

The etiology, clinical diagnosis  
and treatment of H7N9  
avian influenza

Research and Application of Design  
and Development Platform for Advanced  
Control Equipments and Systems

Theoretical innovation and technological breakthrough  
on diagnosis and treatment of severe hepatic diseases

**H7N9禽流感的病原学  
及临床诊治研究**

病原学、临床诊治和疫苗研发  
等多方面获得重大突破

**高端控制装备及系统的  
设计开发平台研究与应用**

保障重大工程的安全可靠和高效优化运行

**重症肝病诊治的理论创新与技术突破**

成功救治数以百计的重症肝病患者

2013

浙江大学  
学术年报

ZHEJIANG UNIVERSITY  
ACADEMIC ANNUAL REPORT

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## PREFACE

Zhejiang University, situated in Hangzhou, a popular tourist destination full of history and culture, is an institution of higher learning with an enduring history of 117 years and a high reputation. During the course of its development, an excellent tradition with the motto of "seeking truth and innovation" came into being, supporting the mission of cultivating elites, promoting technological advances, engendering social development and spreading advanced culture. This comprehensive, research-oriented university has 7 faculties, 37 schools (departments) in 12 disciplines: sciences, engineering, agriculture, medicine, management, philosophy, economics, law, education, literature, history and art, as well as 7 affiliated hospitals of the highest standard. It is endowed with five campuses (Zijingang, Yuquan, Xixi, Huajiachi and Zhijiang), covering an area of 4.5 km<sup>2</sup> in total, university buildings themselves having an area of over 2,070,000 m<sup>2</sup>, with floor space of 260,000 m<sup>2</sup> still under construction. Currently, Zhejiang University houses over 6.58 million books and owns 46,045 full time students, among whom are 23,438 undergraduates, 13,949 master candidates and 8,658 doctoral candidates. In addition, 3,489 foreign students are enrolled as well.

Academic studies are the soul, source and foundation of a university, so academic advances constitute its wisdom, progress and reputation. Zhejiang University, upholding its academic and disciplinary development, has progressed a lot in disciplinary development, talent cultivation, research, academic exchanges and cooperation, and academic systems.

Embodying the creation, inheritance and accumulation of knowledge, the university aims to increase understanding and exploration of the objective world and its reality, to nurture an atmosphere of pursuing truth, impartiality, democracy and tolerance on the campus and to cultivate the culture of respecting, following, understanding and approaching academic studies, all of which serve as the ultimate source of the endless pursuit of students and faculty towards academic studies.

The compilation of the *Academic Annual Report* is targeted at arousing the attention and interest of students, teachers, researchers and the public towards the academic development of Zhejiang University, creating a strong academic atmosphere and enhancing academic exchanges.

By summing up university's academic achievements in 2013, which the online campus community has voted as the most noteworthy, the *Academic Annual Report* introduces and lists them. The Report serves as a compilation of the academic contributions of Zhejiang University members for the past year and serves as a record of Zhejiang University's march forward as a first-class university.

It is evident in this report that, by cherishing the philosophy of "seeking truth," innovation and exploration, Zhejiang University members will be better able to conduct academic studies and better serve the nation and the society with their professional knowledge, deliberation and discrimination.

Gratitude is extended to all who have supported and encouraged the compilation and publication of this year's *Academic Annual Report*.

Academic Committee, Zhejiang University

# ZHEJIANG UNIVERSITY ACADEMIC ANNUAL REPORT 2013

The Academic Annual Report 2013,  
Zhejiang University

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# Academic Development of Zhejiang University in 2013



In 2013, Zhejiang University, ever reforming itself, has made great progress in disciplinary development, academic research, domestic and international academic exchanges and cooperation, and academic system construction by implementing the following “six school-strengthening strategies”: cultivating talents most appropriate to the times, building the highest academic standards, engineering the most excellent research platforms, bringing to campus a galaxy of renowned educators, accumulating high cultural achievements and exploring ever more effective methods of reform.

## I. Disciplinary Development

With the aim of enhancing disciplinary development based on the construction of a “talent team,” optimizing the structure of teaching staff and attracting more talent in more effective ways, in 2013 Zhejiang University brought in 232 new top-notch recruits, among whom 125 were from foreign countries. There are 3,302 full-time teachers, including 1,497 professors, 13 academicians who are members of the Chinese Academy of Sciences, 16 with the Chinese Academy of Engineering, 3 senior professors of humanities, 60 scholars of the national “Recruitment Program of Global Experts,” 36 principal scientists of the “973 Project” and other key scientific research projects, 94 distinguished (chair) professors of the Chang Jiang Scholars Program, 99 winners of the National Science Fund for Distinguished Young Scholars (NSFDYS), 10 state-level outstanding teachers, and 24 members of the National Teaching Steering Committee.

