Design and Production of Filament Wound Composite Structures

Lei Zu*, Shijun Chen, Qian Zhang, Guiming Zhang, Qiaoguo Wu
School of Mechanical Engineering, Hefei University of Technology, Hefei, China
**Corresponding author: zulei@hfut.edu.cn*

Abstract: Filament winding is one of the major manufacturing methods for polymeric composite structures and its productions have become the key components of the power unit and the fuel system. The conventional filament winding process cannot simultaneously achieve the manufacturability and the desired mechanical properties and significantly confines the structural performance improvement of filament-wound structures. One of the key solutions to this limitation is the exploration of a novel winding pattern with more degrees of freedom, which is able to fully utilize the laminate strength of the overwrap while satisfying the requirements for the winding process. Accordingly, the objective of this research is to investigate a new non-geodesic pattern based on variable slippage coefficients along the fiber paths, and to obtain the optimal winding parameters of this new pattern. The mathematical model, mechanical model and the optimization model will be established for the designed non-geodesic pattern. The design methods that integrate the winding pattern, the windability and the structural performance, will be systematically outlined. The effects of the slippage coefficient distribution on the non-geodesic pattern and the resulting vessel performance will be revealed. The advantage of using the present non-geodesic pattern will also be clarified. The results show that the structural performance can be improved by 20%-30% using the present method and a variety of non-symmetrical bodies can be fully overwrapped using the present non-geodesics. The resulting winding patterns simultaneously satisfy the windability and fully utilize the laminate strength. This research is of great scientific and application significance for effectively improving the mechanical performance of filament-wound composite structures.

Keyword: Composite material; Filament winding, Winding pattern, Non-geodesic

Brief CV of Reporter：

Prof. Lei Zu is the Vice-dean and Professor in the Faculty of Mechanical Engineering at Hefei University of Technology, China. He has expertise in design and manufacture of filament-wound composite pressure vessels such as composite cases for solid rocket motors, on-board hydrogen storage tanks, cryogenic fuel tanks. His research group comprises of 1 professor, 3 associate professors, 4 assistant professors, 1 postdoctor and about 50 PhD & master students. Over the past 5 years, he published more than 40 high-profiled international journal papers and 3 academic books. His team was/is involving in more than 30 research projects funded by NSFC, National Key R&D Program, Ministry of Education, the local province, and some enterprises. He is also acting as the Deputy Director of Anhui Provincial Key Lab of Aerospace Structural Parts Forming Technology and Equipment, the Board Member of the Chinese Society for Aeronautics and Astronautics, the Vice Chairman of the Anhui Provincial Society for Aeronautics and Astronautics, the Editorial Board Member of Composite Structures(ELSEVIER), the Executive Board Member of the SAMPE China.

Fatigue mechanical properties and damage analysis of 3D braided composites with defect

Xiaodong Liu and Diantang Zhang*

Jiangnan University, Wuxi, China

Abstract: This paper mainly provides a thorough experimental investigation of tension-tension fatigue (R = 0.1) failure mechanisms in 3D5D braided carbon/epoxy composites without/with yarn-reduction (No-YR/In-YR) subjected to different stress levels of ultimate tensile stress (40%-75%UTS). X-ray computed tomography (Micro-CT) was conducted to visualize and quantify the damage generated in the fatigued samples. More significantly, a novel two-steps segmentation approach was proposed to classify and locate the cracks. The results indicated that the two types of specimens showed similar fatigue behavior, i.e. the extensive debonding of the braided yarns might give rise to the premature significant stiffness degradation of the fatigued samples. However, the tensile strength and the fatigue limit of In-YR 3D5D braided composites were reduced by 28.3% and 22.8% relative to No-YR 3D5D braided composites, respectively, which might be attributed to the variation of failure modes. Particularly, the failure modes of the axial yarns surround the yarn-reduction point evolved from mode I to mode II due to the deformation generated during the fabrication. It is noteworthy that the cracks presented a typical wedge distribution near the yarn reduction point due to the in-plane stress migration.

Keyword：3D braided Composites; Fatigue; Damage mechanics; Micro-C

Brief CV of Reporter：

Professor Diantang Zhang graduated from Tianjin Polytechnic University with a PhD in textile engineering. His main teaching and research interests include three-dimensional （3D） textile structure material science, advanced composite technology, and mechanics of fibrous materials. He has been undertaking and leading a number of research projects supported by the National Natural Science Foundation of China (NSFC), JiangSu Province Outstanding Youth Fund, and Aeronautics and Space Corporations, etc. He has published over 50 SCI and EI journal papers, and 10 patents. He won the second prize of Science and Technology Progress of Jiangsu Province, the third prize of Science and Technology of "Textile Light" Textile Industry Association, the Excellent Doctoral Thesis of China Textile Industry Association, and the Excellent Young Scholar of Jiangnan University.

