南通大学高层次人才培育计划

培养对象申请表

申 请 人：	赵亚红
所在单位：	神经再生重点实验室（与神经科学系、神经再生协同创新中心合署）
申报类别：	A 计划第一档
填表时间：	

南通大学高层次人才工作办公室制

填写说明

一、填写本表前，请认真阅读《南通大学高层次人才支持计划实施办法》和相关通知。

二、申请表中应明确填写清楚申报类别、发展目标、目前已具备的基本条件、未来工作计划等各项内容。

三、表中所涉个人前期业绩成果均应做到真实完整、信息准确、无知识产权纠纷及其他异议。

四、本表请采用 A4 纸双面打印。

一、申请人基本情况

姓　　名	赵亚红	性　　别	女	国　　籍	中华人民共和国
出生年月 年龄（周岁）	1983.12 43	政治面貌	中国共产党党员	党政职务	无
最高学历	博士研究生毕业	最高学位	博士研究生毕业	联系电话	15950885276
现任专业技术职务及任职时间	研究员（自然科学） 2020-07-23				
所在学科一级学科及研究方向	基础医学 神经组织工程				
最高学历毕业学校及毕业时间	江南大学 2018-06-19				
海外学习及工作（含博后）经历	美国 约翰霍普金斯大学（QS6），2018.12-2019.11，访问学者。				

注：海外经历请注明学习工作高校（科研院所）的世界排名、起止时间及个人职务等情况

二、培育目标及现有基础

申报类别	A 计划第一档	
培育目标	A 计划第一档 基金委 JQ	A 计划第二档
	B 计划	

现有基础	（对照培育目标，简要列举申请人已具备的基础条件，着重标出已取得的标志性成果，500字内） 一、科研项目： 1.国家自然科学基金面上项目，2024.1-2027.12，50 万，主持； 2.江苏省自然科学基金委员会面上项目，2023.7-2026.6，10 万，主持； 3.中华人民共和国科学技术部国家重点研发计划子课题，2018.09 2021.06，50 万，主持 二、论文、专著：在著名学术期刊上发表 SCI 论文 62 篇，被引用 1865 次。以南通大学为第作者或通讯作者在本学科 SCI 收录期刊发表 12 篇，其中 Nature Index 论文 3 篇，中科院一论文 6 篇。高被引 1 篇。 三、授权国内与国际发明专利、成果转换情况：近五年以第一发明人获授权发明专利 1 项(亚红; 杨宇民; 刘纪娜; 葛一凡; miR-673-5p 在制备促进神经再生的制剂中的作用, 2021-09-(中国, ZL202111052916.8) 四、其他：担任江苏省神经科学学会监事会监事长、生物材料生物学评价分会第三届委员会员、中国中医药信息学会中医临床药学分会第二届理事；Regenerative Biomaterials、Brain-X Engineered Regeneration 青年编委。

三、近五年主要业绩

（一）主要完成或在研的科研项目（作为负责人承担的国家级科研项目可全部列出，一般不超过 5 项）

项目名称	开始时间/到账时间	项目分类	获得资助金额	本人作用	项目级别（纵向）
壳寡糖介导的施万细胞自噬调控周围神经再生的机制研究	2023-01	面上项目	50	主持	国家级
医用海洋源功能产品生物学评价及临床应用研究	2018-01	国家重点研发计划课题	50	主持	国家级

壳寡糖调控补体C3通路在周围神经缺损修复中血管形成的机制研究	2023-01	面上项目	10	主持	省部级

注：本人作用指负责主持；项目进展情况包括已完成、已完成且成果已转化应用或正在进行等。

（二）近五年主要完成或在研的教学教改项目（作为负责人承担的教学项目可全部列出，一般不超过5项）

项目名称	获奖、立项等级	本人排名	获奖、立项时间

（三）近五年主要论文、著作情况

1.主要论文目录（按重要性排序，合计不超过5篇）

期刊名称	论文题目	论文级别	发表时间	第一署名单位
ADVANCED FUNCTIONAL MATERI	Zinc‐Directed Coordination Network Hydrogels for A20‐Mediated Inflammation Modulation and Enhanced Axonal Regeneration in Spinal Cord Injury	三级：SCI（中科院一区）,三级：SCI（中科院一区）	2025-08-07	第一单位
Advanced Functional Materials	Biomimetic Silk Fibroin Hydrogel for Enhanced Peripheral Nerve Regeneration: Synergistic Effects of Graphene Oxide and Fibroblast Exosome	三级：SCI（中科院一区）	2024-04-25	第一单位
BIOACTIVE MATERIALS	Advancing neural regeneration via adaptable hydrogels: Enriched with Mg2+ and silk fibroin to facilitate endogenous cell infiltration and macrophage polarization	三级：SCI（中科院一区）	2024-03-01	第一单位
BIOACTIVE MATERIALS	Fibroblast exosomal TFAP2C induced by chitosan oligosaccharides promotes peripheral axon regeneration via the miR-132-5p/CAMKK1 axis	三级：SCI（中科院一区）	2023-08-01	第一单位
Regenerative Biomaterials	Chitooligosaccharides accelarate myelin clearance by Wipi1 mediated Schwann cell autophagy promoting peripheral nerve regeneration	四级：SCI（中科院二区）	2025-05-19	第一单位

2.主要著作目录（按重要性排序，合计不超过5本）

书　名	出版社	出版日期

（四）获得主要学术奖励情况（包含科研、教学，按重要性排序，合计不超过 2 项）

获奖项目名称	奖励名称	奖励等级	获奖时间	奖励单位

（五）近五年获得省部级以上荣誉称号情况（按重要性排序，合计不超过 2 项）

荣誉称号	入选时间	颁发部门

（六）授权国内与国际发明专利、成果转换情况（按重要性排序，合计不超过 5 项）

1.授权国内与国际发明专利情况

专利名称	专利号	国别	授权时间	本人排名
WIPI1 蛋白在周围神经再生过程中髓鞘清除中的应用	2024114973700	国内		1
miR-673-5P 在制备促进周围神经再生的制剂中的应用	2021110529168	国内	2022-08-23	1

