-Activated Nanomedicine for Cancer Therapy** Jun Wang (Keynote) *South China University of Technology, China*	**Targeting Immune Modulatory Properties for Bone Biomaterials Development** Yin Xiao (Keynote) *Queensland University of Technology, Australia*	**The Blood Clearance Kinetics and Pathway of Polymeric Micelles in Cancer Drug Delivery** Youqing Shen (Keynote) *Zhejiang University, China*
8:55-9:20	**Enzyme-Instructed Self-Assembly for Controlling Cell Fate** Bing Xu (Keynote) *Brandeis University, USA*	**Biomaterial and Biomimetic Approaches for Cardiac Cell Therapy** Ke Cheng (Keynote) *North Carolina State University, USA*	**In Vitro and In Vivo Evaluation of 3D Printed Ti-6Al-4V Implant** In-Seop Lee (Keynote) *Yonsei University, Korea*
9:20-9:45	**New Scanning Probe Techniques for the Characterization and Manipulation of Biomaterials on the nm-Level** Georg Papastavrou (Keynote) *University of Bayreuth, Germany*	**Osteochondral Repair Using Decellularized Man-Made Hyaline-Like Cartilage Graft** Dong-an Wang (Keynote) *Nanyang Technological University, Singapore*	**Calcium Phosphate-based Biomedical Materials** Xiangdong Kong (Keynote) *Zhejiang Sci-Tech University, China*
9:45-10:00	**Oxidation-sensitive Polypeptide with Conformation-directed Self-assembly** Ding Mingming (Invited) *Sichuan University, China*	**A Smart Skin Regeneration System for Real-time Wound Monitoring and Dynamic Intervention** Lie Ma (Invited) *Zhejiang University, China*	**Cancer Theranostics Based on Iron Oxide Nanoparticles** Aiguo Wu (Invited) *Ningbo Institute of Materials Technology & Engineering, Chinese Academy of Sciences, China*
10:00-10:30	**Coffee break/Poster session**		
	Chair: Jun Wang	**Chair: Yin Xiao**	**Chair: Youqing Shen**
10:30-10:55	**Highly Branched Poly(beta-amino ester)s as New Gene Delivery Vectors** Wenxin Wang (Keynote) *University College Dublin, Ireland*	**Biomimetic Skin Grafts for Guided Wound Healing** Hongjun Wang (Keynote) *Stevens Institute of Technology, USA*	**Multifunctional Tissue Engineering Scaffolds for Postoperative Cancer Patients** Min Wang (Keynote) *The University of Hong Kong, China*
10:55-11:20	**Engineering Nanoparticles to Target Neurons towards the Promotion of Neuroprotection and Neuroregeneration** Ana Paula Pêgo (Keynote) *University of Porto, Portugal*	**To be confirmed** Deling Kong (Keynote) *Nankai University, China*	**There's a lot Going on at the Surface** Guigen Zhang (Keynote) *University of Kentucky, UK*
11:20-11:35	**Self-propelled Colloidal Motors for Biomedical Application** Qiang He (Invited) *Harbin University of Science and Technology, China*	**3D-Printing of Bioactive Scaffolds with Functional Surface** Chengtie Wu (Invited) *Shanghai Institute of Ceramics, Chinese Academy of Sciences China*	**Antimicrobial Polymers in Solution and on the Surface** Runhui Liu (Invited) *East China University of Science and Technology, China*
11:35-11:50	**Macroscopic Supramolecular Assembly and Its Applications on Tissue Scaffolds** Feng Shi (Invited) *Beijing University of Chemical Technology, China*	**Functional Vascular Grafts Induce Tissue Regeneration and Remodeling** Qiang Zhao (Invited) *Nankai University, China*	**Cell Sheet Harvesting from Light-responsive Surfaces** Peng Li (Invited) *Northwestern Polytechnical University, China*
11:50-12:05	**Supramolecular Polymer for Multimodality Cancer Therapy** Zhengwei Mao (Invited) *Zhejiang University, China*	**3D Bioprinting of Chitosan Hydrogel Bioinks with Tunable Stiffness to Regulate Stem Cell Differentiation** *Jun Fu* (Invited) *Ningbo Institute of Materials Technology & Engineering, Chinese Academy of Sciences, China*	**Smart Antibacterial Surfaces with Switchable Bacteria-killing and Bacteria-releasing Capabilities** Qian Yu (Invited) *Soochow University, China*
12:05-14:00	**Lunch**		

	Concurrent I: *(Hall 117, Run Run Shaw Science Building)*	Concurrent II : *(Hall 211, Run Run Shaw Science Building)*	Concurrent III: *(Hall 212, Run Run Shaw Science Building)*
	Chair: Yong Yang	**Chair: Liming Bian**	**Chair: Ulrich Scheler**
14:00-14:25	**Functional Nanoparticles for Biomedical Imaging** Mingyuan Gao (Keynote) *Institute of Chemistry, Chinese Academy of Sciences, China*	**Polymer Nanoparticles for Inhibiting Cell-free Induced Inflammation of Arthritis** Yongming Chen (Keynote) *Sun Yat-sen University, China*	**"Polyelectrolyte Complex Coatings: From Biomimetic methods to Real Coating Technology"** Jian Ji (Keynote) *Zhejiang University, China*
14:25-14:50	**Functionalized Polymer Micelles for Anticancer Drug Delivery** Shaobing Zhou (Keynote) *Southwest Jiaotong University, China*	**Controlled Release of Magnesium Ions Enables In-situ Bone Regeneration** Kelvin Yeung (Keynote) *The University of Hong Kong, China*	**Supramolecular Assemblies of Polyelectrolytes with Phospholipids and Phosphate Ions** Sergio E. Moya (Keynote) *CIC biomaGUNE, Spain*
14:50-15:05	**Bio-inspired Nanovesicles as a Versatile Drug Delivery System** Gang Liu (Invited) *Xiamen University, China*	**Oxidoreductase-Triggered Physiological Preparation of Hydrogels/Microgels for Biomedical Applications** Qigang Wang (Invited) *Tongji University, China*	**Bio-inspired Organs-on-chips System** Yuanjin Zhao (Invited) *Southeast University, China*
15:05-15:20	**Monitoring Transport and Diffusion of Gold Nanoparticles in Live Cancer Cells by Dark Field Optical Microscopy** Ju Chou (Invited) *Florida Gulf Coast University, USA*	**Anti-Cancer Nanomedicine with High Drug Loading and Potent Tumor Targeting** Lichen Yin (Invited) *Soochow University, China*	**Ice-templated Biomimetic Materials for Tissue Engineering** Hao Bai (Invited) *Zhejiang University, China*
15:20-15:50	**Coffee break/Poster session**		
	Chair: Mingyuan Gao	**Chair: Yongming Chen**	**Chair: Jian Ji**
15:50-16:15	**Self-assembled Injectable Nanocomposite Hydrogels Stabilized by Bisphosphonate-Ion Coordination for Promoting in Situ Tissue Regeneration** Yong Yang (Keynote) *University of North Texas, USA*	**Self-assembled Injectable Nanocomposite Hydrogels Stabilized by Bisphosphonate-Ion Coordination for Promoting in situ Tissue Regeneration** Liming Bian (Keynote) *The Chinese University of Hong Kong, China*	**Structure and Dynamics in Polyelectrolyte Multilayers and Complexes-A Magnetic Resonance Study** Ulrich Scheler (Keynote) *Leibniz Institute of Polymer Research Dresden, Germany*
16:15-16:40	**Polymer Matrices with Functional Gradients in Tissue Engineering** *Jin Ho Lee* (Keynote) *Hannam University, Korea*	**New Advances in Biomaterials for Bioprinting and Tissue Regeneration: Engineereing Interfaces** Miguel Oliveira (Keynote) *University of Minho, Portugal*	**Hierarchical Structures in Biogenic and Bio-inspired Calcium Carbonates** Anna Schenk (Keynote) *University of Bayreuth, Germany*
16:40-16:55	**Bio-inspired Anti-oxidant Defense System Constructed By Electrospun F127-based Fibers** Qiang Shi (Invited) *Beijing University of Chemical Technology, China*	**Versatile Organic/Inorganic Nanohybrids for Delivery Systems** Nana Zhao (Invited) *Beijing University of Chemical Technology, China*	**Nanoparticle Surfaces Functionalizion and their Applications in Bacteria Eradication** Jun Deng (Invited) *Army Medical University, China*
16:55-17:10	**Smart Synthetic Biointerfaces: From Reversible Chemical Interactions to Dynamic Biological Effects** Guoqing Pan (Invited) *Jiangsu University, China*	**The Researches on Cells Adhesion on the Biocompatible Polymer Surfaces with Superwettability** Wenlong Song (Invited) *Jilin University, China*	**Polyphenol Films for Anti-platelet Adhesion and the Capture of Circulating Tumor Cells** Lulu Han (Invited) *Dalian University of Technology, China*
17:10-17:20	**Closing ceremony**		


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Plenary Speakers

Keynote Speakers

Invited Speakers

Poster Section

Plenary Speakers

Controlling Protein-surface Interactions in Blood-Material Contact: towards a Fibrinolytic Surface

John L Brash[a,b*], Hong Chen[b], Dan Li[b].
[a]McMaster University, Hamilton, Canada; [c]Soochow University, Suzhou, China
*brashjl@mcmaster.ca

This presentation will touch briefly on several topics related to blood compatibility, blood-material interactions and the design of thromboresistant surfaces. These include plasma protein adsorption, platelet adhesion, protein resistant surfaces, anticoagulant surfaces, and fibrinolytic surfaces. The behaviour of proteins at interfaces is an important underlying theme of our work, and for a number of years we have followed a two-point principle for the design of blood compatible surfaces based on controlling protein-surface interactions: (1) preventing nonspecific protein adsorption ("the enemy"), and (2) promoting the specific adsorption of a target protein (or proteins) expected to provide appropriate bioactivity, e.g. anti-bacterial, anti-inflammatory, anti-thrombotic. The focus in this presentation will be on surfaces having clot-lysing properties based on their ability to "capture" endogenous plasminogen and tissue plasminogen activator (t-PA), the key players in the fibrinolytic system. This represents a relatively unexplored approach to the serious, and seemingly intractable, problem of foreign surface-induced thrombosis, and is in contradistinction to the more common "prevention" approach which has so far failed to provide a solution.

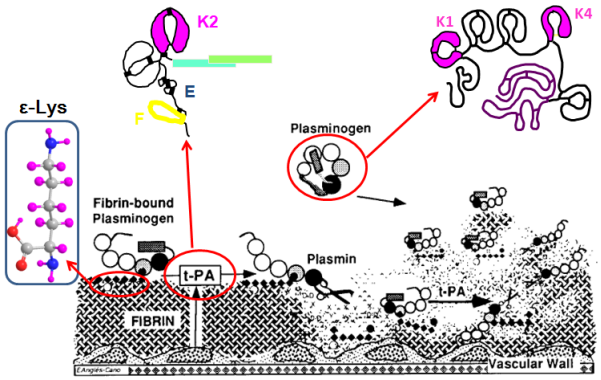

Fig 1. Fibrinolytic system showing capture of plasminogen by fibrin on damaged vessel wall, and release of t-PA from endothelial cells to convert plasminogen to plasmin.

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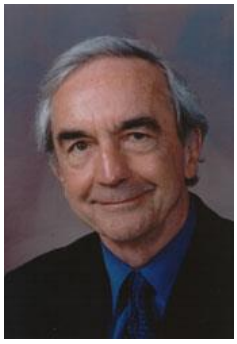
Biography:



John Brash is a Distinguished University Professor of McMaster University, and a Chair Professor of Soochow University. His main interest is in biomaterials and biocompatibility with emphasis on materials for use in blood contact. The behaviour of proteins at interfaces is an important underlying theme. He is a Fellow of the Royal Society of Canada, and recipient of the Clemson Award for Basic Research (1994) and the Founders Award (2009) of the US Society for Biomaterials.

Biomatals for Orthopaedic Applications: Coating or No Coating?

Ling Qin

Director of Musculoskeletal Research Laboratory, Director of Innovative Orthopaedic Biomaterials and Drug Translational Research Laboratory of Li Ka Shing Institute of Health Sciences, The Chinese University of Hong Kong, Hong Kong SAR, P. R. China

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Professor Qin's lab targets major orthopaedic problems with huge global socioeconomic and healthcare burdens, such as osteoporosis and osteonecrosis. For example, biodegradable materials, especially those that do not require removal as conventional rigid metal orthopaedic implants do, are highly desirable for fracture fixation. Based on skeletal physiology and pathophysiology, Qin and his collaborators are investigating magnesium (Mg), an essential mineral element of our bone matrix, is such an ideal candidate. Collaborating with local and international colleagues, they have developed pure magnesium implants, as well as alloys and hybrid systems for safe application in bone fracture fixation and bone defect repair enhancement, with or without physical or chemical based coating.

Qin's multidisciplinary team also looks at the potential healing mechanisms of Mg ions after implant degradation, including both direct and indirect effects of Mg ions on stimulating skeletal regeneration.

Acknowledgement: The work described in this paper was fully supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project No. T13-402/17-N).

References (*: Corresponding author)

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Biography:

Dr. Qin is Professor and Director of Musculoskeletal Research Laboratory in the Department of Orthopaedics & Traumatology, the Chinese University of Hong Kong (www.ort.cuhk.edu.hk). Dr. Qin also holds joint professorship in Shenzhen Institutes of Advance Technology (SIAT) of Chinese Academy of Sciences (CAS) and serves Director of the Translational Medicine Research & Development Center of Institute of Biomedical & Health Engineering of SIAT (www.siat.cas.cn). Dr. Qin has been working on advanced diagnosis, prevention and treatment of bone metabolic disorders, especially osteoporosis and osteonecrosis, in collaboration with research and clinical scientists in medicine, geriatrics, rheumatologists, traditional medicine, and biomaterials. Dr. Qin is the past President of the International Chinese Musculoskeletal Research Society (ICMRS) (www.icmrs.net) and member of a number of journal editorial boards, including Editor-in-chief of Journal of Orthopaedic Translation (http://ees.elsevier.com/jot); He holds memberships in several international and national orthopaedic and related research organizations, including college fellow of American Institute of Medical and Biological Engineering (http://www.aimbe.org) and ICORS International College of Fellows/Fellow of International Orthopaedic Research (http://i-cors.org/events). As Principle Investigator, Dr. Qin has received over 30 competitive research grants (including TRS, CRF, GRF, ITF, HMRF, NSFC-RGC, and EU-NSFC, 12.5 and 13.5 Key R&D projects of the MOST) and over 30 research awards. Dr. Qin also holds 10 new invention or new utility patents.

Dr. Qin published 9 monographs as editor or associate editor, 5 conference proceedings, 90 book chapters, over 400 journal papers in English, German, and Chinese, including 320 SCI articles published in Nat Med, JBMR, Osteoporosis Int, Bone, A&R, Biomaterials, Acta Biomaterialia, Am J Sports Med, Int J Sports Med, etc. with citation over 7000 and a H-index of 46. Dr. Qin's innovative R&D work on biometals for clinical applications has been featured recently in ***Nature*** (https://www.nature.com/articles/d42473-018-00028-w).

Cartilage Engineering – From Bench to Bed-side

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Cartilage defect repair has always been a challenge in clinical treatment. Our lab devoted to fundamental and application oriented research focusing on cartilage regeneration and repair, and achieved some important progresses: ① established chondrogenic induction system which could promote stem cell chondrogenesis for cartilage regeneration by mimicking the chondrogenic micro environment, which may help to address the issue of seed cell source; ② established in vitro 3D cartilage regeneration technology, and established shape control technology for the in vitro regenerated cartilage by combining with CAD-CAM related techniques;③ developed bioreactor to be used specially for cartilage regeneration, and promoted mechanical properties of the in vitro regenerated cartilage;④ established and successfully repaired cartilage defect models (such as articular joint defect, meniscus defect etc.) in big animals;⑤ successfully conducted clinical trials for articular joint repair based on stem cell and in vitro regenerated cartilage. ⑥ recently, achieved important breakthrough on in vitro regeneration of human ear shaped cartilage, which has been clinically translated to treat patient with microtia. These works addressed fundamental issues of cartilage engineering, and played important roles in promoting clinical translation of this technology.

Biography:

Dr. Yilin Cao is a Professor of Plastic Surgery at Shanghai 9th People's Hospital affiliated to Shanghai Jiao Tong University School of Medicine.He graduated from Shanghai Second Medical University with a MD degree in 1975 and with a PhD degree in 1991. His major contribution is the creation of cartilage in the shape of human ear in nude mouse, and thus he received James Barrett Brown Award in 1998, and the Maliniac Lecture—excellent honor esteem in 2010, at the meeting of American Association of Plastic Surgeons. Currently, Prof. Cao serves as the Directors of National Tissue Engineering Center of China; Shanghai Institute of Plastic and Reconstructive Surgery; and Shanghai Key Laboratory of Tissue Engineering. Meanwhile, Prof.

Cao serves as the Asia-Pacific Chapter of Tissue Engineering and Regenerative Medicine International Society; the Vice president of Chinese Society for Biomaterials; the President-elect of the Reparative and Reconstructive Surgery affiliated to Chinese Association of Rehabilitation Medicine; the chief editor of Chinese Journal “Tissue Engineering and Reconstructive Surgery”; and the Executive Editor of Journal “Biomaterials” & "Tissue Engineering"; and many editors of foreign journals such as Journal “Plastic and Reconstructive Surgery"; “Advances in Wound Care”; and “STEM CELLS Translational Medicine”, etc. Up to now, Prof. Cao has published more than 200 research papers, among them there are more than 70 SCI papers as the corresponding author; Editor-in-chief of “the Theory and Practice of Tissue Engineering”, “The Tissue Engineering”; and in addition to participate in the preparation of several monographs. He has trained 6 post-doctoral students, and more than 60 doctoral students; obtained 29 licensed patents, in which one is the patent for utility models.

Carbonized Polymer Dots: Syntheses, Structures & Properties

Bai Yang
State Key Laboratory of Supramolecular Structure and Materials, College of Chemistry,
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In the past decade, a new exciting class of fluorescent nanomaterials has been developed, which is metal-free and carbon-rich. Carbon dots is by far the most famous example of this new class of materials. CNDs are always prepared by two main procedures: the “top-down” cutting route from different carbon resoures; and the “bottom-up” carbonization methods from kinds of molecules or polymers. The CNDs prepared from the former route always possess good carbon crystallinity with relative low quantum yiled. While the latter route is just the reverse.

This presentation will mainly focus on the syntheses, properties and PL mechanism of CDs. Three types of fluorescent CDs were involved in our recent works: graphene quantum dots (GQDs), carbon nanodots (CNDs), and carbonized polymer dots (CPDs). Four respectable PL mechanisms have been confirmed: the quantum confinement effect or conjugated π-domains, which are determined by the carbon core; the surface state, which is determined by hybridization of the carbon backbone and the connected chemical groups; the molecule state, which is determined solely by the fluorescent molecules connected on the surface or interior of the CDs; and the crosslink-enhanced emission (CEE) effect. To give a thorough summary, the category and synthesis routes, as well as the chemical/physical properties for the CDs, are briefly introduced in this presentation.

Acknowledgement：

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Biography:

Bai Yang currently is a professor of the State Key Lab of Supramolecular Structure and Materials, the college of Chemistry at Jilin University. He received his PhD in polymer chemistry and physics in 1991 under the supervision of Prof. Jiacong Shen at Jilin University. His research interests related with polymeric micro- and nanostructures and functional materials, including optical, photonic, photo-electric and photo-responsive materials. He has coauthored over 500 SCI papers published with more than 19000 sum cited times.

Keynote Speakers

Tumor Acidity-Activated Nanomedicine for Cancer Therapy

Prof. Jun Wang
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Cancer nanomedicine has attracted tremendous attentions over the past decades for its versatile applications in drug delivery and cancer therapy. However, the therapeutic efficacy of nanomedicine has only been moderately improved due to the existence of tremendous delivery barriers exposed by the complicated physiological environment. Smart nanoparticles that can navigate in complex biological environment show great promise in improving the treatment efficacy. Tumor develops slightly acidic microenvironment in comparison with healthy tissues due to its abnormal metabolism, as elaborated by the "Warburg effect", which provides a powerful handle for designing intelligent delivery systems to specifically change their physical or chemical properties at tumor site to improve the delivery efficacy. Our group has developed a series of tumor acidity-responsive delivery systems that can change their essential properties such as size, surface charge et al. to overcome the various delivery barriers. Their delivery effectiveness and improved therapeutic efficacy have been investigated in a variety of tumor xenograft models. We believe our findings open a new avenue to design innovative nanoparticulate delivery carriers.

Biography:

Prof. Jun Wang received his B.Sc. degree in Chemistry and Cell Biology in 1993 and Ph.D. degree in Polymer Chemistry and Physics in 1999 from Wuhan University, China. From 1999 to 2004, he worked as a postdoctoral fellow at Johns Hopkins Singapore and Johns Hopkins School of Medicine. He joined University of Science and Technology of China as a full professor in 2004, and moved to South China University of Technology in 2016. His main research focus is biomaterials and nanomedicine. He published more than 160 peer-reviewed papers with total citations over 8600. Currently, he serves as an Associate Editor of Biomaterials Science, and editorial board member of Acta Biomaterialia and ChemNanoMat. He was awarded by the Hundred Talent Program of the Chinese Academy of Science in 2005, "Outstanding Young Scholar Award" of the National Science Foundation of China in 2011 and Fellow of Royal Society of Chemistry in 2016. He received the Second Class Prize of National Natural Science Award of China in 2015.

Enzyme-Instructed Self-Assembly for Controlling Cell Fate

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In this talk, we highlight enzyme-instructed self-assembly (EISA)—the integration of enzymatic transformation and molecular self-assembly—as a multi-step process for the design of soft matters, such as hydrogels, and for the development of cancer therapy. Using apoptosis as an example, we illustrate that the combination of enzymatic transformation and self-assembly, in fact, is an inherent cellular process. After the introduction of EISA of small molecules in the context of supramolecular hydrogelation, we describe several key studies to underscore the promises of EISA for developing cancer therapy. Particularly, we will discuss that EISA allows one to develop approaches to target "undruggable" targets or "untargetable" features of cancer cells and provides the opportunity for simultaneously interacting with multiple targets. We will highlight developing anticancer medicine that inhibit multiple hallmark capabilities of cancer without inducing drug resistance.

Biography:

After receiving his BS and MS from Nanjing University in 1987 and 1990, Bing Xu obtained his PhD in 1996 from the University of Pennsylvania. Before starting his independent research at the Hong Kong University of Science and Technology on the Aug. 2000, he was an NIH postdoctoral fellow at Harvard University. He was tenured as an associated professor in Jan 2006 and became a full professor in July 2008 at HKUST. Bing Xu currently is a professor in the Department of Chemistry, Brandeis University. His research focuses developing nanoscale processes for applications in materials, biology, and medicine.

New Scanning Probe Techniques for the Characterization and Manipulation of Biomaterials on the nm-Level

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Scanning probe microscopy, and in particular atomic force microscopy (AFM), is best known for the high-resolution imaging of surface topographies. But AFM represents also a highly versatile method to probe quantitatively other properties of samples, such as adhesion or elastic modulus. However, most biomaterials are relatively soft and heterogeneous. Hence, new methods have to be developed that are specifically adapted to biomaterials. In this contribution, a number of novel approaches are presented. Examples will include the comparison of direct force measurements with electrokinetic methods for colloidal particles prepared from spider silk proteins [1] or the *in-situ* preparation of *soft* colloidal probes from hydrogel particles. The latter allows not only to probe mechanical properties but also the adhesion behaviour of hydrogels on the molecular level [2], similar to *single molecule force spectroscopy* [3].

Combining AFM with nanofluidics, also often referred to as FluidFM, has been an important innovation for the study of biomaterials. This technique does allow not only to attach in a temporary manner colloidal objects to the end of an AFM-cantilever but also to change in a defined way solution conditions in the vicinity of a sample. At the same force control can be maintained. Here, we will show how this approach can be used to structure hydrogel films with sub-µm precision [4]. The process represents is inverse to additive methods but is applicable to all types of reversibly formed hydrogel films. Moreover, the FluidFM technique allows to break the size limit for colloidal probes and to determine in a direct manner interaction forces down to the level of single nanoparticles [5].

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Biography:

Studied physics at the Universities of Göttingen and Heidelberg. He obtained his PhD at the Max-Planck-Institute of Colloids and Interfaces in the department of Prof. H. Möhwald. After a short stay as postdoc in soft matter physics (University of Greifswald), he went as senior research assistant and later lecturer to the Laboratory of Colloids and Surfaces at the University of Geneva, Switzerland. In 2009, he became associate professor for Physical Chemistry/Physics of Polymers at the University of Bayreuth. Since 2017 he holds the chair of Physical Chemistry II at the University of Bayreuth. Georg Papastavrou is currently director of the Bayreuth Center of Colloidal and Interfaces and the coordinator of the Keylab 'Interface Characterization' of the Bavarian Polymer Institute.

Targeting Immune Modulatory Properties for Bone Biomaterials Development

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In spite of inherent regenerative ability of bone, large amounts of fracture patients still display delayed or compromised bone healing due to patients' age, trauma severity, developmental anomalies, and infections, which requires therapeutic intervention. Various bone biomaterials have been developed aiming to enhance bone regeneration and function. The early inflammation and immune cells influx into the injury sites after the application of biomaterials form a unique osteoimmune environment, which determines the outcome of bone regeneration. Our current strategies on development of bone biomaterials for repairing bone defects point out that manipulation of osteoimmune responses in bone healing environment is critical to achieve better bone regeneration.

Biography:

Dr. Xiao is a Professor at Queensland University of Technology (QUT), a program leader of Bone and Joint Disorders Program at Institute of Health and Biomedical Innovation (IHBI), and a group leader of Bone Biology and Tissue Engineering at IHBI. He obtained his Bachelor and Master degrees in Dentistry from Wuhan University, China. In 2000, he graduated with a PhD from School of Dentistry at the University of Queensland (UQ), Australia. He worked as a research officer at UQ for two years following his graduation and an NHMRC Research Fellowship at the School of Life Sciences at QUT from 2003. In 2005 and 2012 he was appointed an Associate Professor and Professor, respectively in Bone Biology and Tissue Engineering at QUT. He is currently the Director of Australia-China Centre for Tissue Engineering and Regenerative Medicine (ACCTERM).

In the past five years, he has attracted more than $8 million in research funding from nationally competitive grant schemes and other research foundations. Professor Xiao's work has predominantly focused on the fields of bone biology, biomaterials, stem cells, dentistry, osteoarthritis, and tissue regeneration/engineering. He has published two edited books, 10 invited book chapters and more than 200 journal papers with an H-index of 51.

Biomaterial and Biomimetic Approaches for Cardiac Cell Therapy

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Stem cell therapy is a promising strategy for tissue regeneration. The therapeutic benefits of cell therapy are mediated by both direct and indirect mechanisms. However, the application of stem cell therapy in the clinic is hampered by several limitations, namely low engraftment, poor tareting, and immunogenicity/tumorigenecity/stability issues. In this talk, I will present several recent technologies we developed in the lab to mitigate those problems. The approaches we employed are biomaterials and biomimetic strategies to improve the current efficiency of cell transplantation.

Biography:

Ke is Professor in the Department of Molecular Biomedical Sciences at NC State University and Professor in the UNC/NCSU joint Department of Biomedical Engineering. He is also an adjunct professor at the UNC Eshelman School of Pharmacy and UNC School of Medicine. He directs the BioTherapeutics Lab which focuses on stem cells, biomaterials, and nanomedicine for heart and lung regeneration. His lab also studies novel mechanisms of cell extravasation, termed angiopellosis.