To optimize the holistic arrangement of the disciplines, promote the fund-supporting programs of the central government’s “985 Project,” i.e. first-class disciplines and marine disciplines, Zhejiang University furthered its first-class basic discipline development and national key project cultivation programs. A national floating performance incentive of 158 million Yuan was awarded to Zhejiang University for its successful evaluation of the “985 Project” (2010-2013) central fund development

program. Moreover, Zhejiang University plans to invest over 1.8 billion Yuan, including 1.5 billion Yuan collected by the university itself, from the national incentive and transitional funds of the “985 Project” in disciplinary development. Zhejiang University also set up several key and emerging interdisciplinary platforms (e.g. brain science, microscopic observation and digitalized civilization) by conducting disciplinary investigations targeting the cutting-edge disciplines most urgently needed nationally and globally.

According to the ESI statistics issued on November 1st, 2013, Zhejiang University ranked 159 among the world’s academic institutions in cumulative citations of the past decade. Sixteen disciplines were among the world’s top 1% in ESI, among which, Material Science, Chemistry, Engineering and Agricultural Science ranked 26, 29, 33 and 36 respectively; Pharmacology & Toxicology, Computer Science, Plant & Animal science and Mathematics were among the world’s top 100.

## II. Human Potential Cultivation

For building moral excellence and rearing personnel excellence appropriate for the times, a good system and favorable conditions were perfected. On one hand, more funds, an increase of 25% over the previous year were invested in support of teaching. On the other hand, several activities, including the Appraisal for the Second Xiping Teaching Award, were launched to commend faculty with the best performance, creating an atmosphere of recognition for teachers and teaching excellence.

In 2013, 5,797 full-time undergraduates, 4,681 master candidates were admitted; 1,517 were granted doctoral degrees, 6,415 master’s degrees and 4,914 bachelor’s degrees. With career guidance and services offered to students, 96.89% of fresh 2013 graduates secured their initial employment; 57.26% graduates planned to further their studies at home and abroad, an increase of 2.1 percent over the previous year

Students’ capacity for innovation was also expanded. Undergraduates secured one outstanding international prize, 34 international first prizes, four outstanding national prizes and 10 national first prizes in disciplinary competitions. The following are of particular significance: continuously winning the outstanding prize in Mathematical Contest in Modeling & Interdisciplinary Contest in Modeling (MCM/ICM) in the previous four years, and the numbers of the winning are on the top among all the national universities; the national champion of the Small Size Robot League and the third winner in the Small Humanoid League in the Federation of the International Robot-Soccer Association; 16 winners of the Red Dot Design Award (Germany), including 7 best of the best. Moreover, the Innovation Project of the Ministry of Education was carried out and three national doctoral student academic forums were hosted. In addition, international postgraduate education was enhanced: 1,538 postgraduates were selected to study abroad for degrees, for united training, for exchange or for visiting programs. Postgraduates were encouraged to participate in high-level international academic conferences and many excellent papers with Zhejiang University postgraduates as the first authors were published.

With its promotion of Chinese culture and the development of Confucius Institutes, Zhejiang University was approved as a model university for international students to China by the Ministry of Education. The proportion and quality of international students to the university were enhanced in 2013. There were 5,268 international students at Zhejiang University (including non-degree students) recorded in 2013, a rise of 5.3%. 2,499 students among them came for degree studies, a rise of 13.6% over the previous year.

## III. Research Capacity

Guided by the principle of “developing research while promoting quality” suggestions on deepening the meat of scientific research were put forward. Key groups, projects and platforms for national urgent needs and international forefronts were organized in 2013, including the National Engineering Laboratory for Industrial Control System Security Technology and the National and Regional Joint Engineering Laboratory of Industrial Biocatalysis (Zhejiang).

Scientific research maintained strong momentum in 2013. Total research funds of 3.09 billion Yuan were delivered to the school; 713 National Natural Science Foundation of China (NSFC) were approved, with funds of 0.579 billion Yuan, a rise of 3% over the previous year. One innovative research group foundation and one innovative group project of the Ministry of Education were recognized as well.

The university’s basic research capacity was upgraded also. In-situ Research System on Material Structure and Properties under Demanding Conditions of Use, headed by Academician Ze Zhang, was approved as the special development project of the national key research instruments and equipment of the National Natural Science Foundation of China (including funding of 56 million Yuan), achieving a breakthrough in this kind of project. Moreover, Zhejiang University undertook three projects of the National “973 Plan” as the lead participant, securing projects in all the fields of the 973 Plan, including resources and environment. Three key scientific research projects made breakthroughs in quantum control and nanometer research. Besides, there was one special young scientist project and one key project of the National Science Foundation of China achieved by Zhejiang University.

Furthermore, the capacity for key research missions was upgraded. Several key 863 projects were organized, including the chairing of the first public welfare industrial project of the State Oceanic Administration. Zhejiang University also won support for several key scientific projects, including the prevention and treatment of infectious diseases, transgenosis, numerically controlled machine tools, integrated circuit equipment and the treatment of water pollution. Disciplines in advantageous positions were organized to design, implement and participate in a number of key special national defense projects as well. Plenty of cooperation projects with enterprises, with funds above 10 million Yuan were initiated, and 116 of such projects were underway. The “2011 Plan” was carried out for the organization, cultivation and coordination of cooperative innovation centers between the nation, province and the university, including the launch of a cooperative innovation center for the diagnosis and treatment of infectious diseases. Finally, 87 technology transfer contracts were signed and 134 scientific achievements were approved to be implemented or transferred.