2.成果转化情况

成果名称	转化时间	首次受让企业	本人作用（主要负责或参与）

（七）其他成果

1.其他科研项目

项目名称	开始时间/到账时间	项目分类	获得资助金额	项目状态	本人作用	项目级别（纵向）

注：本人作用指负责主持；项目进展情况包括已完成、已完成且成果已转化应用或正在进行等。

2.其他教学教改项目

项目名称	获奖、立项等级	本人排名	获奖、立项时间

3.其他论文

期刊名称	论文题目	论文级别	发表时间	学校署名

4.其他著作

书　名	出版社	出版日期

5.其他学术奖励

获奖项目名称	奖励名称	奖励等级	获奖时间	奖励单位

6.其他授权国内与国际发明专利情况

专利名称	专利号	国别	授权时间	本人排名

8.其他成果转化情况

成果名称	转化 时间	首次受让企业	本人作用 （主要负责或参与）

四、未来工作计划

突破方向	（对照培育目标及现有条件，分析目标达成中的现实差距及需要突破的方面，500 字内） 一．提升科研影响力 申请人深耕生物材料与神经再生领域，与诸多优秀实验室保持着良好互动关系和合作潜力。在此基础上，将进一步积极参加国际学术会议，开展国际交流与合作，常态化邀请国际知名科学家来校进行学术交流，建立长期稳定的实质性国际合作项目，进提升学术国际知名度。 二．提升研究质量 申请人具备机制探讨、材料研发及组织修复验证的全链条研究能力。在前期系列工作基础上，将结合自身研究领域专长，围绕神经组织特异性细胞外基质的仿生构建与功能重建开展系统研究，重点探索病理微环境下细胞外基质的结构特征、细胞互作机制及其工程化再现策略，发展具有可调控性与适应性的仿生功能材料及其先进制造工艺，服务“医药、卫生与健康”领域的科技发展需求。同时，推动生物医学工程领域的交叉创新，力求在该领域形成具有国际影响力的标志性成果。 三．提升转化应用 申请者参与国家药监局国家行业标准起草与验证工作，填补部分行业评价规范空白，加快了我国组织工程医疗器械国际化进程。在此基础上，打通“基础研究-标准制定-产品研发-临床转化”全链条，加速自研材料的验证迭代与产业化，助力相关产品研发的进程和医疗产业高质量发展。

未来工作计划	（对照培育目标、现有条件及拟突破的方向，拟定未来的主要工作及安排，800 字内） 神经系统退化及损伤对家庭和社会造成沉重负担，而疾病进展与治疗过程中的组织力学改变与相关力学生物学机制尚未得到完整阐释，这些复杂力学因素的改变又如何影响神经细胞发育、成熟与病变亦尚未得到完整探索。在前期研究中，申请人发现，神经损伤等病理性条件下，并非简单导致基质刚度增强，更可能涉及基质粘弹性与动态响应性能的变化，值得进一步从微观结构和分子机制层面深入探索。 基于上述发现，申请人在入选长高层次人才岗位后，拟从“生物物理特性解析—关键分子识别—功能模块设计—仿生制造重建”四个层面出发，系统开展神经组织的力学生物学仿生构建与工程制造研究。具体包括：①神经组织细胞外基质的力学-结构-成分变化谱系描绘：收集正常组织及不同疾病进展程度的坐骨神经、脊髓、大脑等典型神经组织样品，利用生物纳米压痕仪及双轴力学测试系统测试，表征神经组织的宏观和微观力学性质，建立神经组织特异性细胞外基质力学特征数据库。②关键调控因子的筛选与功能验证：结合转录组、蛋白质组和基质组数据，揭示神经再生损伤情况下蛋白异常表达、修饰、沉积、降解等改变对组织微观力学特性的影响。提取识别调控细胞外基质力学变化的关键因子，并通过基因编辑与干预策略验证其调控作用。③基于生物力学特征的仿生构建策略：优选透明质酸、海藻酸钠与丝素蛋白等生物相容性良好的天然生物材料，利用多重非共价作用（包括主客体交联、离子配位等）精确组装形成动态交联网络结构，构建组织适应性动态水凝胶体系，匹配神经组织细胞外基质典型力学与生化特征的仿生支架材料。④多尺度先进制造与功能验证：结合 3D 打印、微流控等先进制造技术，实现智能神经移植物的结构精密制造，并通过体外培养和动物模型验证其对细胞行为与组织再生的调控效果。研究将为理解力学生物学对组织稳态与再生能力的影响机制提供基础支撑，同时推动智能仿生神经组织支架材料的个性化设计，具有显著的科学前沿意义与应用潜力。

五、需要学校提供的支持

是否实验类	否	
培育建设经费预算	工作计划	预算（万元）
	参加学术会议：计划参加学术会议 4 次，国际会议 2 次，每次 2 万元，国内会议 2 次，每次 0.5 万。	6
	专家咨询费： 邀请专家学术交流 10 人次，每次 0.5 万元，共 5 万元。	5
	论文出版与学术成果推广：一流学术期刊版面费 2 万元/篇， 3 篇。	6

	实验用试剂、耗材、动物等业务费：7 万元。	7
	测试费：双轴力学、纳米压痕、原子力显微镜等测试神经组织力学性质。	6
	合计	30 万元
其他支持需求清单	科研经费配套支持：用于前期预期实验、成果产出；	
	科研平台与实验条件支持：大型仪器设备减免测试、机时费用；	
	团队支撑：支持自主引进专职科研人员，优先保障生源；	
	学术交流扶持：对接行业顶尖专家，搭建交流渠道，资助参加国内外学术会议。	

五、申请人承诺

（对照未来拟开展的工作，列举需要学院及学校提供的其他支持事项的清单）

1. 以上所填信息均真实有效；
2. 如入选学校培育计划，按期完成培育任务，规范使用学校支持经费；
3. 培育目标达成后，本人志愿在本校服务 10 年以上。

申请人签字：_____

_____年_____月_____日

六、二级单位审核推荐意见

1. 申请人填写的内容是否属实？	是
2. 申请人发展目标是否符合学院发展规划？	是
3. 申请人是否具备培育目标的基础条件及培养潜力？	是
4. 申请人对目标达成的现实差距及突破点的分析是否准确？	是
5. 申请人制定的工作计划是否切实可行？	是
6. 申请人对培育建设经费的预算是否合理？	是
7. 学院是否同意推荐申请人申请相关计划？	是
培养期内，学院为申请人提供以下支持： 在研究生名额分配给予倾斜。 优先使用学院科研和教学平台。 提供优质的科研支撑团队。 党政负责人签字： （单位公章） _____年_____月_____日	

七、学校人才工作领导小组意见

经评审，同意_____同志入选_____培育计划。

组长（签章）：

_____年_____月_____日

八、学校意见

学校公章：　　校长签字：

_____年_____月_____日

申报材料附件

赵亚红


姓名 赵亚红
性别 女 民族 汉
出生 1983 年 12 月 28 日
住址 江苏省南通市崇川区任港
街道战胜村七居155号
公民身份号码 320682198312282309