Prior to this position, Ke was an Assistant Professor at Cedars-Sinai Medical Center and University of California Los Angeles School of Medicine, where his research focused on stem cells and regenerative medicine in animal models. Ke also served as the director of the stem cell lab for multiple clinical trials including a clinical trial using patient's own cardiac stem cells to treat heart attack. Ke's formal education began with a B.S. in Pharmaceutical Engineering from the Zhejiang University, followed by a Ph.D. degree in Biological Engineering from University of Georgia.

Osteochondral Repair Using Decellularized Man-Made Hyaline-Like Cartilage Graft

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The key challenge of lower-limb-joint osteochondral regeneration lies in restoration of the avascular articular cartilage on top of the self-repairable subchondral bones. A quality articular cartilage engraftment is validated by the graft's hyaline cartilaginous phenotype and genuine microstructural architecture. In this tissue engineering study, we endeavor to repair traumatic osteochondral lesions in rabbit knee models using a novel decellularized man-made hyaline-like cartilage xenograft that is produced by 3D cultured porcine chondrocytes in vitro - free of non-cartilaginous constituent. Comparative trials are conducted in parallel among samples with or without graft decellularization. Here, sound osteochondral regeneration of both cartilage and subchondral bones from cartilage engraftment within 100 days after implantation has been shown, including the recoveries in form and function with correct osteochondral composition, structure and phenotype. The decellularized grafts excels other counterparts, which opens this engrafting system to enjoy all superiorities and conveniences brought up by decellularization process in terms of logistic simplicity, immune biocompatibility and micro-architectural genuineness.

Biography:

Dr. Dong-An Wang is an Associate Professor (with tenure) and Program Director of Bioengineering in School of Chemical and Biomedical Engineering (SCBE), Nanyang Technological University (NTU) in Singapore. Dr. Wang's research focuses on biomaterials, tissue engineering, regenerative medicine and molecular pharmaceutics with specialties of functional biomaterials for tissue engineering and therapeutic cell delivery; nucleic acid delivery for therapeutic engineering; applications of stem cells for translational medicine; and engineered biomimetic tissue platforms for in vitro drug evaluation.

As a major/leading author, Dr. Wang has published over 100 high quality journal papers including Nature Materials, Advanced Functional Materials, Scientific Reports, Biomaterials etc., some of which are either editorially quoted by Science, Nature Materials, etc.; or, featured as cover stories. Dr. Wang has been often invited as a theme editor for a number of top journals, such as Advanced Drug Delivery Reviews, Molecular Pharmaceutics etc.

The Blood Clearance Kinetics and Pathway of Polymeric Micelles in Cancer Drug Delivery

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Polymer micelles are one of the most investigated nanocarriers for drug delivery; many have entered clinical trials and some are in clinic use, but polymer micellar delivery systems have not yet shown the expected high therapeutic efficacy in clinics. Further understanding the in vivo behaviors of polymer micelles, particularly how quickly and by what mechanism polymer micelles are cleared (i.e., via micelles or unimers), is key to solving this dilemma. Herein, we hope to answer these questions for the clinically relevant polyethylene glycol-block-poly(ε-caprolactone) (PEG-PCL) micelles and PEG-block- poly(DL-lactide) (PEG-PDLLA) micelles. A small fraction of the hydrophobic chain ends was conjugated with a pair of fluorescence resonance energy transfer (FRET) dyes, Cy5 and Cy5.5, and used to fabricate FRET micelles whose FRET efficiency was correlated to the percentage of polymer chains in the micelles, the micelle degree. In vitro, serum proteins induced PEG-PCL micelle dissociation to some extent; mouse serum or blood surprisingly did not induce micelle dissociation, but shear applied by a microfluidic channel caused most PEG-PCL micelles dissociated. After intravenous administration in mice, the PEG-PCL or PEG-PDLLA micelles were quickly sequestered into the liver as unimers and the micelle degree in the blood quickly decreased to about 20%. The FRET-imaging experiments showed that PEG-PCL micelles quickly dissociated in the blood vessels into unimers, which were found associated with albumin in the blood and in liver. Thus, it is concluded that, upon i.v. injection, the shear and the proteins (particularly albumin) induced the PEG-PCL and PEG-PDLLA micelles to quickly dissociate into unimers, which were then sequestered by Kupffer cells. These findings on in vivo micelle fate and the clearance mechanism are directional for the rational design of polymer micelles for improved therapeutics

Biography:

Dr. Youqing Shen is currently a National Changjiang Scholar Chair Professor and Director of Center for Bionanoengineering in Zhejiang University, China. He received his B.S. and D.Sc degrees from Department of Polymer Science of Zhejiang University and PhD degree from McMaster University, Canada in 2002. He was an assistant professor in 2003-2007 and then early promoted to tenured associate professor in 2007 in the Department of Chemical Engineering of University of Wyoming, USA. In 2008 he moved to Zhejiang University as a Qiushi Chair professor. His research interests are functional polymers for bionanomaterials, nanomedicine, and drug/gene delivery. He is a recipient of Distinguished Young Scholar Fund of National Science Foundation of China in 2008, and Leading Young Scientist by Ministry of Science and Technology of China. He is also the chief PI of a nanomedicine project of National Basic Research Program. He has (co)authored 240 scientific papers with an H-index of 57 as well as more than 10 domestic and international patents. He serves as an associate editor for Ind Eng Chem Res published by American chemical Society. He is also vice director of Committee for Nanomedicine in Chinese Pharmaceutical Association, and vice director of Nanomedicine Division in China Medical Biotechnology Society.

In Vitro and In Vivo Evaluation of 3D Printed Ti-6Al-4V Implant

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Titanium alloys have been widely used as metallic implant materials in spine surgery because of their favourable mechanical properties and biocompatibility. Compared with conventional approaches to fabricate porous scaffolds, selective lasing sintering (SLS) is recognized as a promising metallic printing tool in additive manufacturing for bone tissue engineering. In order to reveal the relationship between printing angle of SLS and physical/biological properties of metallic materials, a series of Ti6Al4V bulks were firstly prepared by SLS with different printing angles (i.e. 40, 50, 60, 70, 80 and 90°). Well-controlled microspheres could be observed on fabricated samples by scanning electron microscope. Samples with 60° printing angle displayed the highest roughness, while samples with 40° printing angle exhibited the lowest roughness. MC3T3-E1 cells were seeded on representative samples to evaluate cytotoxicity, adhesion and proliferation *in vitro*, while no significant differences were observed among each angle group without any toxicity. Furthermore, 3D printed Ti6Al4V scaffolds as spinal fusion cages were fabricated by SLS with high porosity. More newly bone formation could be observed on 3D printed cages by Goldner Trichrome stain at 4 and 12 weeks *in vivo* compared with clinical cages. The present study shows great promise in use of 3D printed Ti6Al4V cages by SLS for surgical treatment of lumbar degenerative diseases.

Biography:

In-Seop Lee, Ph.D, FBSE

He is currently at the Institute of Natural Sciences in Yonsei University. His research interests are to develop materials for medical applications, and have been focused on improving the bio-implant interface. He is founding editors-in-chief for the international journal of Biomedical Materials (IF=2.469): Materials for tissue engineering & regenerative medicine published by Institute of Physics (http://www.iop.org/EJ/bmm).

Calcium Phosphate-based Biomedical Materials

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Calcium phosphates (CaP) are the most important inorganic constituents of biological hard tissues in the form of hydroxyapatite (HAp). They exhibit excellent biocompatibility and function and have been used as ideal biomaterials in clinical studies. Scientists have paid more attention to prepare CaP-based materials for bone and tooth repair. Actually, as a kind of biocompatible and biodegradable materials, CaP nanomaterials showed great potential for gene/drug delivery, imaging agents and immunologic adjuvant for cancer therapy. In particular, CaP nanomaterials can delivery several cancer suppressor gene (*p53*, *lefty*, *Ras*-siRNA etc.) as well as the chemotherapy drugs for tumor treatment. Furthermore, the presence of CaP minerals may also alter the behaviours of cell. Biomineralized laminin (LN), a extracellular matrix (ECM) protein, forming CaP-LN complex coat, could induce neural stem cell differentiate into neural cell. Different from previous understandings, the CaP coat could improve the substrate biocompatibility and showed great potential to co-regulate the cell behaviour for improving medical treatment. More generally, optimizing the combination of functional CaP materials with biomacromolecules (protein, gene) for biomedical science constitutes an important and interesting subject.

Biography:

Dr. Xiangdong Kong is professor at the college of Life Sciences, Zhejiang Sci-Tech University, China. He got the PhD degree in materials and Engineering from Tsinghua University, China. He founded the Institute of Biomaterials and Marine Biological Resources in 2012 and ZSTU-Dentium Joint Research Center, China and Korea, for Biofunctional Materials and Regenerative Medicine in 2014.

Highly Branched Poly(beta-amino ester)s as New Gene Delivery Vectors

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Gene therapy has been considered one of the most promising treatments for various genetic disorders. Among nonviral gene delivery vectors, linear poly(beta-amino ester)s (LPAEs) are one type of the most promising candidates. Since they were first developed in 2000 by Prof. Robert Langer at MIT, more than 2500 LPAEs have been designed, synthesized, and screened for gene transfection, the best-performing LPAEs can even match the viral vectors such as adenovirus in efficiency. However, all previous studies with poly(beta-amino ester)s was focused on their linear structure. In contrast, we have successfully developed highly branched poly(beta-amino ester)s (HPAEs) via an "A2+B3+C2" Michael addition strategy. Gene transfection studies showed that overtaking their linear counterpart, in vitro the optimal HPAEs exhibit robust DNA transfection efficiency and high safety in a range of cell types. In vivo, optimal HPAEs effectively restored the expression of collagen VII in Recessive Dystrophic Epidermal Bullosa (RDEB) knockout and graft mouse models at high levels of efficiency.

Biography:

Wenxin Wang is a Professor in skin research and wound healing at the Charles Institute of Dermatology, School of Medicine, University College Dublin, and a Principle Investigator of Science Foundation Ireland (SFI). Prof Wang's scientific interests and expertise covers the development of polymer therapeutics and gene therapy for the wound healing, extending from dendritic polymers to smart polymers for a wide range of applications particularly for tissue engineering (e.g. hydrogels for stem cell encapsulation and delivery), drug delivery, 3D bio-printing. Prof Wang's scientific achievements have been recognized extensively. His scientific contributions and achievements include 4 book chapters, 14 held patents, 3 filed invention disclosure forms (IDFs), and 167 peer-reviewed scientific publications including

Nature Communications, Science Advances, JACS, Chemical Review, Progress in Polymer Science, Angewandte Chemie, and Advanced Materials. Professor Wang has been invited over 70 times as a keynote or invited speaker at international conferences and universities. As the founder, Prof Wang has launched two spin-out companies: Vornia Ltd (purchased by Ashland – one of Fortune 500 USA companies) and Blafar Ltd. Currently, Prof Wang is the Chairman of Director Board and CSO of Blafar Ltd. Prof Wang won "The Science Foundation Ireland (SFI) Young Scientist Prize in Regenerative Medicine" in 2010 at TERMIS-EU conference. Prof Wang has been selected as an expert reviewer and panel member by 17 research councils and funding. He has hosted 19 conferences as a member of the advisory board, organizer, chair or convener around the world.

Engineering Nanoparticles to Target Neurons towards the Promotion of Neuroprotection and Neuroregeneration

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We have been dedicated to using nano-enabled solutions to the design of new therapeutic approaches towards the enhancement of the process of neuroprotection and neuroregeneration. In this talk, particular emphasis will be given to the design of biomaterial-based nanoparticles engineered at the nanosacale to overcome extra- and intracellular barriers with aim to deliver nucleic acids to neuronal cells in an efficient manner. Two biomaterial-based vectors will be discussed:

- Polymeric nanoparticles based on thiolated trimethyl chitosan to mediate targeted gene delivery to peripheral neurons upon a peripheral and minimally invasive intramuscular administration [1];

- Dendrimer based vectors [2] for brain delivery in the aftermath of stroke.

Emphasis will be given to the application of novel strategies proposed to assess the potential of the developed systems and contribute to the design of more efficient nucleic acid delivery vectors. Namely, the use of:

- Imaging flow cytometry - a highthroughput technique with unique features that combines the statistical strength of flow cytometry with image acquisition of every event - to unravel some critical aspects for vector formulation [3];

- Atomic force microscopy as a tool to assess the specificity of targeted nanoparticles in biological models of high complexity [4];

- Microfluidic-based platforms to mimic the in vivo administration of neurotropic nanoparticles [5].

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Biography:

Ana Paula Pêgo got her Ph.D. in Polymer Chemistry and Biomaterials from the University of Twente, the Netherlands, in 2002. In 2003 she became a researcher at INEB where she is a Principal Investigator since 2012.

By using nanomedicine strategies her group – the nanoBiomaterials for Targeted Therapies (nBTT) Group - aims at providing in situ and in a targeted manner the required signals to promote nervous tissue regeneration. The research on new biomaterials for application in neurosciences includes the development of new polymers for the design of alternative vectors to viruses for efficient nucleic acid delivery and preparation of nerve grafts for spinal cord injury treatment. Societal and ethical issues that concern Regenerative Medicine and NanoMedicine are also a topic in which Ana Pêgo is involved.

She has been appointed the Scientific Director of the Bioimaging Centre for Biomaterials and Regenerative Therapies of INEB and she is an Invited Associate Professor at the Instituto de Ciências Biomédicas Abel Salazar (ICBAS) and at the Faculty of Engineering (FEUP) of the University of Porto. Since 2015, Dr. Ana Paula Pego is a member elected from the European Society for Biomaterials, currently being the ESB Secretary.

Biomimetic Skin Grafts for Guided Wound Healing

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Biography:

Dr. Hongjun Wang is Professor of Biomedical Engineering and Professor of Chemistry and Chemical Biology at the Stevens Institute of Technology, Hoboken, New Jersey, USA. The research interests of the Wang lab (www.stevens.edu/wanglab) mainly focus on biomimetic materials design, 3D tissue reconstruction, *in vitro* tissue-on-a-chip and nanomedicine. His group has contributed a dozen of book chapters and invited reviews, a number of patent applications, over 100 invited talks and seminars and more than 70 peer-reviewed papers in *Advanced Materials, PNAS, ACS Nano* and *Biomaterials*. He is also a recipient of several awards including Provost's Award for Academic Entrepreneurship & Enterprise Development (2017), New Jersey Innovators Award (2016), Jess N. Davis Award for Excellent Research (2015), Jess N. Davis Award for Exemplary Research (2010), etc. Prior to joining Stevens, he was a research fellow at the Wellman Center for Photomedicine, Massachusetts General Hospital and the Department of Dermatology, Harvard Medical School, Boston. Dr. Wang received his 1st Doctorate in Polymer Chemistry & Physics with honors from the Institute of Polymer Chemistry, Nankai University, Tianjin, China. He then worked at a Dutch biomedical company, IsoTis NV, and received his 2nd Doctorate in Biomedical Engineering from the Institute for Biomedical Technology, University of Twente, Netherlands. His research has been funded by NIH, NSF and other agencies.

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Biography:

Professional Education：

1985.9 - 1989.7 Bachelor Nankai University

1989.9 - 1992.7 Master Nankai University

1994.9 - 1997.7 PhD Nankai University

Research Area

Cardiovascular Tissue Engineering

Honors and Awards

2004. New century excellent talent program

2007. National science fund for distinguished young scholars

Representative Publications

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Multifunctional Tissue Engineering Scaffolds for Postoperative Cancer Patients

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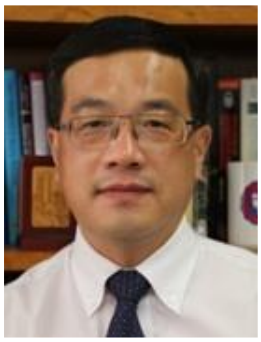
Many cancer patients face high cancer recurrence rates after their tumours have been removed by surgery. Therefore, the early detection and treatment of recurring cancer are vital for them. These patients may also need tissue regeneration at the original tumour site to overcome functional deficiency after surgery. Au-based theranostics can provide diagnostic and therapeutic functions in oncology due to their unique properties; and electrospun tissue engineering scaffolds have many advantages for enhancing tissue regeneration in human bodies. In our investigations, advanced theranostics-incorporated scaffolds have been fabricated using concurrent electrospinning and co-axial electrospray and the performance of these scaffolds has been studied. Electrosprayed, core-shell structured polymer microspheres containing Au-based theranostics are evenly distributed in electrospun nanofibrous polymer scaffolds. Experiments have been conducted for studying theranostics releases by immersing advanced scaffolds in simulated body fluid for different times and the released theranostics are analyzed. *In vitro* biological experiments are performed using HeLa cells to investigate the cancer cell targeting ability and photothermal therapy of released theranostics. Also, both HeLa cells and MCF-7 cells (the control) are incubated separately with sterilized scaffolds. The results show that the advanced scaffolds could release theranostics in a controlled manner and released theranostics could provide cancer cell detection and photothermal therapy functions. Also, *in vitro* biological experiments using smooth muscle cells have demonstrated the potential of scaffolds for tissue regeneration.

Biography:



Min Wang is a full professor at The University of Hong Kong (HKU) and as Programme Director (2013-2018), has led HKU's Medical Engineering Programme (retitled in 2018 as "Biomedical Engineering Programme"). He has worked in universities in the U.K. Singapore and Hong Kong and has been a Guest or Adjunct Professor of a few universities in China. He is an elected fellow of several professional societies (*FIMMM*, 2001; *FIMechE*, 2007; *FHKIE*, 2010; *FBSE*, 2011; *FAIMBE*, 2012; *WAC Academician*, 2013). Since 1991, he has been conducting research in biomaterials and tissue engineering, developing new biomaterials using the composite/hybridization approach. In recent years, he focuses on nano-biomaterials, electrospinning and 3D printing. He has authored a large number of research papers and has given many presentations, including over 150 invited talks at international conferences. He is Series Editor of *Springer Series in Biomaterials Science and Engineering* books and has been Editor, Associate Editor or Editorial Board member of 20 international, printed journals. He serves in the Steering Committee of the International College of Fellows, IUS-BSE.

There's a Lot Going On at the Surface

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In this talk, I will highlight a bioengineering journey toward the search and development of a cost-effective and easy-to-use technological platform for molecular identification and characterization. Analysis of unknown biomolecules in solution can be a complex undertaking. In some situations, identification of all molecular species in a solution is desirable, while in others the recognition of a specific few may be more important. The former involves the use of cost-prohibitive general spectroscopic methods, whereas the latter requires some known information about the target analytes such that probing molecules can be identified and used.

We have made efforts toward bridging this technological gap through the conceptualization, proof, development and validation of a novel biosensing platform based on the ubiquitous surface phenomenon of electric double layer. Specifically, building upon our patented technology we fabricate non-functionalized electrodes in a nanopore to bring molecules to the sensing surface for interrogation. Moreover, by measuring multiple signals related to electron transfer and ion reorganization in the EDL surrounding the molecules, we aim to resolve the physical and chemical structures of the analyte molecules. Since this platform technology is chip based and it operates in a simple way and on a fast time scale, it possesses the potential to become a very cost-effective yet powerful analytic tool.

Biography:

Guigen Zhang is Professor, Halcomb Endowed Chair, and Department Chair of the F. Joseph Halcomb III, M.D. Department of Biomedical Engineering at the University of Kentucky, USA. He holds a BS in Engineering Mechanics, a MS in Biomechanics, and a PhD in Bioengineering. He is a Fellow of the American Institute for Medical and Biological Engineering, Executive Editor of the Biomaterials Forum, President (2017-18) of the Institute of Biological Engineering, and the Founding President of the Chinese Association for Biomaterials (2015-2019). He is one of the four new editors leading the revision of the seminal textbook *Biomaterials Science* by Elsevier. In addition to his extensive publications in the areas of biomechanics, biomaterials and biosensors, Professor Zhang holds numerous patents and has published three books, among them, *Introduction to Integrative Engineering*.

Functional Nanoparticles for Biomedical Imaging

Chunyan Liu[1], Jianfeng Zeng[2], Yi Hou[1], and Mingyuan Gao[1,2]
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Functional inorganic nanoparticles have shown great potentials in diagnosing major diseases such as cancer, atherosclerosis, etc. Through past years, we have been developing versatile functional nanoparticles and nanoparticle-based probes for detecting tiny tumors and lymphatic micrometastasis, evaluating the vulnerability of atherosclerotic plaques, and visualizing tumor microenvironment abnormal signatures for understanding the malignant behaviors of cancers, apart from those for cancer theranostics. In this presentation, we will present our recent studies on above subjects.

Biography:

Dr. Gao is a full Professor from Institute of Chemistry, Chinese Academy of Sciences (CAS)/Chair Professor at Soochow University. He received his BSc (1989) and PhD (1995) in Polymer Chemistry and Physics at Jilin University. He worked as research assistant and associate in Germany from 1996 to 2002 and was AvH fellow between 1996 and 1998. He took the above position upon a 'Hundred-talent Program' of CAS in 2001. He received an award for Distinguished Young Scholars from NSFC in 2002. In 2013, he was appointed as a Chair Professor and Director of the Centre for Molecular Imaging and Nuclear Medicine, Soochow University. He is also guest professors of the fifth affiliated hospital of Sun Yat-Sen University and Chinese PLA General Hospital & Chinese PLA Medical School. Dr. Gao has published 150+ peer-reviewed articles and holds 16+ patents. The total citations amount to 10000+.

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Functionalized Polymer Micelles for Anticancer Drug Delivery

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Multidrug resistance (MDR) is a major problem in cancer chemotherapy. Directly delivering drug-loaded vehicles into the nucleus of MDR cancer cells through nucleopores is an efficient strategy to bypass drug-resistant barriers. Most recently we developed a size changeable polymer micelle system with a dual-shell composed of mPEG-PLA-ss-PEI-DMMA polymer for combating drug resistance in human breast cancer cells. These micelles latently deactivate PEI's amines to negatively charged acid-labile amides to inhibit nonspecific interaction with normal cells but regenerate the original PEI once in acidic tumor tissues and subsequently protonate PEI's amines, resulting in an increase in micellar size. After being internalized by cancer cells, the micelles become larger in the lysosomal environment, and they can easily escape from the lysosomes through the proton sponge effect. Then, PEI shells are deshielded with the cleavage of disulfide bonds under high concentrations of glutathione in the cytoplasm to generate new micelles, whose size is smaller than nucleopores. As a result, they can enter into the nucleus and release cargo intranuclearly to cause cancer cell death. Our work presents a good example of rational design for the direct delivery of nanocarriers into the nucleus and subsequent effective fighting against drug resistant breast cancer.

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Biography:

Prof. Shaobing Zhou is from School of Materials Science and Engineering, Southwest Jiaotong University. He received his Ph.D. degree in organic chemistry from Chengdu Institute of Organic Chemistry, Chinese Academy of Sciences in 2003. In 2004, he joined the faculty of Southwest Jiaotong University as a full professor of polymer chemistry. He was awarded the National Science Fund for Distinguished Young Scientists of China in 2017. His research interests include drug controlled release system and tissue engineering scaffold. He is the author or coauthor of more than 120 refereed articles and 25 Chinese patents/patent applications. He has been cited over 4500 times and has an h-index of 40.

Polymer Nanoparticles for Inhibiting Cell-free Induced Inflammation of Arthritis

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Rheumatoid arthritis (RA) is a kind of chronic inflammatory disease which damages the joints of close 1% of human beings. Present clinical therapy applies mainly on drugs like methotrexate, glucocorticoids and anti-TNF-alfa antibody. But there are serious side effects by these treatments. Recently some evidences indicate that cell-free DNA (cfDNA) acts as damage-associated molecular pattern molecule in activating the Toll-like receptor (TLR) pathway. It is well-known that cationic polymeric materials have been applied to deliver DNA for gene expression. Negative charged polymers form complex with positive charged materials. We have applied cationic polymer nanoparticles (cNPs) to scavenge the cfDNA in the inflammed joints to inhibit TLR activation and thus to treat RA disease. We found that cNPs efficiently inhibit primary macrophage activation by cfDNA through a high DNA binding affinity from cNPs. Clinical scoring, medical imaging, and histology demonstrate efficient therapeutic effect on CIA rat model of arthritis.

Biography:

Yongming Chen received his Master degree in 1990 from Northwest University at Xi'an. In 1993, he obtained his Ph.D. from the Institute of Polymer Chemistry, Nankai University in Tianjin, with Professor B. L. He. From 1994 to 1998, he was Postdoctoral Researcher and later Research Assistant at the Institute of Chemistry, CAS in Beijing, working with Professor F. Xi. Then he spent the period 1998−2001 as Postdoctoral Researcher in Germany: first at the Institute of Organic Chemistry and Macromolecular Chemistry II, University of Düsseldorf, working with Professor G. Wulff and later at the Institute of Physical Chemistry, University of Mainz, working with Professor M. Schmidt. Since 2001, Chen was Professor at the Institute of Chemistry CAS. He moved to Sun Yat-Sen University in 2013. Professor Chen's research interests are in the areas of synthesis of well-defined polymers and polymer application in nanomedicine. He obtained "Distinguished Young Scholars" by National Science Foundation of China (2006) and "Wang Bo-Ren Polymer Research Award" by Chinese Chemistry Society (2011). He also serves as an Editor of *Polymer* since 2007 and editorial advisory board of *Macromolecules* (2011-2013) and *ACS Macro Letters* (2012-2013).

Controlled Release of Magnesium Ions Enables In-situ Bone Regeneration

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A range of magnesium ions (Mg^{2+}) used has demonstrated osteogenic tendency in vitro. Hence, we propose to actualize this concept by designing a new system to precisely control the Mg^{2+} delivery at a particular concentration in vivo in order to effectively stimulate in-situ bone regeneration. To achieve this objective, a monodisperse core-shell microsphere delivery system comprising of poly (lactic-co-glycolic acid) (PLGA) biopolymer, alginate hydrogel, and magnesium oxide nano-particles has been designed by using customized microfluidic capillary device. The PLGA-MgO sponge-like spherical core works as a reservoir of Mg^{2+} while the alginate shell serves as physical barrier to control the outflow of Mg^{2+} at ~50ppm accurately for 2 weeks via its adjustable surface micro-porous network. With the aid of controlled release of Mg^{2+}, the new core-shell microsphere system can effectively enhance osteoblastic activity in vitro and stimulate in-situ bone regeneration in vivo in terms of total bone volume, bone mineral density (BMD), and trabecular thickness after operation. Interestingly, the Young's moduli of formed bone on the core-shell microsphere group have been restored to ~96% of that of the surrounding matured bone. These findings indicate that the concept of precisely controlled release of Mg^{2+} may potentially apply for in-situ bone regeneration clinically.

Biography:

Dr. Kelvin Yeung is passionate in orthopaedic biomaterial research for more than 15 years. His major research areas cover from the development of orthopaedic biomaterials, 3D bio-printing as well as musculoskeletal tissue engineering. He trained as materials scientist in his bachelor degree and then orthopaedic scientist in HKU Medical Faculty for his master degree and PhD, respectively. He is currently tenured associate professor in the Department of Orthopaedics and Traumatology, The University of Hong Kong. His h-index is 41 with more than 5,000 citations. In addition to his more than 180 peer-reviewed SCI journal papers published and 38 filed full patents in various countries, he has also co-founded the OrthoSmart Limited together with Dr Johnson Lau and Prof. Kenneth Cheung so as to translate their research findings to clinical use. He also serves as CEO in

this company. Furthermore, he has been appointed as a consultant of another HK based 3D metal printing medical device company.