## IV. Academic Influence

Several landmark research achievements were scored by Zhejiang University by emphasizing quality, perfecting incentive policies and cultivating research productivity. According to statistics issued by the Institute of Scientific and Technical Information of China (ISTIC), Zhejiang University ranked first in the following three indexes in 2012: 4,912 SCI papers, 29,482 cumulative citations (236,302) in the past decade and 1,429 good-performance papers. Besides this, the overall academic standards and quality were improved with the publication of papers in scientific journals with the world’s highest impact factors, including two papers published in the journal Science, one in Cell, and 6 in the sub-journals of Nature. In addition, one paper was published in The New England Journal of Medicine and five papers in Proceedings of the National Academy of the Sciences of the United States of America (PNAS).

With 2,134 national patents, including 1,423 patents of inventions, Zhejiang University also ranked first in the number of patents among colleges and universities in Mainland China. Eleven projects with Zhejiang University as the first unit of completion got National Science and Technology Awards, among which, Research and Application on the Design and Development Platform of High-end Control Equipment and System, headed by Academician Sun Youxian from the Zhedu Department of Control Science and Engineering, and Theoretical Innovation and Technological Breakthrough in the Diagnosis and Treatment of Severe Liver Disease, headed by Academician Lanjuan Li from the First Affiliated Hospital of the Zhejiang University College of Medicine, were awarded the First Prizes of State Scientific and Technological Progress Award. Meanwhile, three projects won Second Prize in the State Natural Science Awards; three projects won Second Prize in the State Technological Invention Awards; three projects won Second Prize in the State Scientific and Technological Progress Awards, making a record high for the university in 2013.

With the collaborative research in Zhejiang University’s National Key Laboratory of Diagnosis and Treatment of Infectious Diseases, headed by Academician Li Lanjuan and the National Key Laboratory of Emerging Infectious Diseases, Hong Kong University the vaccine strain of the human-infected H7N9 avian influenza virus was successfully developed based on the research on the etiology and clinical diagnosis and treatment of

H7N9 avian influenza. This first independently developed influenza virus vaccine strain by the Chinese eased the nation's dependence on imported influenza virus vaccine strains, constituting one key innovation in the prevention and control of emerging infectious diseases. It was appraised as one of the "Ten Technological Advances of Chinese Higher Schools" in 2013. The project, "Full Carbon Aerogel Solid Materials," from the Department of Macromolecules, was another project that received praise this past year, and Zhejiang University was granted "Distinguished Contribution Team" of 2013 by the General Armament Department of the PRC with the successful application of research results in one key experiment.

#### V. Advances in Philosophy and Social Sciences

Several policies in supporting and safeguarding prosperous advances in the humanities and social sciences were made based on the principles of humanities development. Research funds of 0.21 billion Yuan were delivered to the university in 2013. The university's high-level scientific projects held a leading position among universities in China, with 36 National Social Science Fund projects, seven key bidding projects of National Social Science Fund and two key brainstorm projects in Philosophy and Social Science Research, from the Ministry of Education. In addition, there were 244 SSCI papers, 16 A&HCI papers in the social sciences ranked in the top 1% of the global ESI disciplines. The humanities upgraded their capacity for serving the national decision-making processes with more research conducted on key theoretical and practical issues and several decision-making and advisory reports instructed or commented on by state leaders.

#### VI. International Cooperation and Exchange

Zhejiang University strengthened its ties with top universities and first-class disciplines in the world by establishing a number of international campuses. A Memorandum of Cooperation was signed with Imperial College London, aimed at helping establish an international joint college. Zhejiang University also signed cooperation agreements with Oxford University, with the University College London with University of Illinois at Urbana-Champaign, and with the University of California-Los Angeles, etc. Cooperation agreements were negotiated with famous universities in Canada and Australia, too. The International Campus Construction and Development Committee and its office was set up to make preparations targeted at developing Zheda's international campuses into world renowned bases for education, research, transformation and industrial application.

Moreover, in 2013 students and faculty of the university went abroad 7,137 times for study and exchanges in foreign countries, an increase of 12.8% over 2012. Among them, the number of students reached 3,509. The seventh "Senior Symposium of Chinese—Yale University Leaders" was held; President Jianhua Lin of Zhejiang University was invited to the Sino-US High-level University President Roundtable Conference, which added to our university's international reputation.

Cooperative networks and international cooperative platforms were established with the first-class universities and advanced research institutes in the world. Zhejiang University housed the "Joint Innovation Center for Chinese-Portuguese Advanced Materials," the "Cooperation Platform for the Marine Sciences between Zhejiang University and the University of

Western Australia," the "Zhejiang Province—Schleswig-Holstein Joint Biomass Center," and the "Zhejiang University—University of Marburg 'Tradition-Frust-Future' Strategic Partnership," etc.