Effect of Surface Treatment on Interfacial Property of Glass Fiber/epoxy Composites at High Temperature

Yaqin Fu* and Qing-Qing Ni
Zhejiang Sci-Tech University, Hangzhou 310018, China

Abstract: On the basis of the study on characterization of glass fiber (GF) and epoxy composites, we designed and synthesized a kind of surface treatment agent for improving high temperature performance of the composites. The optimal formula of surface treatment agent selected was utilized to modify the glass fiber surface. The surface topography, wetting ability and mechanical properties of the coated GFs were characterized and analyzed. The glass fibers coated by surface treatment agent and the epoxy resin were used to fabricate the designable composite materials. The interfacial shear strength and cross-section topography of the single-GF/epoxy composites were investigated by the fragmentation test with single fiber model composites and their microstructures were observed and analyzed at both room temperature and high temperature of 150 °C. Results indicated after modified by surface treatment the "membrane–particle" structure was formed on the glass fiber surface which may be beneficial to improve the wetting quality between fiber and resin, enhance the mechanical combination force between the fibers and organic matrix and ease the mismatching of thermal expansion coefficients between organic matrix and inorganic GF. Ultimately, the interfacial shear strength of the single-GF/epoxy composites was increased by 50 % and 68 % at room temperature and high temperature of 150 °C.

Keyword：Glass fiber; Epoxy; Interfacial shear strength; Heat-resistant property

Brief CV of Reporter：

Dr. **Fu Yaqin**, is a professor of Zhejiang Sci-Tech University. She mainly engages in teaching and research works relative to textile composites and silk, obtained the Natural Science Foundation, National Natural Science Joint Foundation, Zhejiang Natural Science Foundation, Cocoon Silk Development Fund of Ministry of Commerce and Enterprise Entrusted Projects, and published more than 150 journal papers and more than 30 national invention patents, including 5 transferred patents and 2 licensed patents. As the first accomplisher, she won the first prize of China National Textile Industry Council, the first prize of China Federation of Commerce, and the Gold Award of China Textile Industry Patent.

Preparation of Functional Nanofiber Membrane and Its Application in the Field of Environmental

Quan Feng

Key Laboratory of Textile Fabrics, College of Textiles and Clothing, Anhui Polytechnic University, Wuhu, Anhui 241000, China

Abstract: In this study, a variety of nanofiber membranes with uniform fiber diameter and good shape were generated by electrospinning and biological culture technology. At the same time, the nanofibers were functionalized by magnetron sputtering, atom transfer radical polymerization grafting and plasma modification methods. As a result, many functional groups are distributed on the surface of the nanofiber. Subsequently, the functional nanofiber membranes (FNMS) was applied to the field of environmental and investigate its removal performance of various pollutants in wastewater. The results show that in terms of heavy metal ion adsorption, FNMS can efficiently and quickly adsorb a variety of metal ions in industrial and domestic wastewater, it also has excellent reusability. In the field of biocatalysis, FNMS can not only efficiently load biological enzymes, but also retain high catalytic activity of enzymes. The enzyme membrane reactor was constructed to realize the on-line catalysis and separation of various dye molecules and phenolic pollutants. In the field of photocatalysis and photoelectrocatalysis, on the one hand, FNMS can efficiently load a variety of photocatalysts, and can realize the efficient catalysis and effective removal of photocatalysts in the catalytic process. In addition, in the field of protein separation and purification, due to the small fiber diameter and high porosity, the solution permeation flux of nanofiber membrane is 4-5 times higher than that of conventional ultrafiltration membrane on the basis of good protein rejection. It shows good protein separation performance.