During these years, he had received numbers of award and scholarship from local and regional competitions such as Young Scientist Award 2005 and Young Engineer Award 2009, respectively. The total amount of grants and sponsors directly arising from his projects in PI and Co-PI capacity is over HK$63M. Additionally, he has supervised 8 PhD and 11 MPhil students since 2006. Furthermore, he obtained 18 prizes and awards from local and international competitions and conferences. Dr Yeung has also become an active member and actively served different executive positions in local and international professional bodies. Apart from these professional positions, he has appointed as Deputy Master of HKU Lap-Chee College so as to oversee the student education programs there. He also served few executive positions in HKU Starr Hall, alumni bodies and patient benefit groups previously.

Polyelectrolyte Complex Coatings: From Biomimetic Methods to Real Coating Technology

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The basement membrane is the special extracellular matrix which supports the endothelium and modulate the vessel repair. The multilayered assembly has becoming the most promising method to mimic the extracellular matrix. We have demonstrated that the multilayered assemblies can not only provide a simple tool to immobilize different bio-funtional molecules but also locally delivery bioactive molecules including drug, gene and peptide etc. The multilayered film can be further explored to have different micro-nanostructures and bio-inspired multifunction including specific wettability, stimuli-responsive and self-adaptive stiffness.

The limitation of current fabrication strategies lies in the problems associated with complicated time consuming operations. Herein, we report a spray approach for two-step fabrication of polyelectrolyte complex coatings (PECCs). Using nanoparticles generated by complexation of polylysine (PLL) and hyaluronic acid (HA) dilute solution as model, we build up a micro-scale, uniform and smooth PECCs by ultrasonic spray deposition and subsequent annealing in 100% RH condition. We demonstrate that spontaneous polymer chain interfusion was activated during 100% RH annealing process, which not only smooth the sprayed raw coatings but also promote their stability in physiological condition. Based on this strategy, we present a one-pot loading of drugs and biomacromoleculs to fabricate biomimetic functional PECCs for bio-applications.

Biography:

Prof. Ji Jian became a full professor in Department of Polymer Science and Engineering, Zhejiang University in 2004. Since 2017, he is director of Institute of Biomedical Macromolecule in Zhejiang University. In 2010, he received the Distinguished Young Scholars Award of the National Science Foundation of China. And in 2015 he was award as Cheung Kong Scholars by Ministry of Education. He is the fellow of The Royal Society of Chemistry, Associate editor for Journal of Materials Chemistry B and on the editorial advisory board for the Biointerphases, Biomaterials Science and J. Biomater. Science, Polymer Edition. His research focuses on interfacial phenomena for biomedical implant, tissue engineering and nanomedicine. Based on the biomimic strategy, several supramolecular self-assemble methods were explored to develop biocompatible and biofunctional surface for biomedical application. Several innovative techniques have been applied to biomedical devices including cardiovascular stent and catheter.,etc

Supramolecular Assemblies of Polyelectrolytes with Phospholipids and Phosphate Ions

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In this presentation we will show different approaches in nanofabrication involving polyelectrolytes and phospholipids and phosphate ions having in common as driving force the strong interaction between primary amines and phosphate groups.

In the first part of the talk we will discuss the use of polyelectrolyte multilayers from poly(styrene sulfonate) (PSS) and poly(allylamine) hydrochloride (PAH) as supports for the assembly of lipid bilayers. We will address the conditions need for the formation of a bilayer on top of the polyelectrolyte multilayers fabricated by the layer by layer assembly technique, and we will analyze the interactions between lipids and PAH [1]. The supported lipid bilayers will be used for the assembly of virus like particles and virosomes as a tool for engineering the surface of colloids and sensor fabrication [2]. We will show as well that the lipid bilayers have a high resistance and that ion channels like gramicidin channels can be incorporated in the bilayers for selective ion transport [3].

Then, we will show the formation of supramolecular polyelectrolyte assemblies, films and nanoparticles that result from the self-assembly of poly(allyamine) hydrochloride with phosphate ions [4]. We will show the use polyamine phosphate nanocarriers (PANs) for silencing RNA (siRNA) encapsulation and delivery. PANs are fabricated by complexation of phosphate anions from phosphate buffer (PB) solution with the amine groups of PAH, Figure 1A. [5] PANs are stable in a narrow pH interval from 7 to 9, and disassembly at pHs higher than 9 and lower than 6. PANs with encapsulated siRNAs are stable in cell media. Once internalized in cells, following endocytic pathways, the PANs will disassembly at the low endosomal pH releasing the siRNA into the cytosol. The efficacy of this approach is shown for the silencing of the Green Fluorescence Protein (GFP) protein in the GFP-A549 cell line, Figure 1B and 1C. Fluorescence Cross Correlation Spectroscopy (FCCS) and Confocal Laser Scanning Microscopy (CLSM) experiments show that siRNAs are released from the PANs and delivery into cytosol. Silencing efficacy was evaluated by flow cytometry, CLSM and western blot assay.

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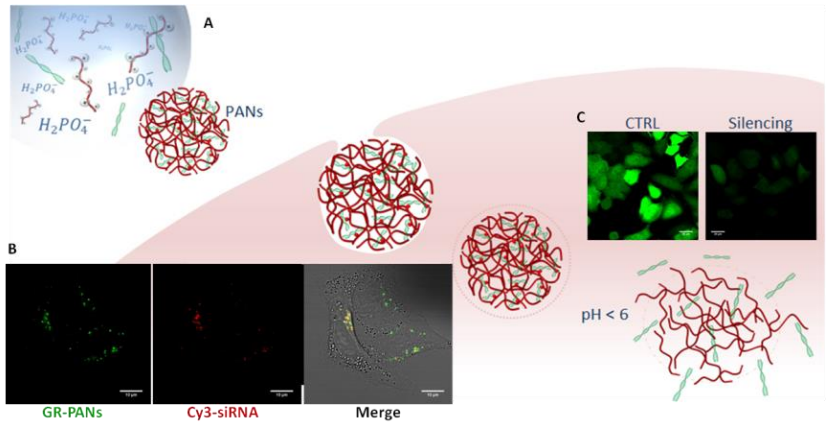

Figure 1: A) Scheme of the fabrication of polyamine phosphate nanocarriers loaded with siRNAs. B) Co-localization experiments with Grenn rhodamine labelled PAH (GR-PANs) and Cy3-labelled siRNAs. C) Confocal Laser Scanning Microscopy images showing that PANs with encapsulated green fluorescence protein (GFP) siRNAs are able to silence GFP in A549 cells expressing this protein.

Biography:

Sergio Moya studied Chemistry at the University of the South in Argentina. He got his PhD in Physical Chemistry at the Max Planck Institute of Colloids and Interfaces in Germany under the supervision of Helmuth Moehwald and Edwin Donath. Then, he was post doct at the College de France, Paris, in the group of Jean Marie Lehn, and in the Nanoscience Centre at the University of Cambridge, UK. Following post doctoral work he was hired as independent researcher at the Centre of Applied Chemistry in Mexico. Presently, he is group leader at Cooperative Centre of Biomaterials (CIC biomaGUNE), San Sebastian, Spain. He is author of 170 articles in different areas of material science and chemistry. His research interests spans the use of polyelectrolytes in nanofabrication, hybrid materials, drug delivery, nanotoxicity and biological fate. He has coordinated several European and international projects.

Nanoscale Regulation of Stem Cell Behavior

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Nanotopographies have been widely utilized to regulate cell behavior. However, the exact role of the nanotopography in cell regulation is still elusive because adhesive proteins such as fibronectin (FN) and collagen are usually coated on the nanotopography. Does nanotopography affect cell behavior directly via the physical cues or indirectly via biochemical cues by affecting the presentation of adhesive ligands? To answer the question, we fabricated nanoscale gratings and rectangle arrays on polystyrene (PS) substrate that cells cannot deform, and then stamped identical nanopatterned rhodamine-labeled FN (rFN) including lines and rectangle array on these nanotopographies and flat substrates. Cell spreading, nuclear deformation, yes-associate protein (YAP) intracellular localization, lamin a/c expression and differentiation of human mesenchymal stem cells (hMSCs) grown on those substrates were examined. It was found that cell spreading was affected by both nanoscale physical and biochemical cues, while the nuclear deformation was more sensitive to the physical cues. The physical nanotopographies played dominant roles in regulating focal adhesion organization and cell proliferation. Further, the nanotopographies could induce the nano-scaled deformation of nuclei and lamin a/c structure in the nuclei. The pharmacological studies indicated that these nanoscaled nuclear deformations could be attenuated by reducing cellular contractility. This study will advance our understanding of the biophysical regulation of cell behavior and contributes to the rational design of cell-substrate interfaces of biomedical devices.

Biography:

Dr. Yong Yang is an Associate Professor in the Department of Biomedical Engineering at the University of North Texas and the Director of the Micro and Nanoengineering Innovation in Medicine (MiNiMedicine) Laboratory. His research focuses on elucidating cell-microenvironment interactions by creating defined biomimetic platforms, and therefore regulating stem cell fates for regenerative medicine and engineering microscale physiologically relevant systems, or tissue chips for understanding, diagnosis and treatment of human diseases. The lab is supported by research grants from NIH and NSF. Dr. Yang has authored over 30 publications in high-profile journals such as Advanced Materials, ACS Nano, JACS and Nano Letters, 80 scientific presentations, and 4 patents. Dr. Yang obtained his Ph.D. from the Department of Chemical and Biomolecular Engineering at The Ohio State University (OSU), and did postdoctoral research in the NSF sponsored Nanoscale Science and Engineering Center for Affordable Nanoengineering of Polymer Biomedical Devices at OSU and then the Department of Biomedical Engineering at Duke University.

Polymer Matrices with Functional Gradients in Tissue Engineering

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Many biological processes in the body are mediated by physical or biochemical signal gradients. There are many kinds of signal gradients in the body, including chemotaxis, heptotaxis, and mechanotaxis. These signal gradients induce the differentiation of stem cells to specific target cells and thus can regenerate target tissues or organs. So, if we can control these physical or biochemical signals and their gradients, we may be able to have more control cell behaviors and enhance tissue formation. We have tried to fabricate various 2D and 3D physical and biochemical gradients for differentiation of stem cells to regenerate target tissues. Among the polymer matrices with these signal gradients, pore size, stiffness, and growth factor gradients to control differentiations of stem cells (bone marrow or adipose-derived stem cells) and regeneration of target tissues (regenerations of bone, bone-to-tendon, nerve, etc.) will be discussed in this presentation

Biography:

Jin Ho LEE, graduated Department of Materials Science and Engineering, University of Utah, U. S. A. with Ph. D. degree in 1988. He worked at Biomaterials Laboratory, Korea Research Institute of Chemical Technology (KRICT) as a senior research scientist from 1988 to 1993. Since 1993, he is a professor in the Department of Advanced Materials and Chemical Engineering, Hannam University, Korea. He served as Secretary General of 7th Asian Symposium on Biomedical Materials (ASBM-7, 2006) and Scientific Program Chair of 2nd World Congress of Tissue Engineering and Regenerative Medicine International Societies (TERMIS-WC, 2009). He was a President of Korean Tissue Engineering and Regenerative Medicine Society (KTERMS) (2012) and served as Conference President in TERMIS-AP Meeting (2014). He was selected as a Fellow of TERMIS in 2015. His recent research area includes stem cells/biocompatible polymer hybrid materials (scaffolds, membranes, microparticles, and hydrogels) for tissue regenerations such as cartilage, bone, tendon, muscle, trachea, vocal fold, and nerves as well as delivery systems of bioactive molecules such as proteins, growth factors, genes, and drugs. He published more than 230 peer-reviewed journal papers, 35 book chapters, and 70 patents.

Self-assembled Injectable Nanocomposite Hydrogels Stabilized by Bisphosphonate-Ion Coordination for Promoting in situ Tissue Regeneration

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Nanocomposite hydrogels consist of a polymer matrix embedded with nanoparticles (NPs), which provide the hydrogels with unique bioactivities and mechanical properties. Incorporation of NPs via in situ precipitation in the polymer matrix further enhances these desirable hydrogel properties. However, the non-cytocompatible pH, osmolality and lengthy duration typically required for such in situ precipitation strategies precludes cell encapsulation in the resultant hydrogels. Bisphosphonate (BP) exhibits a variety of specific bioactivities and excellent binding affinity to multivalent cations such as magnesium ions (Mg2+). Herein, we describe the preparation of nanocomposite hydrogels via self-assembly driven by bisphosphonate-Mg2+ coordination. Upon mixing solutions of polymer bearing BPs, BP monomer (Ac-BP), and Mg2+, this effective and dynamic coordination leads to the rapid self-assembly of Ac-BP-Mg NPs which function as multivalent crosslinkers stabilize the resultant hydrogel structure at physiological pH. The obtained nanocomposite hydrogels are self-healing and exhibit improved mechanical properties compared to hydrogels prepared by blending pre-fabricated NPs. Importantly, our hydrogels allow the encapsulation of cells and subsequent injection without compromising the viability of seeded cells. Furthermore, the acrylate groups on the surface of Ac-BP-Mg NPs enable facile temporal control over the stiffness and crosslinking density of hydrogels via UV-induced secondary crosslinking, and we find that the delayed introduction of this secondary crosslinking enhances cell spreading and osteogenesis.

Biography:

Dr. Bian received his B.Eng and M.Sc degree from the National University of Singapore in 2002 and 2004, respectively. Dr. Bian completed his Ph.D. study in Biomedical Engineering at Columbia University in 2009. Dr. Liming Bian then conducted his postdoctoral research in the Department of Bioengineering, the University of Pennsylvania from 2009 to 2012. In 2012, Dr. Bian joined the Chinese University of Hong Kong as an assistant professor. Dr. Bian's research focuses on the development of novel multiscale biomaterials not only for investigating the role of cell microenvironment factors on stem cell behaviors but also for facilitating the regeneration of diseased or injured tissues and organs. Dr. Bian's research work has been published in the leading journals including PNAS, JACS, Nano Letters, Biomaterials, Advanced Functional Materials, ACS Nano, Macromolecules, and Chemistry of Materials.

New Advances in Biomaterials for Bioprinting and Tissue Regeneration: Engineereing Interfaces

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Protein- and polysaccharide-based biomaterials of natural-origin, processed in a hierarchical manner, can offer the possibility of mimicking several tissue interfaces. At the I3B's, we have been developing several advanced polymeric (e.g., gellan gum, silk fibroin, hyaluronan, and gelatin) and ceramics (e.g., hydroxyapatite and ionic-doped tricalcium phosphates) with the required properties for obtaining hydrogels and bioinks to be used in interface 3D tissue *in vitro* models and tissue regeneration. Several in-house developed dynamic culturing platforms comprising proprietary bioreactors and microfluidics technologies have also been developed in the interface studies. Our most significant contributions dealing with the development of fast-setting hydrogels and bioinks, advanced processing and culturing methods, and *in vitro*/pre-clinical validation will be presented and discussed, herein.

Biography:

J. Miguel Oliveira BSc, PhD (Portuguese, M, 40 years old) is a Principal Investigator "Investigador FCT 2012 and Investigador FCT 2015" at the PT Government Associate Laboratory ICVS/3B's (http://www.3bs.uminho.pt/users/migueloliveira). He is the Director of Pre-Clinical Research at the FIFA MEDICAL CENTER, Estádio do Dragão, Porto, PT since Fev. 2013 and Pro-Director of the 3B's Research Group, Univ. Minho, PT. Currently, he is a Lecturer in Doctoral Program in Tissue Engineering, Regenerative Medicine and Stem Cells (TERM&SC) at UMinho, PT (since Dec. 2013). He is also an Invited lecturer at the Faculty of Medicine, U. Porto (since Sept. 2013) and Dept. of Polymer Eng., UM, PT (2009-present). Along the years he has focused his work on the field of biomaterials for tissue engineering, nanomedicine, stem cells and cell/drug delivery. More recently, he set-up a new research line within the ICVS/3B's on 3D in vitro models for cancer research. As result of his proficiency, he has published so far more than 240 scientific contributions in scientific journals with referee, being 4 of those review papers produced under invitation. Miguel Oliveira was approved 15 patents, published 4 books, 1 special issue in scientific journals, and more than 60 book chapters in books with

international circulation. He has participated in more than 200 communications in national/international conferences and has been invited/keynote speaker in more than 30 plenary sessions. He has an h-index of 33, i10 of 74 and received more than 4400 citations. He has been awarded several prizes including the prestigious Jean Leray Award 2015 from European Society for Biomaterials for Young Scientists for Outstanding Contributions within the field of Biomaterials. He is very active on the elaboration and scientific coordination of several PT and international funded projects. In addition, he is member of the advisory /editorial board of the Journal Bio-Design and Manufacturing, Journal of Materials Science: Materials in Medicine, International Journal of Tissue Engineering, Journal ISRN Biomaterials, The Journal of Experimental Orthopaedics, Journal "Recent Patents on Corrosion Science", and referee in more than 40 international journals.

Structure and Dynamics in Polyelectrolyte Multilayers and Complexes – a Magnetic Resonance Study

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Polyelectrolytes are ideally suited for medical applications because of their inherent charges. Our applications include controlled drug release, surface coating as well water purification. Many applications of polyelectrolytes benefit from their ability of assemble in multilayers or complexes of oppositely charged polyelectrolytes. Besides light scattering the hydrodynamic size of polyelectrolytes and polyelectrolyte complexes maybe determined from diffusion NMR with the advantages that smaller objects, i.e. small molecules, are visible as well and in mixtures individual species are identified by their chemical shift. The charge maybe influenced by external factors like pH and ionic strength and the charge in turn influences the conformation and thus the hydrodynamic size. The conformation in solution is retained in complexes and multilayers as it is seen in solid-state NMR spectra probing spatial proximity showing fewer intermolecular contacts in complexes formed from solutions of high ionic strength. In these cases heterogeneity of the molecular mobility is observed in NMR relaxation experiments detected with chemical shift resolution. Additional highly selective mobility information is derived from EPR of spin-labelled polyelectrolytes. Detailed analysis and simulation of lineshape permit to determine the rate and the geometrical restrictions of the motion. The effective charge, which is influenced by counterion condensation and binding of ligands is directly determined from the combination of diffusion and electrophoresis NMR. Thus the condensation of counterions is directly observed and the degree of counterion condensation is quantified. In the same manner the binding of small molecules and ligands to macromolecules is followed.

Biography:

Since 1996 scientist at the Leibniz-Institut für Polymerforschung Dresden e.V.

Since 2010 head of the Department Polyelectrolytes and Dispersions

2000-2009 head of the Department Surface Modification

2012 and 2014 Visiting Professor Université d'Orléans

1994-1996 postdoc with Prof. R.K. Harris, University of Durham, England

1994 PhD in Physics “Spatially resolved solid-state MAS-NMR spectroscopy”

1991-1994 PhD student at the Max-Planck-Institut für Polymerforschung in Mainz with Prof. H.W. Spiess

1991 Diploma Thesis: "Specification of a scintillation detector for proton recoil spectrometry and fluence measurements”

1989 internship at the Joint Institute for Nuclear Research in Dubna

1986-1991 study of Physics at the Technische Universität Dresden

Hierarchical Structures in Biogenic and Bio-inspired Calcium Carbonates

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Characteristically, many biominerals (e.g. sea shells or glass sponges) are organic/inorganic composite materials showing hierarchical organization, i.e. they are structurally optimized at several length scales. Despite drawing on a limited pool of available elements, nature has developed sophisticated mechanisms to fabricate nanostructured minerals under environmental conditions. Not only are biogenic minerals beautifully sculptured, but their complex architectures also often lead to astounding (mechanical) properties adapted to suit a specific function. Therefore, the study of biominerals has inspired a huge body of biomimetic research aimed at a transfer of their structural and mechanical characteristics into artificial systems. The presentation will discuss examples of biogenic and bio-inspired calcium carbonate-based hybrid materials [1] with a special focus on multiscale analytical techniques to study structural organization and formation processes. [2]

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Biography:

Anna Schenk studied Chemistry in Leipzig (Germany) and Uppsala (Sweden). She performed graduate research on polymer-mineral hybrid materials at the Max Planck Institute of Colloids and Interfaces in Potsdam under the supervision of Prof. Peter Fratzl and received her PhD degree in Physical Chemistry in 2011. From 2011–2013 she worked as a Postdoctoral Research Fellow in the group of Prof. Fiona Meldrum at the University of Leeds (UK) studying the crystallization of calcium carbonate and other minerals under biomimetic conditions. She then joined the Institute of Polymer Chemistry at the University of Stuttgart as a senior postdoctoral scientist in 2013 and received a stipend from the Carl Zeiss Foundation to perform work on virus-directed mineralization. In 2017 Anna Schenk became a Junior Professor at the University of Bayreuth, where her current research focuses on the translation of bio-inspired concepts into synthetic strategies towards functional oxide ceramics and polymer-based hybrid materials.

Invited speaker

Oxidation-sensitive Polypeptide with Conformation-directed Self-assembly

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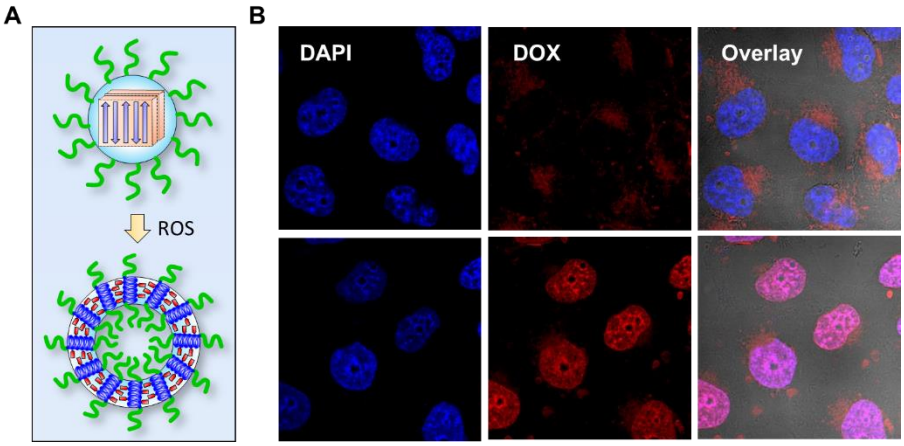
Synthetic polymers can self-assemble into a wide variety of bioinspired nanoscale morphologies. The high chemical tunability of polymers in principle allows for fine tailoring of the assembled structures and functionalities for biotechnology and medicine applications. To this end, we first proposed a new method for controlling the architecture and function of self-assemblies via multiple hydrophilic domains. The surface of the assemblies could be further engineered with various ligands and cationic surfactant to collaboratively enhance the cell internalization of polymeric nanocarriers. Furthermore, a novel "molecular engineering" strategy was developed to partitionally integrate desired functions and smart switches in a single polyurethane carrier. In addition, we proposed a conformation-regulated assembly strategy, where the change of secondary structures from β-sheet to α-helix endows the polypeptide assemblies with excellent specificity for controlled payload release and improved cell interaction in response to reactive oxygen species, resulting in excellent biological performance (e.g., anticancer) both in vitro and in vivo..



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Biography:

Mingming Ding received his B.S. degree in Polymer Materials and Engineering in 2006 and his Ph.D. degree in Materials Science in 2011 from Sichuan University. After completing his postdoctoral research in Biomedical Engineering at Sichuan University, he joined CPSE, Sichuan University, in 2013 as an associate professor. He has applied or authorized 6 patents, and published over 40 publications in Adv. Mater., J. Am. Chem. Soc., ACS Nano, Biomaterials, etc., which have been cited over 1000 times and highlighted by several international newsmagazines and scientific research journals.

A Smart Skin Regeneration System for Real-time Wound Monitoring and Dynamic Intervention

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Skin regeneration is one of the most important problems in clinic. The unknown state of wound is a major cause for delaying the repair process. Therefore, developing novel skin regeneration materials to break the unknown state of repair process and dynamically match the needs of different stages is of the utmost importance to skin regeneration. Based on this, we constructed a smart skin regeneration system by combing the flexible sensing technology with skin regeneration materials. We demonstrated that this smart skin regeneration system could be an effective tool to realize the real-time monitoring of wound and then offer an early warning for abnormal condition of wound repair. In the meantime, this system could also guide the skin regeneration material to give a proper intervention treatment.

Biography:

Lie Ma is a Professor in Department of Polymer Science and Engineering at Zhejiang University. He graduated from Harbin Institute of Technology in 1999 as a bachelor and obtained his PhD degree in Zhejiang University in 2004, under the supervision of Prof. Jiacong Shen and Prof. Changyou Gao. After that, he joined Department of Polymer Science and Engineering, Zhejiang University, as a faculty. He was appointed an associate professor in 2006 and professor in 2011 at Zhejiang University. His research interests are materials for tissue engineering and regenerative medicine, especially materials for skin regeneration. As the project leader, he has gotten more than 10 projects from the National Natural Science Foundation of China and the National Key Research Program of China et.al. He has published more than 70 papers in Biomaterials, Tissue Engineering, et al. and achieved 10 patents and 3 Scientific and Technological Award of Zhejiang Province.

Cancer Theranostics Based on Iron Oxide Nanoparticles

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Iron oxide nanoparticles are widely used in cancer theranostics[1-3]. At NIMTE, we focused on the biomedical applications of iron oxide nanoparticles, particularly on contrast agents in magnetic resonance imaging (MRI) [2-9]. We have investigated high efficiency, high specificity and low toxicity contrast agents in MRI based on iron oxide nanoparticles. We will present these data and new progress in detail here.

Acknowledgement:

Financial supports by NSFC (U1432114, U1501501) and CAS (2010-735).

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Biography:

Aiguo Wu/Professor

Research interests: Nano-/Bio- Materials for Cancer Theranostics

1) **Published Papers: 150+** papers published in Peer Reviewer International Journals (*Chem Soc. Rev.*, *Biomaterials, Adv. Mater., ACS Nano, PNAS, Chem. Commun., Adv. Sci. etc.*)

2) **Patents**: Applied **109** Chinese, International Patents, Awarded **48** ones including **1** US one

3) **Invited Presentations**: **70** invited conference presentations, **50+** invited talks

4) **Citations**: **4600+**, H-index=**38**

5) **Book**: ***Nanomaterials for Tumor Targeting Theranostics***, Editors: **Mingqian Tan, Aiguo Wu**, World Scientific Publishing, Singapore, 2015 published.

Self-propelled Colloidal Motors for Biomedical Application

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Current drug nanocarriers have potential to perform targeted drug delivery since they can achieve longer systemic circulation so that more drugs can be deposited at the tumor site through the enhanced permeability and retention (EPR) effect. Although various nanocarriers have been successfully used to deliver drugs, the targeting ratios are still very low since they cannot actively seek the tumor site and also lack a propelling force to penetrate the tumor beyond their normal diffusion limit.

In this talk, I will present that living cells with intrinsic chemotaxis capability such as neutrophils can be turned into self-guided biohybrid micromotors by integrating synthesized nanoparticles for actively targeted drug transport. The resulting biohybrid micromotors possess chemotactic capability toward the chemoattractant gradients secreted by E. coli. Camouflaging mesoporous silica nanoparticles (MSNs) with E. coli membranes not only enables the uptake of MSNs into neutrophils without losing cellular activity and motility, but also reduce the leakage of water-soluble drugs from nanoparticles. This camouflaging strategy should be applicable to the construction of other biohybrid motors through integrating functional nanoparticles into living cells. Moreover, such hybrid neutrophil motors with intense chemotaxis and biocompatibility may provide a new trend in the design of next-generation drug delivery for actively seeking sites of diseases and targeted drug transport.