#### VII. Academic System Construction

The Academic Committee, based on Regulations of the Zhejiang University Academic Committee, exerted great influence in disciplinary construction and development planning, "985 Project" construction, the "2011 Plan," the setting and adjustment of schools and departments at Zhejiang University by exercising its academic power.

To give full play to the systematic management of faculties and professors' academic management, to motivate the various schools and departments to be vigorous in their academic performance and to sharpen the comprehensive strength and core competitiveness of Zhejiang University, the Academic Committee put forward the idea of "forming an integrated and layered academic management system by establishing and perfecting the academic committee systems of Zhejiang University, faculties, schools and departments," which will help give reign to a more holistic functioning of the university, facilitate systematic academic management and scientific decision making, enhance the self-management and self-development of schools and colleges and better realize professors' academic management. Through detailed research and discussions, Regulations of Zhejiang University Faculties and Rules of the Academic (Professor) Committees of Zhejiang University Schools and Departments were stipulated to clarify the nature, functions of faculties and the obligations of the academic committees of schools and departments.

"There stands a National University on the bank of the River of ZheShui" with the philosophy of "Seeking Truth and Innovation," and as such, in 2014 Zhejiang University aims to continue creating and disseminating knowledge, popularizing and carrying forward civilization, and serving and leading the society while propelling national prosperity, social development and human progress.



THE NATIONAL AWARD FOR SCIENCE  
AND TECHNOLOGY PROGRESS IN 2013  
FIRST PRIZE

THE ACADEMIC COMMITTEE  
OF ZHEJIANG UNIVERSITY

## Research and Application of Design and Development Platform for Advanced Control Equipments and Systems



Selected as The TOP 10 Academic Advances of the Year

Facing the national needs, the design and development platform, which is composed of hardware platform, software platform, and advanced control and optimization platform, has played an irreplaceable role in independently developing the advanced control equipments and systems for national major equipments and major projects.

### Project Leader: Youxian Sun

Control equipments and control systems are the nerve centers, operation centers, and security barriers of the modern industrial equipments and of the major projects in the areas of metallurgy energy, chemicals, defense and so on. Their functions are to monitor, control and optimize the entire process and product quality, and to ensure reliable and efficient operation of various equipments.

After 50 years of major equipment development in China, we have had considerable design and manufacturing capabilities, but most of the accompanying advanced control equipments depend on foreign developed countries, especially the core technology platform for developing advanced control equipments is almost completely monopolized by foreign countries. The control system development lag is one of the key reasons why the Chinese industry is large but not strong, which brings potential threat to the national economic security and industrial security.

Facing the national needs, after a decade of technology development and applied research, the research group of Prof. Sun Youxian has solved the four key problems of high security, high reliability, high adaptability, and large scale, and made significant innovations to establish successfully the design and development platform for developing advanced control equipments and systems. The advanced control equipment and system design and development platform, which is with independent intellectual property, is composed of the hardware platform, the software platform, and the advanced control and optimization platform. It has played an irreplaceable role in the development of advanced control equipments and systems for national major equipments and major projects.

In the design and development hardware platform for advanced control equipments and systems, the research group has solved the redundant fault-tolerant control technology, the online performance monitoring technology, and highly adaptable intelligent module technology. So, the advanced control equipments and systems can adapt to a variety of harsh industrial environments and complex control projects.



In the design and development software platform for advanced control equipments and systems, the research group has implemented the multi-field project object model technology, the cluster distributed real-time database technology, and the integrated development environment. The control algorithms can be encapsulated, reused, reconstructed and cloud-updated for different industries. Meanwhile, the control algorithms also support multi-user collaborative programming, remote maintenance, and security control.

On the basis of the hardware platform and the software platform, the research group has further developed the advanced control and optimization platform for advanced control equipments and systems, and has successfully apply to the large-scale blast furnace TRT equipments, air separation plants, and national other major equipments or major projects. Typical applications include:

(1) Large-scale blast furnace gas top pressure recovery turbine unit (short for TRT) intelligent controlsystem: The stability of top pressure, stability of acceleration process, security of emergency switch of the intelligent control system are better than other similar controlsystems in the international. The research group narrowed the fluctuations of top pressure to 1.5kPa comparing to 3kPa by using international control system. And the research group reduced the time of emergency switch from 8 seconds to 2 seconds. This high-precision control technology pushed the wide and rapid application of TRT unit in the country, and significantly promoted to save energy and reduce emissions in national steel industry. After the application

of the technology of this project, Liuzhou Iron and Steel Plant can recover over 500 million kWh of electricity every year