报告人简介：凤权，工学博士，教授，硕士生导师，教育部纺织类教指委非织造材料与工程分会委员，安徽省教学名师。主持并完成国家自然科学基金（面上项目）1 项、安徽省自然科学基金（面上项目）2 项、安徽省科技计划项目（对外合作）1 项、安徽高校省级自然科学研究项目 4 项（其中 2 项分别为重大项目和重点项目）、国家特种显示工程技术研究中心开放课题 1 项、生态纺织教育部重点实验室开放课题 1 项、安徽省重大教学改革项目 2 项、省教学研究重点项目 1 项，参与多项国家、省级及企业合作研究项目；获得安徽省在线教学成果特等奖、三等奖各 1 项，省科技进步二等奖、三等奖各 1 项；主持申报发明专利 8 项；发表研究论文近 50 篇，其中以第一作者发表近 30 篇。多次受邀作为 Journal of Membrane Science(JMS),Journal of Applied Polymer Science(JAPS),Journal of Engineered Fibers and Fabrics(JEFF)等国际学术期刊审稿人。

静电纺微纳米纤维的形貌再造及其储锂性能

夏鑫
新疆大学，乌鲁木齐市， 中国

摘　要: 静电纺微纳米纤维因其长径比大，形貌结构可控性强，在电化学领域得到了广泛应用。为丰富静电纺微纳米纤维的形貌结构多样性，提高其力学性、结晶度等性能，本研究聚焦于对静电纺微纳米纤维进行后处理，即分别采用深冷处理作为碳化热处理的补偿方法以及自研制常温常压PECVD设备对Sn/C基微纳米纤维进行形貌再造。阐明了微/纳米纤维的形貌再造与结构重塑后加工构建机制——深冷处理做为热补偿处理与碳化热处理的轮替制度。通过调节深冷与碳化处理的顺序、降/升温速率、最低温控制，阶段停滞时间等处理参数，依据微/纳米纤维前驱体特点（无机、有机或含水等），在热处理以及补充热处理过程中起到晶粒细化、再结晶、晶型优先取向的作用，可以有效控制微/纳米纤维的形貌结构及及其中无机纳米粒子晶型取向。成功研制了在常温常压环境中的等离子体增强化学气相沉积设备，通过在Sn/C基微纳米纤维上类金刚石的沉积，获得了多维结构的微纳米纤维负极材料，揭示了类金刚石在不同Sn/C前驱体微纳米纤维中的优先沉积理论，为微纳米纤维的储锂能力提高提供了有效策略。

关键词：微纳米纤维；深冷处理；常温常压PECVD；形貌再造；储锂性能

报告人简介：夏鑫，新疆大学纺织与服装学院教授，博士生导师。长期从事功能性纤维材料的构建机理分析与应用研究工作。在新疆特色及优势纺织原材料的开发与应用、微纳米纤维结构构建及机理分析方面有较深造诣。主持国家自然科学基金项目2项、国家科技委项目1项、自治区自然科学基金项目、自治区产学研联合基金等自治区级项目3项、教育厅高校科研计划项目2项，自治区各厅局及企业委托项目近10项。2016年入选“新疆自治区青年科技创新人才培养工程”计划，组建的“新疆特种纺织材料的开发与应用”创新团队于2017年获批自治区创新团队，新疆维吾尔自治区杰出青年。发表核心期刊论文60余篇，授权发明专利6项，完成科研成果转化2000万。

高性能无机纤维在立体机织工况下的损伤评价

吴宁*，王玉，韩美月，韩雨桐，焦亚男，陈利
天津工业大学，天津， 中国

摘　要: 立体机织过程中，以高强高模碳纤维、氮化硅纤维、氧化铝纤维为代表的高性能无机纤维由于受到摩擦、弯曲、剪切等作用而易产生损伤，这会直接导致最终复合材料制品性能显著下降。目前立体机织过程各工序导致的高性能纤维的损伤机制尚未阐明且纤维损伤评价方法尚未见文献报道。本课题组根据立体织造工况中纤维的运动与受力特点，探讨了纤维束之间滑动摩擦时的接触面积变化规律; 建立了模拟开口工序中经纱/纬纱之间、模拟打纬工序中经纱纤维束/钢筘之间的摩擦磨损性能测试方法; 建立了模拟经纱、法向纱纤维束弯曲损伤的测试方法。采用这些实验模拟方法研究了立体织物经密、纬密和厚度等参数变化对高性能纤维损伤行为的影响，初步建立了高性能无机纤维的立体机织损伤评价体系。

关键词：高性能无机纤维；立体机织；实验模拟；损伤评价；

报告人简介：吴宁，副研究员、博士生导师，研究方向为高性能纤维可织性；大尺寸纺织结构复合材料预制体成形技术；复合材料层间增强增韧；承担或参与多项国家重点研发计划，国防民口配套项目、国家自然科学基金项目及航天院所委托合作项目，发表SCI、EI 收录高水平论文40余篇，参编英文著作1 部，授权国家发明专利4项。