中华人民共和国
居民身份证
签发机关 南通市公安局崇川分局
有效期限 2016.03.15-2036.03.15

江南大学
JIANGNAN UNIVERSITY

博士学位证书

证书编号：10295220180100 24

赵亚红，女，1983 年 12 月 28 日生。经审核，符合本校 纺织科学与工程 学科博士学位授予规定，依据《江南大学章程》，特授予其 工学 博士学位。

校 长 陈坚

学位评定委员会主席

二〇一八 年 六 月 十九 日

姓　　名　赵亚红

性　　别　女

身份证号　320682198312282309

工作单位　南通大学

编　　号　20204236G0096

经　江苏省南通大学教师高级专业技术资格评审委员会于2020年07月23日评审，赵亚红已具备 研究员 资格。

公布文号：　通大人〔2020〕12号

发证机关

（印章）

2020年07月23日

ADVANCED FUNCTIONAL MATERIALS
www.afm-journal.de

Zinc-Directed Coordination Network Hydrogels for A20-Mediated Inflammation Modulation and Enhanced Axonal Regeneration in Spinal Cord Injury

Jianye Zhang, Yisheng Gao, Miao Zhang, Yue Zhao, Chunxue Wang, Jiahuan Gong, Supeng Ding, Mengke Liu, Xueying Zhao, Bingxin Wu, Yumin Yang,* and Yahong Zhao**

Remodeling the adaptive microenvironment with biomaterials presents a promising avenue for addressing chronic inflammation that contributes to spinal cord injury (SCI) repair. Hydrogels have been widely employed to enhance tissue regeneration following SCI. Additionally, zinc (Zn) ions are effective in immune modulation for the central nervous system. However, significant challenges remain in preparing hydrogels combining bioactive Zn^{2+} with biological functionality for traumatic SCI repair. In this study, a self-healing hydrogel composed of an alginate network based on dynamic Zn^{2+}/bisphosphonate (BP) cross–linking, and a silk fibroin interpenetrating polymer network is reported. It is observed that the neurite outgrowth is promoted by Zn^{2+} and shows dependency on Zn^{2+} concentration. Moreover, the Zn^{2+}-releasing hydrogel enhances neuronal axon growth and influences neural stem cell proliferation and differentiation. In addition, the hydrogel regulates microglial cell fate by upregulating the anti-inflammatory signaling molecule A20 through inhibition of the NF-κB pathway. Therefore, this hydrogel effectively improves immune response modulation while promoting neural regeneration and functional recovery, including motor, sensory, and bladder function in completely transected SCI. These results indicate the Zn^{2+}/BP-based hydrogel holds the potential for traumatic SCI treatment.

1. Introduction

Traumatic spinal cord injury (SCI) caused by trauma, such as falls, traffic accidents, or violence, accounts for >20.6 million cases worldwide every year.[1,2] SCI initiates a series of pathophysiological events, frequently resulting in severe and permanent disabilities including sensory and motor loss, and even paralysis.[3] Following SCI, the initial reaction involves immune cell activation and a complex inflammatory response in the surrounding areas, leading to ionic imbalances, reactive oxygen species (ROS) generation, and neuronal death.[4,5] Numerous studies have revealed that the harsh environment associated with post-injury systemic inflammatory, especially chronic inflammation poses a formidable hurdle for successful neural regeneration and functional recovery.[6,7] Therefore, establishing effective therapeutic targets to address inflammation is crucial for regenerative treatment in SCI. Tissue engineering scaffolds, with biophysical and biochemical cues, show great promise for axonal growth by providing a permissive environment.[8]

As 3D polymeric networks with high water content, hydrogels are considered as an appealing option because their mechanical properties mimic the soft nature of spinal cords, and serve as a bridge to promote neural regeneration.[9] Hydrogels with dynamic bonds provide distinct benefits due to their adaptability in mechanical properties and structure, thereby enhancing

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Fibroblast exosomal TFAP2C induced by chitosan oligosaccharides promotes peripheral axon regeneration via the miR-132-5p/CAMKK1 axis

Yahong Zhao [a], Jina Liu [a], Sha Liu [a], Panpan Yang [b], Yunyun Liang [a], Jinyu Ma [a], Susu Mao [a], Cheng Sun [a,**], Yumin Yang [a,*]

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chitosan oligosaccharides
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axon regeneration

ABSTRACT

Chitosan and its degradation product, oligosaccharides, have been shown to facilitate peripheral nerve regeneration. However, the underlying mechanisms are not well understood. In this study, we analyzed the protein expression profiles in sciatic nerves after injury using proteomics. A group of proteins related to exosome packaging and transport is up-regulated by chitosan oligosaccharides (COS), implying that exosomes are involved in COS-induced peripheral nerve regeneration. In fact, exosomes derived from fibroblasts (f-EXOs) treated with COS significantly promoted axon extension and regeneration. Exosomal protein identification and functional studies, revealed that TFAP2C is a key factor in neurite outgrowth induced by COS-f-EXOs. Furthermore, we showed that TFAP2C targets the pri-miRNA-132 gene and represses miR-132-5p expression in dorsal root ganglion neurons. *Camkk1* is a downstream substrate of miR-132-5p that positively affects axon extension. In rats, miR-132-5p antagomir stimulates CAMKK1 expression and improves axon regeneration and functional recovery in sciatic nerves after injury. Our data reveal the mechanism for COS in axon regeneration, that is COS induce fibroblasts to produce TFAP2C-enriched EXOs, which are then transferred into axons to promote axon regeneration via miR-132-5p/CAMKK1. Moreover, these results show a new facet of fibroblasts in axon regeneration in peripheral nerves.

1. Introduction

Unlike axon regeneration in the central nervous system (CNS), axon regeneration in the peripheral nervous system (PNS) is relatively easy and achievable [1–3]. However, long distance defects in the PNS remain a challenge at clinics [4]. Autologous nerve implantation exhibits the best outcomes and is considered as the gold standard of surgical intervention for peripheral axon regeneration [5]. However, limited sources and permanent injuries at the donor sites significantly impede wide application of this technique. Therefore, artificial grafts are used at the center of peripheral nerve surgery [6,7].

