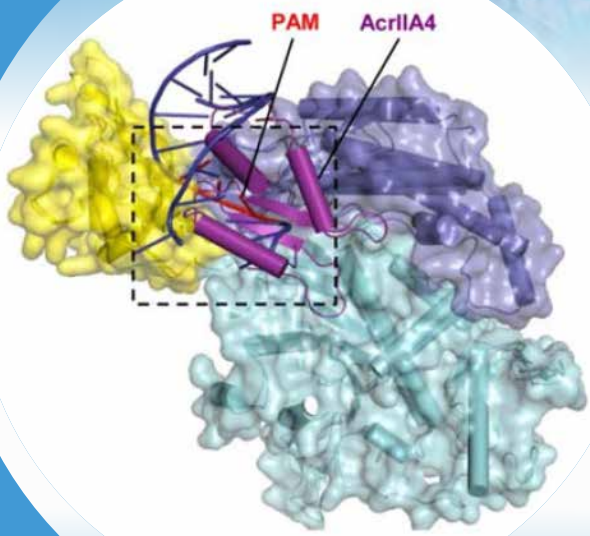
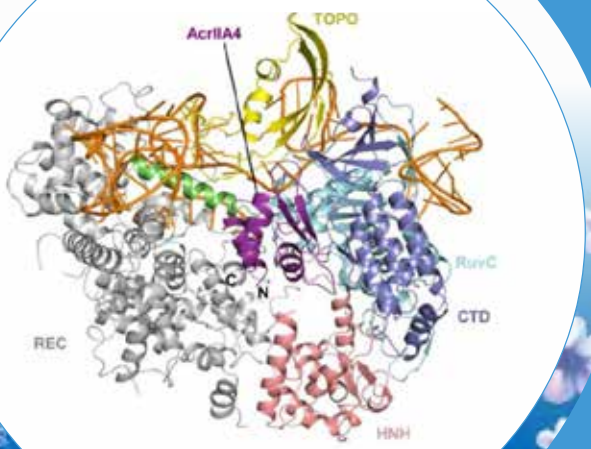
HARBIN INSTITUTE OF TECHNOLOGY
NEWSLETTER 2017 ISSUE 1

HIT TIMES

HIT WON 4 NATIONAL SCIENCE AND TECHNOLOGY AWARDS





HIT INTERNATIONAL CULTURE CARNIVAL 2017

HIT TIMES

HARBIN INSTITUTE
OF TECHNOLOGY
NEWSLETTER
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Contents

AWARDS & HONORS

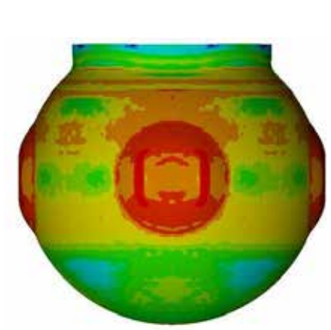
HIT WON 4 NATIONAL SCIENCE AND TECHNOLOGY AWARDS

The annual "National Science and Technology Awards Ceremony" was held on January 9th, 2017. The event took place at the Great Hall of the People in Beijing. China's most prestigious awards for scientific and technological achievements in 2016 were presented to 279 research projects.

Harbin Institute of Technology won 4 awards including 3 National Technological Invention Awards, and 1 National Scientific and Technological Progress Award.

Three projects won the 2nd prizes of the National Technological Invention Award: the project led by Prof. Cao Xibin from the School of Astronautics, the project led by Prof. Yuan Shijian from the School of Materials Science and Engineering, and the project led by Prof. Tan Jiubin from the School of Electrical Engineering & Automation.

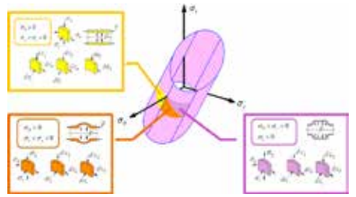
The project "Study and Application on Key Technologies of Large Span Spatial Steel Structures" led by Prof. Fan Feng from the School of Civil Engineering won the 2nd prize of the National Scientific and Technological Progress Award. ■



PROF. YUAN SHIJIAN WON THE 2ND PRIZE OF NATIONAL TECHNOLOGICAL INVENTION AWARD

For the development of the aerospace and automotive industries, Prof. Yuan Shijian's team invented and developed advanced high-pressure fluid forming technology for manufacturing components featuring lightweight, integrated and high reliability performance. In the technology, high-pressure fluid is applied as a medium to form a sheet blank or a tube blank into complex shaped components with high precision and performance. The team established three dimensional stress theory of high-pressure fluid forming, invented the multi-directional loading process for complex structure and the warm gas forming process for light alloys, and developed a series of large-scale computer control forming equipment. The complex components have been applied to spacecrafts and aircrafts, and have achieved mass production in the automotive industry.

At present, Prof. Yuan is the leader of the Yangtze River Scholar Innovation Team; he is also the director of the National Key Laboratory for Precision Hot Processing of Metals. The progress on the high-pressure fluid forming technology won the 2nd prize of the National Technological Invention Award in 2017. ■



PROF. TAN JIUBIN WON THE 2ND PRIZE OF NATIONAL TECHNOLOGICAL INVENTION AWARD

The Precision Micro-vibration Isolation Technology Research Team of Harbin Institute of Technology (HIT), led by Prof. Tan Jiubin (Member of the Chinese Academy of Engineering), won the 2nd Prize of the National Technological Invention Award for their breakthrough research on ultra-large and precision air-magnetic hybrid vibration isolation.

The environmental micro-vibration caused by municipal traffic, human walking and the earth's pulsation is generally undetectable for its micron-scale vibration amplitude. However, for advanced scientific experiment facilities, ultra-precision measuring instruments and manufacturing equipment whose precision is up to micrometers, nanometers and even sub-nanometers, this vibration interference is a key factor that limits the accuracy of experimental results, precision and performance improvement of instruments and equipment. Micro-vibration isolation technology is becoming an indispensable key technology supporting China's sophisticated scientific research and high-end equipment manufacturing industry. In advanced scientific experimental facilities, large-scale precision micro-vibration isolation platforms are core equipment to isolate the environmental micro-vibration interference. In national metrology reference/standard devices, precision vibration isolation devices are important equipment to guarantee the value is accurate and identical nationwide. In kinds of ultra-precision instruments and equipment, embedded precision vibration isolated frames are core base elements to ensure their accuracy and performance.

Large/ultra-large precision isolation technology is sophisticated and quite difficult to develop. There are some technical difficulties that have been researched for decades. In a large micro-vibration isolation system, the load capacity and the stiffness of isolation elements are influenced and restricted by each other, so that it is quite difficult to reduce the system's natural frequency, and yet difficult to make the natural frequency break through the bottleneck of several Hertz. When the load weight floated by the micro-vibration isolation platform is over hundreds of tons, the size of the platform is pretty large, the mechanism and law of vibration transmission is complicated, and the distributed deformation and attitude control of the ultra-large platform becomes technically difficult.

After more than 10 years of painstaking research, Prof. Tan's research team has completed the whole process of innovative research, including exploration of new principles, breakthroughs in core technologies, equipment development and engineering applications. A route of single-layer micro-vibration isolation technology that meets requirements of Chinese equipment development has been explored. A micro-vibration isolation method based on active negative stiffness, platform attitude monitoring and adjustment method based on laser reference surface has been successfully developed. The first ultra-large precision micro-vibration isolation platform based on an air-magnetic hybrid array in China has been developed. The dimension of the platform is up to 40m×7.5m, and the floating weight is up to 1,500 tons. According to the field test results by the National Institute of Metrology, China, triaxial natural frequencies of the system broke through 1Hz at the same time, which is better than other similar technology. The first micro-vibration isolation platform system for assembly and testing of high-performance satellite cameras in China has been developed, significantly improving the accuracy and efficiency of satellite camera tests. The proposed single-layer platform technical route successfully achieves the properties of ultra-large dimension, ultra-heavy weight and ultra-precision micro-vibration isolation performance at the same time, and has significant technical advantages over foreign multi-layer platform technical route in load capacity and working space dimension.

A product system with a series of precision micro-vibration isolation platforms and embedded micro-vibration isolators has been successfully developed. This product system meets major national needs and promotes the development of China's large-scale precision instruments and manufacturing equipment toward the high-end and ultra-precision direction. The developed large/ultra-large precision micro-vibration isolation platform products support China's cutting-edge scientific and technical research. The developed ultra-precision embedded micro-vibration isolators were used during the establishment of national metrology reference/standard devices, and effectively guarantee the accuracy of quantity value dissemination. The developed embedded micro-vibration isolation frames have been applied in ultra-precision manufacturing equipment, ensuring their nano-precision and performance. The research team has been granted more than 100 invention patents, including 5 international patents. They formulated 3 standards in this field.