A High-Value, Low-Cost Recycling of Waste Fiber Reinforced Plastic

Jian Shi[1*] and Limin Bao[2]
1. Akita Prefectural University, Yurihonjo, Japan,
2. Shinshu University, Ueda, Japan

Abstract: Fiber Reinforced Plastic (FRP) composites materials have been widely used in various engineering fields (e.g., marine boats, bathtubs, construction, and automobiles), due to their heat resistance, corrosion resistance, and mechanical strength. However， recycling of FRP is very difficult because it is made of thermo-setting polyester resin, inorganic filler, and fiber. The resin is a cross-linked polymer of styrene and unsaturated polyester resin consisting of glycol and organic acid. To investigate the possibility of recycling and reusing matrix and reinforcements, a project of preventing environmental deterioration was performed. In this study, a new decomposition method for recycling FRP waste by superheated steam was developed, and a recycling system was developed for the treatment of FRP. Separation of the resin matrix and reinforcement fiber from the FRP was attempted, and the effect of the pyrolysis parameters on the mechanical properties of recycled glass fiber was investigated.

Keyword：Waste FRP; Recycling; Superheated steam

Brief CV of Reporter：
Dr. Jian Shi is currently an Assistant Professor at the Department of Mechanical Engineering, Akita Prefectural University, Yurihonjo, Akita, Japan. He received his PhD degree in Engineering from Shinshu University in Ueda, Nagano, Japan. His research interests include advanced fiber reinforced polymer composites and functional nanomaterials for composites, biomaterials, and energy. He has successfully completed 2 major R&D research projects on fiber reinforced polymer composites funded by Japan Society for the Promotion of Science.

3D Printing of High-performance Continuous Carbon Fiber Reinforced Thermoplastics

Masahito Ueda[1*]
1. Nihon University, Tokyo, Japan

Abstract: A 3D printing technique for a continuous carbon fiber reinforced thermoplastic (CFRTP) was studied to improve the mechanical properties of the 3D-printed product. A hot-compaction roller was equipped with a fused filament fabrication (FFF)-based 3D printer to press the filament against the printer bed immediately after the printing to reduce voids and improve adhesion between the filaments. The effect of hot compaction during the 3D printing process on the mechanical properties of the printed specimen was examined by means of tensile and bending tests. The experimental results showed that the hot compaction during 3D printing improved the mechanical properties of the printed parts. A relatively flat fracture surface was observed for the 3D-printed specimen with hot-compaction, while an uneven fracture surface was observed for that without hot-compaction, which could be caused by the differences in void content and their distribution. Voids in the specimen were visualized using X-ray computed tomography. The void fractions of the 3D-printed specimen were reduced from 10% to 3%, indicating that the voids were discharged by hot compaction during printing. However, dispersed small voids were still observed evenly in the 3DCP specimen. The 3D-printed specimens exhibited almost the same bending properties as the hot-pressed 3D-printed specimen without hot compaction. It was shown that hot compaction had the same effect as hot pressing as a post-process.

Keywords：Polymer-matrix composites; Carbon fiber; 3D printing; Mechanical properties

Brief CV of Reporter：

Associate Professor Masahito UEDA received his Ph.D. in Mechanical Engineering in 2006 from Tokyo Institute of Technology (Japan). Since then, he has been working as a Research Associate (2006 - 2009), Assistant Professor (2009-2016), and Associate Professor (2016-present) in the department of Mechanical Engineering, College of Science and Technology, Nihon University (Japan). His current research activities include micro-mechanics, joining, and 3D printing of polymer matrix composites. He is the chair of Composites 2.0 (3D-printed composites) society in the Japan Society for Composite Materials (JSCM) and the manager of Processing of Polymer-based Composites group in Materials and Processing Division, the Japan Society of Mechanical Engineers (JSME). He has received the best paper awards from The Japan Reinforced Plastics Society (JRPS) in 2011 and from JSCM in 2016, 2019, and 2020. He was an Editor-in-Chief of the journal of the Japan Society for Composite materials (2019-2020). He is an editorial board of Advanced Composite Materials.