Artificial grafts made of natural and/or synthetic biopolymers that are designed to have the necessary mechanical and biochemical cues for neural regeneration. There has been numerous of studies reported on various fronts (design, materials, preparation methods, factors, etc.) to achieve the onerous task of getting an ideal artificial graft [8,9]. The basic expectations of a material include biocompatibility, biodegradability, and appropriate mechanical properties. The physical, chemical, biochemical and topographical features regulate functional recovery of damaged peripheral nerves, which should be considered in the design of artificial grafts by different fabrication methods [10]. The advent of advanced technologies such as injection molding, 3D bioprinting, electrospining, have been employed for fabricating artificial grafts. Injection molding technique was used to fabricate artificial grafts with intraluminal channels. Different patterns of aligned and random fibrous regions can be generated by electrospining [11]. 3D bioprinting could be beneficial in easing the production of patient-specific artificial grafts [12]. Artificial grafts loaded with neurotropic factors, drugs and genes are some of the futuristic areas of interest since the sequence, timing, dosage, delivery vector, and duration of therapy remain to be solved [7].

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Biomimetic Silk Fibroin Hydrogel for Enhanced Peripheral Nerve Regeneration: Synergistic Effects of Graphene Oxide and Fibroblast Exosome

Yisheng Gao, Chaolun Dai, Miao Zhang, Jianye Zhang, Long Yin, Wanhua Li, Kunyu Zhang, Yumin Yang, and Yahong Zhao**

Peripheral nerve injury represents a critical clinical challenge. Employing tissue engineering, biomimetic scaffolds mimicking the biophysical and biochemical cues of the native extracellular matrix have shown promise. Specifically, conductive matrices, mirroring neural tissue's electrical properties, hold potential for neural tissue repair. However, the synergistic impact of conductivity and biomolecules on injured peripheral nerves remains unexplored. In this study, conductive hydrogels via a three-step click chemical reaction method, incorporating silk fibroin, graphene oxide, and Polyethylene Glycol Diacrylate is crafted. The inclusion of fibroblast exosomes yielded a synergistic effect, enhancing recovery from peripheral nerve injuries. Graphene oxide heightened the electron transmission capacity of the hydrogels, while fibroblast exosomes endowed them with the ability to modulate cellular behaviors. This resulted in enhanced axon and myelin regeneration. Furthermore, the hydrogel facilitated vascular regeneration during peripheral nerve recovery through the VEGF/NOTCH signaling pathway. Transplanting conductive hydrogel conduits laden with fibroblast exosomes led to substantial functional recovery in a rat sciatic nerve transection model. Consequently, a novel strategy to expedite the intricate repair of peripheral nerve injuries is proposed.

1. Introduction

Peripheral nerve injury (PNI) profoundly affects human quality of life, occurring in ≈1 in every 1000 individuals.[1] PNI leads to axonal discontinuity, distal nerve fiberization, and neuronal demise, culminating in compromised motor, sensory, and autonomic functions.[2,3] Despite the peripheral nervous system (PNS) having a greater axonal regeneration ability than the central nervous system, the self-repair of peripheral nerves is always incomplete, resulting in poor functional recovery.[4,5] Only 25% of patients can restore normal motor function, and less than 3% of patients can fully regain sensation. While short-distance lateral injuries can be rectified through direct anastomosis, long-distance nerve defects require surgical grafting of a transplant to prevent excessive nerve tension during the repair process. Autograft nerve transplantation, despite being the preferred standard for such defects, faces constraints like

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Advancing neural regeneration via adaptable hydrogels: Enriched with Mg^{2+} and silk fibroin to facilitate endogenous cell infiltration and macrophage polarization

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ABSTRACT

Peripheral nerve injury is a complex and challenging medical condition due to the limited ability of nerves to regenerate, resulting in the loss of both sensory and motor function. Hydrogels have emerged as a promising biomaterial for promoting peripheral nerve regeneration, while conventional hydrogels are generally unable to support endogenous cell infiltration due to limited network dynamics, thereby compromising the therapeutic outcomes. Herein, we present a cell adaptable hydrogel containing a tissue-mimetic silk fibroin network and a dynamically crosslinked bisphosphonated-alginate network. The dynamic network of this hydrogel can respond to cell-generated forces to undergo the cell-mediated reorganization, thereby effectively facilitating the rapid infiltration of Schwann cells and macrophages, as well as the ingrowth of axons. We further show that the magnesium ions released from the hydrogel not only promote neurite outgrowth but also regulate the polarization of macrophages in a sequential manner, contributing to the formation of a regenerative microenvironment. Therefore, this hydrogel effectively prevents muscle atrophy and promotes the regeneration and functional recovery of nerve defects of up to 10 mm within 8 weeks. The findings from this study demonstrate that adaptable hydrogels are promising inductive biomaterials for enhancing the therapeutic outcomes of peripheral nerve injury treatments.

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Exosomal miR-673-5p from fibroblasts promotes Schwann cell-mediated peripheral neuron myelination by targeting the TSC2/mTORC1/SREBP2 axis

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Peripheral myelination is a complicated process, wherein Schwann cells (SCs) promote the formation of the myelin sheath around the axons of peripheral neurons. Fibroblasts are the second resident cells in the peripheral nerves; however, the precise function of fibroblasts in SC-mediated myelination has rarely been examined. Here, we show that exosomes derived from fibroblasts boost myelination-related gene expression in SCs. We used exosome sequencing, together with bioinformatic analysis, to demonstrate that exosomal microRNA miR-673-5p is capable of stimulating myelin gene expression in SCs. Subsequent functional studies revealed that miR-673-5p targets the regulator of mechanistic target of the rapamycin (mTOR) complex 1 (mTORC1) tuberous sclerosis complex 2 in SCs, leading to the activation of downstream signaling pathways including mTORC1 and sterol-regulatory element binding protein 2. In vivo experiments further confirmed that miR-673-5p activates the tuberous sclerosis complex 2/mTORC1/sterol-regulatory element binding protein 2 axis, thus promoting the synthesis of cholesterol and related lipids and subsequently accelerating myelin sheath maturation in peripheral nerves. Overall, our findings revealed exosome-mediated cross talk between fibroblasts and SCs that plays a pivotal role in peripheral myelination. We propose that exosomes derived from fibroblasts and miR-673-5p might be useful for promoting peripheral myelination in translational medicine.