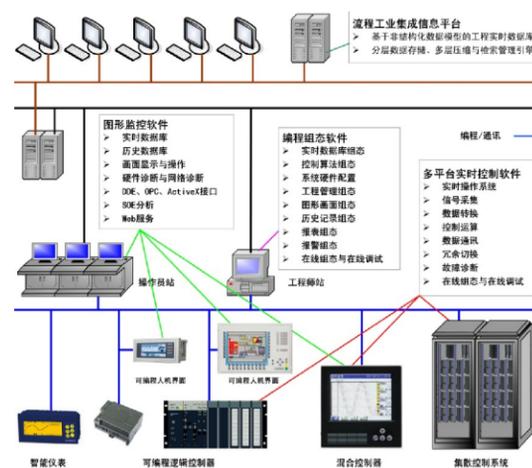
(2) The integration system of optimization and control for the large-scale air separation unit: air separation unit (ASU), as a major general unit of metallurgical, petrochemical, coal chemical industry and other areas, is a typical application object of the complex industry, where the dynamic modeling, optimization of energy saving and high-purity control are mainly involved international research difficulties. Many scientists in this research field from the United States, Japan etc. devote their lifetimes to research them. Over the last decade, the research group first reported both the inverse response and the unique wave phenomena of the internal thermally coupled distillation in the world by both the theoretical and applied researches. A nonlinear wave model was then proposed, which revealed the intrinsic reason why this energy efficient process is difficult to control. Furthermore, a novel integrated optimal design approach to ensure the product quality and the maximum performance under controllability and maneuverability was proposed. An efficient control scheme with very high purity, 99.999%, for thermally coupled distillation was then achieved, and a variety of highly efficient optimization methods of both energy-saving potential and production potential were further obtained. The research group solved the above difficulties finally, and formed a series of key technologies of optimization and control with independent intellectual property, which were of the international leading level, and a number of inventions were therefore authorized to the applications in the international leading companies of air separation industry.





In February 2012, the State Key Laboratory Assessment Panel led by Academician Zhang Bo visited the State Key Laboratory of Industrial Control Technology and spoke highly of the project achievements: "The design and development platform for advanced control equipments and systems has played an irreplaceable role in the development of advanced control equipments and systems for national major equipments and major projects." Academician Zhang Bo gave a further explanation of this unique evaluation: "Although other State Key Laboratories in the field of automation also have a lot of application achievements and also achieve good economic benefits, however, only this laboratory has designed and developed a series of advanced control equipments and systems, and broke the monopoly of foreign technologies. So, the Assessment Panel agrees to use the 'irreplaceable' word."

The project achievements have been successfully applied to more than 2500 units in the large-scale blast furnace TRT equipments, air separation plants, thermal power plants and other industrial equipments. The customers include the famous largest of 5000 cubic meters of blast furnace in China Baosteel Group, and the largest 5250 cubic meters of blast furnace in Korea Hyundai Steel Group. The technical performance indicators surpass the foreign mainstream systems and achieve the leading level of similar technology. The advanced control equipments and systems have the international market competitiveness, and have been exported to USA, Germany, Japan, Korea and other foreign countries. We have obtained 65 patents and 30 software copyrights, published 108 SCI&EI papers and 4 books. In the nearly three years, Output value of 18.91 billion yuan and economic benefit value of 7.29 billion yuan were created. Meanwhile, significant social benefits were also generated for promoting energy conservation and emission reduction.



## Theoretical Innovation and Technological Breakthrough on Diagnosis and Treatment of Severe Hepatic Diseases



Severe hepatic diseases mortality is as high as up to 80%, which is a world-wide hard problem. With 14 years continuous research, academician Lanjuan Li and her team make a series of theoretical innovation and technical breakthrough in fields of diagnosis and treatment of severe hepatic diseases, and treat tens of thousands of patients with severe hepatic diseases, that is kind of new medical miracle.

### Project Leader: Lanjuan Li

On January 10, 2014, the national science and technology awards conference was held in Beijing Great Hall of the People. The project theoretical innovation and technological breakthrough on diagnosis and treatment of severe hepatic diseases led by academician Lanjuan Li won the first prize of national science and technology progress prize in 2013. Premier keqiang Li gave the prize, President jinpings Xi shook hands and expressed greetings with academician Lanjuan Li and academician Shusen Zheng.

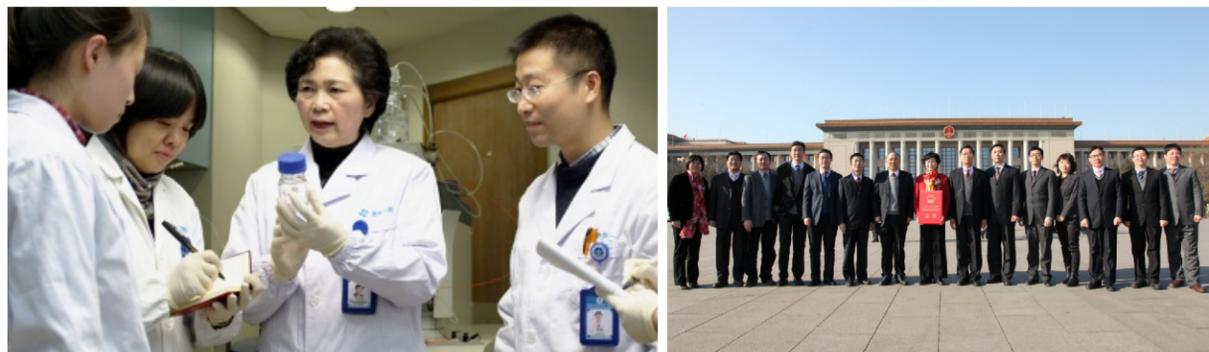
With 14 years continuous research, academician Lanjuan Li, academician Shusen Zheng and over 100 researchers team create new treatment for severe hepatic diseases, that is combined Li's artificial liver system and artificial liver transplantation therapy, publish 276 SCI papers, cited 1784 times and have 18 invention patents, which is highly appreciated by domestic and foreign colleague, and academician Lanjuan Li is praised as the leader of world's largest artificial liver group.