Evaluation of Very High Cycle Fatigue Property of CFRP Laminates by Using Ultrasonic Fatigue Testing Technique

Yoshinobu Shimamura[1*], Takuya Hayashi[2], Keiichiro Tohgo[1] and Tomoyuki Fujii[1]
1. Shizuoka University, Shizuoka, Japan
2. Kawasaki Heavy Industries, Ltd., Gifu, Japan

Abstract: Carbon fiber reinforced plastics (CFRP) have been applied to large-scale structure subjected to cyclic loading such as aircrafts and wind turbines. The fatigue behavior in the very high cycle fatigue of CFRP laminates is little known so far. Thus, accelerated fatigue testing methods should be developed in order to conduct fatigue tests up to the very high cycle region within practical period. In this study, an ultrasonic fatigue testing technique was used to conduct accelerated fatigue testing at 20 kHz. A dumbbell-shaped specimen shape was designed to provide higher applied stress at the necked portion of the specimen so that the specimen fails due to fatigue loading at 20kHz. Then, fatigue testing of quasi-isotropic CFRP laminates were conducted up to 10^9 cycles by using an ultrasonic axial fatigue testing machine with R=-1. The results revealed that quasi-isotropic CFRP laminates failed in the very high cycle region.

Keyword：Very high cycle fatigue; Ultrasonic fatigue testing technique; CFRP laminate

Brief CV of Reporter：
Prof. Yoshinobu Shimamura received his PhD degree in Mechanical Engineering from Tokyo Institute of Technology, Tokyo, Japan in 2000. He is currently a Professor in Shizuoka University. Prof. Shimamura is a fellow of Japan Society for Mechanical Engineers, a manager in Solid Mechanics and Materials Engineering Category of bulletins of Japan Society for Mechanical Engineers, a director of Far East and Oceanic Fracture Society, and a chairperson of the committee on fracture mechanics of the Society of Materials Science, Japan.

A multi-functional graphene/Calotropis gigantea yarn

Junze Zhang[1], Zekun Liu[2], Yuling Li[3], Gang Li[1]*
[1]*National Engineering Laboratory for Modern Silk, College of Textile and Clothing Engineering, Soochow University, Suzhou 215123, China*
[2]*Department of Materials, University of Manchester, Oxford Road, Manchester, M13 9PL, UK*
[3]*Key Laboratory of Textile Science & Technology (Donghua University), 201620, Ministry of Education*
*Corresponding author' email: tcligang@suda.edu.cn

Abstract

Graphene-functionalized fibers have attracted substantial attention due to their potential applications in flexible wearable electronic devices. In this work, we developed a graphene-coated Calotropis gigantea yarn by pad dyeing with graphene oxide and reduction process, which endows it with high conductivity and outstanding conducting stability. The coated Calotropis gigantea yarns show high hydrophilicity and better breaking strength. By optimizing the pad dyeing process, the modified Calotropis gigantea yarns display high electrical conductivity of 7 S/m. Range value of the additive concentration of GO solution is 3.665, indicate that electrical conductivity of graphene-coated yarns exhibits stronger dependence on the additive concentration of GO solution. The combination between hydrogen bond of the fiber and the oxygen bond of graphene during dyeing process renders the functionalized yarns stable conductivity to washing and bending. Based on the simple fabrication process, and fascinating performance, the graphene-coated yarns show great potential in flexible wearable electronic devices.

Keywords: Graphene; Calotropis gigantea yarns; Conductive fibers; Scale production; Functionalization

报告人简介：李刚，教授，博士，院长助理，总实验室主任。江苏省第十五批“六大人才高峰”高层次人才、江苏省“双创计划”科技副总入选人才、江苏省侨联青年委员会委员、苏州大学侨青会副会长、侨联委员。2013 年博士研究生毕业于香港理工大学，毕业后留校任纺织生物工程研发中心副研究员，2019 年获批公派美国塔夫茨大学访问学者项目。自 2006 年开始，在纺织和生物医用材料等多领域展开跨学科研究。曾工作于杜邦中国集团（上海）等公司。现为苏州大学现代丝绸国家工程实验室、苏大-塔夫茨大学联合实验室、美国国家工程院院士、美国国家卫生研究院（NIH）主任 David Kaplan 教授团队成员。主要发表中英文论文 100 余篇，包括 Biomaterials （IF 10.2）、Acta Biomaterialia（IF 8.9）、Advanced Healthcare Materials（IF 9.9）、Advanced Functional Materials（IF 16.8）等权威 SCI 杂志；引用次数 1200 次，H 指数 18，i10 指数 33（Google Scholar）。先后主持和参与国家自然科学基金、国家重点研发计划、省部级项目等项目 20 余项，曾获“香港首届创新大赛”冠军、苏州市“最美侨界之星”获得者、苏州市人才科技工作特别顾问、全国纺织优秀硕士论文和陈维稷优秀论文指导老师等荣誉。申请发明专利 35 项和国际 PCT 专利 2 项，已授权 19 件，其中 1 件日本发明专利。主要学术兼职为中国博士后科学基金评审专家、中国纺织工程学会高级会员、中国生物材料学会会员、江苏省高企认定专家库技术专家、Journal of Fiber Bioengineering Informatics 副主编等职，担任 Biomaterials、ACS Sustainable Chemistry & Engineering 等 30 余种国际 SCI 杂志审稿人。