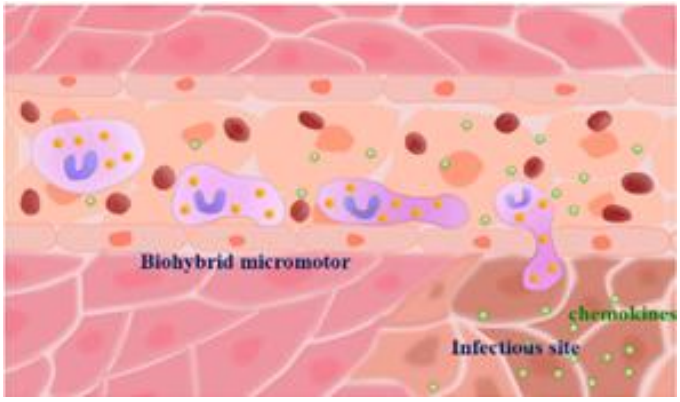

Figure 1. Schematic illustration of Chemotaxis-Guided Hybrid Neutrophil Micromotor for Actively Targeted Drug Transport.

Acknowledgement:

This work was supported by the National Natural Science Foundation of China.

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Biography:

Qiang He is a Professor at the Micro/Nanotechnology Research Center, Harbin Institute of Technology (HIT), China. He obtained his PhD from the Institute of Chemistry, the Chinese Academy of Sciences (ICCAS) in 2003. He then joined the ICCAS as an assistant professor and became an associate professor in 2006. He spent four years as a research fellow of the Alexander von Humboldt Foundation in the Max Plank Institute of Colloids and Interfaces, Germany. He joined HIT as a full professor in 2010. His research interests include active colloids, artificial micro-/nanomachines, and stimuli-responsive materials for biomedical applications.

Macroscopic Supramolecular Assembly and Its Applications on Tissue Scaffolds

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Macroscopic supramolecular assembly (MSA) is a recent advancement in supramolecular chemistry regarding assembly events between building blocks larger than ten micrometer. Researches on this topic have provided both a deep fundamental understanding of massive molecular recognition at interfaces in a multivalent manner and novel methodologies for the fabrication of supramolecular materials. To address the problems of "what kind of building blocks could achieve macroscopic assembly?", we have established a general design rule of MSA: assembly probability decreases with the increasing elastic modulus of building blocks. Moreover, we have proposed the concept of "flexible spacing coating" to achieve MSA of rigid materials. To promote the practical applications of MSA, we have fabricated biocompatible 3D structures with targeted chemical modification, which provide a novel strategy to address the current challenges in fabricating complex 3D tissue scaffolds with localized protein for future induced cell differentiation.

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Biography:

Prof. Feng Shi obtained his BSc (2001) and MSc (2004) from Jilin University, and PhD (2007) from Tsinghua University. He did postdoctoral work at Max Planck Institute for Polymer Research (2008) and worked as a professor in Beijing University of Chemical Technology since 2008. He has been awarded with Beijing Nova Program of China (2009), New Century Excellent Talents in University (2011), Fok Ying Tung Education Foundation from Ministry of Education (2012), Excellent Young Scientist Foundation of NSFC (2014) and Young Changjiang Scholar (2015).

Supramolecular Polymer-Based Nanomedicine: High Therapeutic Performance and Negligible Long-Term Immunotoxicity

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Nanomedicines have achieved several breakthroughs in cancer treatment over the past decades; however, their potential immunotoxicities are ignored, which results in serious adverse effects and greatly reduces the potential in clinical translation. Herein, we innovatively develop a theranostic supramolecular polymer using β-cyclodextrin as the host and camptothecin (CPT) as the guest linked by a glutathione-cleavable disulfide bond. The supramolecular polymerization remarkably increases the solubility of CPT by a factor of 232 and effectively inhibits its lactone ring opening in physiological environment, which is favorable for intravenous formulation and maintenance of the therapeutic efficacy. Supramolecular nanoparticles can be prepared through orthogonal self-assembly driven by π−π stacking interaction, host−guest complexation, and hydrogen bonds. The sophisticated nanomedicine constructed from the obtained supramolecular polymer can be specifically delivered to tumor sites and rapidly excreted from body after drug release, thus effectively avoiding systemic toxicity, especially long-term immunotoxicity. This pioneering example integrating the advantages of the dynamic nature of supramolecular chemistry and nanotechnology provides a promising platform for cancer therapy.

Biography:

Dr. Zhengwei Mao got his Ph.D in 2007, under the supervision of Prof. Jiacong Shen and Prof. Changyou Gao. He worked as a postdoc follow at Max Planck Institute of Colloids and interfaces, Germany, from 2007 to 2009, under the supervision of Prof. Helmuth Mohwald and Prof. Dayang Wang. He joined Department of Polymer Science and Engineering, Zhejiang University at the end of 2009 and was appointed as an associate professor since the May of 2010. His research interests include designing functional nanomaterials for drug delivery and the interfaces of biomaterials for tissue regeneration. He has published more than 60 papers on peer-review journals such as *Nat Comm, Biomaterials, J Am Chem Soc, Angew Chem Int Ed, ACS Nano, Nano Letters* and so on. The publications were cited for over 3,000 times and H index is 34. He received “Young investigator award” from “Chinese Association for Biomaterials” at 2017.Currently, he serves as editor of Materialia.

3D-Printing of Bioactive Scaffolds with Functional Surface

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For therapy and regeneration of bone defects resulting from malignant bone disease, it is of great importance to develop multifunctional biomaterials for bone therapy and regeneration. Conventional biomaterials always lack multifunctional properties, limiting their application for treating and repairing bone disease (e.g. bone tumors)-initiated defects. How to design and prepare bioscaffolds with favorable microenvironments for disease therapy and tissue regeneration is one of interesting topics in the fields of biomaterials and tissue engineering. We developed several strategies, including harnessing nutrient elements, biomimetic structure and functional interface as well as thermo-therapy to construct multifunctional scaffolds by 3D-Pringting method for therapy and regeneration of bone tissues. It is interesting to find that both nutrient elements and biomimetic surface structure of the printed bioscaffolds have important effect on the stimulation of osteogenesis and angiogenesis of stem cells, and thermotherapy plays an important role to treating bone tumors. Therefore, we put forward new concept that 3D-Printed bioscaffolds with functional surface by combined bone therapy and regeneration could be a new direction of bone tissue engineering.

Biography:

Prof. Chengtie Wu is now working in Shanghai Institute of Ceramics, Chinese Academy of Sciences (SIC, CAS). He completed his Ph.D in 2006, and then he worked in the University of Sydney, Dresden University of Technology, Germany and Queensland University of Technology where he was awarded Vice-Chancellor Research Fellow, APDI Fellow and Alexander von Humboldt Fellow. In 2012, Dr Wu has been recruited to work in SIC, CAS, as One-Hundred Talent Program of Chinese Academy of Sciences. Then he was awarded Recruitment Program of Global Young Experts of China (One-Thousand Young Talent Program), Shanghai Pujiang Talent Program and Shanghai Outstanding Academic

Leaders. Prof Wu's research focuses on bioactive inorganic materials for bone tissue engineering. Up to now, Prof Wu has published more than 170 SCI peer-review journal papers, including Mater Today, ACS Nano, Adv Funct Mater (4), Biomaterials (21), Chem Mater, NPG Asia Mater, Chem Sci, Small, J Control Release, Nanoscales, Acta Biomater (30), Carbon, J Mater Chem, ACS Appl Mater& Interface, Bone, Tissue Eng. etc. The papers have been cited more than 6200 times, H Index 46 via SCI, Web of Science. Prof Wu has been awarded 24patents, in which 3 of them have been transferred to companies. Prof Wu was awarded the Young Scientists of Chinese Biomaterials Society in 2016 and he is now the Associate editors for "Applied Materials Today" and "Biomedical Glasses", as well as the editorial board member of "Acta Biomaterialia".

Vascular Regeneration in Tissue-engineered Vascular Grafts

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Vascular graft has proven to be an effective strategy for the treatment of cardiovascular diseases. However grafts made solely from synthetic polymers cannot satisfy the clinic requirements in terms of low long-term patency, because they only provide a simple structural or physical replacement without the biological functions.

In order to resolve this problem, we aim to fabricate novel vascular grafts which could mimic native extracellular matrix (ECM) in terms of both physiological structure and functions. The bio-mimetic microenvironment thus fabricated enables functional tissue reconstruction through promoting cell survival, migration, and proliferation, as well as regulating migration and oriented differentiation of vascular stem cells. Therefore, long-term patency as well as functional homeostasis could be anticipated.

Biography:

Dr. Qiang Zhao received B. Eng degree from Northwestern Polytechnical University in 2001, and Ph.D. degree in Materials Science & Engineering from Tianjin University (China) in 2006. After three years of postdoctoral training at City University of Hong Kong, he joined College of Life Sciences, Nankai University (China) as associate professor in 2009, and was promoted to full professor in 2014 as well as PI of the State Key Laboratory of Medicinal Chemical Biology. He is the recipient of Excellent Young Scientist Program of NSFC (2015). Currently his research interest focuses on cardiovascular biomaterials and tissue engineering. He has authored over 50 peer-reviewed research papers (including Circ Res, Adv Sci, J Am Soc Nephrol, Biomaterials, J Control Release, etc.), 3 book chapters, and 6 patents granted or pending.

3D Bioprinting of Chitosan Hydrogel Bioinks With Tunable Stiffness to Regulate Stem Cell Differentiation

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Biocompatible hydrogel bioinks with suitable stiffness for stem cell growth and differentiation, have been critical for 3D bioprinting of scaffolds for tissue repair and regeneration [1, 2]. Here, we introduce a new dynamic polymer network bioinks consisting of hydrosoluble chitosan methacrylate (CHMA, Figure 1a) and oxidized chondroitin sulphate (OCS, Figure 1b). CHMA can both undergo UV-crosslinking and dynamic Schiff base crosslinking with OCS (Figure 1c). The hydrogels are biocompatible according to the subcutaneous injection experiment, which induced little inflammation up to 14 days (Figure 1d). Rheology measurements on bioinks with different formulations demonstrate excellent rapid self-healing (Figure 1e), which is critical for the fidelity of the printed constructs. The mechanical properties of CHMA-OCS hydrogels were readily tuneable by UV-crosslinking and CHMA-OCS ratios to meet cell requirements. The prepolymers are used to encapsulate stem cells, with very high cell viability (Figure 2a). Thus, the cell-laden bioinks are used for the 3D printing of complex, large-scale, cell-laden constructs with tuneable mechanical stiffness between 0.5 kPa to 8 kPa (Figure 2b), which are beneficial for the osteogenic differentiation of BMSCs.

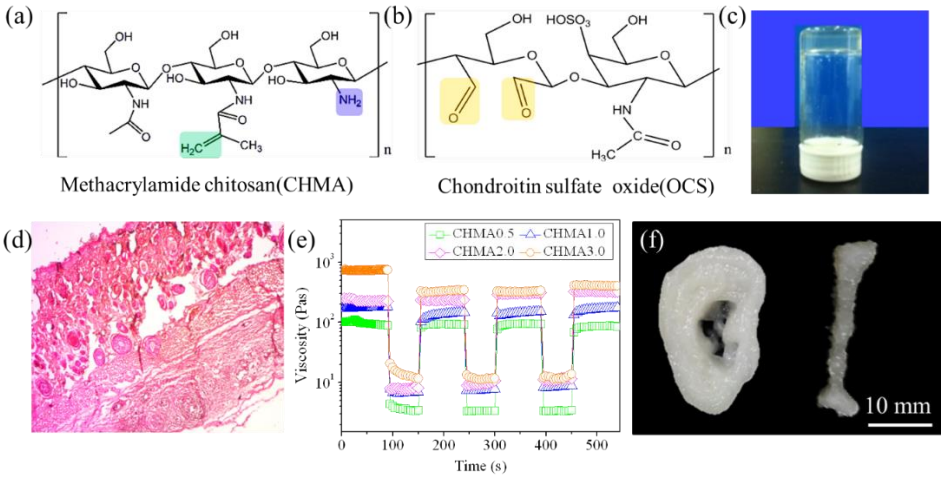

Figure 1. (a, b) The chemical structures of methacrylate chitosan (CHMA) and chondroitin sulphate oxide (OCS). (c) A photo of CHMA-OCS hydrogel after UV crosslinking; (d) The HE stained histological image of subcutaneous tissue after hydrogel injection at day 14. (e) The self-healing of hydrogels under alternative shearing at 0.1 s^{-1} and 15 s^{-1}; (f) 3D printed freestanding hydrogel constructs with high aspect ratios and high shape fidelity.

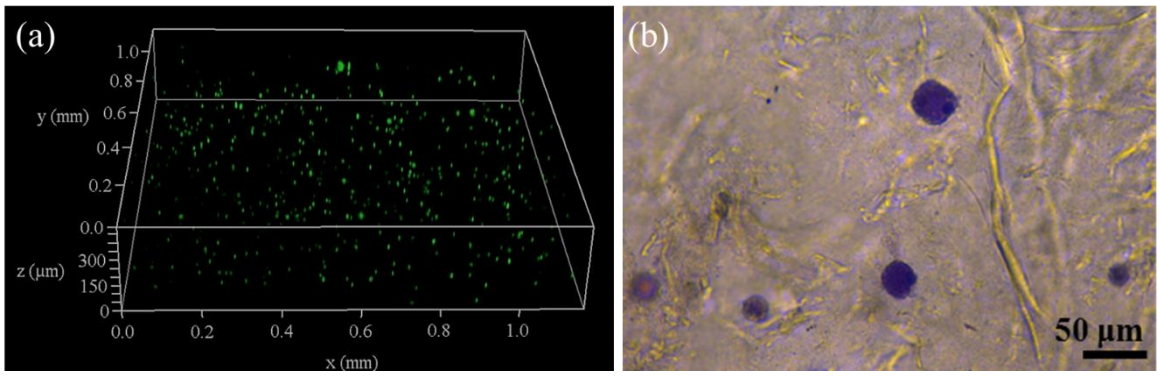

Figure 2. 3D Cell viability (a) and osteogenic differentiation of BMSCs (b) in CHMA-OCS hydrogels.

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Biography:

Prof. Jun Fu received his PhD degree in Polymer Chemistry and Physics from Changchun Institute of Applied Chemistry, Chinese Academy of Science (CAS) in 2005. Then he moved to Max Planck Institute for Polymer Research in Mainz, Germany, and, in 2007, he joined the Massachusetts General Hospital/Harvard Medical School as a Research Fellow, working on high performance polymers for joint implants. In 2010, Dr. Fu was appointed as a full professor of biomedical polymer materials in the Ningbo Institute of Materials Technology, CAS. He has been making innovative research on tough and functional polymer materials for biomedical applications. He has developed a series of tough, responsive, and biofunctional polymer hydrogels that respond to environmental stimuli and/or provide excellent supports to preferential adhesion, growth, and proliferation of cells, with a purpose for applications to cartilage replacement, regeneration and repair.

Prof. Fu has co-authored more than 90 peer-reviewed scientific journal papers in Chem Mater, ACS Appl Mater Interf, Chem Commun, Macromolecules, ACS Macro Lett, and J Mater Chem B, etc., and received more than 3160 citations. He is a member of the American Chemical Society, the Materials Research Society, the Chinese Chemical Society, and the Chinese Biomedical Materials Society. In 2017, he was selected as the member of advisory board of J Mater Chem B.

Antimicrobial Nylon-3 Polymers in Solution and on the Surface

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Drug-resistant microbial infection has been a major challenge to human health. Natural Host defense peptides (HDP) display broad-spectrum antimicrobial activity and low possibility for microbes to develop resistance. We studied nylon-3 polymers (poly-β-peptides) as mimics of HDP to address above limitations of HDP. These nylon-3 polymers display potent activity against multiple drug-resistant bacterial species, including methicillin-resistant *S. aurues* (*MRSA*) and vancomycin-resistant *E. faecium* (*VREF*). When nylon-3 polymer was tethered to the surface via covalent bonding, the polymer still demonstrates potent antimicrobial activities against *E. coli* and MRSA. Moreover, the nylon-3 modified surface is compatible with red blood cells and supports the growth of mammalian cells. The structure diversity of nylon-3 polymers implies the potential application of this type of polymer as antimicrobial materials.

Biography:

Professor Runhui Liu obtained B.S. and M.S. in Pharmaceutical Engineering in 2001 and 2004 respectively at East China University of Science & Technology (ECUST). He obtained Ph.D in carbohydrate synthesis 2009 at Purdue University. Afterward, he worked as a postdoc at California Institute of Technology and University of Wisconsin-Madison respectively during 2010-2014. In 2015, he took a professor position in the School of Materials Science and Engineering at ECUST. His current research focuses on polypeptide polymers for antimicrobial and tissue engineering applications.

Mussel-inspired Antimicrobial Coatings to Combat Biomaterial-associated Infections

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Biomaterial-associated infections (BAI) are rising widespread and engendering severe threat to public health. Therefore, it is urgent to develop new type antimicrobial compounds and coatings to combat with BAI. Here, N-carboxyanhydride (NCA) synthesized antimicrobial peptides were tethered onto biomaterial's surface using mussel-inspired chemistry to generate coatings which is capable of resisting the biofilm formation.

Methacrylate-ended polypeptides/polypeptoids (MePpep/MePsar) were successfully synthesized via ring-opening polymerization of NCA. These oligomers were further initiated under ultraviolet (UV) irradiation by a mussel-inspired polydopamine (pDA) layer which is attachable on virtually all materials surface to generate a polymer brush coating. This brush-like polymer coating comprising cationic antimicrobial polypeptides (MePpep) and antifouling polysarcosine (MePsar) exhibited effective antimicrobial activity against four pathogens (Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Candida albicans), as well as antifouling activity in the resistance to protein and platelet adhesion, and thus prevented biofilm formation for up to 7 days. An in vitro cytotoxicity study showed that this coating is biocompatible with mouse fibroblast (L929) cells. More importantly, this coating exhibited significant anti-infectivity in vivo. This dual-functional polymer brush coating can be immobilized on the surface of multiple categories of materials through the mussel-inspired pDA coating, and thus should be widely applicable for combating infection in many classes of bio-medical materials.

Ti-based materials are widely used in orthopedic and dental repair or replacements. Catechol-protected dopamine was used as the initiator to initiate the ROP of Lys-/Phe-NCAs to obtain a catechol-terminated antimicrobial polypeptide (DAPpep). Nano-structured surfaces which mimic the cicada's wing exhibit confining antibacterial activity. With the tethering of mussel-inspired antimicrobial peptides, such surface exhibit potent broad-spectrum antibacterial activity and capable of preventing the biofilm formation for more than 2 weeks. This bio-inspired surface is also

biocompatible with mammalian cells and could prevent the biomaterial-associated infection in vivo. Moreover, it also promoted the formation of hydroxyapatite at the biointerface. Therefore, this coating is ideal for dental and orthopaedic implants.

Biography:

Li Peng is a professor in the Institute of Flexible Electronics (IFE) and Institute of Biomedical Materials and Engineering (IBME) at Northwestern Polytechnical University. He earned his bachelor degree in chemical engineering and technology at Tianjin University in 2006. He received his Ph.D. and postdoctoral training in chemical and biomolecular engineering under the supervision of Prof. Mary B. Chan-Park at Nanyang Technological University from 2007 to 2013. His research interests are the development of biomaterials and their applications, especially antimicrobial materials. He focused on the design and synthesis of antimicrobial peptides and polymers, fabrication of antimicrobial coatings for bio-medical devices and water disinfection.

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Smart Antibacterial Surfaces with Switchable Bacteria-killing and Bacteria-releasing Capabilities

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Attachment and subsequent colonization by bacteria on the surfaces of synthetic materials and devices lead to serious consequences including infection, contamination and biofouling, posing serious problems in both human healthcare and industrial applications. Therefore, antibacterial surfaces that prevent bacterial attachment and biofilm formation have been a longstanding focus of considerable interest and research efforts. Recently, a promising "kill-release" strategy has been proposed and applied to construct so-called smart antibacterial surfaces, which can kill bacteria attached to their surface and then undergo on-demand release of the dead bacteria and other debris to reveal a clean surface under an appropriate stimulus, thereby maintaining effective long-term antibacterial activity. In this report, we show several representative smart antibacterial surfaces with switchable biocidal activity and bacteria-release capability, which are designed by exploiting the advantageous features of stimuli-responsive polymers and natural or synthetic biocides.

Biography:

Qian Yu received his PhD degree in Materials Science from Wuhan University of Technology in 2011, and then worked in the Department of Biomedical Engineering at Duke University under Prof. Gabriel Lopez as a postdoctoral associate (2011- 2014). In 2014 he joined Soochow University and was appointed as an associate professor. His research interests include development of stimuli-responsive polymers for biomedical applications, multifunctional antibacterial surfaces, and nanostructural biointerfaces. So far, he has published more than 50 papers on peer-reviewed journals with total citation more than 1500 times (H index = 23). He became the editor of Colloid and Interface Science Communications since 2017.

Biomimetic Synthesis of Nanovesicles for Targeted Drug Delivery

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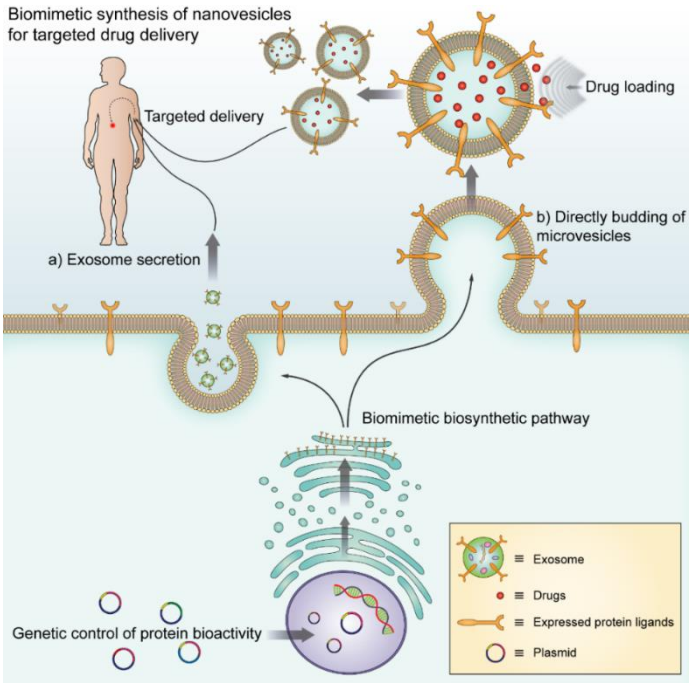
Targeted drug delivery to the sites of disease plays a significant role in personalized and precision nanomedicine. A variety of nanovehicles have been synthesized following different strategies and applied in specifically delivering drugs. However, major issues of the application of nanovehicles remain challenging with regards to the aspects of delivery vehicle, synthesis strategy and biological activity. The next generation of functionalized nanovesicles, featuring high specificity and efficiency by using biomimetic synthesis strategies, shows promise for the application in precisely targeted therapy. In this presentation, an innovative biomimetic nanoparticle platform for delivering therapeutic anticancer agents and imaging-guided cancer therapy will be introduced. In addition, the major hurdles in the clinical translation of cell membrane-based delivery systems will be discussed.



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[3] Genetically engineered liposome-like nanovesicles as active targeted transport platform. Adv Mater, 2018, 30: 201705350

Biography:

Gang Liu received his MD degree from North Sichuan Medical College (China) in 2002 and PhD degree from Sichuan University (China) in 2009. Subsequently, He focused his training on nanomedicine and molecular imaging at the National Institutes of Biomedical Imaging and Bioengineering, National Institutes of Health. In 2012, he joined the Center for Molecular Imaging and Translational Medicine, Xiamen University. Currently he is a Professor of Biomedical and Bioengineering and his research interests include biomaterials, theranostics, and molecular imaging.

Monitoring Transport and Diffusion of Gold Nanoparticles in Live Cancer Cells by Dark Field Optical Microscopy

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Kerry Lee, Lyndsay Rhodes
Department of Biology Science, Florida Gulf Coast University, Fort Myers, FL 33965
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Gold nanoparticles possess distinctive physicochemical properties and can be used as unconventional therapeutic approaches for targeting of cancer cells. However, the mechanism of the interaction between gold nanoparticles and cancer cells is still not clear.

The purpose of this study was to grow gold nanoparticles with controlable particle sizes and use them to study their transport and diffusion in live cancer cells. We treated MCF-7 (breast cancer cells) with 8 nm gold nanoparticles for 72 hours and visualized gold nanoparticles in the live cancer cells for different transport times. A dark field optical microscope (DFOM) was used to examine their transport or diffusion in the cancer cells as shown in Figure 1. Two concentrations of gold nanoparticles were tested in MCF7 cancer cells to determine the transport rate of the gold nanoparticles in the cancer cells. The results show that gold nanoparticles were able to enter not only cell membranes, but also nucleus of cancer cells. The transport or accumulation rate of gold nanoparticles in cancer cells was dependent on the time and the concentration of gold nanoparticles.

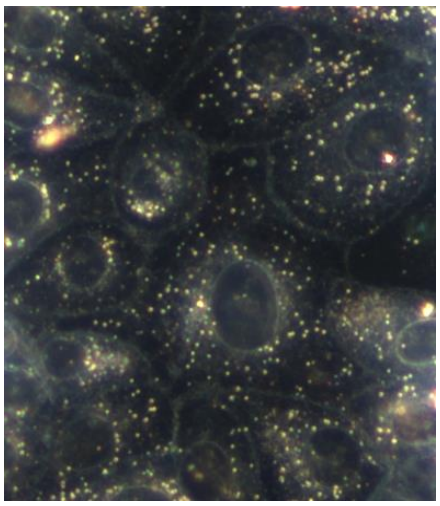

Figure 1. DFOM image of gold nanoparticles (green dots) accumulated in MCF-7 for 72 hours.

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Biography:

Dr. Ju Chou is an Associate Professor in the Department of Chemistry and Physics at Florida Gulf Coast University. She received her Ph.D. in chemistry from the Chinese Academy of Science, Changchun, China in 1995. After that, Dr. Chou worked as a postdoctoral fellow in RIKEN Research Institute in Japan for a year during 1996-1997. She came to the United States as a visiting research scholar working at University of California-Irvine and later at University of California-Santa Barbara, respectively. Dr. Chou's research areas include bio-electrochemistry of proteins such as cytochrome c, myoglobin and hemoglobin, bioaccumulation of trace elements in tissues, synthesis and characterization of nanomaterials. Dr. Chou's recent research interests also include green synthesis of gold nanoparticles and environmental analysis of toxic metals in water, soil and human hair. She also collaborates with biology professors on the application of gold nanoparticles in biological systems such as cancer cells and zebrafish embryos. This research focuses on the design of nanoparticles for potential applications in in vitro and in vivo assays of studying toxicity, biocompatibility and transport of gold nanoparticles.

Oxidoreductase-Triggered Physiological Preparation of Hydrogels/Microgels for Biomedical Applications

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Due to its 3D crosslinked networks and adjustable physicochemical properties, hydrogels have been widely applied in tissue engineering, drug-delivery system, pollution regulation, polymer electrolyte, agricultural drought-resistance, cosmetic and food area. However, the harsh prepared conditions and high chemical residues of traditional hydrogel both seriously limited their bio-related applications. Therefore, the preparation of hydrogel on the physiological condition is an important topic with great challenges. Here, we introduced the recent advances on severals mitochondria-inspired enzyme polymerized methodology and 3D bio-printing concept from enzymatic polymerization. Finally, some typical applications of enzyme-containning hydrogel/microgel in bioimaging, tissue engineering and cancer therapy are introduced step by step.