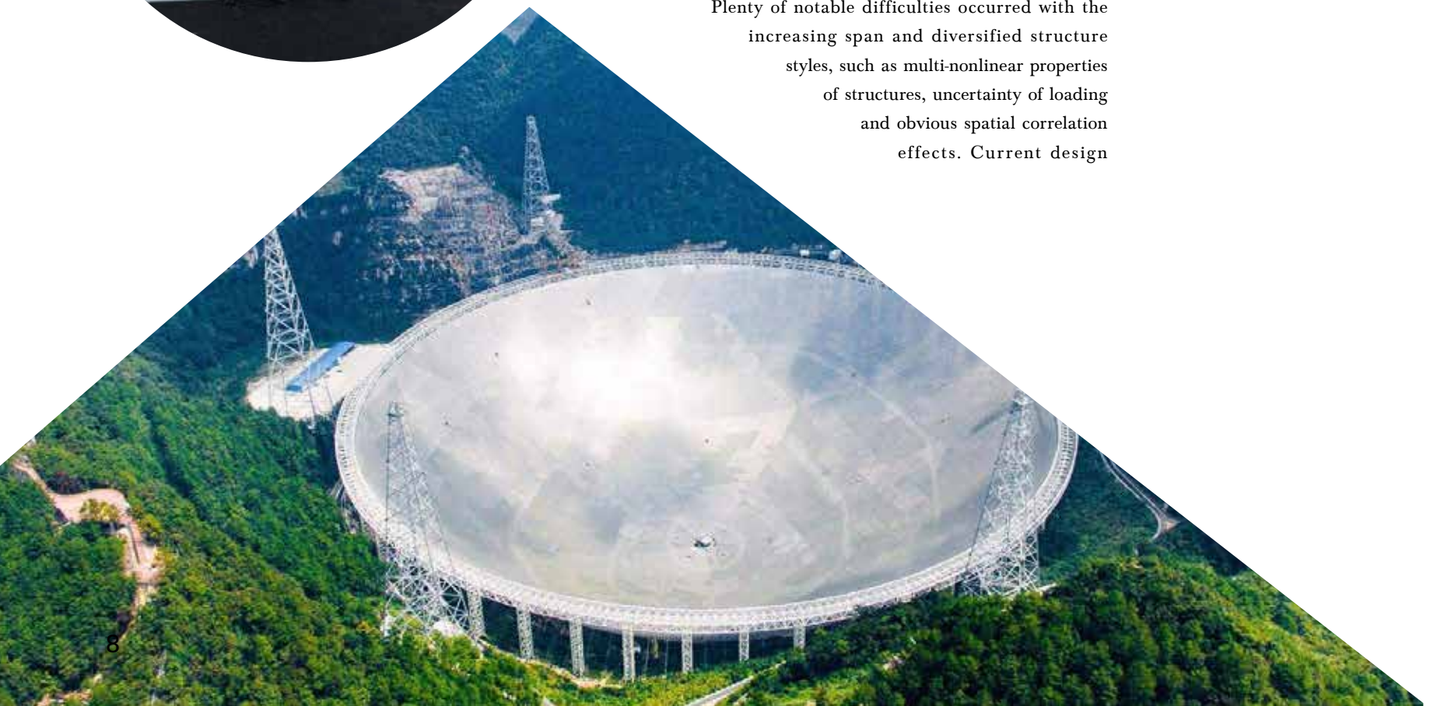
Ultra-large precision micro-vibration isolation platform based on air-magnetic hybrid array (40 m×7.5 m, floating weight 1,500 tons)

Platform attitude monitoring and adjustment equipment based on laser reference surface

PROF. FAN FENG WON THE 2ND PRIZE OF NATIONAL SCIENTIFIC AND TECHNOLOGICAL PROGRESS AWARD

The project “Study and Application on Key Technologies of Large Span Spatial Steel Structures” won the 2nd prize of National Scientific and Technological Progress Award, which was undertaken by Prof. Fan Feng and CAS member Shen Shizhao’s research team from School of Civil Engineering.

In the past 30 years, rapid progress has been made in the field of Chinese large span spatial steel structures. Plenty of notable difficulties occurred with the increasing span and diversified structure styles, such as multi-nonlinear properties of structures, uncertainty of loading and obvious spatial correlation effects. Current design theories, structure styles and construction technology cannot meet the needs of fast development of engineering project demands. The research team has had cooperation with large steel structural design and construction enterprises for nearly two decades. Systematical research has been made in key design theories, new structural systems, and green intelligent construction technology of large span spatial steel structures. The innovation achievements of which are listed as follows.

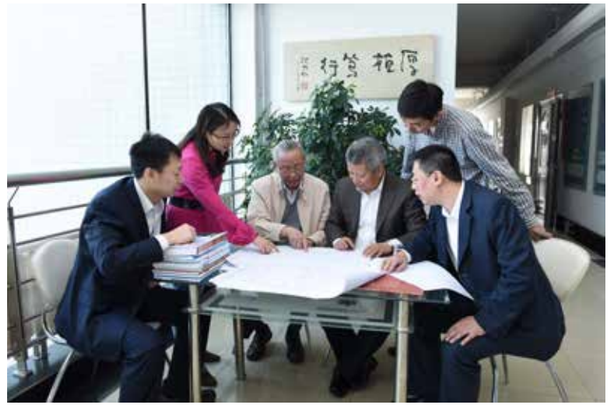


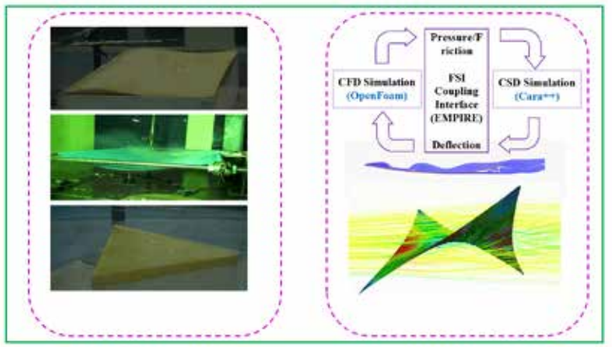
(1) Design theory and methods for nonlinear stability, earthquake action and wind resistance of large span spatial steel structures have been rigorously proposed, which solve the key design difficulties such as strong earthquake response and wind induced coupling effect of structures.

(2) New structural systems have been developed such as reticulated domes using semi-rigid joints, free-form space structures, and large cable-net structure with real-time deforming. These have been applied in some large-scale public buildings.

(3) The complete technology of green intelligent construction has been studied, such as lean production of irregular cross-sections and complex members, accurate position and 4D dynamic measurement, automatic welding and swarm unloading technology. These research achievements are broadly applied in 50 stadiums or gyms, 12 transportation joint projects and 15 exhibition buildings.

The Space Structure Research Centre of HIT, founded by Prof. Shen Shizhao and led by Prof. Fan Feng, is one of the leading, well-organized and stable research teams in the field of large span spatial steel structures. There are 20 teachers and more than 100 postgraduates in the centre now. In the past 5 years, more than 30 students graduated every year. Moreover, Prof. Fan Feng won the National Science Fund for Distinguished Young Scholars and was selected as a Cheung Kong Scholar Professor.■





CCMS WON THE AWARD OF NATIONAL WORKER PIONEER

In May 2017, the Centre for Composite Materials and Structures (CCMS) was awarded the “National Worker Pioneer” by All-China Federation of Trade Unions.

CCMS was established in 1989. It brings together the composites and structures research activities across Harbin Institute of Technology (HIT) based in the School of Astronautics. It was awarded the 2nd Prize of National Technological Invention Award (4 times), the 2nd Prize of National Scientific and Technological Progress Award, the 2nd Prize of National Natural Science Award (twice), the Innovative Research Group of the National Natural Science Foundation of China,

the National Defense Science and Technology Innovation Team, the Program for Changjiang Scholars and Innovative Research Team in University (PCSIRT), the Innovation Team in Key Areas of Ministry of Science and Technology, etc.

It has received many innovative achievements in the aerospace and other fields, and has tackled key scientific and technological issues such as thermal protection systems and materials, lightweight materials and structures, and special photoelectric function materials and smart materials. It has completed more than 100 research projects, including the National Program on Key Basic Research Project (973 Program), the National High Technology Research and Development Program (863 Program), and programs granted by the National Natural Science Foundation of China, etc. More than 2000 scientific articles have been published and more than 200 patents of invention have been authorized.

1 TEAM AND 4 INDIVIDUALS FROM HIT WON THE NATIONAL AWARD FOR EXCELLENCE IN INNOVATION

On the first National Science and Technology Workers' day, the inaugural award ceremony of National Award for Excellence in Innovation was held in Beijing. The Ministry of Human Resources and Social Security (MOHRSS), the China Association for Science and Technology, the Ministry of Science and Technology (MOST), and the State-owned Assets Supervision and Administration Commission of the State Council jointly established the National Award for Excellence in Innovation. At the ceremony, 10 teams were awarded the National Award for Excellence in Innovation plagues, 28 individuals were awarded the National Award for Excellence in Innovation medals and 254 individuals were awarded the National Award for Excellence in Innovation certificates.■

Awards & Honors
HIT TIMES 2017

One team and four individuals from HIT were on the award list:

The team of advanced composites in special environments (Plague)

Prof. Ren Nanqi from the School of Municipal and Environmental Engineering (Certificate)

Prof. Cao Xibin from the School of Astronautics (Certificate)

Prof. Liu Hong from the School of Mechatronics Engineering (Certificate)

Prof. Wang Fei from the School of Mechatronics Engineering (Certificate)

8 HIT PROFESSORS SELECTED IN CHEUNG KONG SCHOLARS PROGRAMME

Awards & Honors
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The Cheung Kong Scholars Programme was established by the Li Ka-shing Foundation (LKSF) and the Ministry of Education (MoE) in 1998 to help support the country's pressing need to foster innovation and higher education reform. The Programme has been responsible for setting up specially appointed professorship posts in various universities throughout the country and has attracted a large group of overseas Chinese to return to the Mainland to work in academic and research positions. It has also created the Cheung Kong Scholar's Achievement Awards to give recognition to academics for outstanding achievements in their fields of research. The great achievements are powering new discoveries and new possibilities to extend the boundaries of science in universities and research institutes throughout the Mainland.