3D Woven Composites: A Promising Platform for Advanced Multifunctional Structures

Fujun Xu*,Kun Zhang and Liangang Zheng
College of Textiles, Donghua University, Shanghai 201620, China

Abstract: The composite structures with lightweight, excellent mechanical and multifunctional properties are crucial to their applications in the fields of industrial, civil as well as aerospace engineering. Traditional laminate composites which are mainly made of fiber or fabric, are prone to lamination failure of low-speed impact or shear to load. Three-dimensional (3D) woven fabric reinforced composites, due to the exist of vertical binding yarn, exhibit extraordinary structural integrity and delamination resistance. Furthermore, the multi-layer integrated structure of 3D woven fabric provides a proper environment for the embedded functional fibers. In this speech, mechanical, thermal as well as dielectric properties of the 3D woven composites will be introduced. Moreover, some multifunctional structures based on 3D woven composites, such as 3D textile antenna, 3D woven sensing and E-heating composites will be introduced.

Keyword： 3D woven fabric; 3D Composites; Mechanical properties; Multifunctional properties

简介：许福军，教授/博导，东华大学纺织学院副院长。主要从事三维纺织结构复合材料和智能可穿戴的研究工作。先后主持国家自然科学基金、上海市自然科学基金、上海市军民融合重大专项等科研项目20余项。在Adv. Mater.; ACS Nano; ACS AMI等SCI杂志发表论文70篇；授权国家发明专利45项 (转化4项）；先后任Compos Part B-Eng和 Adv. Fib. Mater. Special Issue）等5个国际学术杂志编委和国内核心期刊《现代纺织技术》学术副主编。许福军教授指导的科技创新课题荣获挑战杯大学生课外创新作品竞赛，“全国二等奖”和“上海市特等奖”等国家/省部级奖励25项；个人荣获中国纺织工业联合会教学成果奖二等奖；上海市挑战杯大学生创业大赛优秀指导教师等省部级奖励/荣誉15项。2020年，所负责科研团队获得“上海市五四青年奖章集体”。

蚕丝的功能化与丝素蛋白基新材料

王宗乾

安徽工程大学，芜湖， 中国

报告提纲：

1. 蚕丝文化
2. 蚕丝染色新技术
3. 蚕丝耐光稳定性能的提升
4. 丝素蛋白溶液的制备与调控
5. 丝素蛋白基气凝胶新材料

报告人简介：

王宗乾，男，山东嘉祥县人，博士后，教授，硕导，安徽省学术和技术带头人后备人选，安徽省高校中青年学科（专业）拔尖人才。现任安徽工程大学科技处副处长，安徽省纺织印染行业技术中心负责人，纺织科学与工程一级学科（博士立项建设支撑学科）带头人。2016年浙江理工大学纺织科学与工程学科博士毕业，2018年赴美国加州大学戴维斯分校（UC Davis）访学。

兼任中国产业用纺织品协会功能纺织品分会理事、安徽省“双千工程”成员、中国纺织工程学会高级会员、《毛纺科技》编委、安徽省科技期刊编辑学会第七届理事会理事等职。

Bacterial Cellulose/Chitosan Composite Based Aerogels for Piezoresistive Sensors and Multifunctional Adsorbents

Dawei Li*
Nantong University, Nantong, China,

Abstract: Flexible, compressible and conductive aerogels were fabricated by incorporating polyaniline (PANI) into bacterial cellulose/chitosan (BC/CH) composites through facile freeze-drying technique. The PANI/BC/CH aerogel fabricated with the BC:CH weight ratio of 1:1 displayed the highest resistance response and showed extremely high sensitivity (1.41 kPa^{-1}), low pressure detection (32 Pa), wide range of pressure deformation and extraordinary stability as a piezoresistive sensor, which could detect human motions, ranging from joint movement to speech recognitions. In addition, a novel adsorbent based on zeolitic imidazolate framework-67 (ZIF-67, a sort of metal-organic framework) modified BC/CH composite aerogel was prepared through a facile method combining physical mixture, in situ synthesis, and lyophilization. The loading rate of ZIF-67 was as high as 46.1% and the BET specific surface area of ZIF-67/BC/CH aerogel reached to 268.7 m^2g^{-1}, which was much larger than that of BC/CH aerogel (8.4 m^2 g^{-1}). The as-prepared ZIF-67/BC/CH aerogel was employed to remove heavy metal ions and organic dye in aqueous solution. The adsorption capacities of the composite aerogel for Cu^{2+} and Cr^{6+} were 200.6 mg g^{-1} and 152.1 mg g^{-1}, respectively. Moreover, the adsorption mechanism was investigated by X-ray photoelectron spectroscopy (XPS). Besides, the aerogel also showed almost 100% of removal rate toward active red X-3B through one time of adsorption. Consequently, the ZIF-67/BC/CH aerogel, as a novel and high efficient adsorbent, has a good application potential for wastewater treatment.