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Biography:

Qigang Wang is a currently a professor in the School of Chemical Science and Engineering, Tongji University. He received his Ph.D. from Shanghai Institute of Ceramics, Chinese Academy of Sciences, in 2005. He was the postdoctor at the Hong Kong University of Science and Technology, The University of Tokyo, and Riken from 2005 to 2011. His research interests focus on enzymatic polymerized methodology, printing/molding of functional hydrogels or nanogels, and hierarchical structure gel designs for tissue engineering/electronics/bioelectronics.

Anti-Cancer Nanomedicine with High Drug Loading and Potent Tumor Targeting

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The therapeutic performance of anti-cancer nanomedicine is greatly challenged by the low drug loading and tumor targeting. To overcome these issues, we first developed micelles with high drug loading and quantitative loading efficiency by enhancing the coordination interaction between polymer and drug or reducing the inter-molecular interactions between hydrophobic drugs. Thus, hydrophobic drugs, such as doxorubin or camptothecin can be encapsulated into micelles with drug loading capacity of 40~50% and loading efficiency higher than 95%. We further developed an efficient cancer targeting strategy, "active tissue targeting via anchored click chemistry" (ATTACK), which is achieved through selective labeling of cancer cells via sugar metabolism followed by the highly effective bioorthogonal "click" chemistry. With this strategy, cancer cells can be selectively and effectively labelled at the density of 2-3 orders of magnitude higher than endogenous receptors.

Biography:

Lichen Yin obtained a B.S. degree in Biological Sciences from Fudan University, 2005, and a Ph.D. degree in Biochemistry & Molecular Biology from Fudan University, 2010. He was a postdoctoral fellow at UIUC from 2010 to 2014, and then joined FUNSOM, Soochow University, in 2014 as a full professor. He has co-authored over 80 publications (over 50 as first or corresponding authors in Nat Chem Biol, Nat Commun, JACS, Angew Chem Int Ed, Adv Mater, and etc), with a total non-self-citation over 3000 and an H-index of 30. He received the "NSFC Outstanding Youth Foundation" and the "Specially-Appointed Professorship in Jiangsu Province" in 2017

Bio-inspired Organs-on-chips System

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"Organ-on-a-chip" systems integrate microengineering, microfluidic technologies, and biomimetic principles to create key aspects of living organs faithfully, including critical microarchitecture, spatiotemporal cell–cell interactions, and extracellular microenvironments. This creative platform and its multi-organ integration recapitulating organ-level structures and functions can bring unprecedented benefits to a diversity of applications, such as developing human in vitro models for healthy or diseased organs, enabling the investigation of fundamental mechanisms in disease etiology and organogenesis, benefiting drug development in toxicity screening and target discovery, and potentially serving as replacements for animal testing. Recent advances in novel designs and examples for developing organ-on-a-chip platforms are reviewed. The potential for using this emerging technology in understanding human physiology including mechanical, chemical, and electrical signals with precise spatiotemporal controls are discussed. The current challenges and future directions that need to be pursued for these proof-of-concept studies are also be highlighted.

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Biography:

Yuanjin Zhao received his Clinical Medicine Bachelor degree in 2006 and Biomedical Engineering PhD in 2011 from Southeast University. In 2009-2010, he worked as a research scholar in Prof. David A. Weitz's group at Harvard University. He was appointed as a full Professor in 2015 at Southeast University. His current scientific interests include microfluidics and organs on chips. He has published more than 110 research papers in international journals and applied more than 70 related patents. His recent awards include the Young Chemist Award of Chinese Chemical Society.

Ice-templated Biomimetic Materials for Tissue Engineering

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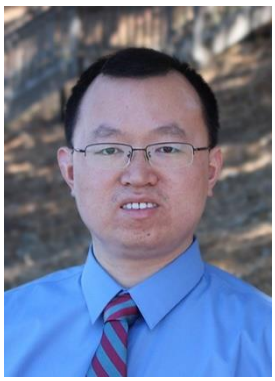
One of the most important issues in tissue engineering is searching for new materials and processing techniques to create novel scaffolds with 3-D porous structures. Ideal tissue engineering scaffolds should have good biocompatibility, biodegradability, and beneficial mechanical properties. In our research, we use an ice-templating method, attempting to build biomimetic bone implants that adapt to physiological conditions, interact with surrounding tissues, and repair themselves. Most recently, we developed a bidirectional freezing technique to achieve hydroxyapatite (HA) scaffold with large-scale aligned porous structure, which could be beneficial for improving cell seeding and migration. By further infiltration such scaffolds with poly (methyl methacrylate) (PMMA), we have fabricated a HA/PMMA composite with nacre-mimetic alternative layered architectures. Such composite has similar composition and mechanical properties with human cortical bone, which make it a promising candidate for bone implants.

Biography:



Dr. Hao Bai is currently a professor at College of Chemical and Biological Engineering, Zhejiang University. He received his B.S. degree from Department of Polymer Science and Engineering, Zhejiang University (2006), and his Ph.D. degree in physical chemistry from National Center for Nanoscience and Technology, Chinese Academy of Sciences under the supervision of Prof. Lei Jiang (2012). After completed his postdoctoral research at Lawrence Berkeley National Laboratory and University of California, Berkeley in 2015, he joined Zhejiang University with the support of the “1000 Youth Talents Plan” of China. His main research interest is bioinspired engineering of smart materials and systems with multiscale architecture and multifunctionality.

Bio-inspired Anti-oxidant Defense System Constructed By Electrospun F127-based Fibers

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Cells were continuously exposed to oxidative damage by overproduction of reactive oxygen species (ROS) when they contacted implanted biomaterials. The strategy to prevent cells from oxidative injures remains challenge. Inspired by the antioxidant defence system of cells, we constructed a biocompatible and ROS-responsive architecture on the substrate of elastomer. We demonstrated that the stable and hydrophilic architecture was constructed by phase separation of polymer components and crosslinking between polymer chains during electrospinning; the ROS-responsive fibers controlled the release of antioxidants to reduce the oxidative damage to cells. The bio-inspired architecture not only reduced mechanical and oxidative damage to cells but maintained normal ROS level for physiological haemostasis.

Biography:

Qiang Shi is a Professor in the State Key Laboratory of Polymer Physics and Chemistry at Changchun Institute of Applied Chemistry. He graduated in Jilin University from 1995 and obtained his PhD degree in polymer chemistry and physics from the Changchun Institute of Applied Chemistry in 2006. He obtained second award of National Science and Technology Progress in 2009 and first award of JiLin Science and Technology Progress in 2006. His research interests focus on: 1) Surface and Interface of Polymer; 2) Biomedical Polymers and Blood-contacting Biomaterials. He has 6 authorized patents and over 50 publications in the peer-reviewed journals, such as Nanoscale, Chem. Commun., ACS Appl. Mater. Interfaces, etc.

Smart Synthetic Biointerfaces: From Reversible Chemical Interactions to Dynamic Biological Effects

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In living systems, the dynamic interactions between cells and the extracellular matrix (ECM) are exquisite characteristics of cell-level biological processes. These interactions, which can be triggered by extracellular environmental changes or specific biomolecules, can promote specific cell signaling and biochemical cascades, and are central in the physiology and pathological processes like tissue self-repair and tumorigenesis. To mimic such dynamic interactions, artificial matrices with reversible display of bioactive ligands for modulating cell-biomaterial interactions have attracted much attention for in-situ cell biology experimentation and tissue engineering. Furthermore, a dynamic biomaterial interface with reversibly immobilized ligands has also shown great promise in drug targeting and isolation methods for therapeutics and diagnostics. In this talk, Prof. Dr. Pan will present his major work in this field by using synthetic chemistry, including dynamic covalent chemistry, molecular imprinting and semi-dynamic coordinative chemistry. Also in the talk, he will discuss the related biomedical applications of the newly developed biointerfaces, for example, the potential for CTCs capture, tissue engineering and the surface biofunctionalization of medical implants.

Biography:

Guoqing Pan obtained his Ph.D. in polymer chemistry and physics from Nankai University (China) in 2011. Then he worked in Soochow University (China) as a lecturer. He joined in the group of Prof. Kenneth J. Shea in the Department of Chemistry in University of California, Irvine (CA, USA) as a visiting scholar in 2014. He was then supported by the European Union "Horizon-2020" action (2015), as an Individual Fellowship of Marie Skłodowska-Curie (Host Professor: Börje Sellergren in Malmö University, Sweden). Now he is a full professor in Jiangsu University (Zhenjiang, China). His research interests encompass smart biointerfaces, molecular imprinting, hydrogels, biomaterials, smart polymers as well as functional nanomaterials for biomedical applications. He has been in charge of over 10 research projects from China and EU and held 10 Chinese or US patent. In addition, he has published over 60 peer-reviewed scientific papers in leading journals of chemistry and materials such as *Chem. Soc. Rev.*, *Angew. Chem.*, *J. Am. Chem. Soc.*, *Adv. Funct. Mater.*, *Small*, *Biomaterials*, etc.

Versatile Organic/Inorganic Nanohybrids for Delivery Systems

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Organic/inorganic nanohybrids with favorable physical and chemical properties constructed form suitable surface functionalization of inorganic nanoparticles (NPs) with superior polycations are promising candidates as carriers with multi-functions. The morphology (size and shape) of NPs are considered to have an intense influence on their interaction with cells and biological systems, while the effect of morphology on gene carriers are poorly understood. We developed several facile strategies to construct organic/inorganic nanohybrids of polycations and inorganic nanoparticles. Grafting-from, grafting onto and host-guest interactions were all utilized for the fabrication of nanohybrids. Furthermore, we employed SiO_2 and Au NPs as model systems to investigate the morphology effect. A series of novel gene carriers based on polycation-functionalized SiO_2 and Au NPs with different morphologies were designed and synthesized, including nanospheres, nano-octahedras, nanorods, arrow-headed nanorods and chiral nanorods, et al. The morphology of both SiO_2 and Au NPs is demonstrated to play an important role in gene transfection. Based on the results, star-shaped hollow silica carriers with photothermal gold caps were synthesized for the co-delivery of drugs and genes. One dimensional nanohybrids of polycations and iron oxide or quantum dots were also designed and satisfying therapeutic effects were achieved. In addition, magnetic resonance (MR) or fluorescence imaging could be realized in the same nanostructure. Therefore, combing the intriguing properties of inorganic parts, the carriers could integrate the functions of imaging and be employed for theranostic platforms. These results may provide new avenues to develop promising carriers and useful information for the application of NPs in biomedical areas.

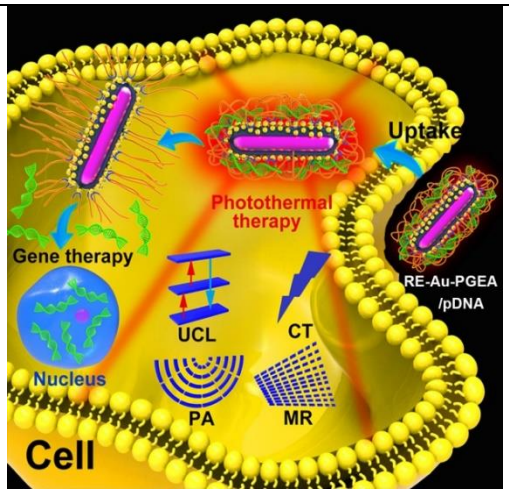

Figure 1. Schematic illustration of RE-Au-PEGA nanohybrids for theranostic platform.

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Biography:

Dr. Nana Zhao received her Ph.D. in Physical Chemistry from Peking University in 2008, China. After post-doctoral work with Prof. Eugenia Kumacheva at the University of Toronto, Canada and Prof. Lutgard De Jonghe at Lawrence Berkeley National Laboratory, she joined Beijing University of Chemical Technology, China as an Associate Professor in 2012 and was promoted to Professor in 2016. Her current research interests focus on the design, synthesis and application of organic/inorganic nanohybrids.

The Researches on Cells Adhesion on the Biocompatible Polymer Surfaces with Super Wettability

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The realization on controlling cells behaviours by engineering the surface superwettability has attracted more and more research interests. For the superhydrophobic surface, the cells adhesion was inhibited on the superhydrophobic polylactic acid surface in the first 24h culture; and there was no obvious inhibiting effect on the superhydrophilic surface. Regarding to the superhydrophilic surface, especially for porous chitosan scaffold surface with ultrafast spreading property, cells could be trapped in the scaffold quickly; the cells adhesion, growth and proliferation were improved combined with UV irradiation. It will shorten the trapped time of cells into scaffold, sequentially decrease the cured time for the patients. The method of constructing ultra-fast spreading property on the porous scaffold surface will offer more simple way on fabricating excellent tissue engineering scaffolds.

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Biography:

Dr. Wenlong Song received his B.Sc. degree in applied chemistry in 2002 from Jilin University, China, and awarded his Ph.D. degree in 2007 with Prof. Fengqi Liu and Prof. Lei Jiang under a joint course of College of Chemistry, Jilin University and the Institute of Chemistry, Chinese Academy of Sciences (ICCAS). Then he worked as a postdoctoral fellow in 3B's group-Biomaterials, Biodegradables and Biomimetics in Minho University of Portugal. In 2011, he joined the State Key Laboratory of Supramolecular Structure and Materials, Jilin University. His research interests are focused on: (1) Investigating the interaction between bioinspired surface/interface and cells; (2) Constructing biomimetic hydrogels for artificial cartilage.

Nanoparticle Surfaces Functionalizion and their Applications in Bacteria Eradication

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Bacterial infections pose a serious global challenge that threatens public health and causes heavy economic burdens. The presence of pathogenic bacteria in susceptible interfaces or wounds can lead to infection, which causes a drastic increase in toxins that may significantly extend or disturb the healing process. Moreover, the problem is further exacerbated by the rise in the global antimicrobial resistance crisis, where antimicrobial agents traditionally used to limit, prevent, or eliminate pathogenic microbial growth have been ineffective. Thus, to address the global problem of antibiotic resistance, the development of alternative antimicrobials and their corresponding formulations has become an urgent need. Among the candidates for alternative antimicrobials, nanoparticles (NPs) provide versatile platforms for therapeutic applications based on their physical properties. The surface fictionalizations of NPs can provide direct multivalent interactions to bacteria, allowing NPs to be exploited as multifunctional therapeutic agents. Here, we will introduce the NPs functionalized with self-adaptive and multifunctional (*e.g.*, imaging and therapy together) properties for drug-resistant bacteria eradication.

Biography:

Jun Deng is a Professor at Institute of Burn Research, Southwest Hospital, State Key Lab of Trauma, Burn and Combined Injury, Third Military Medical University (Army Medical University), Chongqing, China. He received his BS degree in Department of Chemical and Chemical Engineering from Sun Yat-sen University, China in 2010, his PhD degree in Polymer Science and Engineering from Zhejiang University in 2016, his supervisors are Academician Shen Jiacong, and Professor Changyou Gao. His primary research interest is in material surface functionalization and its application in bacteria ablation, tumor eradication and promoting wound healing. He has published 19 papers as the first author or corresponding author and has been highly cited with a total of over 150 citations. He has achieved a patent conversion of over 2 million RMB, 1 book and given some keynote and plenary lectures globally. He is also an Early Career Editorial Advisory Board of *ACS Biomaterials Science and Engineering*.

Polyphenol Films for Anti-platelet Adhesion and the Capture of Circulating Tumor Cells

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Platelet and leukocyte adhesion on the biomaterials not only can cause undesirable clinical outcomes (e.g., thrombosis and inflammatory response) but also can impaire the functionalities of biomaterials. Until now, the surfaces of platelet- and leukocyte-repellent materials are generally fabricated by two approaches: 1) constructing bioinert surfaces by employing hydrophilic antifouling polymers; 2) designing bioactive coatings with immobilization of biomolecules to inhibiting cell adhesion. However, the construction of bioinert surfaces commonly require complicated chemical synthesis and multistep surface treatments, and bioactive proteins are expensive and also easy to deactivate or degrade.

Inspired by the anti-platelet and anti-inflammatory effects of natural polyphenols, as well as the simple and rapid coating process of polyphenol self-assembly film, we proposed a strategy to construct platelet- and leukocyte-repellent materials using the polyphenol film. First, the stable polyphenol film was constructed and then the anti-platelet adhesion performance of the film was investigated.[1-3] Finally, we examined the anti-leukocyte adhesion performance of the film and explored its application in the capture of circulating tumor cells.[4-5]

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Biography：

Research Area: Blood contacted materials surface and interface, blood purification adsorption materials, and capture of circulating tumor cells from whole blood

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2012-2017, Postdoctor & Lecturer, School of Life Science and Biotechnology, Dalian University of Technology

2017-Present, Associate Professor, School of Life Science and Biotechnology, Dalian University of Technology

Poster Section

The Biocompatibility of Iridium Oxide Film with Neural Stem Cell and Enhanced Neurite Extension of Neuron-like Cell with Electrical Stimulation

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[b]Institute of Natural Sciences, Yonsei University, Seoul 03722, Korea

Various neural stimulating electrodes have been widely employed to investigate neural activities and diagnose, also for treating many diseases. In this study, iridium (Ir) thin film was deposited on titanium substrate by radio-frequency (RF) magnetron sputtering, and then activated it in sulfuric acid (H_2SO_4) to form iridium oxide (IrO_x) through repetitive potential sweeps. The resultant IrO_x film showed a porous and open structure with enlarged effective surface area, and exhibited superior electrochemical performance. The biocompatibility of IrO_x was investigated by cytotoxicity, cell attachment and proliferation with neural stem cells (NSCs). The IrO_x film could support NSC attachment, proliferation and improve processes elongation without causing toxicity. When applied biphasic electrical stimulation, the neurite extension of neuron-like cells was enhanced. And significant reorientation of neurite alignment was found on IrO_x with perpendicular stimulation compared with parallel stimulation. These findings suggest that activated IrO_x film is a promising candidate for the development of neural stimulating electrodes.

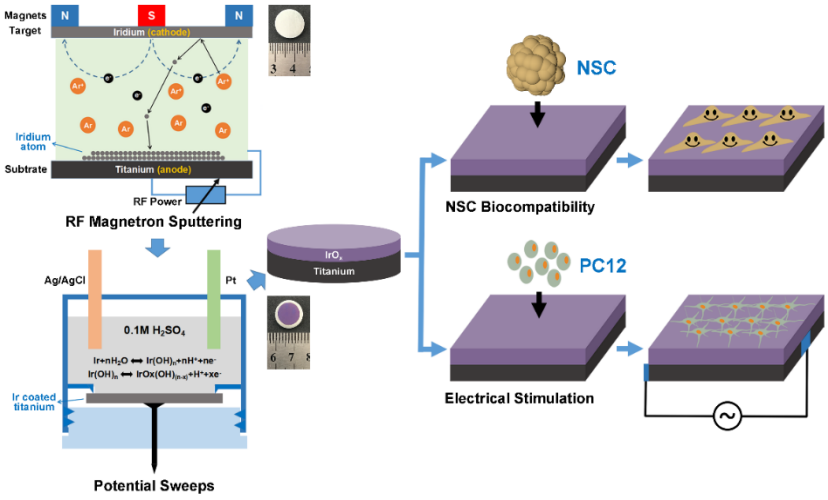

Figure 1 Schematic illustration of IrO_x film fabrication, NSC biocompatibility and electrical stimulation of PC12 on IrO_x.

Acknowledgement: This research was partly by National Natural Science Foundation of China (51502265), and partly by Zhejiang Provincial Natural Science Foundation of China (LQ16E020006).

Polylysine grafted PPFU promote macrophage polarized to a M2 phenotype

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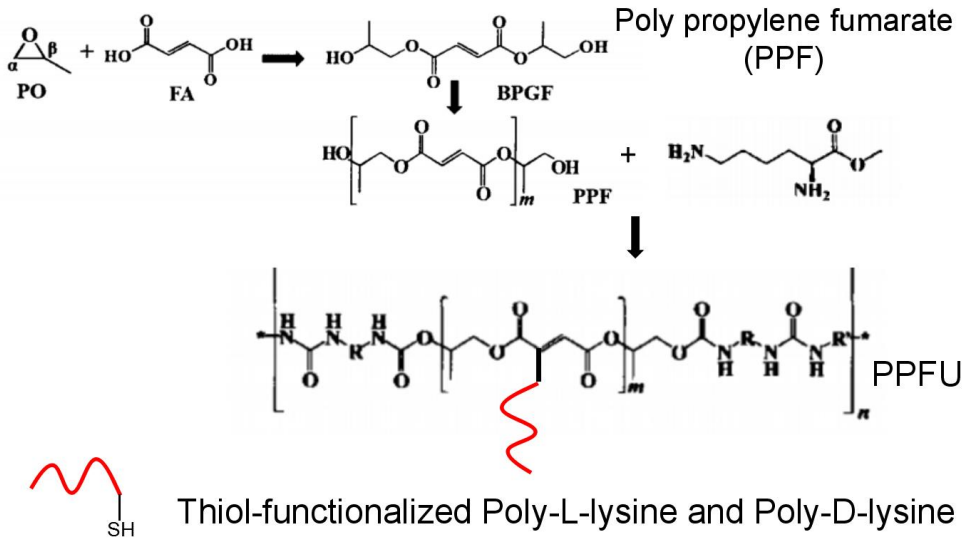
The immune system is the first responder to tissue trauma and to a biomaterial implant. M1/M2 macrophage balance polarization governs the fate of an organ in inflammation or injury. Surface property of biomaterials can largely influence tissue repair progress through modulating macrophage function. Macrophage can be polarized to M1 or M2 phenotype by interact with different particles and biomaterial surfaces, and surface charge seems an important factor. PPFU is degradable and has good biocompatibility and can be functionalized easly. We grafted polylysine with positive charge to PPFU to investigate how macrophage polarized on this materials. Results show polylysine grafted PPFU can dramatically up-regulate macrophage M2 related genes and protein expression and cytokines release, while induced low level of ROS and NO synthesis and limited affect on phagocytosis. These data suggested that polylysine grafted PPFU can promote macrophage polarized to a M2 phenotype in vitro, and can be a promising biomaterial to promote tissure repair during implantation.



Hofmeister Effect-Assisted One Step Fabrication of Ductile and Strong Gelatin Hydrogel

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Gelatin is a natural protein, which dissolves in hot water and forms hydrogel when cooled. The mechanics of this gel are weak and a lot of effort has been devoted to enhancing its mechanical strength. [1, 2] In this work, a strong and ductile gelatin hydrogel is prepared by simply soaking a virgin gelatin gel in an ammonium sulfate solution.[3] The treated hydrogels have an extraordinary ultimate strength (compressive and tensile strains of over 99% and 500%, respectively, and stresses of 12 and 3 MPa) superior to that of common protein gels. Chain bundling, hydrophobic interaction domains, and micro phase separation regions induced by Hofmeister effect endow hydrogels with eminent mechanical properties. Besides, anions on Hofmeister series can monitor properties of hydrogels, where kosmotropic ions enhance the mechanical properties while chaotropic ions result in softened gels.

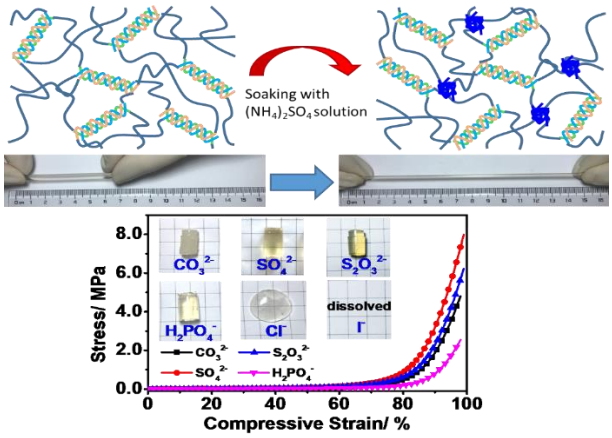

Figure 1. Strengthening mechanisms and mechanical properties of gelatin hydrogels treated by different anions in the Hofmeister series

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Hetero-nanostructures of Hydroxyl-rich Polycation Wrapped Cellulose-gold Hybrids for Combined Cancer Therapy

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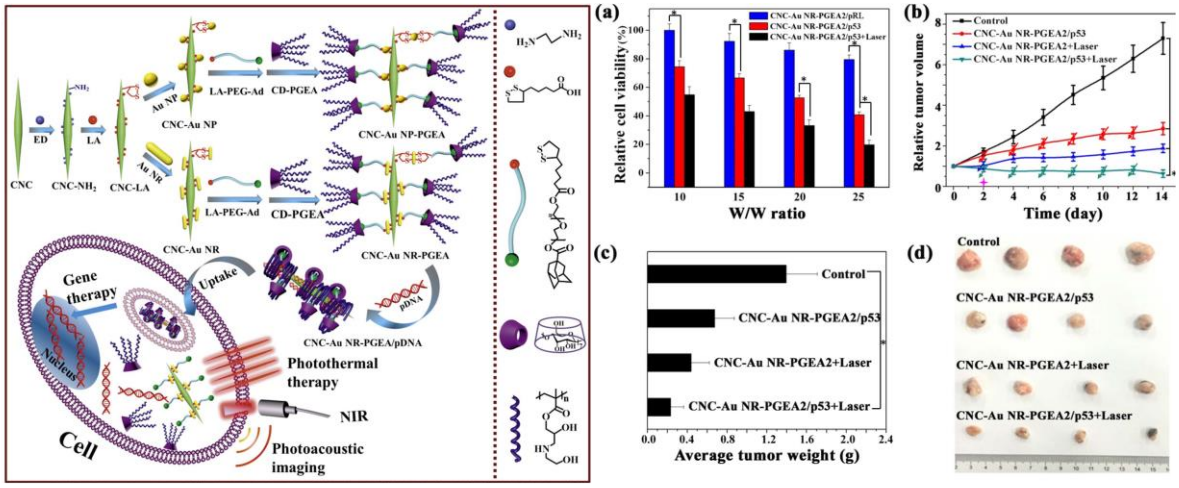
The development of new hetero-nanostructures for multifunctional applications in cancer therapy has attracted widespread attention. We put forward a facile approach to synthesize multifunctional hetero-nanostructures of cellulose nanocrystal (CNC)-gold nanoparticle hybrids wrapped with low-toxic hydroxyl-rich polycations to integrate versatile functions for effective cancer therapy. Biocompatible CNCs with the superior rod-like morphology for high cellular uptake were employed as substrates to flexibly load spherical gold nanoparticles (Au NPs) or gold nanorods (Au NRs) through gold-thiolate bonds, producing hetero-layered nanohybrids of CNC-Au NPs or CNC-Au NRs. Profound hydroxyl-rich cationic gene carrier, CD-PGEA (comprising β-cyclodextrin cores and ethanolamine-functionalized poly(glycidyl methacrylate) arms), was then assembled onto the surface of CNC-Au nanohybrids through host-guest interaction and gold-thiolate bonds, where PEG was employed as the intermediate and spacer. The resultant CNC-Au-PGEA hetero-nanostructures exhibited excellent performances as gene carriers. Furthermore, CNC-Au NR-PGEA comprising Au NRs demonstrated favorable optical absorption properties and were validated for photoacoustic imaging and combined photothermal/gene therapy with considerable antitumor effects. The present work provided a flexible strategy for the construction of new multifunctional hetero-nanostructures with high antitumor efficacy.