In 2017, 8 professors recommended by Harbin Institute of Technology were selected in the Cheung Kong Scholars Programme:

Prof. Fan Feng from the School of Civil Engineering

Prof. Li Yao from the School of Astronautics

Prof. Sun Cheng from the School of Architecture

Prof. Wu Xiaohong from the School of Chemistry and Chemical Engineering

Prof. Ye Qiang from the School of Management

Prof. Hans Ågren

Prof. Qiu Jianbin from the School of Astronautics

Prof. Shuai Yong from the School of Energy Science and Engineering

HIT DELEGATION WON THE DISTINGUISHED DELEGATION OF NMUN 2017

On March 23rd, the closing ceremony of National Model United Nations (NMUN) guided by the United Nations Department of Public Information was held in United Nations Headquarters. The HIT delegation was awarded the Distinguished Delegation of the NMUN for the first time.

The NMUN annually draws participants from more than 130 UN Member States to address current global issues. The experiential learning programs, including the world's largest university-level Model UN, provide students with a forum to hone skills in diplomacy, negotiation, critical thinking, compromise, public speaking, writing, and research. Students benefit from the longstanding partnership with the UN and utilize simulation procedural rules developed decades ago with UNITAR.

NMUN 2017 was held in New York from March 19th to 23rd, which attracted about 230 delegations from the University of Washington in the US, the Technical University of Munich in Germany, Renmin University of China and other universities worldwide. The award-winning teams and individuals are evaluated and selected by the special jury of National Model United Nations according to the comprehensive performance and the contribution achievements.

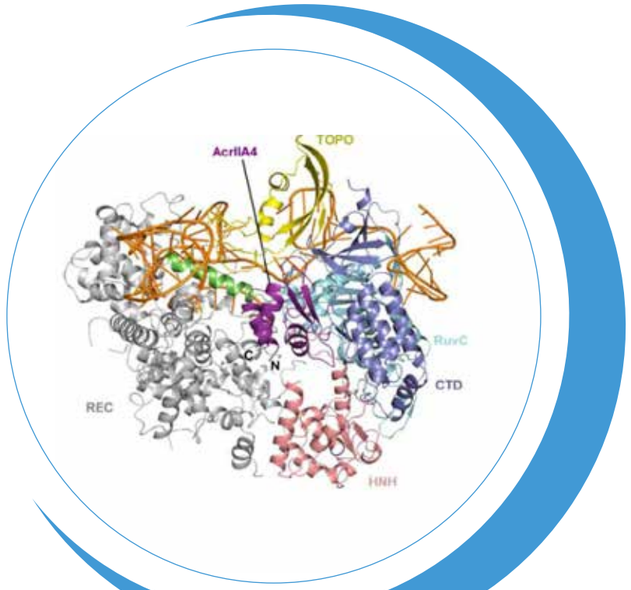
HIT DELEGATION WON THE DISTINGUISHED DELEGATION OF THE FAR EASTERN UN 2017

From May 5th to 8th, Far Eastern Model United Nations 2017 was held in Vladivostok, Russian Federation. HIT delegation was awarded the Distinguished Delegation.

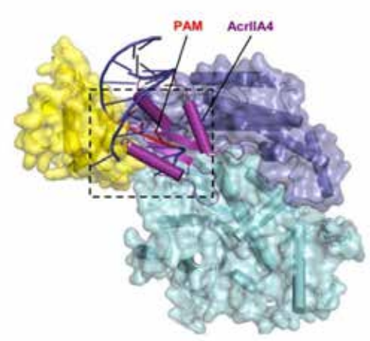
More than 70 delegations from China, Vietnam, Switzerland and other countries attended the conference. During the 4-day conference, 3 members of HIT delegation debated with other delegations on the hot topics of nuclear safety issues, world sustainable development and reform issues. Because of the outstanding performance, they won the Distinguished Delegation Award. ■


CERTIFICATE OF PARTICIPATION
MODEL UNITED NATIONS OF THE RUSSIAN FAR EAST
RECOGNIZES
Harbin Institute of Technology
as a
DISTINGUISHED DELEGATION
at the
Far Eastern Model United Nations 2017
held on May 5-8, in Vladivostok, Russian Federation

STRUCTURAL BASIS OF CRISPR–SpyCas9 INHIBITION BY AN ANTI-CRISPR PROTEIN



In April 2017, the group led by Prof. Huang Zhiwei from the School of Life Science and Technology at Harbin Institute of Technology published a research paper titled "Structural Basis of CRISPR–SpyCas9 Inhibition by an Anti-CRISPR Protein" in the journal Nature. The study revealed the mechanism of Streptococcus pyogenes Cas9 (SpyCas9) inhibition by anti-CRISPR AcrIIA4, providing a structural basis for developing genetically codable "off-switch" tool to temporally, spatially or conditionally control the activities of the most widely used SpyCas9 within cells and tissues.



CRISPR-Cas systems are important adaptive immune systems that defend against infection by phages. The well-characterized SpyCas9 system, which belongs to type II-A CRISPR subtype, is the most common and powerful tool for genome editing that can edit DNA more efficiently through the RNA-guided endonuclease activity of Cas9. Although the combination of SpyCas9, and a synthetic single-guide RNA (sgRNA) has been harnessed as a two-component programmable system for manipulating the genome in various organisms, there are currently limited ways to control over SpyCas9 activity after it has been delivered or activated, leading to unwanted genome edits within cells or tissues by excessive or prolonged SpyCas9 activity. Recently, two anti-CRISPR proteins (AcrIIA2 and AcrIIA4 from Listeria monocytogenes prophages) have been identified, both of which inhibit SpyCas9 and LmoCas9 activity in bacteria and human cells. However, the mechanism of AcrIIA2- or AcrIIA4-mediated Cas9 inhibition remains unknown.

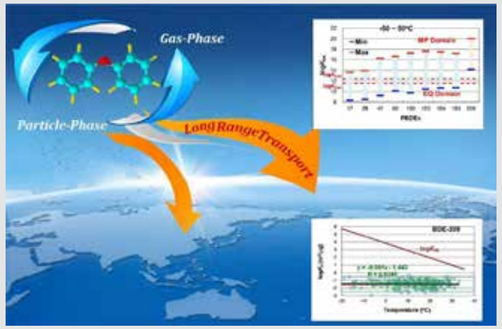
To further elucidate the molecular mechanism underlying SpyCas9 inhibition by anti-CRISPR AcrIIA4, Huang's group determined the crystal structure of SpyCas9 in complex with a sgRNA and AcrIIA4 at 3.0 Å resolution. The structure reveals that AcrIIA4 inhibits SpyCas9 activity through structurally mimicking the PAM to occupy the PAM-interacting site in the PAM-interacting domain, thereby blocking SpyCas9 recognition of the dsDNA substrates. AcrIIA4 further inhibits the endonuclease activity of SpyCas9 by shielding its RuvC active site. Structural comparison reveals that formation of the AcrIIA4-binding site of SpyCas9 is induced by sgRNA binding. The study reveals that AcrIIA2 and AcrIIA4 function by directly and specifically interacting with SpyCas9 in a sgRNA-dependent manner to inhibit the dsDNA cleavage activity.