Myelination is a complicated biological process which involves the formation of a myelin sheath around nerve cell axons so as to insulate them from the surroundings and thus favoring electrical impulses passing along the axon. Schwann cells (SCs) and oligodendrocytes are the two main glial cells responsible for myelination in the peripheral nervous system and central nervous system (CNS). Myelin membranes are mainly composed of proteins and lipids, including cholesterol, galactosphingolipids, and saturated long-chain fatty acids, which account for at least 70% of the dry weight of myelin membranes (1). Defects in lipid synthesis in SCs or oligodendrocytes are often associated with various neuropathies such as Smith-Lemli-Opitz-syndrome, Refsum's disease, and Tangier disease (2–4). In accordance, any interruption in lipid synthesis has been shown to impair the structure and function of myelin in both the peripheral nervous system and CNS (5–12).

Fibroblasts are widely distributed in many types of tissues, and their main task is to synthesize and organize matrix proteins (13, 14). Fibroblasts in normal adult tissues are generally quiescent. However, as they can be activated under specific conditions, such as wound healing, tissue fibrosis, and cancer progression, fibroblasts play key roles in tissue repair, scar formation, and tumor metastasis (15–18). In peripheral nerves, SCs and fibroblasts are the two main types of cells, accounting for 45% and 25%, respectively (19). Moreover, similar to SCs, fibroblasts are derived from neural crest stem cells (20). Most recently, fibroblasts were identified in peripheral nerves of neonatal rats by cell population identification using single-cell transcriptomics (21). Although fibroblasts have been considered as resident cells in the peripheral nerves for a long time, to date, the precise functions of fibroblasts are not well understood. It has been shown that in cut nerves, ephrin-B/EphB2 signaling between fibroblasts and SCs directs cell sorting and guides the regrowth of axons across the wound (22). Exosomes are endosome-derived small extracellular vesicles with diameters of 40 to 150 nm (23). By trafficking RNA, DNA, proteins, and lipids, exosomes have been shown to play various essential roles, especially in cell–cell interaction (24–26). Due to the same niches for fibroblasts and SCs in peripheral nerves, we predicted that fibroblast exosomes might be a key transducer for regulating behaviors of SC such as myelination.

In the present study, we examined the potential interaction between fibroblasts and SCs, and found that fibroblast-derived exosomes promote myelin gene expression in SCs. Exosome sequencing followed by bioinformatics analysis revealed that exosomal miR-673-5p is a key molecule for transducing promoted myelin gene expression in SCs. Furthermore, it was noted that miR-673-5p targets the axis of TSC2/ mechanistic

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LETTER

Dual Dynamic Coordination-Driven Hydrogels Accelerate Infected Wound Healing by Enhancing Nerve Regeneration

Yisheng Gao, Long Yin, Jianye Zhang, Miao Zhang, Wanhua Li, Yumin Yang,* and Yahong Zhao*

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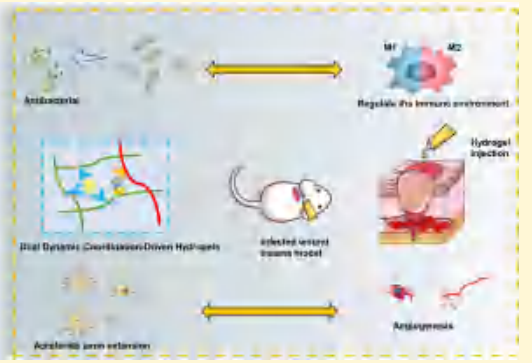
ABSTRACT: **Wound healing, a complex process involving hemostasis, inflammation, proliferation, and remodeling, is often hindered by factors like infection or a weakened immune response. Existing studies often neglect the crucial role of nerve regeneration. Our study introduces a novel hydrogel system using functionalized bisphosphonic acid grafted onto sodium alginate, combined with hyaluronic acid and metal ions (Fe^{3+} and Zn^{2+}), to enhance wound healing in infectious environments. The interaction between bisphosphonates and Zn^{2+} forms a secondary network that facilitates the release of Fe^{3+} and Zn^{2+} ions. This mechanism offers broad-spectrum antibacterial action and regulates the immune environment, promoting M2 macrophage polarization. Additionally, the hydrogel supports neurogenesis and angiogenesis, essential for complete tissue repair. Enhancing nerve regeneration restores neural function and accelerates wound healing. Its injectability, self-healing properties, and biocompatibility make this hydrogel a promising candidate for advanced wound dressings, potentially reducing healing time and improving infected wound management.**



1. INTRODUCTION

The skin is a crucial organ in the human body, responsible for protecting against external harm, regulating body temperature, and sensing external stimuli.[1] Due to its exposure, skin is vulnerable to external damage. Once damaged, skin healing involves a complex and prolonged process including hemostasis, inflammation, proliferation, wound remodeling, and scar formation.[2] The wound healing process consists of four continuous and overlapping phases: hemostasis, inflammation, proliferation, and remodeling. Following wound trauma, compromised blood supply and the accumulation of inflammatory mediators trigger an inflammatory response, which can be further exacerbated by conditions such as hyperglycemia, excessive oxidative stress, multiple infections, neuropathies, and vascular disorders.[3] Additionally, the immune microenvironment evolves over time to match the entire repair process.[4]

Substantial evidence indicates that a timely shift in macrophage phenotype to M2 can transition the inflammation phase into the proliferation phase, thereby accelerating wound healing.[5−7] Recently, various agents, including bioactive factor carriers, nanoparticles, and specially designed scaffolds, have been identified for macrophage reprogramming. These agents function by locally releasing immunomodulatory factors or directly influencing macrophages through physical and chemical signals, thereby enabling precise control over their activities.[8] For instance, metal ions such as zinc and magnesium have been demonstrated to modulate macrophage phenotype and function by influencing intracellular signaling pathways. Zinc ions, in particular, have been utilized in the coating of biomaterials to regulate macrophage responses.[9] These coatings release zinc ions, promoting the transition of macrophages from the M1 to the M2 phenotype, thus supporting anti-inflammatory and tissue repair processes.[10−13] Metal-ion-based strategies offer a novel approach to designing anti-inflammatory biomaterials and promoting tissue regeneration. While individual metal ions exhibit some antibacterial activity, the incorporation of additional metal ions with antibacterial properties is crucial for achieving stronger antibacterial effects and enhanced biocompatibility. This multimetal ion strategy provides novel insights into the development of biomaterials with enhanced antibacterial properties.[14]

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Research article

Chitooligosaccharides accelarate myelin clearance by Wipi1 mediated Schwann cell autophagy promoting peripheral nerve regeneration