"Li's artificial liver" significantly reduced the mortality rate of liver failure patients, which is currently the best treatment of acute and chronic severe hepatitis

Liver failure is a kind of clinical critical disease with a 60-80% mortality rate, and its diagnosis and treatment is not only a clinical difficulty but also a scientific research hot spot. In the 1980s, under the supervision of Academician Lanjuan Li, the research group from the first affiliated hospital of Zhejiang University created a unique and effective method named Li's non biological artificial liver (Li-NBAL) for treating liver failure according to different causes, pathogenesis and clinical features of patients.

The Li-NBAL includes a series of units including plasma exchange, hemofiltration hemoperfusion, hemodialysis, plasma adsorption et al and flexibly combines these units according to patients' conditions, which can compensate the liver's functions such as detoxification, protein synthesis, metabolism of bile secretion and immune defense et al.





More than 40 patients with liver failure were saved due to the introduction of this artificial liver. This study obtained second prize of national Science and Technology Progress Award in 1998. Since then, Lanjuan Li and her team continued to improve the artificial liver technique. Through the optimization and standardizing treatment process, reducing the dependence on plasma, further improved the effect of treatment. According to statistics, the First Affiliated Hospital of Zhejiang University has used Li's artificial liver technique in more than 5000 cases, successfully rescued more than 1800 patients of severe hepatitis, including many patients with hepatic encephalopathy. It reduced the mortality rate of acute and subacute severe hepatitis from 88.1% to 22.1%, chronic severe hepatitis from 84.6% to 56.6%, opening up a new way of treatment on patients with severe hepatitis. In order to benefit more people, Academician Li held artificial liver study class once a year, extended the artificial liver technique to the whole country. At present, there are 31 provinces and cities, more than 300 hospitals, accumulated using the artificial liver treatment for liver failure more than 100 thousand times, saving numerous lives of critically ill patients, is the best technology for treatment of hepatic failure.

Artificial liver technology creates the opportunity for liver transplantation. The 5-year survival rate of liver transplant recipients with severe hepatic diseases increases to more than 80%.

At present, the number of patients with viral hepatitis, fatty liver disease or autoimmune liver disease is 100 million, meaning that liver disease severely threaten the life and health of people.

To bring more hope to severe patients, Academician Li and Academician Zheng innovatively adopt a new treatment -artificial liver combined with liver transplantation. It not only provides severe patients with more time to wait for transplant donor, but also improves patients' liver function. Therefore, more patients are reborn through transplantation. In addition, Academician Li creatively applies artificial liver to liver transplantation, which reduces 22% of bleeding during liver transplantation and 27% of intensive care unit stay time after surgery. At the same time, the 5-year survival rate of liver transplant recipients with severe hepatic diseases increases to more than 80%. It effectively solves difficulties of poor treatment effect and high fatality rate during liver transplantation and makes a new breakthrough in Hangzhou standard of liver transplantation for hepatocellular carcinoma. And it has been proven effective in western countries.

At present, the First Affiliated Hospital of Zhejiang University has carried out 1200 cases of liver transplantation, 172 cases of living donor liver transplantation. 1-year, 3-year and 5-year survival rate are 95.2%, 84.9% and 75.7% respectively. The curative effect has arrived at the international leading level.

Find the relationship between intestinal micro-ecology and liver disease for the first time, and create a new strategy to prevent and cure severe hepatic diseases by intervening micro-ecology.

Normal intestinal microbiome is the largest bacterial system in human. Intestinal bacteria flora begin to colonize when human is born, and determinately inhabit after 1-2 weeks. Then, the distribution and number of bacteria remain relatively stable, which accompany with our whole life. Normal intestinal microbiome benefits our health. Intestinal bacterial flora is not only connected to gastrointestinal system, but also closely related to liver disease which is even one of direct reasons for death of patients with decompensated cirrhosis or severe hepatitis.

In 1994, Academician Li and her team found that bacteria resulting to infection and endotoxin avating hepatopathy were from human intestinal tract, first revealed that diversity of endogenous virulence genes in intestinal microbiome increased when liver disease became more severe, and unveiled that variety of lachnospiraceae was closely related to severe hepatic diseases, facilitating future efforts to better prevent and treat severe hepatic diseases.