By revealing the mechanism of SpyCas9 inhibition by anti-CRISPR AcrIIA4, this study enhanced our understanding of the "arms race" coevolutionary mechanism between the bacterial immune system (CRISPR-Cas9) and phage defense system (Anti-CRISPR), and provided a structural basis for the developing of tools to temporally, spatially or conditionally control the activities of the widely used SpyCas9. It is worth mentioning that this is another important study published in Nature in the host-pathogen interaction field by Prof. Huang Zhiwei's laboratory.■

REFERENCE

Dong, M Guo, S Wang, Y Zhu, S Wang, et al. Structural basis of CRISPR-SpyCas9 inhibition by an anti-CRISPR protein. Nature, 2017, 546 (7658) :436

NEW UNDERSTANDING OF THE LONG-RANGE ATMOSPHERIC TRANSPORT OF BDE-209 INTO THE ARCTIC



A new gas/particle partitioning theory leads to a new understanding of the long-range atmospheric transport of decabrominated diphenyl ethers (BDE-209) into the Arctic. Commercial decabromodiphenyl ether (ComDecaBDE), with BDE-209 as the major compound is an important brominated flame retardant (BFR) and belongs to the category of persistent organic pollutants (POPs). It has been widely believed by environmental scientists worldwide that BDE-209 in air is entirely sorbed on particles due to its low vapor pressure (P_L) and high octanol–air partition coefficient (K_{OA}) according to equilibrium theory for gas/particle partitioning of semi-volatile compounds (SVOCs). As a consequence, BDE-209 has been viewed strictly as a particulate component in the atmosphere, which then dominates perspectives on relevant atmospheric processes and modeled outcomes of its environmental fate,

including its potential for long-range atmospheric transport (LRAT). At first, as a particulate, it has been suggested that BDE-209 would not distribute widely through the atmosphere despite intense use in the industrialized world and would be difficult to transport to remote areas—the Arctic in particular—via LRAT. Monitoring data, however, showed another story. Scientists have identified BDE-209 in the atmosphere at various sites far away from populated and industrial centers, including Arctic air. This puzzling phenomenon has made the scientists believe that LRAT must occur for BDE-209 by the movement of particles—not air—and this particle transport could travel great distances and eventually enter the Arctic. This point of view has dominant the scientific community for decades.

A research team led by Prof. Li Yifan from the International Joint Research Center for Persistent Toxic Substances (IJRC-PTS), the State Key Laboratory of Urban Water Resource and Environment, and the School of Environment, Harbin Institute of Technology (HIT), published a paper titled “Decabrominated Diphenyl Ethers (BDE-209) in Chinese and Global Air:Levels, Gas/Particle Partitioning, and Long-Range Transport: Is Long Range Transport of BDE-209 Really Governed by the Movement of Particles?” in Environmental Science & Technology, the top journal in international environmental research areas, as one of the Highlighted Papers on the journal’s homepage. The published study subverted the prevailing view and proved both theoretically and by monitoring data that, like many other SVOCs, BDE-209 can enter the Arctic through LRAT mainly by air transport rather than by particle movement.

This research is based on a new steady state theory of gas-particle partitioning for PBDEs established by Prof. Li’s group, which indicates that PBDEs in the atmosphere are in a steady state and the equilibrium state is a special case when particle deposition can be ignored. Under this theory, Prof. Li and co-workers discovered that, like other SVOCs, BDE-209 cannot be entirely sorbed to atmospheric particles; and there is a significant amount of gaseous BDE-209 in global atmosphere, which is subject to LRAT. Therefore, it is not surprising that BDE-209 can enter the Arctic through LRAT mainly by air transport rather than by particle movement. By challenging the current view that BDE-209 enters the Arctic through LRAT by particle movement, this is a significant advancement in understanding the global transport process and the pathways entering the Arctic for chemicals with low volatility and high octanol–air partition coefficients, such as BDE-209. Furthermore, it is suggested that without further evaluation, it is risky to assume that other toxic chemicals with high K_{OA}s are entirely constrained to the atmospheric particulate phase.

This research was jointly supported by the National Natural Science Foundation of China, the State Key Laboratory of Urban Water Resource and Environment.

REFERENCE

Yi-Fan Li, Li-Na Qiao, Nanqi Ren, Ed Sverko, Donald Mackay, and Robie W. Macdonald. Decabrominated diphenyl ethers (BDE-209) in Chinese and global air: levels, gas/particle partitioning, and long-range transport: ss long rangetransport of BDE-209 really governed by the movement of particles? Environmental Science &Technology, 2017, 51, 1035-1042

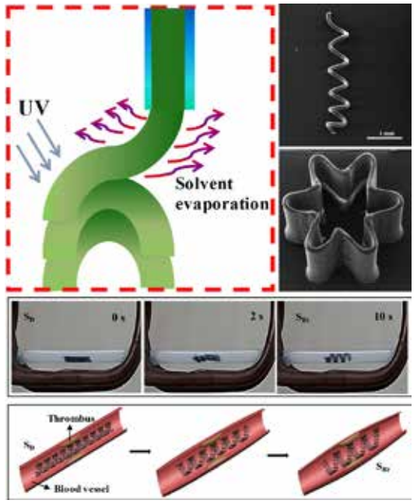
FOUR-DIMENSIONAL PRINTING OF REMOTELY-ACTUATED SHAPE MEMORY POLYMER COMPOSITES: A NEW WAY FOR PERSONALIZED IMPLANT DEVICES

Four-dimensional (4D) printing refers to a new manufacturing technique that enables the physical properties (e.g., shape, structure, dimension) of a three-dimensional (3D) printed object to achieve self-transformation under appropriate external stimulus such as heat, water, electricity, ultraviolet (UV) light, and magnetic field. This technique presents great potential to be applied in aerospace, biomedicine, electronics and robotics, etc.

Recently, Prof. Leng Jinsong’s group achieved direct-write 4D printing of a remotely-actuated shape memory polymer composite. This 4D printable shape memory composite “ink” was prepared by a biodegradable polymer, a UV crosslinker, iron oxide and a fast evaporation solvent. During the printing process, the fast evaporation of the solvent enabled the

retention of the printed shape. The UV irradiation introduced a chemically crosslinking network into the polymer for enhanced shape memory behavior. Structures with user-defined geometries could be constructed by adjusting the printing parameters. They designed and successfully printed a 4D scaffold. The movement of the scaffold can be magnetically controlled under a constant magnetic field. Interestingly, this scaffold could present remotely-actuated self-expandable behavior under alternating magnetic field.

This research is expected to be used in many fields, especially in biomedical and minimally invasive areas, which paves a new way for intelligent and personalized implant devices. The result has been published in the top international journal ACS Applied Materials & Interfaces.

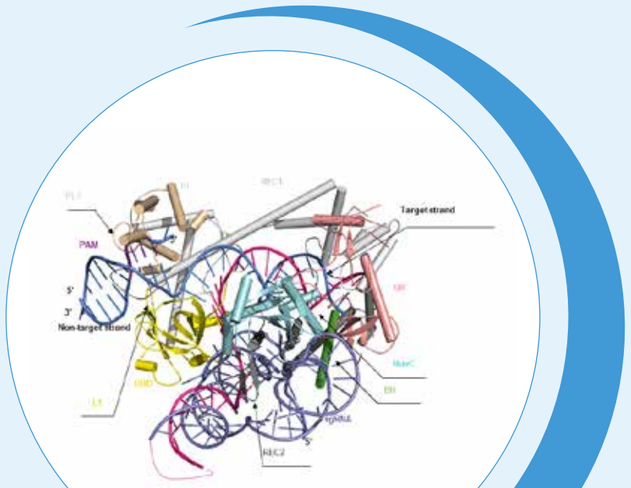


Direct-write 4D printing of a shape memory composite and its potential application as an intravascular stent

REFERENCE

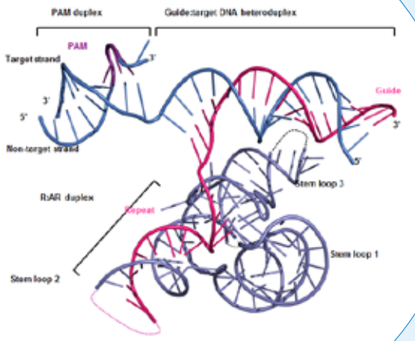
Hongqiu Wei, Qiwei Zhang, Yongtao Yao, Liwu Liu, Yanju Liu and Jinsong Leng. Direct-write fabrication of 4D active shape-changing structures based on shape memory polymer and its nanocomposite. ACS Applied Materials & Interfaces, 2017, 1: 876-883

STRUCTURAL BASIS OF STRINGENT PAM RECOGNITION BY CRISPR-C2c1 IN COMPLEX WITH sgRNA



On April 4, Prof. Huang Zhiwei's team from the School of Life Science and Technology at Harbin Institute of Technology published a research paper titled "Structural Basis of Stringent PAM Recognition by CRISPR-C2c1 in Complex with sgRNA" in the Advance Online Publication of the journal Cell Research.

Recently, a Class 2 CRISPR effector protein, C2c1 (classified as type V-B), has been identified to cleave DNA under the guide of crRNA: tracrRNA, distinct from a type V-A effector protein Cpf1 that only



requires a single crRNA. In addition, C2c1 and Cpf1 recognize different PAM sequences. Like Cpf1, C2c1 contains aconserved RuvC endonuclease domain, though it harbors a second endonuclease domain that is not well defined by sequence. C2c1 has been proved to be endonuclease-active in human cell lysates. The mechanism underlying C2c1-mediated cleavage remains elusive.

To reveal the molecular mechanism by which C2c1 recognizes sgRNA and binds to PAM-DNA, the team determined the crystal structure of Bacillus thermoamylovorans C2c1 (BthC2c1) in complex with a 123-nt sgRNA containing nearly full-length crRNA and tracrRNA, 28-nt target DNA, and a 12-nt non-target DNA at 2.70Å resolution. Structural studies revealed that, unlike the loosely-recognized PAM sequences of Cas9 and Cpf1, BthC2c1 recognizes the PAM sequence in a rigorous fashion. By analyzing the structure, it is inferred that deleting Loop 1 (38-nt) of sgRNA located on the surface of BthC2c1 does not affect the activity of BthC2c1 to guide the cleavage. What's more, Sanger sequencing was used to analyze the DNA ends of the cleaved products of in vitro cleavage reactions. It revealed that the BthC2c1 cleavage site on the target strand is located outside the guide: target heteroduplex segment. This is distinct from Cas9 and Cpf1, both of which cleave the target strand within the guide: target heteroduplex segment.