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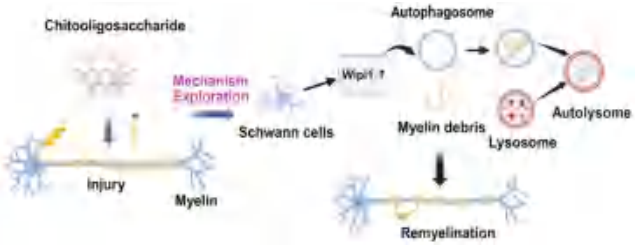
Abstract



As the most feasible method to reconstruct long-distance peripheral nerve injuries, tissue-engineered nerves rely on biomaterials as a key driving factor. Chitooligosaccharides, intermediate products of chitosan degradation, have the ability to positively regulate nerve regeneration microenvironments. However, the impact of chitooligosaccharides on clearance of myelin debris during Wallerian degeneration is unrevealed. The focus is on exploring the role of chitooligosaccharides in myelin clearance, which is a crucial preparation stage for nerve regeneration. The effects of chitooligosaccharides on nerve regeneration were demonstrated through the morphological and functional evaluations. Then, the myelin lipids and proteins were analyzed using the morphological staining, and molecular and protein detection. The microstructure and ultrastructure observations of lysosomes and autophagosomes were performed. In addition, the proteomics and bioinformatics analysis of injured nerves treated with chitooligosaccharides. The interacting molecules and the regulatory network of Wipi1 were further predicted. On the basis of positive roles on peripheral nerve regeneration, it was illustrated that chitooligosaccharides accelerated the clearance of myelin. Furthermore chitooligosaccharides could regulate lysosomal and autophagic functions, and its role in promoting myelin clearance was mainly related to the enhanced autophagy of Schwann cells rather than macrophages. The big data analysis revealed that Wipi1 was notably upregulated in Schwann cells, mediating chitooligosaccharides to promote autophagy and myelin clearance. Meanwhile, as a potential therapeutic target, Wipi1 significantly accelerated myelin clearance and lipid metabolism after peripheral nerve injury. Our research deepens the comprehensive understanding of the positive regulatory role of chitosan and chitooligosaccharides; and it expands new content and ideas for designing and constructing better tissue-engineered nerves from the perspective of mutual communication and response between biomaterials and body tissues.

Keywords: chitooligosaccharide; myelin clearance; Schwann cell; autophagy; Wipi1

Introduction

The peripheral nervous system possesses certain self-healing capacity, and its functional recovery is related to the quality of local nerve regeneration microenvironment [1–3]. The peripheral nerve regeneration microenvironment refers to all factors that affect nerve regeneration in terms of time and space in the regeneration chamber involving the communications between biomaterials and tissues [4–6], such as vascularization, inflammation and immunity, chemotaxis and adhesion and guidance to cells. In addition, the sufficient growth space is required first for peripheral nerves regeneration. Wallerian degeneration is quickly initiated in the distal nerve trunk post lesion [7, 8]. The cytoskeletons disintegrate, axons collapse into granular and amorphous fragments, and myelin sheaths disintegrate to a large number of fragments [9, 10]. Meanwhile, accompanied by migration and aggregation of Schwann cells (SCs) and macrophages, damaged axons and myelin debris are degraded and cleared [11–13]. This is precisely to leave sufficient space in advance for nerve regeneration, so that subsequent biological processes such as axonal growth and myelin formation can proceed normally.

Therefore, myelin clearance is crucial for nerve regeneration. The rupture of myelin after nerve injury leads to the production of myelin ovoid fragments, which contain many factors including myelin associated glycoprotein (MAG). These factors restrain axonal regeneration and hinder the process of nerve repair [14, 15]. For the peripheral nervous system, the rapid cellular response enables the rapid myelin clearance, creating a favorable extracellular environment that promotes axonal regeneration. If myelin debris in the

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发明专利请求书 1 份 5 页
实质审查请求书 文件份数：1 份
申请方案卷号：NJJIP1-202410-009

提示：

1.申请人收到专利申请受理通知书之后，认为其记载的内容与申请人所提交的相应内容不一致时，可以向国家知识产权局请求更正。

2.申请人收到专利申请受理通知书之后，再向国家知识产权局办理各种手续时，均应当准确、清晰地写明申请号。

审 查 员：自动受理
联系电话：010-62356655

审查部门：初审及流程管理部

纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路 6 号 国家知识产权局专利局受理处收
电子申请，应当通过专利业务办理系统以电子文件形式提交相关文件。除另有规定外，以纸件等其他形式提交的文件视为未提交。

项目批准号	32371400
申请代码	C1002
归口管理部门	
依托单位代码	22601908A0697-1266

国家自然科学基金

资助项目计划书

（预算制项目）

资助类别：面上项目

亚类说明：

附注说明：

项目名称：壳寡糖介导的施万细胞自噬调控周围神经再生的机制研究

直接费用：50万元　　执行年限：2024.01-2027.12

负 责 人：赵亚红

通讯地址：江苏省南通市啬园路9号

邮政编码：226001　　电　　话：0513-85051800

电子邮件：zhaoyh108@163.com

依托单位：南通大学

联 系 人：仇群仁　　电　　话：0513-85012139

填表日期：2023年09月01日

国家自然科学基金委员会制

Version：1.001.915

课题编号：2018YFC1105604　　**密　级：公开**

国家重点研发计划
课题任务书

课题名称：	医用海洋源功能产品生物学评价及临床应用研究
所属项目：	医用级海洋源生物材料绿色规模化生产及先进功能产品研发
所属专项：	生物医用材料研发与组织器官修复替代
项目牵头承担单位：	青岛明月海藻集团有限公司
课题承担单位：	上海市第六人民医院
课题负责人：	张伟
执行期限：	2018 年 09 月 至 2021 年 06 月