Keyword：Bacterial cellulose; Composite aerogel; Metal-organic framework; Piezoresistive sensor; Adsorbent

报告人简介：李大伟，博士，南通大学教授，硕士生导师。2016 年毕业于江南大学纺织科学与工程专业，获工学博士学位。2014 年 10 月~2015 年 10 月受国家留学基金委资助赴美国 North Carolina State University 进行博士联合培养。2017 年江苏省优秀博士学位论文获得者。主要研究方向包括智能可穿戴材料的设计与制备、生物传感纤维材料的研究、纳米结构功能纺织材料研究等。主持国家自然科学基金、中国博士后科学基金面上项目、江苏省自然科学基金、南通市科技计划项目等科研项目 6 项。在 Biosensors & Bioelectronics、ACS Applied Materials & Interfaces、Chemical Engineering Journal 等国际知名期刊上共发表 SCI 收录学术论文 68 篇，其中第一作者和通讯作者 18 篇（中科院一区论文 6 篇）。参编《Electrospinning：Nanofabrication and Applications》外文著作 1 部。申请授权发明专利 10 余件。目前为中国纺织工程学会会员，担任 Nano Energy、Chemical Engineering Journal、Carbohydrate Polymers 等期刊审稿人。

E-mail: ldw@ntu.edu.cn

Design of Three Dimensional Hollow-Structured Fabric Composites and Their Compression Property

Chunhong Zhu[1*]
[1] *Faculty of Textile Science and Technology, Shinshu University, Ueda, Nagano, 386-8 567, Japan*

Abstract: In this study, a kind of three-dimensional (3D) hollow-structured woven fabrics, such as circle-structured and honeycomb-structured fabrics, were designed, fabricated and then composited with polyurethane elastomer. After that, the compression property of these composites were discussed. The in-plane compression-recovery curve showed that similar to conventional fabrics, hysteresis effect during the compression and the recovery process can also be found. Moreover, the effects of the cell size, fabric layers, and yarn fineness on the compression property were discussed, using the stress value when compressed to 65% of its initial thickness, energy absorption, and specific energy absorptions evaluation parameters. Results showed that the cell size had an important effect on the compression property of the composites. From this study, it can be concluded that the cell size, weft yarn fineness, and fabric layer had an influence on the compression property of composite. For 3D hollow-structured fabric design, the above parameters should be considered to satisfy the need for practical use.

Keyword：3D hollow-structured woven fabric; composite; compression property; cell size

Brief CV of Reporter：

Dr. Chunhong Zhu is an Associate Professor in the Department of Advanced Textile and Kansei Engineering, Faculty of Textile Science and Technology, Shinshu University, Japan.
She obtained her Master's degree from Soochow University majored in Textile Materials and Design in 2010. After that, she received her Ph.D. from Shinshu University in 2014. From 2014 to 2015, she worked as a R&D in a Japanese company and returned to Shinshu University as a faculty member in 2015.
Her research interests include three-dimensional fabrics, functional and smart textiles. She has been responsible for several research programs, including Japan Society for the Promotion of Science (JSPS) Kakenhi for early-Career Scientists, Takeuchi grant-in-aid, et al.

Preparation of Polystyrene Nanofiber-Supported Metal-organic Framework with Formaldehyde Adsorption Properties

Fan Liu, Yuankun Chen, Wanli Yue, Baoji Hu, Kai Weng, Tong Lu, Weili Shao

(School of Textile, Zhongyuan University of Technology, Zhengzhou 450007, Henan)

Abstract: Air quality is particularly important to public health. Therefore, effective purification and filtration of indoor and outdoor air has become an urgent need. Metal-organic frameworks (MOFs) have been used in the field of gas adsorption because of their superior specific surface area and porosity. However, MOFs are generally presented in powder form, which is not conducive to practical application. In this study, to expand the practical application of MOFs, polystyrene (PS) was used as raw material to prepare PS nanofiber membrane as the matrix material through electrostatic spinning. Then, Co^{2+} ions were dispersed onto PS and coordinated with 2-methylimidazole ligand in an immersion solution, such that the MOF material grew on the nanofiber in situ, yielding the ZIF-67@PS composite membrane. The results of this study showed that the formaldehyde adsorption and filtration properties of the ZIF-67@PS nanofiber membrane were significantly better than those of pure PS nanofiber membrane.