Key Words：Cellulose nanocrystal; Gold nanorod; CD-PGEA; Combined therapy



Multistimuli-responsive Fluorescent Micelles Based on the Self-assembly Hyperbranched Polymer for Drug Delivery and Release

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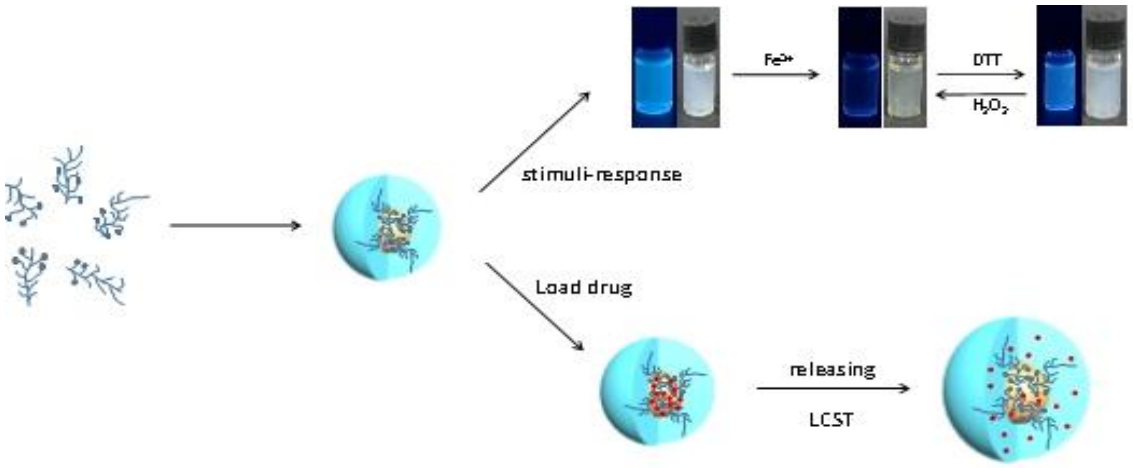
During the past decades, the applications of stimuli-responsive polymers and biopolymers have become a very important field of research. The ability of stimuli-respond and molecular structure features are important for the hyperbranched polymer micelles for wide applications as drug delivery, diagnostics, biomaterials and sensors. One of the most important stimuli-responsive properties is thermal-responsive[1-3]. It is know that some disease not only induces the production of pyrogenic cytokines in the host, but also produce oxygen free radicals and other metabolites. Introducing stimuli response structure into drug delivery system can make the system not only detect the reactive oxygen but also release through stimuli-response abilities.



We selected hyperbranched polymers (Boltorn H20) as backbone due to its biocompatibility and hyperbranched architectures. By grafting PSE at the end groups of H20, we prepared a novel amphiphilic hyperbranched copolymer H20-PSE. The amphiphilic polymer can form micelles by self-assembling in aqueous solution with bright fluorescence. The micelle showed fluorescent changes to the Fe3+, DTT and H2O2 systems. With introducing Fe3+ into the micelles solution, the fluorescence of micelles was turned off. Then, adding DTT into the solution, the fluorescence

recovered. By continuously repeated addition of Fe3+ and DTT, the fluorescence could be turn off and on with good repeatability. Moreover, the H20-PSE micelles could be changed following temperature changes and the LCST of micelles was 38℃ between the normal tissues and fever as well as inflammation. Following the stimulative responsive ability, the H20-PSE micelles could have potential application in drug delivery and targeted control release. The controllable thermal-responsive materials could have a great potential usefulness as a drug delivery and controlled release system.

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Thermodynamics, kinetics and mechanistic study on chitosan/tripolyphosphate complexation and particle formation

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Ionically crosslinked chitosan micro- and nanoparticles are widely used as potential drug and gene delivery vehicle due to their biocompatibility, ability to protect the bioactive payloads and promote their trans-mucus delivery. However, and the lack of systematic understanding on the particle formation/coagulation mechanism limited the control over their size, stability and the further development. Here, we systematically investigated the effect of degree of deacetylation (DD), pH, ionic strength, counterion concentrations and solution mixing method on the interaction thermodynamic and kinetics between chitosan/tripolyphosphate (TPP). Based on these, the mechanism of micro- and nanoparticle formation and coagulation was also interpretated. It demonstrated that the particle formation and coagulation kinetics could be reduced exponentially by addition of monovalent salt (NaCl), which led to more stable and uniform particles. By slowing down the formation kinetics, the particle formation mechanism was also revealed that the primary particles with diameters of 15-30 nm was first formed and then coagulated into the final particles. The slower coagulation under high ionic strength also suggested that the particle aggregation was mostly due to the interparticle bridging of TPP molecules. Moreover, the DD showed an even greater impact on both the stability of these particles where chitosan samples with lower DD interacted much weaker with TPP and disassembled under high pH and ionic strength, while high DD led to the low solubility and hence the precipitation of chitosan particles under neutral pH. The study on mixing kinetics revealed that the local saturation played an important role on determining the final particle morphologies.

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In Vivo Evaluation of the PLGA/TCP/Mg Porous Scaffold Fabricated by 3D-printing for Bone Regeneration

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Introduction

Bone regeneration is a significant event in bone tissue engineering. The beta-tricalcium phosphate (TCP) and poly (L-lactide-co-glycolide) (PLGA) are well known for their exllent biodegradability, bioabsorbability and osteogenic roperties. They can be combined to fabricate a porous scaffold, and used as a bone substitute for bone defect repair. In order to promote bone regeneration, we designed and fabricated an innovative bioactive porous scaffold composed of poly (lactide-co-glycolide, PLGA), beta-tricalcium phosphate (TCP) and magnesium (Mg) with well-defined biomimic microstructure through the low-temperature 3D printing technology. In this study, the authors aimed to investigate the *in vivo* osteogenic and angiogenic effect of PLGA/TCP/Mg porous scaffold. The effect of magnesium in angiogensis and osteogenesis was observed in this study.

Materials & Methods

Firstly, PLGA/TCP and PLGA/TCP/Mg scaffolds were fabricated at -30°C using an advanced low-temperature rapid-prototyping machine (CLRF-2000-II, Tsinghua University, China) following previously published procedure. Then, a steroid–associated osteonecrosis (SAON) rabbit model with 3 mm bone defect tunnel in both distal femora was developed accroding to our published paper[1]. The samples were randomly divided into three groups: (i) control group without any implantation after the surgery, (ii) PLGA/TCP group with PLGA/TCP scaffold implanted into the bone tunnel, and (iii) PLGA/TCP/Magnesium group with PLGA/TCP/Magnesium implanted into the bone tunnel. Finally, the following techniques were used to detect the osteogenic and the performance distribution into

vascular of the porous scaffolds. Dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) was used to observe the blood perfusion function at the defect sites at 0,2,4,8 weeks post-surgery. Micro-CT scanning and X-ray were used to analysis the in vivo osteogenetic effect of the PLGA/TCP/Magnesium. Micro-CT based angiography was used to evaluate the vascular architecture by injecting Microfil into the abdominal aorta. Bone tissue volume density (BV/TV, %), connectivity density (Conn.D, 1/mm3), trabecular number (Tb.N, 1/mm), in bone tunnel were measured by Micro-CT.

Results & Discussion

Acording to the DCE-MRI results, we found that at week 2 and 4, PLGA/TCP/Mg group performed good blood perfusion and showed significantly higher “maximum enhancement” than the PLGA/TCP group and control group($p<0.05$, $n=3$). Micro-CT data showed that at week 12, the BV/TV, Conn.D and Tb.N of PLGA/TCP/Magnesium group increased significantly than those in control group ($p<0.05$, $n=8$).

Conclusions

The in vivo study shows that the PLGA/TCP/Mg scaffolds have good osteogenetic and angiogenic effect and the scaffold is a promising biomaterial for bone regeneration.

Key Words： PLGA/TCP/Mg scaffolds, 3D printing, *In Vivo,* osteogenetic, angiogenic

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磁性纳米复合材料表面构筑及其对生物分子的特异性富集

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关键字：磁性纳米粒；复合材料；特异性富集

引言

蛋白质是生物体的重要组成部分，对维持正常生命活动、调节生物体生理功能起着非常重要的作用。蛋白质的磷酸化和糖基化是常见的蛋白质翻译后修饰和生物调控过程。[1] 目前已知的糖尿病、癌症、阿兹海默症等疾病的发生都与异常的蛋白质磷酸化、糖基化密切相关。[2] 因此，对磷酸化、糖基化蛋白质/肽段的精确识别、分离、检测是分析机体在正常和疾病状态下信号转导通路的最基本、最重要的步骤。本文设计了一种表面功能化聚氨乙基甲基丙烯酸酯-精氨酸（poly(2-Aminoethyl methacrylate hydrochloride)- arginine, PAMA-Arg）的超顺磁性纳米复合球，可高选择性的捕获磷酸化蛋白质/肽段，再利用材料的超顺磁性分离吸附的磷酸化蛋白质/肽段，实现对磷酸化蛋白质/肽段的高特异性富集、分离，及检测。

材料和方法

首先采用溶剂热法，以醋酸铵（CH_3COONH_4）和柠檬酸三钠（$Na_3C_6H_5O_7$）为原料，在乙二醇($(CH_2OH)_2$, EG)中高温高压条件下，制备得到 Fe_3O_4 磁性纳米球；将上述 Fe_3O_4 悬浮液加入多巴胺的 Tris-buffer 中，在室温下反应 6 h，经过磁分离处理获得表面包覆 PDA 的磁性纳米球；将此磁性纳米球分散于 DMF 中，在氮气保护下，分别加入三乙胺和 BiBB，在 0 °C 反应 1 h 后再在室温下反应 24 h，再加入 BiBB、TPMA、AMA 和 SA，在 35 °C 反应 4 h，经过磁分离获得 Fe_3O_4/PDA/PAMA 纳米复合球；最后，将 Fe_3O_4/PDA/PAMA 纳米复合球、精氨酸、EDCI、HOBT 和 DIPEA 加入去离子水中，在室温下反应 24 h，经过磁分离获得 Fe_3O_4/PDA/PAMA-Arg 纳米复合球。

结果与讨论

从扫描电镜和透射电镜照片（图 1）可知，Fe_3O_4/PDA/PAMA-Arg 纳米复合球约为 460 nm 左右，且粒径分布窄。此超顺磁性纳米复合球还具有饱和磁化强度高，磁响应快等优点。以标准磷酸化蛋白（β-酪蛋白）为考察对象，评价了材料对磷酸化肽段的富集能力。结果表明，Fe_3O_4/PDA/PAMA-Arg 纳米复合球具有高检测灵敏性（0.2 fmol，图 2）、高选择性（β-casein/BSA=1:500），以及高稳定性（材料可循环使用 5 次仍具有优异性能），这可能是由于 PAMA-Arg 刷上丰富的胍基和氨基基团；在模型蛋白混合液中，Fe_3O_4/PDA/PAMA-Arg 纳米复合球展现了对磷酸化蛋白（卵清蛋白）的高选择性吸附能力；甚至在实际生物样本（蛋

清、脱脂牛奶，鼠脑组织）中，Fe_3O_4/PDA/PAMA-Arg 纳米复合球也显示了对痕量磷酸化生物分子富集的巨大潜力。

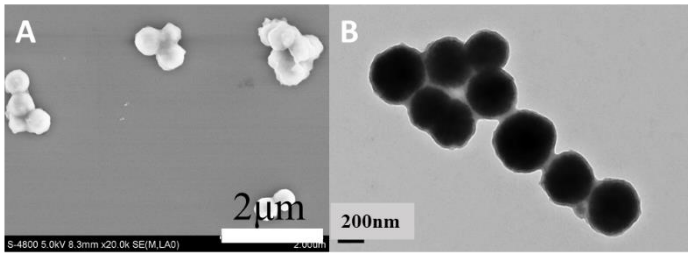

图 1、Fe_3O_4/PDA/PAMA-Arg 纳米复合球的扫描电镜（A）和透射电镜照片(B).

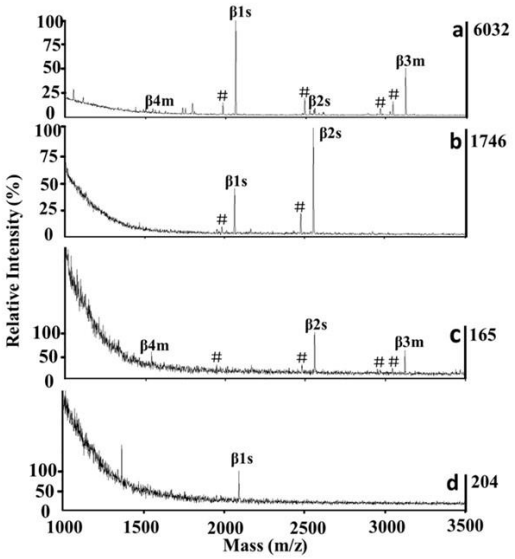

图 2、Fe_3O_4/PDA/PAMA-Arg 纳米复合球富集不同浓度的 β-酪蛋白消化液后的 MALDI-TOF 质谱图: (a) 10^{-9} M, (b) 10^{-10} M, (c) 10^{-11} M, and 10^{-12} M. (s, 单磷酸化肽; m, 多磷酸化肽; #, 去磷酸化肽).

结论

Fe_3O_4/PDA/PAMA-Arg 纳米复合球对痕量磷酸化肽富集具有高检测灵敏性，以及高选择性，这可能是由于 PAMA-Arg 刷上丰富的胍基和氨基基团。在对实际生物样本中痕量磷酸化生物分子富集，展现了巨大潜力。

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In-situ Formable and Thermosensitive Liposomal Hydrogels as Curcumin Carriers

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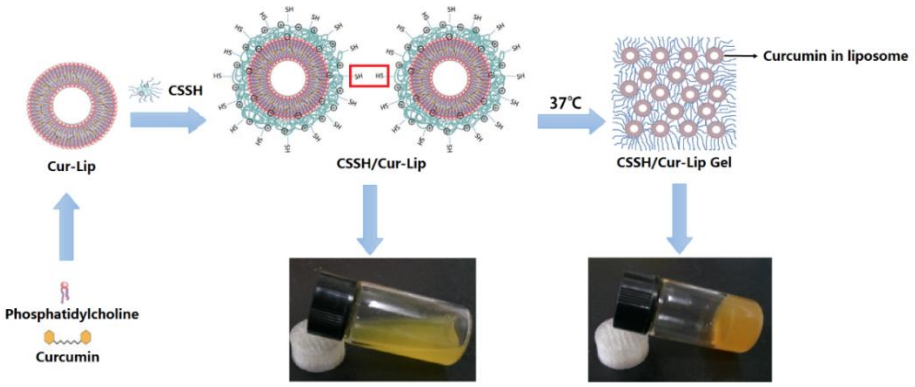
In order to improve the water solubility and bioavailability, curcumin was encapsulated by liposomes (Cur-Lip), which was further coated with thiolated chitosan (CSSH) to form liposomal hydrogels (CSSH/Cur-Lip). The gel is thermosensitive with *in-situ* injection performance which is fluidic at low temperatures and gels quickly at 37°C, with the gelation time between 19s and 217s by rheological test, and between 5min and 8min by vial inverting method. SEM showed that the freeze-dried Lip gels were porous, with obvious distribution of spherical Cur-Lip or CSSH coated Cur-Lip. The largest swelling ratio and cumulative release of 200μM/g CSSH/Cur-Lip gels were 131.19±8.01% and 58.53±3.14%, respectively. Worthily, the resilient gels were compressive even after five cycles of compression. Cytotoxicity test indicated that the Lip gels had better cytocompatibility. But after encapsulation of curcumin, MCF-7 cells were suppressed and killed dramatically after 48h and 72h. The CSSH/Cur-Lip gels can be designed as a promising novel drug delivery vehicle to be used as carriers for drug delivery to minimize burst release and as tissue engineering scaffolds for tissue regeneration, especially for tissue regeneration after tumor resection.



Graphical abstract

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Influence of Porous Gelatin Hydrogels on Chondrocyte Functions

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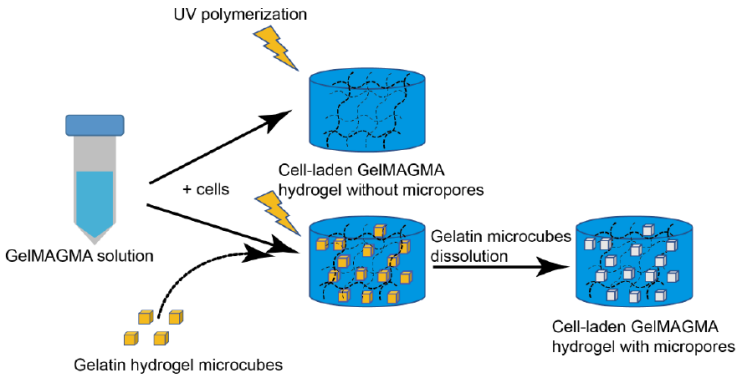
Hydrogels can provide biomimetic three-dimensional microenvironments for transplanted cells and are attractive scaffolds for cartilage tissue engineering [1]. Pore size and porous structures have showed significantly influences on chondrocyte functions [2, 3]. In this study, gelatin hydrogels with microporous structures were prepared and their effect on cartilage tissue engineering was compared with gelatin hydrogels without microporous structures. Gelatin bulk hydrogels were prepared by photo-initiated cross-linking of glycidyl methacrylate-modified GelMA (GelMAGMA) macromers. Micropores were formed in the bulk hydrogels by dissolution of gelatin microgels prepared by a cutting method. Chondrocytes in the microporous hydrogels showed higher proliferation while lower expression and production of cartilaginous matrices than did the chondrocytes cultured in hydrogels without microporous structures.



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Engineering Materials for Bio-applications

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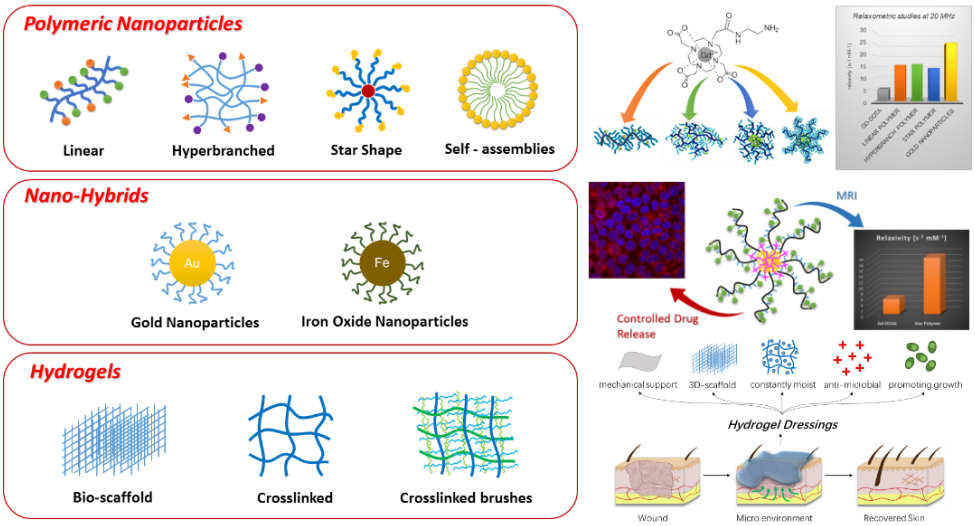
The development of medical progress essentially depends on bio-materials. Bio-materials have been engineered via modern polymerizations to suit a wide variety of applications. Various nanoparticles have been optimized by ATRP and RAFT approach to yield well-defined designable and repeatable structures. The introduced polymer chain contains functional and reactive side (core) units have emerged as important building blocks for the preparation of novel materials, finding applications in a wide range of biomedical and materials researches. The first example is that we prepared macromolecular ligands for positive MRI imaging via “grafting to” strategy. Such macromolecular ligands have the potential to serve as components of Gd MRI agents as there are enhanced effects on relaxivity, allowing for lower Gd concentrations to achieve contrast, while potentially imparting control over pharmacokinetics. The second example is multi-functional particles were designed which providing potential applications in stimuli-responsive controlled drug release theranostic applications. The third example is hydrogel dressings in wound healing applications. The engineered hydrogel presents mechanical support, 3D-scaffold, constantly moist and promoting growth properties and may serve as a micro environment for skin regeneration.

Key Words: Biomaterials; drug delivery; MRI; Hydrogel; Controlled polymerization.



Drug Eluting Coating of Intraocular Lens for PCO Prevention

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Posterior Capsule Opacification (PCO) is a significant complication of Intraocular Lens (IOL) implantation in cataract surgery. It is reported that the adhesion of the residual Lens Epithelial Cells (LEC) onto the implanted IOLs after the surgery, followed with the Epithelial-Mesenchymal Transition (EMT), migration and proliferation, is the key issue in the PCO development. Surface modification provides a convenient yet useful way to improve the biocompatibility of the implantable biomaterials[1]. Surface modification via polyelectrolyte electrostatic Layer-by-Layer (LbL) method and Surface Initiated-Reversible Addition-Fragmentation Chain Transfer (SI-RAFT) Polymerization were carried out to generate anti-adhesive IOL surface in our previous investigations[2-4]. Recently, drug eluting surface coatings with both anti-adhesion and anti-proliferation properties were fabricated onto the IOL surface via LbL method. Such multifunctional surface modification shows enhanced prevention of the PCO incidence after intraocular implantation (Fig 1).

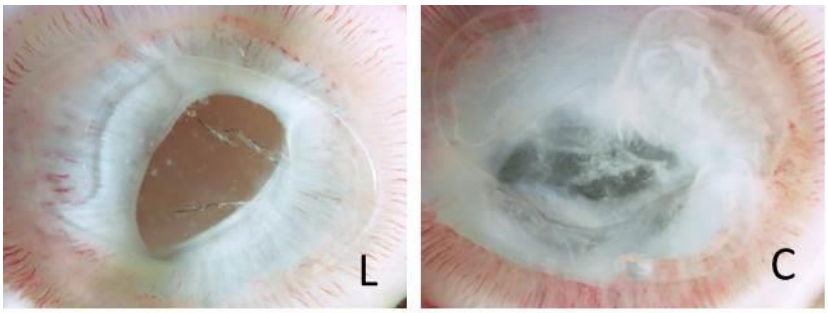

Fig 1. The PCO development in the capsule after IOL in vivo implantation, with (L) or without (C) drug eluting coating modification.

Acknowledgement
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EGCG/Cystamine Nanoparticles Responsive to the Redox Microenvironment for Treatment of Atherosclerosis

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Atherosclerosis is the main cause of coronary artery disease (CAD). Percutaneous coronary interventions is a common treatment for CAD which used as nonsurgical techniques, that probably lead to arterial restenosis. In addition, the trigger step of atherosclerosis is the low-density lipoprotein oxidized to oxidized low-density lipoprotein in the oxidative stress, therefore, for oxidative stress caused by reactive oxygen species associated with free radicals, we hypothesize a nanocarrier which is sensitive to the high reactive oxygen species (ROS) may serve as an effective targeted agent for the treatment of atherosclerosis. To demonstrate this hypothesis, synergistic cross-linking nanoparticles in epigallocatechin gallate (EGCG) and cystamine solution is an ideal carrier material. Meanwhile, using rapamycin (RAP) as a candidate drug, responsive nanoplatforms were fabricated. Drugs loaded in nanoparticles can be released after nanocarriers are cleaved due to the breakage of disulfide bonds in oxidizing and reducing environments. Both the drug-loaded nanoparticles and the unloaded nanoparticles were characterized. The TEM showed that nanoparticles have a uniform particle size distribution and the size is less than 200nm. In vitro release studies confirmed these nanocarrier exhibited desirable responsive behaviors. in vitro cell culture revealed their good safety profile and dose-related cytostatic behavior. Flow cytometry analysis indicated that these responsive nanoparticles could be effectively internalized by macrophages in both the dose-dependent and time-dependent, which effectively inhibited macrophage proliferation and suppressed foam cell formation by RAP. Accordingly, nanotherapeutics responsive to the redox microenvironment hold great potential for the management of vascular restenosis by selectively releasing drug molecules at the Atherosclerosis sites.

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Hemostatic Porous Sponges of Cross-linked Hyaluronic Acid/Cationized Dextran by One Self-foaming Process

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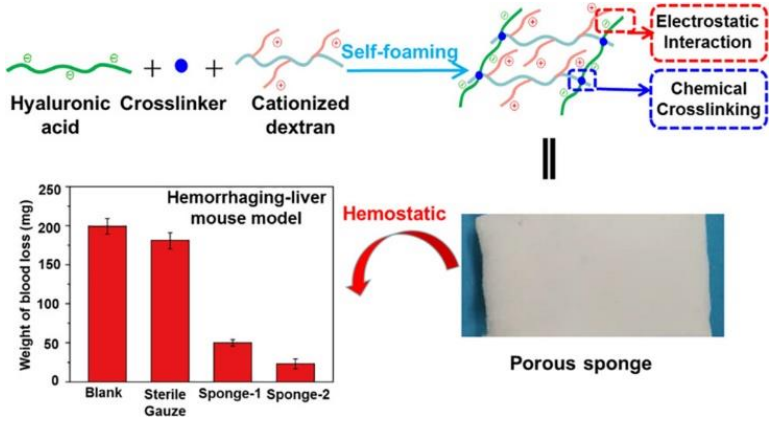
Effective hemostatic materials are very important for treating trauma cases. Natural polysaccharides have been particularly appealing in the development of new hemostatic materials due to their unique functions in human bodies. In this work, different polysaccharide-based hemostatic porous sponges (SHDP or SHDQ) of cross-linked hyaluronic acid (HA)/cationized dextran were readily prepared by the self-foaming process of HA and poly((2-dimethyl amino)-ethyl methacrylate)-grafted dextran (Dex-PDM) or partially-quaternized Dex-PDM in the presence of sodium trimetaphosphate crosslinkers. SHDP and SHDQ sponges were investigated in terms of liquidabsorption ability, hemolysis, whole-blood clotting and hemostatic activity in hemorrhaging-liver models. SHDQ sponges displayed higher porosity , swelling ratios, good blood compatibility and excellenthemostatic properties . The present study demonstrated that the self-foaming process of HA/Dex-PDM under a 'green' condition is an effective meansto produce new hemostatic materials.



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Controlled release of BMP-2 from zwitterionic PLGA scaffold for efficient repair of critical-sized rat calvarial defect

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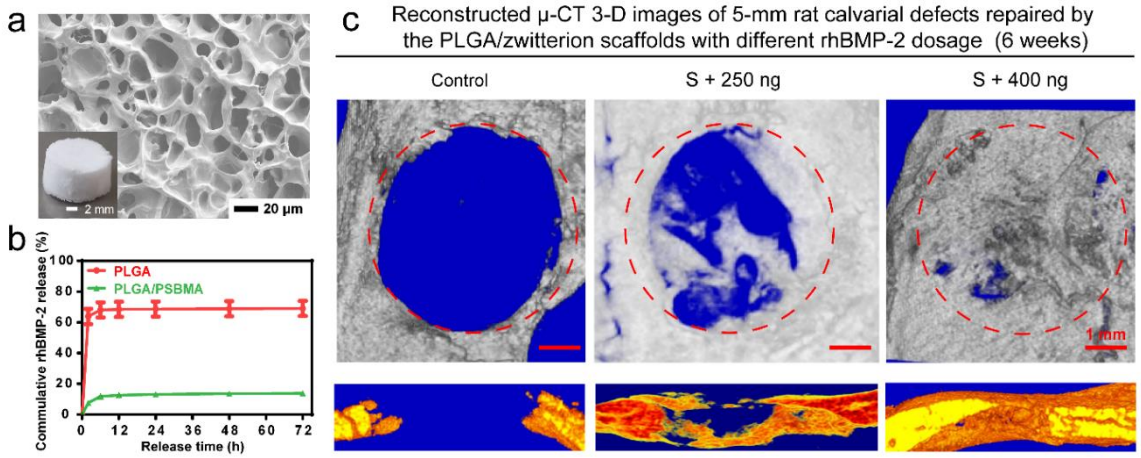
There is an urgent need to develop bioactive and effective tissue engineering scaffolds for the repair of critical-sized calvarial defect [1-3]. In this work, we developed a novel scaffold compositing of poly-lactic-co-glycolic acid (PLGA) and zwitterionic hydrogel (PSBMA) (Fig.a) for the controlled delivery of BMP-2. Interestingly, the introduction of PSBMA component significantly altered the degradation behavior of the scaffold, exhibiting a sustained degradation manner as compared with the burst degradation of the pristine PLGA scaffold. The *in vitro* studies showed that PLGA/PSBMA scaffold enables the sustained release of BMP-2 with bioactivity preserved (Fig.b), as demonstrated by the strong ability to induce the osteogenesis differentiation of MSC cells. *In vivo* studies revealed that the PLGA/PSBMA scaffolds are capable of guiding the functional healing of 5-mm critical-sized rat calvarial defect under super-low dose of rhBMP-2 (250 - 400 ng/scaffold).