Find new screening biomarkers for hepatocellular carcinoma and cirrhosis, making the accuracy of hepatocellular carcinoma and cirrhosis identification increase to 96.4%.

Alpha fetoprotein (AFP) is a common tumor marker in clinic to screen hepatocellular carcinoma (HCC). But AFP value in 10%-15% of hepatocellular carcinoma patients is normal. Therefore, we cannot exclude HCC even if the result is negative.

Aiming at solving this problem, academician Li and her team concentrate on the study, finding and identifying 13 potential serum biomarkers. They first discover that canavaninosuccinate decreases significantly in patients with cirrhosis and increases in patients with HCC. This means that there are more evidences for the differential diagnosis of HCC. In addition, the accuracy of HCC and cirrhosis identification diagnosis can increase to 96.4% by establishing metabolic profiling of liver cancer and diagnostic mode of cirrhosis, which is better than AFP with the accuracy of 74%.

Headed by academician Lanjuan Li and academician Shusen Zheng, all researchers in State Key Laboratory for Diagnosis and Treatment of Infectious Diseases work hard, some of them are responsible for National Key S & T Special Projects, "973" project, "863" project and other national or provincial and ministerial projects, get a series of theoretical innovation and technological achievements in the field of diagnosis and treatment of severe hepatic diseases, cure many patients with fulminant hepatitis.

## ACADEMIC ADVANCES OF ZHEJIANG UNIVERSITY IN 2013

THE ACADEMIC COMMITTEE  
OF ZHEJIANG UNIVERSITY

# Discovery of New Se Compound Superconductors



Getting high temperature superconductors is a one-century dream for scientists. Understanding well on this macro-quantum behavior is a challenge for the physicist wisdom. Discovery of superconductivity in three Se compounds by Prof. Minghu Fang provides a new way to understand the unconventional superconductivity.

**Project Leader: Minghu Fang**



A superconductor is a material that can conduct electricity or transport electrons with no resistance. This means no heat, sound or any other form of energy would be released from the material when it has reached "critical temperature" ( $T_c$ ). Superconducting cable can be used to transport a large current and make a magnet with higher magnetic field, which has been applied to the medical testing, brain research, maglev train, controlled nuclear fusion et al. Since superconductivity with  $T_c=4.2\text{ K}$  ( $-269\text{ }^\circ\text{C}$ ) was first observed in Hg by Dutch physicist Onnes in 1911, in the past 100 years, research achievements in this field, 10 physicists, obtained 5 times Nobel prize. Physicists observed superconductivity with different  $T_c$  in many elements and alloys. In 1986, the discovery of high temperature superconductivity ( $T_c>77\text{ K}$ ,  $\text{LN}_2$  temperature) in copper oxides excites physicists to search for higher  $T_c$  superconductors and reveal its microscopic origin. However, physicists encountered many unprecedented difficulties in the making-wire and the understanding on superconductivity for these compounds. Thus, in order to reveal their mechanism, the search for other new superconductors becomes one of the most important topics in both the physics and material disciplines.

After the discovery of superconductivity with  $T_c=26\text{ K}$  in the FeAs compounds was made by a Japanese scientist at the beginning of 2008, many Fe-based superconductors were discovered, most of which was made by the Chinese physicists. Prof. Minghu Fang's group, Department of Physics of our University, discovered three  $(\text{Ti,K,Rb})\text{Fe}_2\text{Se}_2$ ,  $\text{Fe}(\text{Te,Se})$  and  $\text{TiNi}_2\text{Se}_2$  superconductors and proposed many new ideas on these Fe-based superconductors.

In Nov, 2013, their work on superconductivity in the new  $\text{TiNi}_2\text{Se}_2$  compound was published in Physical Review Letters (PRL), the top best journal of physics, as an Editor's suggestion. Now, there are 10 laboratories in the world to do the research using the crystals grew by Prof. Fang's group, indicating that the research on this

compound may become an activity topic in the superconductivity field. In Dec., 2010, Prof. Fang's group reported first the discovery of a bulk 30K and a 40K sign of superconductivity in the  $(\text{Ti,K,Rb})\text{Fe}_2\text{Se}_2$  compounds and suggested the existence of Fe vacancies super-lattice in these compounds. After this work was published in the Europhysics Letters (EPL) in the April, 2011, it has been cited more than 250 times. In the April, 2013, Thomson Reuters released a report on Research Fronts 2013: 100 Top-Ranked Specialties in the 10 Sciences and Social Sciences. Research on  $(\text{Ti,K,Rb})\text{Fe}_2\text{Se}_2$  superconductors was chosen as the first one in the 10 Top-ranked in the physics. In the 49 core papers of this field in the world, there are 5 papers provided by Prof. Minghu Fang's group. In the July of 2008, Prof. Fang, who was an invited scholar in Tulane

University, reported first 14K superconductivity in  $\text{Fe}(\text{Te,Se})$  system. This work was published in Physical Review B (PRB) as an Editor's Suggestion in the Dec. of 2008, which has been cited more than 200 times.