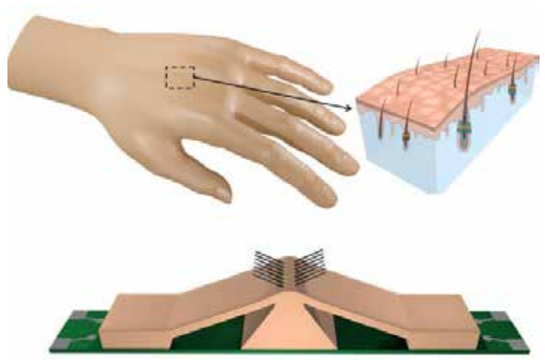
The data presented here not only reveal the mechanism of recognition of sgRNA and PAM-duplex by BthC2c1, which is different from those of Cas9 and Cpf1, but also provide insights into the generation of engineered C2c1 family of proteins with better efficiency and specificity for genome manipulation applications. This is another research achievement made by Prof. Huang's laboratory in the field of host-pathogen interaction systems and genome editing systems that was established in 2017.

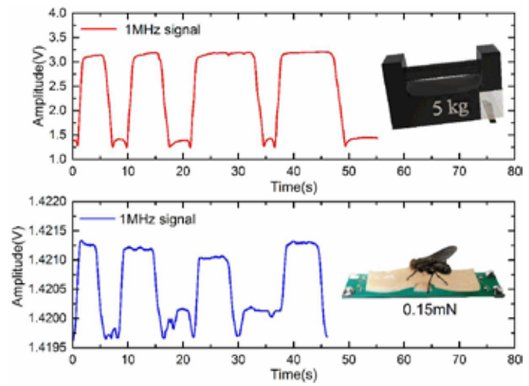
REFERENCE

D Wu, X Guan, Y Zhu, K Ren, Z Huang. Structural basis of stringent PAM recognition by CRISPR-C2c1 in complex with sgRNA. Cell Research, 2017

BIOMIMIC
HAIRY SKIN SENSOR

Our skin is a remarkable sensor and is capable to detect a diversity of stimuli such as force, heat, moisture, texture and more via direct physical contact. It plays a key role for human beings to handle different kinds of external stimuli and to perform complex operations. Robots and prosthetics are becoming ever more





human-like, but the electronic skins designed to enhance their usefulness don't yet have the full range of tactile senses that we have.

Prof. He Xiaodong's group in the Center for Composite Materials and Structures, School of Astronautics of HIT reported a hairy skin tactile sensor which replicated skin's abilities and provided amazing features such as high sensitivity, wide force detection range, long-term durability, abrasion resistance, and material identification.

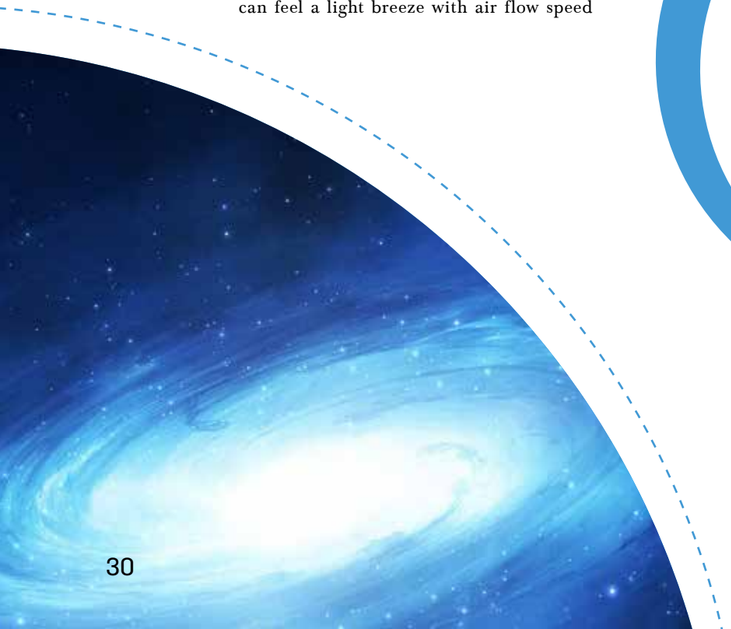
The idea is borrowed from human hairy skin which covers over 95% of the human body. By combining an array of artificial hairs with glass-coated, cobalt-based microwires and wires embedded silicon-rubber skin, an impressive range of sensitivity is achieved making the sensor capable to withstand a 50 Newton weight and to detect a fly. Slip and friction forces which are critical for robotic applications such as holding objects are also tested by integrating the sensor onto a two-finger robot gripper. In addition, the sensor can feel a light breeze with air flow speed in the range of 3 – 4.5 m/s, and identify insulating, conducting, and soft ferromagnetic materials.

The hairy skin sensor has broadly envisioned new applications for intelligent robot hands, artificial prosthesis sensory systems, and healthcare equipment.

This work was supported by the National Natural Science Foundation of China and reported in ACS Applied Materials & Interfaces and on forbes.com. The supplemental video was chosen as a Headline Science video of the American Chemical Society.

REFERENCE

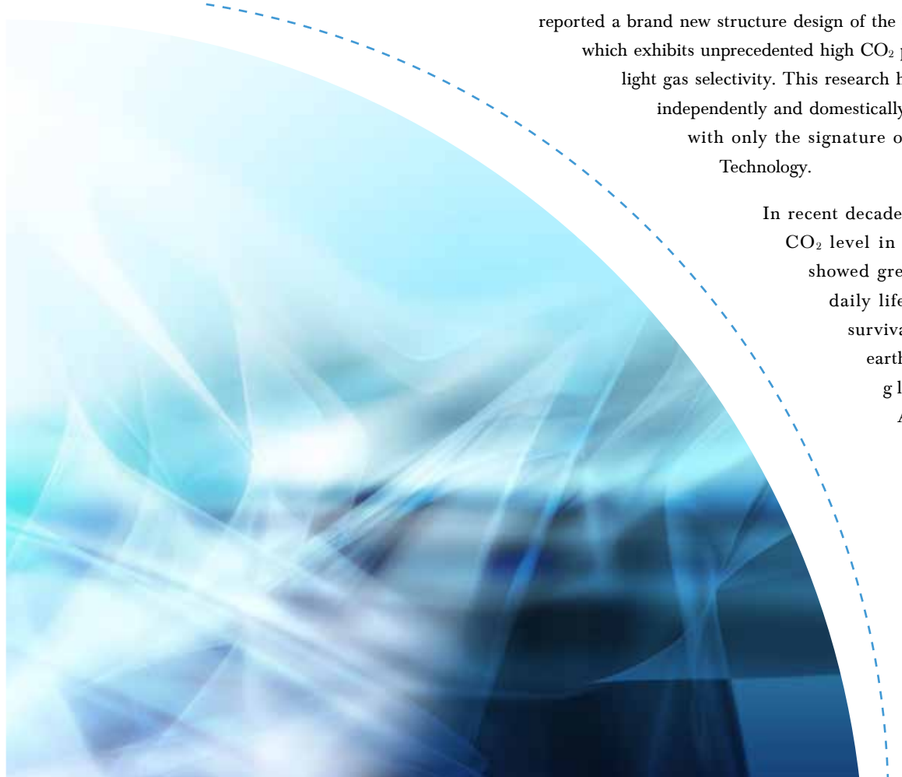
J Zhang, L Hao, F Yang, W Jiao, W Liu, et al. Biomimic hairy skin tactile sensor based on ferromagnetic microwires. Acs Applied Materials & Interfaces, 2016, 8 (49):33848



BREAKTHROUGHS IN CO_2-PHILIC MEMBRANE FOR HIGHLY EFFICIENT CO_2 CAPTURE

In February 2017, a team led by Prof. Shao Lu from the Department of Chemistry and Chemical Engineering at HIT published a research paper titled "Pushing CO_2-Philic Membrane Performance to the Limit by Designing Semi-Interpenetrating Networks (SIPN) for Sustainable CO_2 Separations" in Energy & Environmental Science as an inside front cover paper. This study reported a brand new structure design of the CO_2-philic membrane, which exhibits unprecedented high CO_2 permeability and CO_2/light gas selectivity. This research has been accomplished independently and domestically by Prof. Shao's team with only the signature of Harbin Institute of Technology.