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Surface-Modified Hydroxyapatite Nanoparticle-Reinforced Polylactides for Three-Dimensional Printed Bone Tissue Engineering Scaffolds

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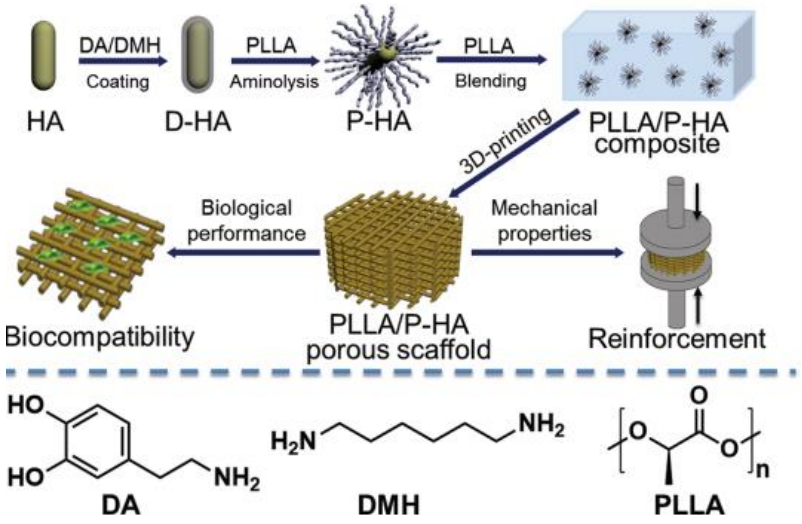
Bone defects represent a clinical challenge that severely impacts the quality of life of affected patients. To match the shapeof a bone defect area exactly, additive manufacturing has emerged as a promising technology to produce customized bone regeneration scaffolds for bone defect treatment. We developed a new three-dimensional (3D)-printed poly(L-lactic acid) (PLLA)/hydroxyapatite (HA) composite scaffolds. HA nanoparticles were first modified by a straightforward, economical method. Briefly, HA nanoparticles were modified with dopamine and hexamethylenediamine, and PLLA chains were grafted onto the HA nanoparticles by aminolysis reaction. Then, the PLLA-modified HA nanoparticles were blended with PLLA to form a thermoplastic composite for 3D printing. Due to the high compatibility between the PLLA matrix and PLLA-modified HA nanoparticles, the 3D-printed PLLA/HA scaffolds possess robust mechanical properties and good biocompatibility. This study provides a flexible strategy to fabricate scaffolds for the customized treatment of bone defects.

Key Words: Nanocomposite; Surface modification; Bone regeneration; Additive manufacturing; Customized treatment



Double Emulsion Templated Microspheres with Hierarchical Porous Structures: A Candidate for Trapping Virus-Like Particles

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Polymeric microspheres with hierarchical pores from nanometer to micrometer scales have attracted great interest in various fields, such as adsorption, tissue engineering, drug delivery, and chromatography [1, 2]. Here we report two-step membrane emulsification approach for controllable fabrication of uniform polymeric microspheres containing highly interconnected hierarchical porous structures (Figure 1A). The hierarchical porous microspheres possess well-defined micrometer-sized pores that are derived from the inner microdrops of W/O/W emulsions, and controllable nanometer-sized pores that are derived from reverse micelle swelling in the oil phase of W/O/W emulsions. After polymerization, micrometer-sized pores and nanometer-sized pores can be formed respectively (Figure 1B). The porous microspheres elaborately combine the advantages of enhanced mass transfer, large functional surface area. After modification with active groups, such microspheres can be treated as ideal chromatographic media to purify virus-like particle (VLP) such as HPV and FMDV.

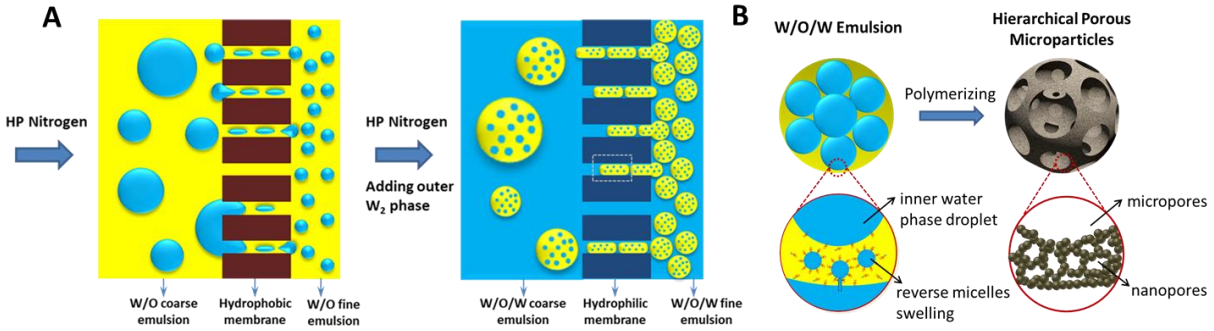

Figure 1 A. Fabrication of W/O/W emulsion by two step premix membrane emulsification. B. Strategy for controllable fabrication of interconnected hierarchical porous microparticles based on W/O/W emulsions.

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组织修复用生物粘合剂的制备与性能研究

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随着外科手术日益增多，对组织修复材料的要求越来越高，因而研发可粘合伤口的生物粘合剂具有重要的理论意义和实际应用价值[1-2]。受贻贝蛋白启发，多巴(DOPA)及其衍生物3,4-二羟基苯丙酸(DPA)由于其超强的黏附性能已被广泛应用于材料的改性[3-4]。本文利用 DPA 接枝改性壳聚糖(CS)制备具有优异黏附性能的壳聚糖-3,4-二羟基苯丙酸(CS-DPA)；利用聚乙二醇缩水甘油醚（PEGDGE）交联不同接枝率 CS-DPA，调节配比，构筑不同交联网络结构的材料 PEG-（CS-DPA）-PEG，制备成生物粘合剂材料。本文通过良好的结构设计以及制备过程的调控，简单快速地构建结构和性能稳定、具有较高力学强度和粘结能力的组织修复材料，并探索其与组织间的相互作用，性能测试结果显示：生物粘合剂与基质间粘结性良好，与猪皮的粘结强度达到 22.5 kPa，与猪软骨的粘结强度可达 145.34 kPa；粘合剂力学性能较好，压缩模量可达 0.93 MPa；具有良好的细胞相容性，细胞的存活率达到 90%。结果表明该种材料具有良好的粘合能力，适宜力学性能、优异的细胞黏附性和细胞相容性，有望作为组织修复材料应用于生物医药领域。

关键词：生物粘合剂；壳聚糖；聚乙二醇；3,4-二羟基苯丙酸；组织修复材料

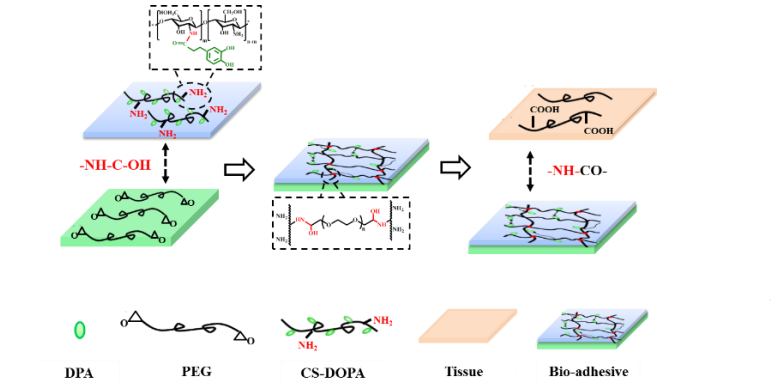

Figure 1. Schematic illustration of the synthesis of bio-adhesive

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基于聚多巴胺的药物载体的制备及其性能研究

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随着癌症发病率的逐年上升，开发具有优异性能的药物载体在生物医用中具有重要的意义与广阔的前景[1]。近年来基于聚多巴胺(PDA)的药物载体受到了科研人员广泛关注，其中聚多巴胺纳米粒子具有制备方法简单，黏附性强，表面易官能化、良好的生物相容性和生物可降解性，作为药物载体时具有很好的应用潜力和使用价值[2]。本文利用二氧化硅（SiO2）为模板，通过多巴胺（DA）在碱性条件下在模板表面氧化自聚，形成壳层，然后用氢氟酸（HF）移除模板的方式制备了不同粒径和壳层厚度的空心聚多巴胺(HPDA)纳米粒子。为了提高纳米粒子的稳定性和延长体内循环时间，将具有良好生物相容性和生物可降解性的巯基壳聚糖（CS-SH）通过迈克尔加成反应包覆在纳米粒子表面。本文通过空心聚多巴胺/壳聚糖纳米粒子与聚多巴胺/壳聚糖纳米粒子的比较，并探索其结构、形态及其负载载药后的性能，结果表明该药物载体在 PBS 中能长期保持稳定，且空心聚多巴胺复合纳米颗粒对于阿霉素（DOX）具有更高的药物包封率和载药量。

关键词：聚多巴胺；壳聚糖；药物载体

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Preparation and Study of the Redox-senstive Catecholamine Crosslinked Coating

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Coronary artery disease is a common disease that threatens human health, and its morbidity and mortality have gone beyond cancer and become the first killer to human health. Coronary artery disease is mainly caused by coronary atherosclerosis, and the trigger step of atherosclerosis is the low-density lipoprotein oxidized to oxidized low-density lipoprotein in the oxidative stress. For oxidative stress caused by reactive oxygen species associated with free radicals, such as superoxide anion, hydroxyl radical, H2O2, a modified layer with better biocompatibility and oxidative response is beneficial to vascular stents application property. In this work, two kinds of functional molecules, epigallocatechin gallate (EGCG) and cystamine, were introduced into the surface of 316L stainless steel. Utilizing the biological functions of EGCG such as anti-oxidation and inhibiting the proliferation of smooth muscle cells, and the disulfide bond of cystamine break property under oxidative or reductive condition, to obtain a multi-functional coating with treatment effect and redox response ability. This coating expected to adapt to the microenvironment of the lesion, and improve the biocompatibility of the vascular stents. In vitro hydrolysis studies confirmed these surfaces exhibited desirable responsive behaviors. Both in vitro cell culture and in vivo evaluations revealed their good safety profile. EGCG / cystamine cross-linked film can respond to the redox conditions, promote endothelial cell growth, inhibit smooth muscle cell proliferation, and have good blood compatibility. The EGCG / cystamine coating studied in this work has excellent biocompatibility and has responsiveness property to the microenvironment of the lesion, which provides a new idea for the development of functionalized modified coating of vascular stent.

Acknowledgement

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Encapsulation of Single Mammalian Cells with Cytoprotective Polymer Nanoshell

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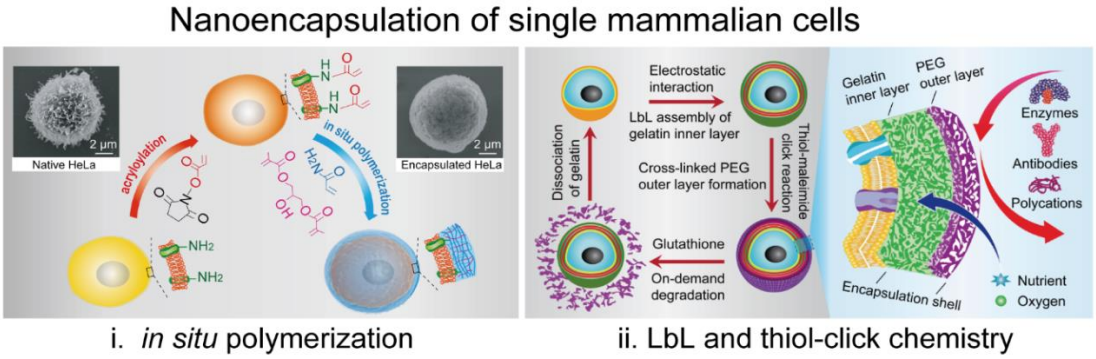
Nanoencapsulation of single mammalian cells has great potential application in the field of biomedical, biotechnological and bioelectronic. However, existing techniques for cell nanoencapsulation generally yield short sustaining period and loose structure of encapsulation shell, which fails to meet the long-term cytoprotection and immunosuppression requirements. In our work, a series of mild approaches were developed for encapsulation of single mammalian cells with cytoprotective polymer nanoshell. For instance, the nanoencapsulated single living HeLa cells, hMSCs and BACs were prepared by *in situ* polymerization. The polymer nanoshell was able to prevent the penetration of macro-external entities, while maintaining the free exchange of smaller molecules; Moreover, by combination of LbL assembly and thiol-click chemistry, the single HeLa cells were encapsulated with a gelatin inner layer and a cross-linked PEG outer layer. The encapsulated cells showed a high viability, long persistence period, effective resistance against macro external entities and high physical stress. On-demand cell release could also be achieved by selective cleavage of succinimide thioether linkage in the PEG outer layer. These works provide the new direction for single mammalian cell nanoencapsulation, which is of great importance for cell therapy, cell delivery, cell-based sensing, as well as biological research at the single-cell level.



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促进软骨再生水凝胶的制备及其无损成像评估

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软骨由于缺乏内在愈合响应能力，对于软骨缺损修复一直是个挑战。至今尽管各种各样促进软骨再生的支架层出不穷，但是既能促进软骨再生，又能无损监测材料降解及新生软骨状态的支架很罕见。在本研究中，将一种能引导软骨间充质干细胞分化成软骨细胞的非蛋白小分子通路试剂绑定至超顺磁性四氧化三铁纳米粒子表面，并采用一步技术负载至葡聚糖/纳米微晶纤维素复合水凝胶中。通过对材料物理化学性能，以及体内体外生物相容性评估，发现复合支架能吸引宿主软骨间充质干细胞聚集于缺损部位，在植入材料中生长良好，其中磁性纳米粒子能很好的缓释小分子药物，高效的促进软骨间质充干细胞分化成软骨细胞，并且能明显的增强核磁共振造影效果，与细胞共培养能保持稳定的成像强度，并未出现磁豫率损失。在动物模型中，新生软骨的形貌能无损可视化的通过核磁共振成像动态评估，结合组化免疫分析，复合支架获得良好的修复效果。并且通过无损动态监测，植入支架在12周内能缓慢降解。因此，制备的多功能复合支架在软骨再生方面提供了一个新视角。

关键词：无损观察；超顺磁性四氧化三铁；核磁共振成像；软骨再生；葡聚糖

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Plasma Surface Modification for Interfacial Bonding Enhancement in Dental Restorations

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Acrylic resins have received widespread clinical acceptance in dentistry, such as dental restoration and treatment of caries. Interface bonding is the most crucial factor for the success of these dental procedures [1]. This study is to evaluate plasma treatment effects on dentin surfaces for improving adhesive/dentin interface bonding.

Extracted unerupted human third molars were used after crown removal to expose the dentin surface. A non-thermal atmospheric plasma brush was used to modify/prepare dentin surfaces prior to traditional dental composite restoration procedures [2]. Dental adhesives including total etch and self-etch adhesives and dental composite were applied to the dentin surfaces as directed by manufacturers' instructions. Micro-tensile bonding strength test results (Fig. 1) showed that, as compared with the untreated controls, the bonding strength with plasma treatment increased over 30% for total etch adhesive and over 22% for self-etch adhesive. SEM examination did show that, with plasma treated dentin, thicker hybrid layer and longer resin tags were formed at the interface to

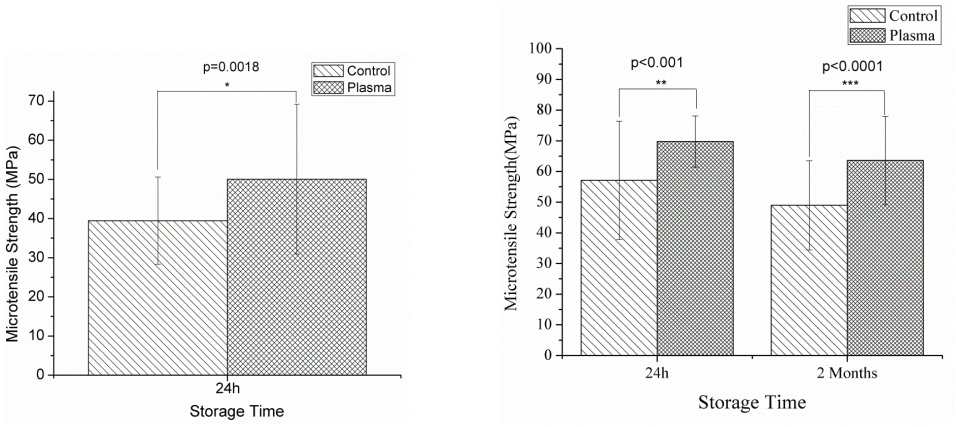

Fig. 1. Adhesive/dentin interface bonding strength for plasma treated specimens and their untreated controls. Top: Total etch adhesive; Bottom: Self etch adhesive.

enhance the interfacial bonding. The improved interfacial bonding through plasma treatment will greatly improve the successful rate and longevity of dental restoration. The results obtained in this study, therefore, show the great promise of atmospheric plasma technology in dental clinical applications.

Acknowledgment

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Research on Tough and Self-healing Poly(L-glutamic acid) Based Composite Hydrogel for Tissue Engineering

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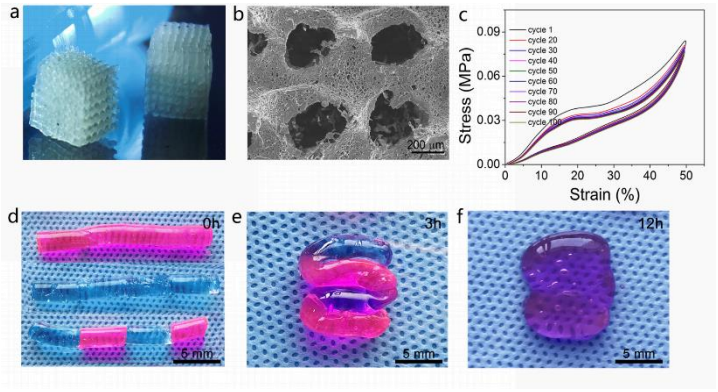
Load-bearing tissues play an important role in daily life.[1] To achieve better regeneration of load-bearing tissues, developing biodegradable biomaterials with excellent mechanical properties and self-healing is of particular importance but still remains a challenge.[2]

In this study, poly (L-glutamic acid) (PLGA) based composite hydrogel was designed by filling soft self-healing hydrogels into a tough porous hydrogel to combine their advantages. The tough porous hydrogel was fabricated by cross-linking PLGA-*g*-PCL with PEG and treated by laser ablation to form uniform porous structure. Attributed to hydrophobic assembly of PCL, the porous scaffold exhibited the maximum compressive stress of 0.51 MPa with the maximum strain of 80 % and could fully recover after cyclic compression tests. Aldehyde group modified PLGA and chitosan were employed to fabricate self-healing hydrogel based on Schiff reaction, followed by being composited with tough porous hydrogels. Filling with self-healing hydrogel improved cell loading efficiency by 2.9 folds to that of porous hydrogel. Live/dead staining images revealed that 89% of laden cells kept alive after 7 days culture. The developed composite hydrogel will be a promising biomaterial for the repair of load-bearing tissues.



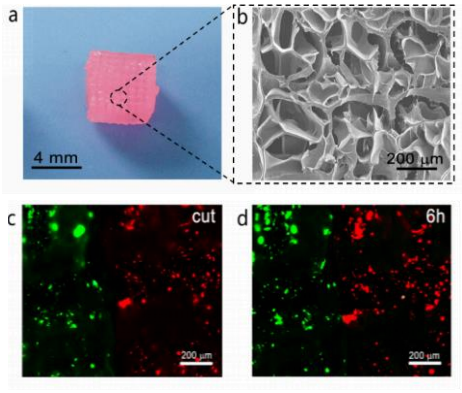


Figure1（L）. (a) Digital image, (b) SEM images of porous structure and (c) 100 cyclic loading-unloading curves of tough porous scaffolds. (d) Self-healing process of hydrogels stained with Methyl blue (blue) and Rhodamine B (red).

Figure 2（R）. Pores structure of the composite hydrogel. (a) Digital images and SEM images. (c, d) Fluorescence images with ASCs labeled by DiO (green) and DiL (red), respectively.

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Graphene oxide anchored on micropatterned PLCL film for peripheral nerve regeneration

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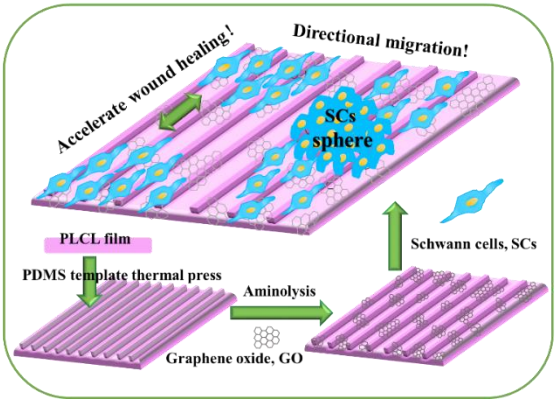
Large defect gaps (generally > 5 mm) in peripheral nerve system (PNS) caused by traffic accident, diseases as well as natural disasters lead to enormous healthcare expenditure and poor life quality of numerous patients, which becomes an increasingly serious challenge. It is suggested that specific topographical, chemical and biological cues, which can mimic the beneficial signals from native nerve tissue, should be integrated into the surface of biomaterials platforms. Herein, the graphene oxide (GO) was coated on the surface of PLCL films after aminolysis. On the micropatterned PLCL with GO films, the patterns of a smaller size lead to a larger number of elongated cells with a higher length to width ratio along the stripe direction, and more extensive directional migration of cells. The wound healing percentage was highest and cells migrated from the cell spheres farthest on 3/3μm-PLCL/GO film. Moreover, the regeneration of injured sciatic nerve was better in the conduit obtained by 3/3μm-PLCL/GO film compared to samples without GO or patterns.

Schematic illustration to show the fabrication process of GO modified micropatterned poly(D,L-lactide-co-caprolactone) (PLCL) film. This composite substrate is expected to promote the alignment, wound healing and directional migration of Schwann cells from cell spheres.



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UV responsive multilayers for synergetic effect on anti-biofilm and pro-tissue regeneration

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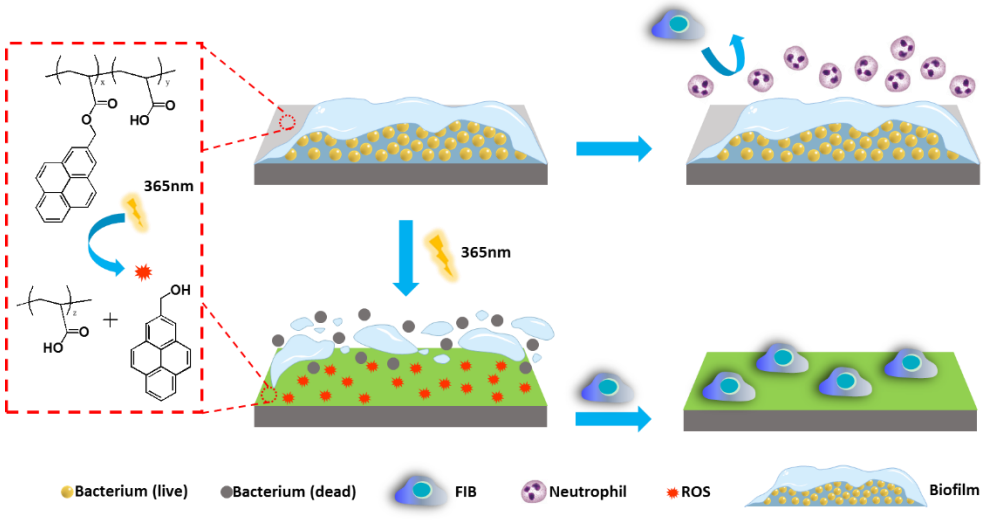
The increasing demands of surgical implantation highlighted significance of microbial infection, especially biofilm contamination on the surface of implants. Because the biofilms developed by colonized microbes will hinder the adhesion of host cells on implants, which is a crucial step in tissue integration between implants and surrounding tissues. The effect of traditional procedures including administration of antibiotics and debridement surgery were limited. The formation of multilayered and thick biofilms directly stands for persistent infection, leading to implants removal in the worst circumstances. In this work, UV triggered multilayers were fabricated in the form of coatings on implants for elimination of mature biofilms and tissue regeneration. Under UV irradiation, the cleavage of pyrene ester bonds contained in multilayers generates reactive oxygen species (ROS) massively and rapidly. Generated ROS were absorbed by biofilms and lead to destruction of bacteria and degradation of matrix, providing suitable environments for host cell attachments subsequently, leading to promoted regeneration of surrounding tissues.



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Microspheres with Different combination modes of poly (γ-benzyl-L-glutamate) and hydroxyapatite causing diversified osteogenesis

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Hydroxyapatite (HA)/polymer composite scaffolds provide a similar composition and architecture to natural bone matrix. The modes of combining HA with polymer can be classified into physical mixing and chemical grafting. By the means of physical mixing, HA tends to present on the surface of polymer matrix, serving as a bridge to interact with cells directly and enhancing the osteogenic differentiation of stem cells. However, physical mixing often results in uneven distribution of HA within the matrix due to poor interfacial compatibility and cohesiveness between HA and most of polymers, which may lead to irregular cell growth [1]. Compared with physical mixing, chemical grafting combines polymer chains with HA by chemical bonds, facilitating even distribution of HA within the polymer matrix. The well dispersion provide cells with an increasing access to HA, which was contributing to cellular proliferation and osteogenesis. While the strong force of combination between HA and polymer may constrain release of calcium and phosphate ions, weakening the osteogenic differentiation of stem cells [2]. Which one is the better strategy to construct HA/polymer composites? Our comparative study showed that the composites combined by chemical grafting could substantially improve the homogeneity of microspheres. Therefore, r-ADSCs in HA-g-PBLG exhibited a better cell penetration, a more homogeneous mineralization deposition and finally achieve a preferable result of cell proliferation and osteogenic differentiation.

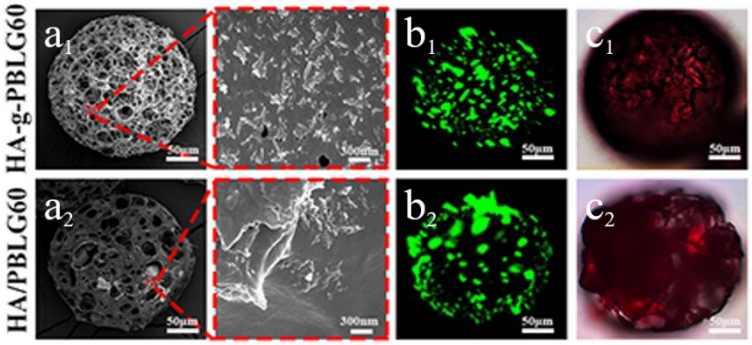

Figure 1. (a_1-a_2) SEM image of HA-g-PBLG and HA/PBLG microspheres, (b_1-b_2) CLSM images of microspheres-r-ADSCs which were labelled with Dio before seeding and (c_1-c_2) the alizarin red staining analyses at 14 days of culture.