中华人民共和国科学技术部制

2018 年 09 月 04 日

课题基本信息表

<table>
<tr><td>课题名称</td><td colspan="6">医用海洋源功能产品生物学评价及临床应用研究</td></tr>
<tr><td>课题编号</td><td colspan="6">2018YFC1105604</td></tr>
<tr><td>所属项目</td><td colspan="6">医用级海洋源生物材料绿色规模化生产及先进功能产品研发</td></tr>
<tr><td>所属专项</td><td colspan="6">生物医用材料研发与组织器官修复替代</td></tr>
<tr><td>密级</td><td colspan="2">■公开 □秘密 □机密</td><td>单位总数</td><td colspan="3">5</td></tr>
<tr><td>课题类型</td><td colspan="6">□基础前沿■重大共性关键技术□应用示范研究□其他</td></tr>
<tr><td>课题活动类型</td><td colspan="6">□基础前沿■应用研究□试验发展</td></tr>
<tr><td>课题研究
所属学科</td><td colspan="6">材料科学
生物材料</td></tr>
<tr><td>课题成果应用的主要国民经济行业</td><td colspan="6">卫生和社会工作</td></tr>
<tr><td>课题的社会经济目标</td><td colspan="6">卫生事业发展
诊断与治疗</td></tr>
<tr><td>经费预算</td><td colspan="6">总需求 278.50 万元，其中中央财政专项经费需求 170.00 万元</td></tr>
<tr><td rowspan="2">课题周期节点</td><td>起始时间</td><td>2018 年 09 月</td><td>结束时间</td><td colspan="2">2021 年 06 月</td></tr>
<tr><td>实施周期</td><td>共 34 个月</td><td>预计中期时间点</td><td colspan="2">2019 年 12 月</td></tr>
<tr><td rowspan="6">课题承担单位</td><td>单位名称</td><td colspan="2">上海市第六人民医院</td><td>单位性质</td><td colspan="2">其他事业单位</td></tr>
<tr><td>单位所在地</td><td colspan="2">上海市 直辖区 徐汇区</td><td>组织机构代码</td><td colspan="2">425026521</td></tr>
<tr><td>通信地址</td><td colspan="2">上海市宜山路 600 号</td><td>邮政编码</td><td colspan="2">200233</td></tr>
<tr><td>银行账号</td><td colspan="2">310066632010149001093</td><td>法定代表人姓名</td><td colspan="2">贾伟平</td></tr>
<tr><td>单位开户名称</td><td colspan="5">上海市第六人民医院</td></tr>
<tr><td>开户银行（全称）</td><td colspan="5">301290050096|交通银行上海漕河泾支行</td></tr>
<tr><td rowspan="2">课题负责人</td><td>姓 名</td><td>张伟</td><td>性 别</td><td>■男 □女</td><td>出生日期</td><td>1970-01-31</td></tr>
<tr><td>证件类型</td><td>身份证</td><td>证件号码</td><td colspan="3">310101197001310411</td></tr>
</table>

	所在单位	上海市第六人民医院			
	最高学位	■博士□硕士□学士□其他			
	职 称	■正高级□副高级□中级□初级□其他		职务	主任医师
	电子邮箱	orthozhang@163.com	移动电话	13916060909	
课题联系人	姓 名	位晓娟	电子邮箱	xjweish@163.com	
	固定电话	021-64369181	移动电话	18930173684	
	证件类型	身份证	证件号码	370283198101142246	
课题财务负责人	姓 名	徐迅	电子邮箱	caiwu6h@126.com	
	固定电话	021-24058209	移动电话	18930177568	
	证件类型	身份证	证件号码	31010419720916044X	

其他参与单位	序号	单位名称	单位性质	组织机构代码
	1	上海市第六人民医院	其他事业单位	425026521
	2	南通大学	大专院校	12320000466012919A
	3	青岛明月海藻集团有限公司	合资企业	91370211706477986J
	4	青岛博益特生物材料股份有限公司	私营企业	91370200783723562H
	5	石家庄亿生堂医用品有限公司	私营企业	91130185765199988X9

课题参加人数	14 人。其中：	高级职称 5 人，中级职称 4 人，初级职称 0 人，其他 5 人；
		博士学位 3 人，硕士学位 5 人，学士学位 5 人，其他 1 人。

课题简介(限500字以内)	随着国家建设海洋强国战略布局的展开以及军民融合的深入，先进功能性海洋医疗装备和产品的开发也势在必行。壳聚糖、海藻酸是最具代表性的海洋源生物医用材料，虽然已有多种产品上市，但仍缺乏规模化、标准化的原料平台，产品开发的国际竞争力不强。建立标准化、规范化、规模化的海洋源生物材料原料及产品示范平台，是制约行业发展的关键瓶颈问题。 本课题主要目标是基于海洋源生物材料、根据原位组织工程理论，完成海藻酸基原位诱导心肌修复水凝胶材料、降解速度可调控的神经移植物产品、壳聚糖基动脉止血材料、壳聚糖基创伤敷料及海藻酸盐基医用敷料等医用海洋源功能产品生物学评价及临床转化，探讨并揭示其心肌修复、引导神经再生、止血愈创等

九、课题参加人员基本情况表

填表说明： 1.职称分类：A、正高级　B、副高级　C、中级　D、初级　E、其他；
2.投入本课题的全时工作时间（人月）是指在课题实施期间该人总共为课题工作的满月度工作量；累计是指课题组所有人员投入人月之和；
3.课题固定研究人员需填写人员明细；
4.是否有工资性收入：Y、是　N、否；
5.人员分类代码：A、课题负责人　B、课题骨干　C、其他研究人员；
6.工作单位：填写单位全称，其中高校要具体填写到所在院系。

序号	姓名	性别	出生日期	身份证号码（军官证、护照）	技术职称	职务	学位	专业	投入本课题的全时工作时间（人月）	人员分类	在课题中分担的任务	是否有工资性收入	工作单位
1	张伟	男	1970-01-31	310101197001310411	正高级	主任医师	博士	骨科	24	课题负责人	课题总体设计、组织实施	Y	上海市第六人民医院骨科
2	赵亚红	女	1983-12-28	320682198312282309	中级	无	硕士	神经生物学	15	课题骨干	降解速度可调控的神经移植物产品的研发和评价	Y	南通大学神经再生重点实验室
3	刘洪武	男	1963-04-22	370223196304220018	副高级	无	硕士	化学工程	15	课题骨干	海藻酸盐基医用敷料产	Y	青岛明月海藻集团有限公司

江苏省神经科学学会第三次会员代表大会召开

发布日期：2025.07.15 分享到：

7月5日，江苏省神经科学学会第三次会员代表大会召开，来自全省神经科学领域各高校院所、医疗机构、医药企业的会员代表170余人参加大会。

会议指出，江苏省神经科学学会是江苏省神经科学领域具有学术影响力、技术创新力和会员凝聚力的全省性科技社团，近年来在学术交流、人才培养、科学普及、智库建设等方面主动作为，为推动江苏省神经科学事业高质量发展作出了积极贡献。同时，对学会新一届理事会和学会未来发展提出了三点希望：一要坚持党建引领，把牢学会发展方向；二要履行“四服务”职能，助力高质量发展；三要强化自身建设，打造一流科技社团。