Keywords: Metal Organic Framework; Electrospinning; Filtration Performance; Formaldehyde Adsorption

报告人简介：刘凡，博士，中原工学院副教授，长期从事纳米纤维宏量化制备关键技术及装备的开发、纳米纤维复合新材料的开发、纳米纤维功能化改性等应用性研究，发表相关学术论文20余篇。在纳米纤维复合滤材方向与企业展开深入的产学研合作，累计横向项目经费达500多万。

Effect of nanofiller on the mechanical property and shape memory pr operty of the shape memory epoxy

Yubing Dong
Zhejiang Sci-Tech University, Hangzhou, China

Abstract: The purpose of this research is to study the effect of nanofiller (such as, CNT, nanosilica, graphene, MXene) on the mechanical property and shape memory property of the shape memory epoxy. The results showed that a small amount of nanofiller can significanlty improve the mechanical property and shape memory property of the shape memory epoxy. However, at high content, the nanofiller is difficult to disperse, and the enhancement of the nanofiller on the mechanical property and shape memory property of the shape memory epoxy is no longer significant. The relate works were published on Composites Science and Techlogy, Composite Part A, which will give reference for the study of nanofiller reinforment shape memory polymer composites.

Keyword：Polymer-matrix composites; Shape memory epoxy; Nanofiller

Brief CV of Reporter：

Dr. Yubing Dong received his PhD degree in Biofunction and Fiber Engineering from Shinshu University, Nagano, Japan, in 2015. He is currently an associate Professor in the Materials Science and Technology at Zhejiang Sci-Tech University. He research foucse on the shape memory polymers development and application, and published more than 40 journal papers and more than 7 patents. He has been responsible for more than 8 research programs, including National Key R&D Program of China, and National Natural Science Fund of China, etc.

Deformation Mechanism of Nano Layered Solid

Xiao-Wen LEI[1*]
1. Department of Mechanical Engineering, Faculty of Engineering, University of Fukui, Fukui, Japan

Abstract: Graphite consists of carbon atoms arranged in layers of hexagonal lattice. In this research, we aim to obtain the fundamental knowledge about controlling the out-of-plane deformation of graphite with lattice defects. We discuss the simulation result of graphite with arranged lattice defects under compression force using molecular dynamics method. The results of simulation show that out-of-plane deformation like delamination and kink deformation occur. The positions of out-of-plane deformation correspond to the location of dislocations. The out-of-plane deformation is not only affected by the positions of dislocations but misorientation angle due to dislocation array. Compressive stress-compressive strain curve of the simulation shows that maximum compressive stress becomes relatively higher as increasing the number of dislocations. We investigate the mean curvature of each layer of graphite to discuss the amplitude of out-of-plane deformation. We use dip isogon method which is often used to study the folding mechanism of strata in geology to classify the deformation of adjacent layers. From the obtained results, there is possibility of controlling compressive deformation of graphite by arranging dislocations.

Keyword：graphite; lattice defect; kink deformation; mean curvature.

Brief CV of Reporter：

2010. 4～2012. 3	Interdisciplinary Graduate School of Science and Technology, Shinshu University, Japan, (Grade skipping) Ph.D.
2011.10～2011.12	Columbia Nanomechanics Research Center (CNRC), Department of Earth and Environmental Engineering, Columbia University in the City of New York, USA, Visiting Research Fellow.
2012. 4～2013. 2	Interdisciplinary Graduate School of Science and Technology, Shinshu Univer -sity, Japan, Postdoctoral Research Fellow.
2013. 3～2016. 2	Department of Adaptive Machine Systems Graduate School of Engineering, Osaka University, Japan, Specially Appointed Assistant Professor.
2016. 3～2018. 9	Department of Mechanical Engineering Faculty of Engineering, University of Fukui, Japan, Senior Assistant Professor.
2018.10～present	Department of Mechanical Engineering Faculty of Engineering, University of Fukui, Japan, Associate Professor.