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Acknowledgements

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Facile Synthesis of In-situ Formable and In-situ Mineralized Chitosan/Alginate Hydrogels with Ca^{2+} Induced Healing Ability

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In-situ forming hydrogel with structural and compositional similarities to the natural extracellular matrix, has been getting more and more attentions. Homogeneous mineralization and self-sealing ability would benefit it for bone application. In this case, we selected natural polysaccharides chitosan (CS) and sodium alginate (SA) to form hydrogels through facile and rapid Michael addition and electrostatic interaction. To mimic the slow mineralization in vivo, β-glycerophosphate calcium phosphate and calcium chloride solution (CaP) with concentration of 0, 30%, 50% and 70% (wt.%) were pre-mixed in the precursors as sources of phosphate and calcium, which were utilized further to transform in-situ to hydroxyapatite (HAp) under mediation of phosphatase alkaline (ALP). In addition, the free carboxyl groups on SA in the hydrogels were expected to heal the emerging cracks by external Ca^{2+}. Vial tilting method and rheology analysis showed that all the hydrogels formed uniformly in-situ within 10 min. The cryogels displayed a continuous and porous structure under SEM, and could restore to hydrogels within 30 min after absorbing water. XRD revealed that after dialysis with ALP, the weak crystalline HAp patterns became more obvious with the increasing concentration of CaP and the extension of aging time. The two slices in the healing experiment were observed to integrate rapidly and the firm interface was verified further with SEM. Finally the osteoblasts culture demonstrated tha t the addition of CaP enhanced the cell viability and proliferation, and the values for 70% at day 7 was close to that of the control. It is foreseeable that the hydrogels will have potential application for hard tissue repair.

Keywords: Biomimetic，Composite materials，Polysaccharide，In-situ formable hydrogels，Michael addition， In vitro mineralization

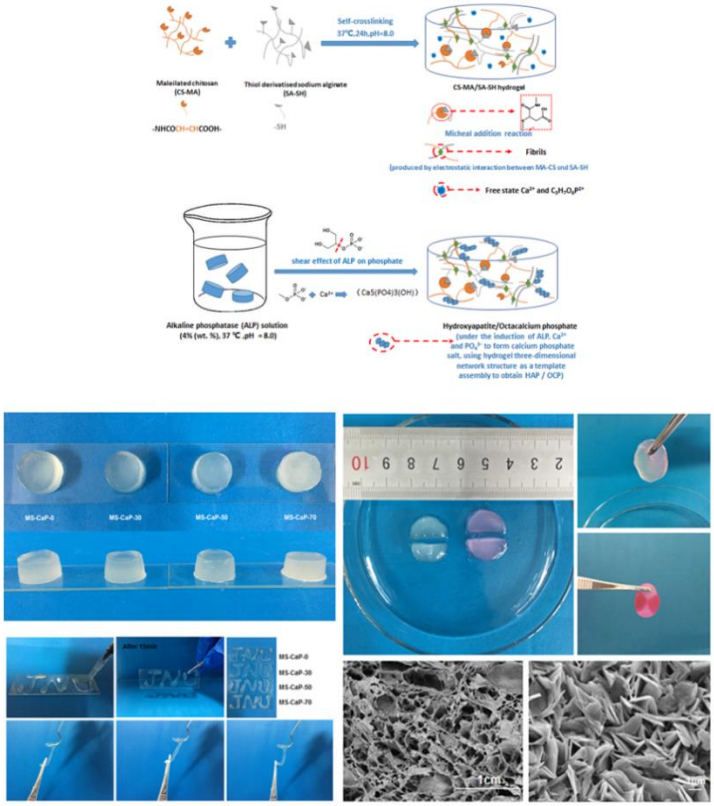

Fig. 1 Synthetic diagram and self-healing of CS-MA/SA-SH, mineralization experimental results

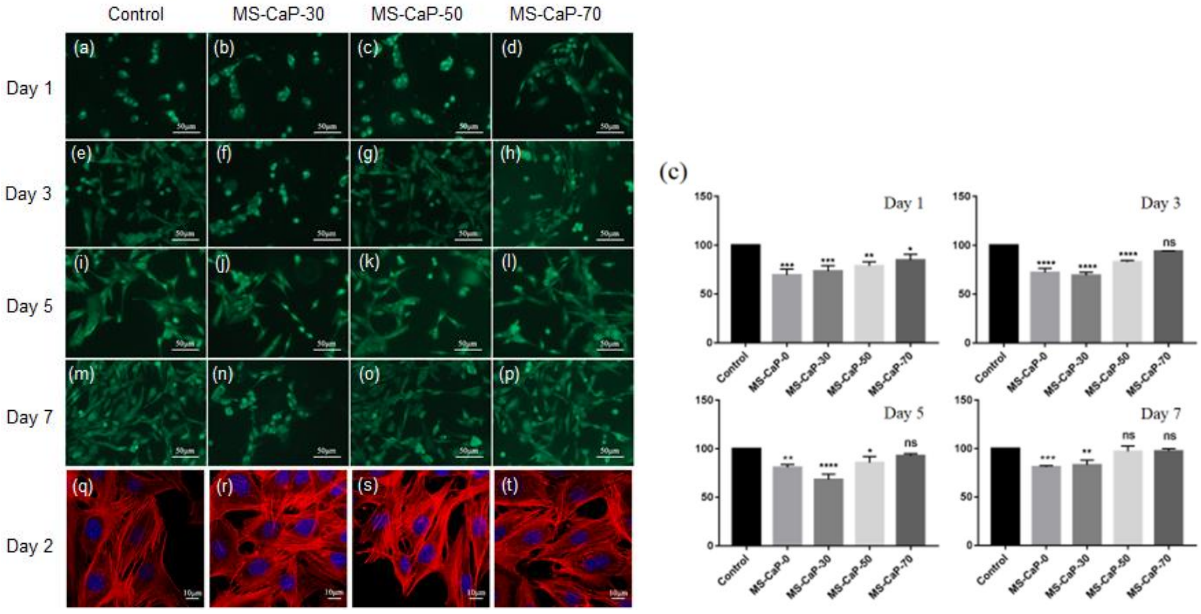

Fig. 2 Cell AO/EB test and differential analysis of toxicity

Nanocomposite Porous Microcarriers Based on Strontium-Substituted HA-g-Poly(γ-benzyl-L-glutamate) for Bone Tissue Engineering

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Reconstruction and regeneration of skeletal tissues via tissue engineering strategies have gained great interest for a long time. The manufacture of suitable three-dimensional scaffolds to support cell growth and extracellular matrix (ECM) deposition is important in tissue engineering. Recently, microcarriers have aroused wide concern because of their advantages, such as having a high specific surface area, directly injecting, and maintaining the cell differentiation phenotype. Thus, the microcarriers seeded with cells can be injected into the target site to achieve the purpose of repairing irregular tissue defects.

In the present study, strontium-substituted hydroxyapatite-graft-PBLG (Sr10-HA-g-PBLG, with 10 mol % Ca^{2+} replaced by Sr^{2+}) was prepared by ring-opening polymerization of γ-benzyl-L-glutamate N-carboxyanhydride (BLG-NCA). Sr10-HA-g-PBLG porous microcarriers were then fabricated via double emulsion evaporation method. Herein, we combined the osteoinductivity of Sr^{2+} ions[1] with the degradability of polymers to create the bioactive complexes microcarriers for bone regeneration.

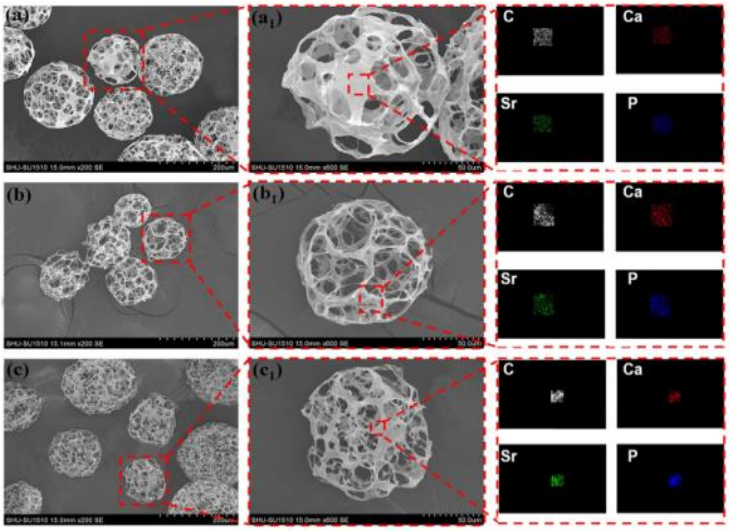

Figure 1. Microstructure of Sr10-HA-g-PBLG porous microcarriers. As we can see, The Sr10-HA nano-particles were evenly dispersed within the porous microcarriers matrix.

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Dual-crosslinked Amorphous Polysaccharide Hydrogels Based on Chitosan/Alginate for Wound Healing Applications

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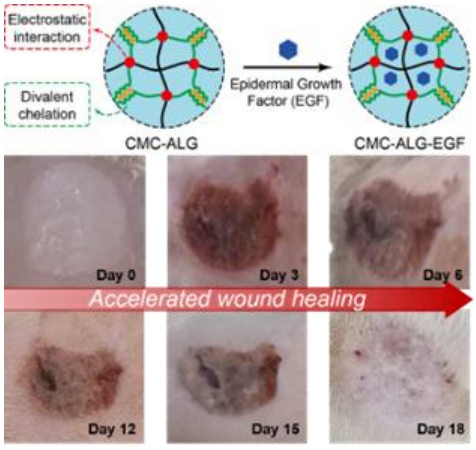
Development of advanced wound dressing materials with rapid healing rates is in urgent demand for wound cares. A suitable micro-environment will promote cell proliferation and migration, which benefits to early wound healing and prevents inflammations and scars. In this work, *N*-carboxymethyl chitosan (CMC) and alginate (ALG) based hydrogels were prepared *via* both electrostatic interaction and divalent chelation with epidermal growth factor (EGF) payload to promote the cell proliferation and wound healing. The dual-crosslinked hydrogels were investigated in terms of rheology, water retention ability and the release rate of EGF. Moreover, such amorphous hydrogel could promote cell proliferation and accelerate wound healing. The present study demonstrated that dual-crosslinked polysaccharide hydrogels are promising in wound care management.



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Selective Adhesion of Bone Marrow Mesenchymal Stem Cells on E7-Modified Collagen Substrates Evaluated by a Flow Model

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Bone marrow mesenchymal stem cells (BMSCs) have been widely used for tissue regeneration. However, owing to the low survival and lost pluripotency of ex vivo BMSCs, only a few of them are directly involved in tissue regeneration. Therefore, many investigations have focused on the recruitment of endogenous BMSCs. Nevertheless, most commonly used chemoattractants, such as SDF-1α, would recruit not only stem cells but also other cells like inflammatory cells, which may further cause fibrosis during the long inflammatory stage. Therefore, it is crucial to construct a biocompatible substrate with a specific affinity for BMSCs. E7 peptide (EPLQLKM) has been demonstrated to promote BMSCs adhesion significantly, while its selectivity for BMSCs when co-cultured with other cells in a flow condition has rarely been reported. In this study, different amounts of E7 peptide was immobilized onto collagen substrates using a different dose of sulfo-SMCC (sulfosuccinimidyl 4- (N-maleimidomethyl) cyclohexane-1- carboxylate) as a cross-linking agent. The results of cell adhesion rate, adhesion force and spreading area demonstrated that the increasing E7 peptide leads to a significant enhancement of the adhesion of BMSCs compared to RAW264.7 cells (inflammatory cells) and NIH3T3 cells (fibrocytes). More importantly, such selectivity was ulteriorly verified in a flow model which was innovatively designed to stimulate stem cells capturing in vivo. The validation on 2D surface reflected a promising prospect for 3D scaffold application, which indicated the E7-modified collagen scaffolds might serve as a candidate with great potential in in situ tissue regeneration.

Design and preparation of microcarriers suitable for human mesenchymal stem cells expansion

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Human mesenchymal stem cells (hMSCs) are considered to be the closest to clinical applications in various types of stem cells. However, even for bone marrow, the content of hMSCs is only 0.001% to 0.01%. It is difficult to meet the needs of cell therapy, so it is necessary to separate and purify in vitro, and then be cultured and expanded to meet the requirements. Microcarrier is one of the main factors influencing the expansion of hMSCS. In this study, we designed two types of microcarriers, positive-charged microcarrier and peptide-coupled microcarrier. In this study, we focused on the effect of mechanical strength or hardness on cell expansion after the optimization of other properties including charge density and polypeptide density and so on. The hardness was adjusted by the content of polysaccharide concentration in the microcarriers from 8% to 16%. We found that the effect of the microcarrier hardness is significantly different in the proliferation of hMSCs on these two types of carriers (Fig. 1). For the positive-charged microcarrier, there was an optimal value for hardness. While for the peptide-coupled microcarrier, in the range investigated, the higher the hardness, the better the proliferation. The change of hardness had no significant effect on maintaining self-renewal and undifferentiated state in hMSCs. Next, we developed a kind of microcarrier with large cavities (Fig. 2), the proliferation of hMSCs on this kind of microcarrier is quite different from the above-mentioned two types of solid microcarriers, and the further research is in process.

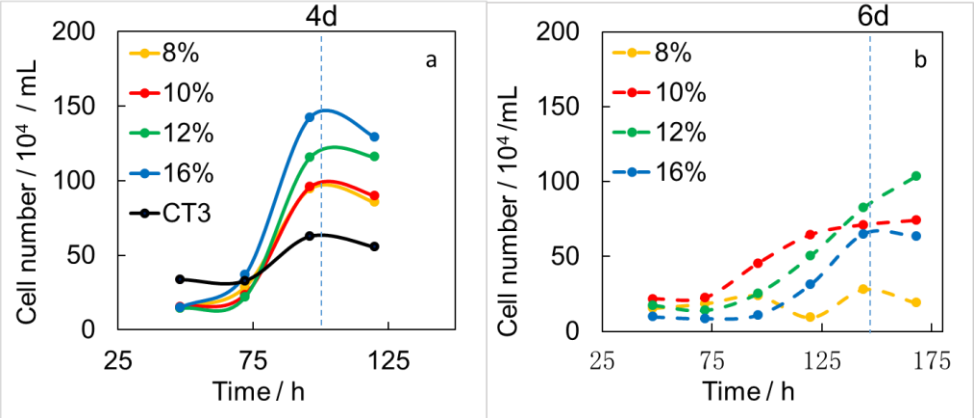

Fig.1 Effect of the hardness of microcarrier on the proliferation of hMSCs on the positive-charged microcarrier (a) and peptide-coupled microcarrier (b).

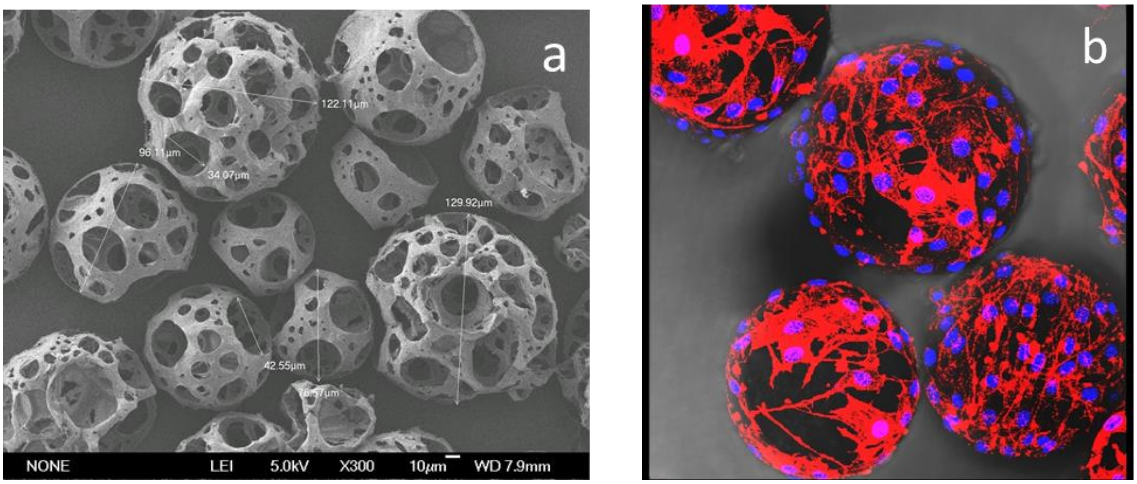

Fig.2 Microcarriers with large cavities (a) and CLSM images of hMSCs cultured on them (b)

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磁性羟基磷灰石复合支架表面特异蛋白冠促前成骨细胞增殖

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关键字：蛋白冠；细胞增殖；信号通路；复合支架；磁性纳米粒

引言：

大量的研究表明磁场能加速骨创伤愈合，磁性纳米颗粒由于其特有的性质而被广泛应用于骨组织工程领域。目前，研究者们将磁性纳米粒与各种基体支架（羟基磷灰石生物陶瓷、胶原、聚（L-丙交酯）、聚 ε-己内酯等）复合，所获得的复合支架显著促进骨相关细胞的增殖[1-2]。然而，磁性支架促进细胞增殖的机理并不明确。当生物材料在体内使用时，其表面会立即被一些内源性的蛋白质所覆盖，形成一层类似于 “晕”的大分子复合层，称为“蛋白冠”[3-4]。一旦支架进入生物流体，其表面所形成的蛋白冠的组成成分与数量会进一步调控体内外细胞的选择性粘附、迁移、增殖、分化以及组织对材料的响应性，最终决定材料的生物相容性和生物功能表现。因此，本文将从蛋白冠的角度探讨磁性复合支架促进前成骨细胞增殖的机理。关注材料表面蛋白冠的形成，将为发展新型生物材料表面改性的技术方法，研发具有新功能的生物材料表界面，开发新型生物材料及医疗器械提供一定参考依据。

材料和方法：

研究方法如下：首先，将磁性 Fe_3O_4 纳米粒子的正己烷胶体溶液与规格为 φ14x2mm 的羟基磷灰石（Hydroxyapatite Scaffold，HA 与骨基质的无机组分相似）支架在室温浸泡 24h 后真空干燥得到磁性羟基磷灰石复合支架(Magnetic Hydroxyapatite Scaffold，MHA)。其次，从体内（大鼠股骨植入）和体外（胎牛血清，FBS；细胞外分泌物，ES；细胞培养液，FBS+ES）同时研究 HA 和 MHA 两种支架在不同条件下孵育所形成的蛋白冠。分别用十二烷基硫酸钠聚丙烯酰胺凝胶电泳（sodium dodecyl sulfate polyacrylamide gel electrophoresis，SDS-PAGE）、液相色谱-质谱/质谱联用（liquid chromatography-tandem mass chromatography，LC-MS/MS）等对不同条件下的蛋白冠进行表征。最后，用酶联免疫吸附测定细胞内相关蛋白的表达水平。

结果与讨论：

前成骨细胞 MC3T3-E1 增殖结果表明，磁性羟基磷灰石支架具有优异的超顺磁性且能显著促进细胞增殖。体内、体外蛋白冠的表征数据显示：两种支架表面形成的蛋白冠随不同孵育条件的变化而变化；在同一孵育条件下，与 HA 支架相比，MHA 能显著富集更多与 MAPK/ERK 级联相关的蛋白质（图 1）。大量的研究证明 MAPK/ERK 信号通路在成骨细胞增

殖中起着很重要的作用[5]。通过酶联免疫吸附实验对 MAPK/ERK 信号通路中几种关键蛋白丝裂原活化蛋白激酶激酶 1/2（MEK1/2）和细胞外信号调节激酶 1/2（ERK1/2）的表达水平进行测定，发现 MHA 组所考察的关键蛋白的表达量均显著高于 HA 组；用抑制剂 PD98059 特异性阻断 MAPK/ERK 信号通路后，MHA 组 MEK1/2 和 ERK1/2 的表达量明显降低（低于 HA 组），细胞增殖降低（图 2）。综合以上结果表明（图 3），MHA 表面所形成的蛋白冠主要是通过富集功能蛋白进一步激活 MAPK/ERK 信号通路，从而促进前成骨细胞(MC3T3-E1)的增殖。

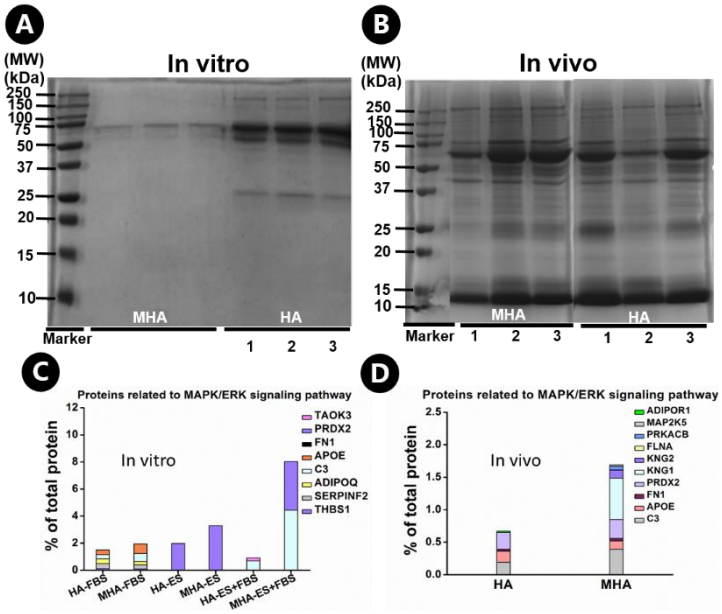

图 1. 羟基磷灰石(HA)和磁性羟基磷灰石（MHA）支架分别在体外、体内形成的蛋白冠的 SDS-PAGE（图 A 和图 B），LC-MS/MS 表征，并按照参与的生物学过程和分子功能对蛋白质进行分类（图 C 和图 D）

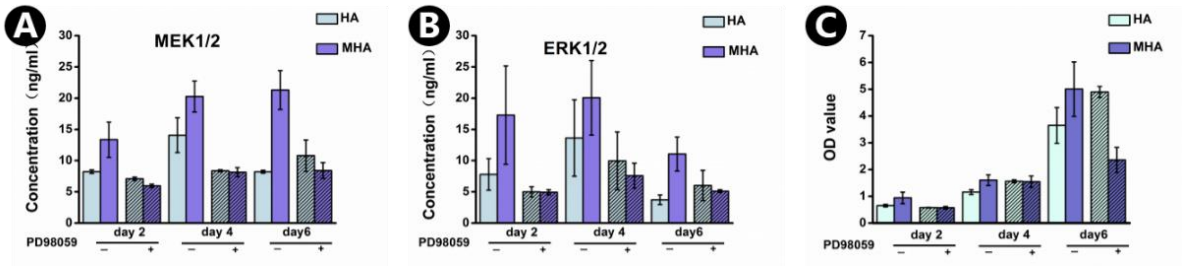

图 2. PD98059(MEK1/2 特异性抑制剂)处理前后 MAPK/ERK 信号通路关键蛋白 MEK1/2 和 ERK1/2 的表达及成骨细胞增殖的评价

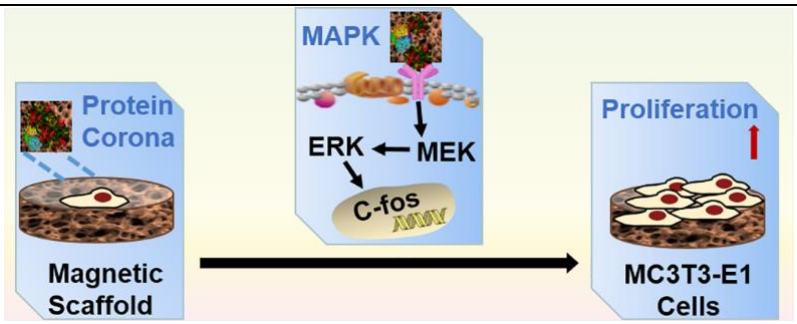

图 3. 磁性羟基磷灰石符合支架促进前成骨细胞增殖的机理

结论：

蛋白冠的组成成分、数量显著影响前成骨细胞的增殖行为。与羟基磷灰石支架相比，磁性羟基磷灰石复合支架中磁性纳米粒的引入导致了支架表面蛋白冠的组成发生变化，可能通过富积丝裂原蛋白激酶信号通路上游的蛋白质，从而促进前成骨细胞（MC3T3-E1）的增殖。该研究不仅为磁性支架上细胞增殖的分子机制提供了重要认识，而且为骨组织工程支架的设计提供了一定的依据。

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Antimicrobial Silicone Surfaces: from Nanoclusters to Cells

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Silicone is a major component of most biomedical materials. The antimicrobial silicone surfaces are developed to prevent the pathogen colonization and related device-associated infections. In the first system, we introduced antimicrobial ultrasmall metal nanoclusters (Ag NCs, Au NCs) to the silicone surfaces, which show wide-spectrum antimicrobial activity, much more efficient than the bulk metals or nanoparticles. This superior antimicrobial property is attributed to the ultrasmall size of metal nanoclusters, which would allow them to better interact with bacteria.

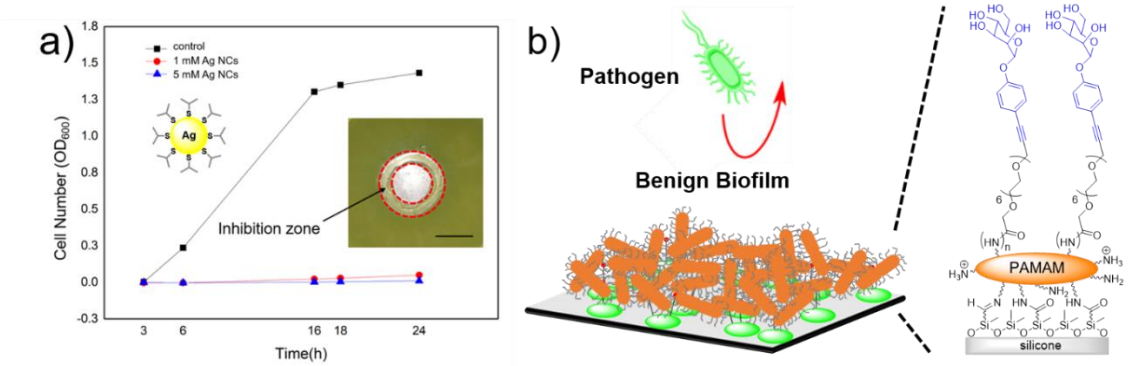

Figure 1. a) Comparison in cell numbers between the control sample, the sample with Ag NCs during a period of 24h incubation. Agar diffusion assay showing the presence of a clear zone surrounding the well where Ag NCs were introduced (scale bar of 1cm). b) Schemetic illustration of probiotic *fim*+ *E. coli* 83972 biofilms formed after 48 h of incubation on G5 PAMAM-Mannoside silicone surfaces.

In the second system, we immobilized probiotic bacterial cells on the silicone surfaces that form benign biofilms, as a natural, live prophylactic against pathogen colonization. The stability and antimicrobial activity were evaluated. 94% probiotic bacteria retained on the modified silicone under >0.5 Pa shear stress. After being challenged by three pathogenic isolates for 11 days, large amounts of non-pathogenic bacteria remained on the surfaces and reduced the colonization of pathogens by >3.2-log.

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