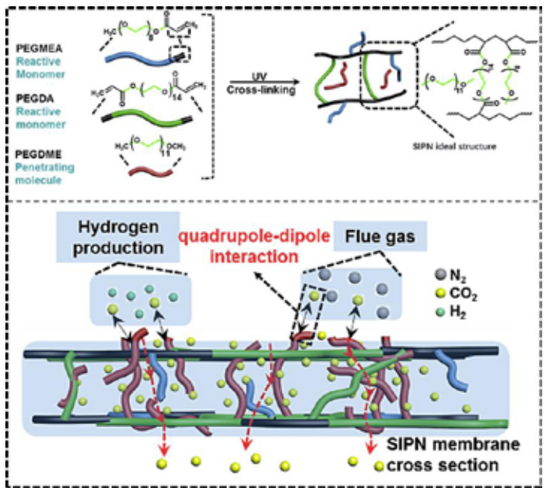
In recent decades, the ever-increasing CO_2 level in the atmosphere has showed great impact on human daily life and threatened the survival of other species on earth through accelerating global warming. Adopting advanced CO_2 separation technologies, especially the environmental-friendly and



energy-saving membrane process, is an efficient way to ease such environment pressure. However, in reality, the lack of highly efficient materials that are suitable for CO_2 separation impedes membrane deployment during greenhouse gas sequestration. Clearly, membrane materials with superior CO_2 permeability and excellent selectivity must be developed to address this technology gap.

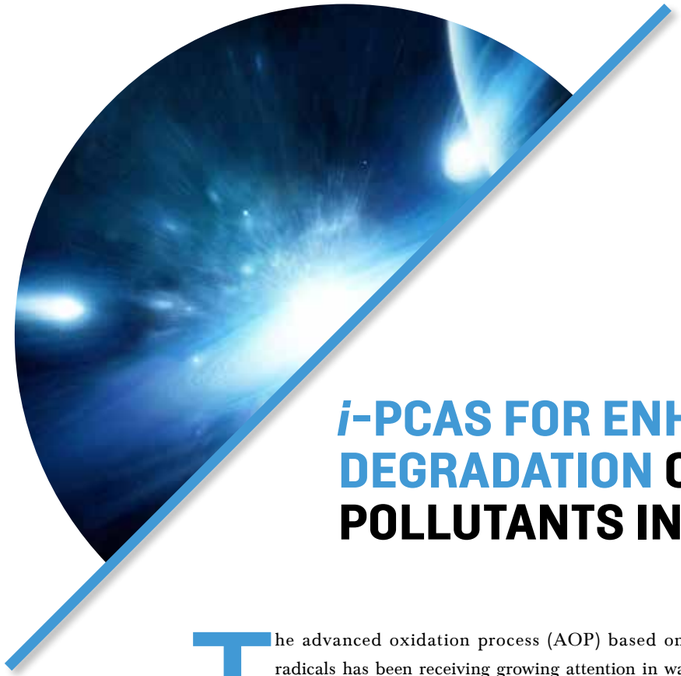
In this study, Prof. Shao's team designed a novel PEO-based semi-interpenetrating network (SIPN) through embedding a non-reactive linear PEG into a UV-induced cross-linking system of two acrylate functionalized PEOs. The SIPN membranes were achieved via a simple, one-step UV polymerization. The linear PEG chains are multi-functional and act as CO_2 sorption enhancers, artificial plasticizers and free volume regulators that generate a more flexible and CO_2 favorable microenvironment for accelerating both the CO_2 solution and diffusion in SIPN membranes. The CO_2 separation capability of such SIPN membranes can be easily controlled by adjusting the amount of embedded PEG to push the performance of the CO_2-philic membrane to the limit. This extremely facile performance-manipulating strategy establishes the CO_2-philic SIPN membranes as an exciting platform for sustainable CO_2 separations.

This research was financially supported by the National Natural Science Foundation of China, Harbin Science and Technology Innovation Talent Funds, and HIT Environment and Ecology Innovation Special Funds.



REFERENCE

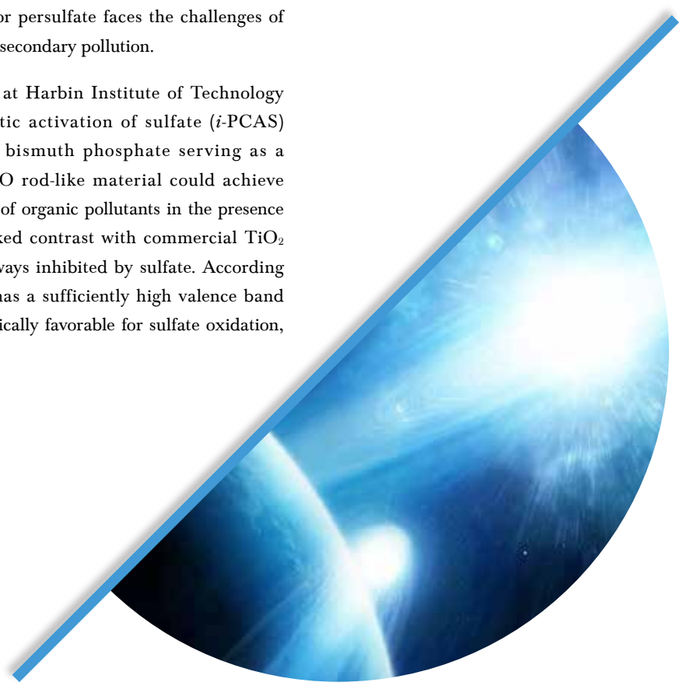
Jiang X, Li S, Shao L. Pushing CO2-philic membrane performance to the limit by designing semi-interpenetrating networks (SIPN) for sustainable CO2 separations. Energy & Environmental Science, 2017, 10: 1339-1344



i-PCAS FOR ENHANCED DEGRADATION OF ORGANIC POLLUTANTS IN WATER

The advanced oxidation process (AOP) based on $SO_4^{\bullet-}$ radicals has been receiving growing attention in water and wastewater treatment by virtue of their higher redox potential than $\bullet OH$, wider working pH range, as well as much longer half–life time. However, producing $SO_4^{\bullet-}$ radicals by activation of peroxymonosulfate or persulfate faces the challenges of high operational cost and potential secondary pollution.

Prof. You Shijie's research team at Harbin Institute of Technology proposed an *in-situ* photocatalytic activation of sulfate (*i*-PCAS) to produce $SO_4^{\bullet-}$radicals with bismuth phosphate serving as a photocatalyst. The prepared BPO rod-like material could achieve remarkably enhanced degradation of organic pollutants in the presence of sulfate. This presented a marked contrast with commercial TiO_2 (P25), whose performance was always inhibited by sulfate. According to theoretical calculations, BPO has a sufficiently high valence band potential, making it thermodynamically favorable for sulfate oxidation,



and weaker interaction with $SO_4^{\bullet-}$ radicals resulting in higher reactivity toward target organic pollutants.

This study provides a proof-in-concept demonstration of *i*-PCAS for producing $SO_4^{\bullet-}$ radicals by utilizing original sulfate in a water environment itself. It may offer a new protocol in the design of *i*-PCAS-based AOPs where $SO_4^{\bullet-}$ radicals can work together with •OH radicals. In particular, it will be highly desirable for this mode to find applications in water treatment systems equipped with UV-light disinfection units, where the sulfate can be photocatalytically activated for simultaneous enhanced degradation and detoxification. The results appear to be attractive, unlike chemical activation, since the photocatalysis only uses sulfate and does not require any chemicals such as PS and PMS, making it much easier, more economical and more sustainable for water treatment.

This work has been published in Environmental Science & Technology and highlighted on the homepage. ■

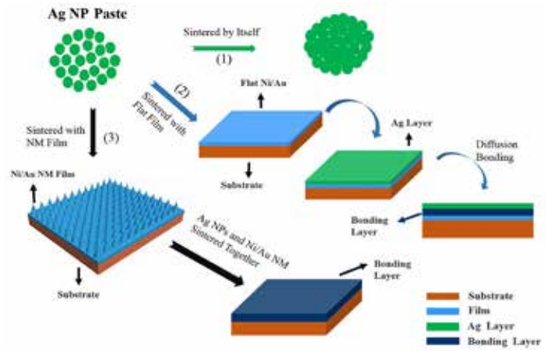
REFERENCE

Guoshuai Liu, Shijie You, Yang Tan, and Nanqi Ren. In situ photochemical activation of sulfate for enhanced degradation of organic pollutants in water. Environmental Science & Technology, 2017, 51 (4) :2339

BREAKTHROUGHS IN ELECTRONIC PACKAGING MATERIAL AND TECHNOLOGY

The team led by Prof. Wang Chunqing from the State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology (HIT) recently published a paper titled "One-Step Fabrication of 3D Nanohierarchical Nickel Nanomace Array to Sinter with Silver NPs and the Interfacial Analysis" in the materials science magazine ACS Applied Materials & Interfaces. The team achieved breakthroughs in electronic packaging material and technology.

Depending on the size effect, nano-materials (such as Ag nanoparticles, Ag NPs) could sinter at low



temperatures and serve at high temperatures, which was an innovation to achieve interconnection in the microelectronics packaging field. Compared to the sintering rate between Ag NPs paste, it was found that the sinter rate was slower between Ag NPs paste and the conventional pad surface, which was caused by the energy mismatch between the Ag NPs and the conventional substrate.