大会选举产生了学会新一届理事会理事和负责人。东南大学教授赵春杰当选第三届理事会理事长，南通大学教授王勇军等7人当选副理事长，东南大学附属中大医院教授王红星当选秘书长，南通大学教授赵亚红当选监事长。

新当选理事长赵春杰作表态发言。赵春杰表示，新一届理事会深感责任重大、使命光荣，将恪尽职守，团结带领全体会员，紧密围绕国家和江苏省重大战略需求，聚焦神经科学前沿领域：一是持续强化学术引领，打造高层次、品牌化的学术交流平台；二是积极推动产学研深度融合，促进科技成果转化应用；三是大力加强科学普及，提升公众对脑科学的认知水平；四是注重青年人才培养，为学科发展注入持久活力；五是不断完善学会自身建设，提升服务会员的能力和水平。她号召全体会员同心同德，开拓创新，共同谱写江苏神经科学事业发展的新篇章。

大会期间，还举办了学术报告会。多伦多大学教授卓敏以“皮层突触可塑性及其在脑疾病中的重要性”为题作主旨报告，南京大学教授闫超、西湖大学教授李波、同济大学附属养志康复医院靳令经、中国药科大学教授侯筱宇等专家学者分享了最新研究成果。此外，为鼓励学术交流，本次大会特别设立了壁报交流活动。经过组委会初选，31份高质量壁报在会场进行了集中展示。（江苏省神经科学学会 省科协学会部）

江苏省科协供稿

相关链接

2025企创融通汇“专精特新”专场活动在江苏淮安举行

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南京科技馆上演“光的十层解密”：院士专家科普基层行 点亮科学之光

“智汇金陵·科创争鸣”首届科技竞技主题嘉年华之科普图书市集举办

2025中国科协海智青年科技志愿服务夏令营（江苏营）走进江苏连云港

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中国科技发展基金会与恒瑞医药、齐鲁制…

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2025年第六期中国科技会堂论坛聚焦氢赋…

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全国科普月 | 我们的抗敌英雄

全国科普月 | 大自然中“调查”，微探索中…

聘　书

兹聘请 赵亚红 担任中国生物材料学会生物材料生物学评价分会第三届委员会委员，聘期2023年6月至2027年6月。

中国生物材料学会生物材料生物学评价分会

二〇二三年六月

江 苏 省 科 技 项 目 合 同

计 划 类 别 基础研究计划自然科学基金--面上项目

项 目 编 号 BK20231338

项 目 名 称 壳寡糖调控补体C3通路在周围神经缺损修复中血管形成的机制研究

项 目 类 别 JC1105 神经生物学

起 止 年 限 2023 年 9 月 至 2026 年 8 月

项目负责人 赵亚红 电话及手机 15950885276

项目联系人 施振佺 电话及手机 13773678369 0513-85012139

承担单位 南通大学

单位地址 南通市啬园路9号

项目主管部门 南通市科学技术局

江 苏 省 科 学 技 术 厅

二〇二三年

Regenerative Biomaterials

OXFORD UNIVERSITY PRESS

CERTIFICATE OF APPOINTMENT

This is to certify that

Dr. Yahong Zhao

Nantong University

has been appointed as a **Youth Editorial Board Member** of
the journal ***Regenerative Biomaterials*** for a term from October 2025 to October 2027.
This appointment is in recognition of your expertise and anticipated contributions to the journal.
We look forward to a fruitful collaboration.

Xingdong Zhang
Editor-in-Chief

Nicholas Peppas
Editor-in-Chief

Jiandong Ding
Executive Associate Editor-in-Chief

Regenerative Biomaterials
Chinese Society for Biomaterials

Brain-X
Interdisciplinary Brain

CERTIFICATE OF APPOINTMENT

This certificate is awarded to

Yahong Zhao

as a Youth Editorial Board Member of

Brain-X

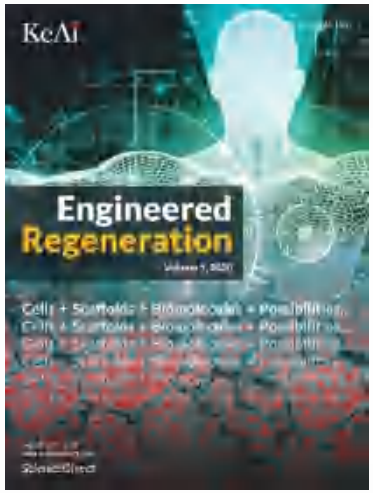
From January 2025 to December 2025

Kunlin Jin

Chief-in-Editor, *Brain-X*
January 2025

www.brain-x.science

Certificate of Merit



We hereby recognize

Dr. Yahong Zhao

Nantong University

as Young Editorial Board Member for the journal ***Engineered Regeneration***.

from 2026 to 2028

KeAi
CHINESE ROOTS
GLOBAL IMPACT

CERTIFICATE OF MERIT

We hereby recognize

Yahong Zhao

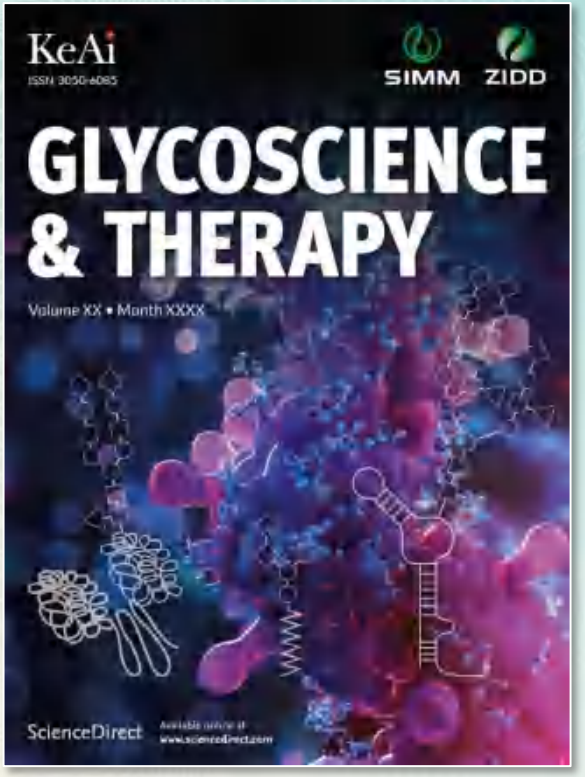
as the Youth Editorial Board Member for the journal

Glycoscience & Therapy

From July 2025 to December 2026

Editor-in-Chief: Peter H. Seeberger
Kan Ding

Issued date: July 2025



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