The team fabricated the three-dimensional (3D) nano-hierarchical Ni nanomace (Ni NM) array on copper substrate by only one step with electrochemical method. The unique structure was covered with Au film without changing the morphology and sintered with silver nanoparticles (Ag NPs) paste.

Advanced physical methods were used to analyze the structure and sinter process. The results showed that metallurgical bonding was successfully achieved at 250 ℃ without any gas or vacuum shield and extra pressure. The Ni NM array was able to insert into the silver layer without any void. Through calculating, the nanostructure surface energy was matched with the Ag NPs. Based on the excellent 3D nano-hierarchical structure, the shear strength was 6 times stronger than the flat Ni/Au coated substrate. The 3D Ni NM array has achieved excellent bonding interface and great potential application in microelectronics packaging field.

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

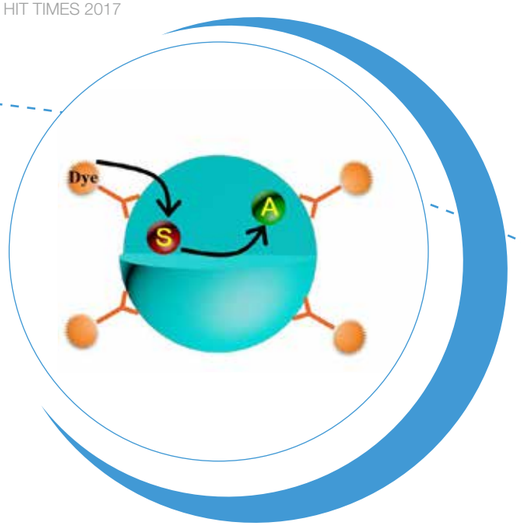
REFERENCE

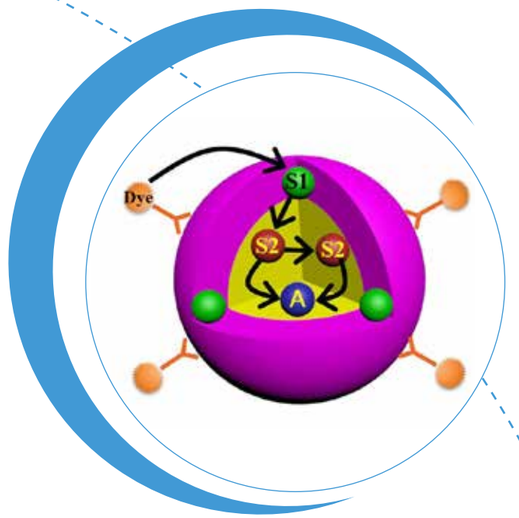
Zhou W, Zheng Z, Wang C, et al. One-step fabrication of 3d nanohierarchical nickel nanomace array to sinter with silver NPs and the interfacial analysis. ACS Applied Materials & Interfaces, 2017, 9(5): 4798-4807

NEW UNDERSTANDINGS OF THE HYBRID ORGANIC-INORGANIC SYSTEM OF DYE SENSITIZED UPCONVERSION NANOPARTICLES

A research team led by Prof. Chen Guanying from the School of Chemistry and Chemical Engineering & the Key Laboratory of Micro-systems and Micro-structures recently published a paper titled “Dye-Sensitized Lanthanide-Doped Upconversion Nanoparticles” in the prestigious journal Chemical Society Reviews. A range of new understanding in the emerging field of dye sensitized upconversion nanoparticles has been unveiled as a tutorial review, which is an outgrowth of the landmark works of Prof. Chen on dye sensitized lanthanide-doped upconversion nanoparticles (UCNPs), laying a foundation for controlling the hybrid organic-inorganic systems for brighter photoluminescence.

UCNPs are nanoscale particles with a size in the range of 1-100 nm that can emit an anti-Stokes-type upconverted luminescence, in which two or more incident photons of low energy (e.g., near infrared, NIR) are sequentially absorbed and converted into one light photon with higher energy (e.g., visible) via the ladder-like energy levels of doped trivalent lanthanide ions. The upconverted luminescence can be produced under low light power density from laser diodes and light emitting diodes (LED) or even under direct sun light irradiance on the Earth’s surface. UCNPs are of particular interest for applications ranging from deep tissue bioimaging and biosensing, to whole-spectrum photovoltaics to forensics and anti-counterfeiting. Compared with other luminescent materials (organic dyes, fluorescent proteins and quantum dots), UCNPs have distinct superior advantages such as spectrally distinct and narrow emission, non-blinking, non-photobleaching, and unique NIR-to-visible upconverted luminescence. However, despite these advantages, the weak and narrow absorption of lanthanide ions, poses a fundamental limit of UCNPs to withhold their brightness, creating a long-standing hurdle for the field. To resolve this problem, inspired by “antenna effect” in lanthanide coordination complexes, a new concept of energy, cascaded upconversion, has been conceived and coined by Prof. Chen’s team, which utilizes organic dyes to harvest light and then transport the absorbed energy to the core of an inorganic core/shell structure, boosting the upconversion luminescence brightness by two orders of magnitude. This concept was also successfully applied to fields spanning from NIR bio-imaging, to multicolor displays, and to photovoltaics, as showcased by recent publications in the Journal of the American





Chemical Society (2016, 138, 16192-16195), and Nano Letter (2015, 15, 7400-7407). The “Tutorial Review” paper published in Chemical Society Review is a groundbreaking work on dye-sensitized upconversion, aiming to attract more attention worldwide to fertilize the emerging field.

In this seminal review, the authors elaborated on the theoretical perspectives of Förster and Dexter processes, highlighted energy transfer processes at the organic-inorganic and core/shell interfaces, made critical comments on recent developments of dye-sensitized upconversion, and finally casted a look at their future promising applications in photovoltaics, anti-counterfeiting, bioimaging, photodynamic therapy and optogenetics in the near infrared range. These new understandings on dye-sensitized upconversion eventually will entail bright, stable, and efficient hybrid organic-inorganic upconversion materials for important technological applications.

This work was financially supported by the National Natural Science Foundation of China, the National Natural Science Fund for Distinguished Young Scholars, the Swedish Energy Agency, the Fundamental Research Funds for the Central Universities, China, and the Start-Up Fund of Shenzhen University.

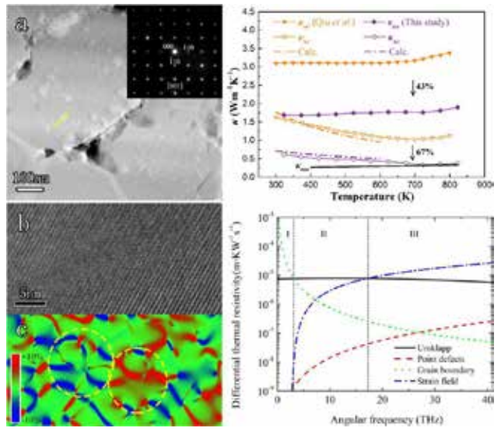
REFERENCE

X Wang, RR Valiev, TY Ohulchanskyy, Ågren H, C Yang, et al. Dye-sensitized lanthanide-doped upconversion nanoparticles. Chemical Society Reviews, 2017, 46 (14):4150

NEW MECHANISM TO REDUCE THE THERMAL CONDUCTIVITY OF THERMOELECTRIC MATERIALS

A team led by Associate Prof. Geng Huiyuan and Prof. Zhang Lixia from the State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology published a cover article titled "Filling-Fraction Fluctuation Leading to Glasslike Ultralow Thermal Conductivity in Caged Skutterudites" in the Physical Review Letters. The results provide an effective and general mechanism to improve the performance of thermoelectric materials.

Caged-compound $LaFe_4Sb_{12}$ is among the best thermoelectric materials, which can directly convert heat to electricity. However, the lattice thermal conductivity is far above the amorphous limit, indicating that there is still much room for improvement in the thermoelectric



properties of $LaFe_4Sb_{12}$.

The team has experimentally discovered the uneven distribution of La filling atoms in the $LaFe_4Sb_{12}$ system, which is shown to be thermodynamically stable based on first-principles calculations. A multiscale filling fraction fluctuation introduces multiple phonon scattering mechanisms to a wide-frequency spectrum of phonons including the rattling effect, strain field, and nanodots. The glasslike ultralow thermal conductivity and minimum lattice thermal conductivity approaching the theoretical minimum indicated that the uneven distribution of filling atoms is effective to release the potential of a “phonon-glass electron-crystal” for caged compounds, such as skutterudites and clathrates.

This work was supported by the "Hundred Talents Program" of Harbin Institute of Technology and the State Key Laboratory of Advanced Welding and Joining.

REFERENCE

W Ren, H Geng, Z Zhang, and L Zhang. Filling-fraction fluctuation leading to glasslike ultralow thermal conductivity in caged skutterudites, Physical Review Letters, 2017, 118:245901

NEWS & EVENTS

HIT CELEBRATED THE 2ND CHINA AEROSPACE DAY

Xi Jinping, General Secretary of the Central Committee of the Communist Party of China(CPC), when meeting with the astronauts and research participants of Tiangong 2 and Shenzhou 11 manned mission emphasized that "the universe is immensely incomparable, and the exploration is endless. Only by continuous innovation can China move towards the better future." On April 24th, Harbin Institute of Technology (HIT) held a series of activities with the theme of "Aerospace Creates Better Life" to celebrate the 2nd China Aerospace Day.

Wang Shuquan (Party Secretary of HIT), Xiong Sihao (Deputy Party Secretary of HIT), Zhang Hongtao (Deputy Party Secretary of HIT and Vice President of HIT), Wu Songquan (Member of HIT Party Committee and HIT Propaganda Minister), and Peng Yuankui (Assistant Principal) participated in the flag-raising ceremony.

This year is also the 30th Anniversary of the School of Astronautics at HIT. Academician Du Shanyi, Academician Chen Yushu and 30 teacher and student representatives took part in the torch relay to show the HIT inheritance. HIT President Zhou Yu, Members of the Chinese Academy of Engineering Yang Shie, Cai Hegao, Du Shanyi, Zhao Liancheng and Chen Yushu attended the book donation ceremony. Academician Huang Wenhu made a keynote speech.

On the same day, School Union and PE Department organized a hiking activity. HIT Press held Shenzhou-5 virtual reality experience activity. By using the Shenzhou-5 spacecraft virtual reality display platform, more than 30 students wore a VR headset to experience the whole process of the preparation before launch, launch, separation, and return. Propaganda Department of HIT Party Committee invited ZAKER Harbin to do the webcast of HIT Aerospace Museum tour for 33,000 nationwide space enthusiasts. More than 40 teachers and students from Harbin South Road Primary School came to visit the space museum under the guidance of HIT volunteers and student commentators. The HIT LilacSat Micro-nano Satellite Team members visited the HIT kindergarten to show wonderful videos and pictures and sow the seeds of the space dream.■

HIT PRESIDENT ZHOU YU VISITED UNIVERSITIES IN THE UNITED STATES

From May 16th to 18th, a 6 person delegation led by HIT President Zhou Yu visited the University of Illinois Urbana-Champaign, Northwestern University and the University of Chicago.

On May 16th, the HIT delegation visited the University of Illinois Urbana-Champaign and had a discussion with Chancellor Robert J. Jones, the Vice Provost for International Affairs and Global Strategies (VPIAGS), Reitumetse Obakeng Mabokela, and Director of Operations of the Technology Entrepreneur Center, Jed Taylor. The two sides achieved initial cooperation intent on the mode and innovation of personnel training and the industrialization of scientific research between the two universities. During the visit, the delegation also visited the College of Engineering and the College of Liberal Arts and Sciences and conducted discussions and exchanges on expanding the cooperation with related officials.

On May 17th, the delegation visited Northwestern University, and had a discussion with the Assistant Vice President for International Relations, Kim Rapp and related officials of School of Engineering and Applied Science. They reached a preliminary intention on the establishment of an undergraduate cooperative project. During the visit, the delegation also visited the Farley Center for Entrepreneurship and Innovation at Northwestern University.

On May 18th, the delegation visited the University of Chicago, and had a discussion with the Executive Vice President for Research, Innovation and National Laboratories, Eric D. Isaacs and the Associate Vice President of Entrepreneurship and Innovation, reached a preliminary intention on the establishment of an undergraduate cooperative project in order to strengthen in-depth cooperation in discipline construction and student training.

HIT PRESIDENT ZHOU YU VISITED SAINT PETERSBURG UNIVERSITY

From May 31st to June 3rd, a delegation led by Heilongjiang Governor Lu Hao visited Russia. HIT President Zhou Yu was invited to accompany the visit to Saint Petersburg University (SPbU), where he had a discussion with the SPbU Rector Nikolay Kropachev on mutual research projects with HIT and expanding the mission of the SPbU's representation office in HIT.

Mr. Nikolay Kropachev extended a warm welcome to the delegation and highly evaluated the collaboration between the university and Heilongjiang Province as a real example of humanitarian ties on a high level, which is an important contribution to partner relationships between the regions. SPbU also proposed a new format of collaboration as a legal expert support for businesses. "The University, as a leading Russian centre for expert evaluations, executes the orders from the Russian government and has rich experience in legal support of foreign partners concerning differences in legal systems between Russia and other countries", said the Senior Vice-Rector Ilia Dementiev. It has the potential to develop, said the Governor, as Heilongjiang is one of the China's leading centres that has business in Russia, and this format will ensure a balanced relationships between Russia's Government and China's enterprises, as well as understating in academic and business communities.

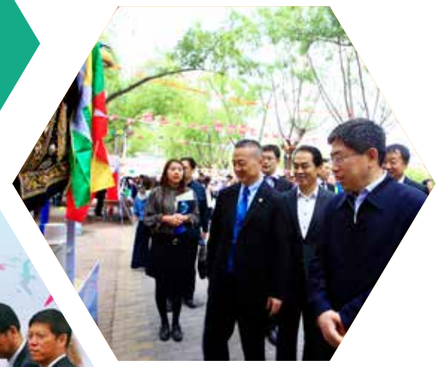
An active collaboration between the university and Heilongjiang Province started in 2014, when they signed a memorandum on education and research collaboration. SPbU and Heilongjiang are collaborating within the Russian-Chinese partner relationship. HIT President Zhou Yu reminded listeners that SPbU and HIT are implementing a number of big projects, including those in plasma physics, ecology, environment, and cultural heritage preservation of the Chinese Eastern Railway.■

SINO-JAPAN UNIVERSITY FORUM 2017

On May 14th, the Sino-Japan University Forum was held in Shanghai. Leaders from more than 50 universities attended the forum, such as Nagoya University, Hokkaido University, Waseda University, Tongji University, Zhejiang University, Dalian University of Technology, etc.

HIT Vice President Han Jiecai attended the forum and gave a speech. In the speech, Prof. Han introduced the profile, research content and long-term significance of “aerospace simulation systems on ground”.

Since 2010, the Sino-Japanese University Forum has been held in turn in China and Japan. It was sponsored by Mr. Kazuki Okimura, former President of the Japan Science and Technology Agency and 2015 winner of Chinese Government Friendship Award. It is an important scientific and educational platform between Chinese and Japanese universities.■



HIT INTERNATIONAL CULTURE CARNIVAL 2017

On June 3, the 3rd HIT International Culture Carnival was held. HIT Party Secretary Wang Shuquan, HIT Vice President Ren Nanqi and other related provincial leaders attended opening ceremony and pressed the ball to start the carnival.

More than 2000 students from 120 countries displayed characteristic culture from around the world. With songs, laughter and music echoing throughout HIT, international students with different colours, nations and languages, dressed in costumes with their own cultural characteristics, presented their special cultural items, such as foods, clothes and products, which attracted attention. ■

HIT INTERNATIONAL CULTURE CARNIVAL 2017

HIT ROBOT
SHOWCASED IN CES

On January 3rd, the 50th Consumer Electronics Show kicked off in Las Vegas. Most of the major electronics companies showed up, including Samsung, LG and Dell. Leju Robotics established by the PhD team from Harbin Institute of Technology showcased the "AELOS" and "TALOS" robot products with its 100% independent R & D.

"AELOS" has chat, simultaneous interpretation, voice search, voice repeat, voice command and other intelligent voice functions. It also has touching sensor and 9-axis acceleration sensor, and is capable of sensing touch around to maintain a balance. With 16 joints DOF, it is more flexible than the most robot products on the market. With its unique structural design and testified rigorous step algorithm planning, it can ensure the servo high-precision-rotation at the same time, which means AELOS can easily do tens of thousands of delicate actions. No matter if it is yoga, jumping, gymnastics, or even a set of difficult actions, AELOS can always show you the most exciting performance. Based on multi-OS and BT connection with a smart phone app or using game controller directly, AELOS is under the fingertip control, which enhances the interactive experience. It is also a smart robot with powerful intelligent learning module and algorithm to learn the freshest actions and language skills through the app.

As the first Chinese humanoid robot with visual function, "TALOS" is 60cm high, with arms and legs like a human and a UFO-shaped head, together with a blue background light, making it like a star in science fiction movie. It has the ability to grab light items with simple structured hands, each of which has 3 fingers. 22 high speed joints make it extremely human-like, whether its steps of feet or swinging of arms when walking. Different from ordinary robots' direction-altering process which follows the order of stop first, then change direction, then move forward, TALOS can smartly adjust the walking route, producing a smooth and natural walking curve. The Leju team tackled the technological difficulty and realized its swift and steady walking with the maximum step interval of about 15cm, 3 steps per second, and the maximum speed of 45cm per second, equivalent to the walking speed of a child.

Leju Robotics gathered a group of young and brilliant elites in the field of robotics and A.I. possessing a 100% independent IP of robotics hardware and control system, even mastering the related core technologies of robotics, mechanical design, core parts manufacturing, and A.I. algorithm. They are creative for the most inspirational robot and endowing robot humanoid outlook and wisdom of human being closely.

During the Consumer Electronics Show, AELOS and TALOS won international recognition and Leju Robotics signed cooperation contracts with customers from the United States, Germany, Spain, etc. ■

REFERENCE

http://www.lejurobot.com/
http://lejurobot.cn/en/

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