In the past 5 years, Prof. Fang and his collaborators have published 36 papers, in which 1 paper was published in Nature, 6 papers in PRL, 11 papers in PRB, 4 papers in EPL, and 3 papers was chosen as one of the 100 Most Influential International Academic Articles of China, and 10 papers are chosen as the highly cited paper in Web of Science. Prof. Fang was invited by many international conferences and workshops as an invited speaker or key lecture.



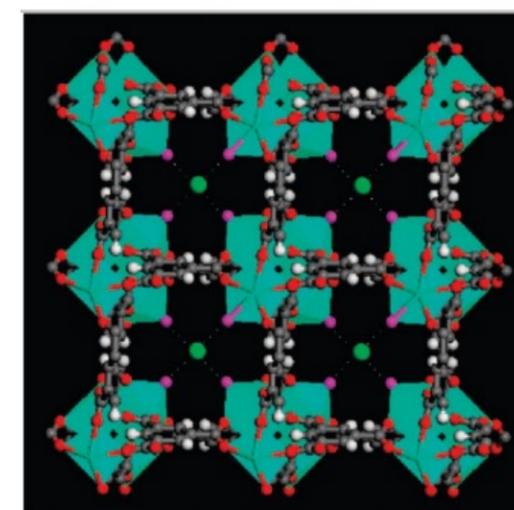
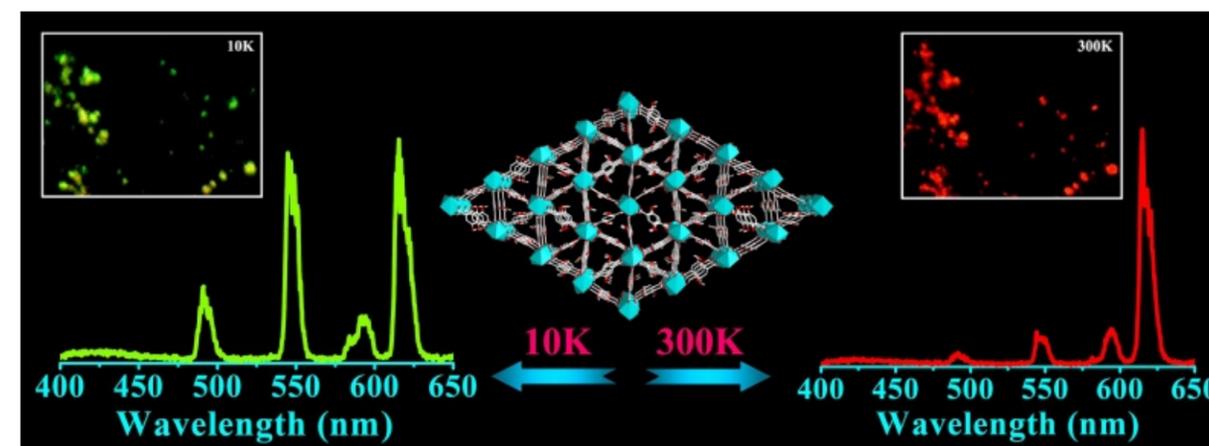
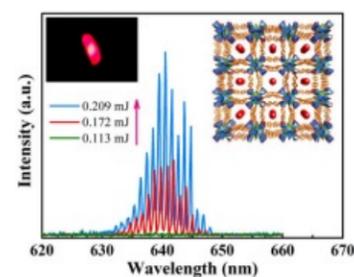
# Metal-Organic Frameworks (MOFs) for Photonics Applications



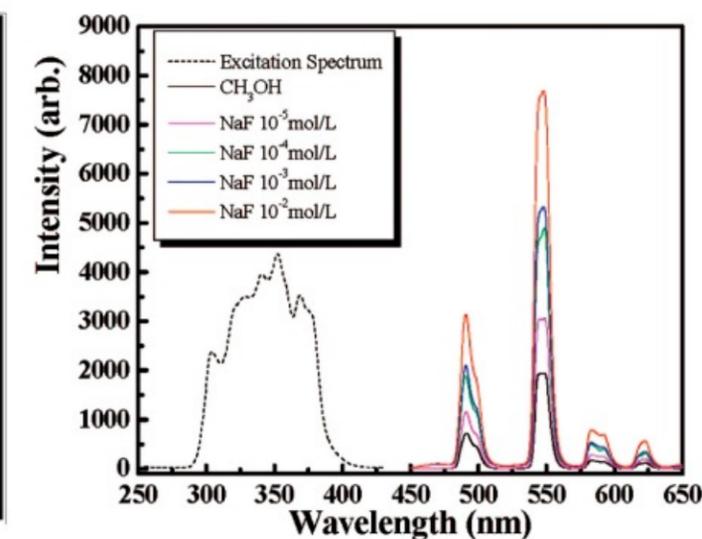
The research on photonics metal-organic frameworks strongly promote the development and application of MOFs in the field of photonics, and the results greatly improved the academic status and academic influence of Zhejiang University.

## Project Leader: Guodong Qian

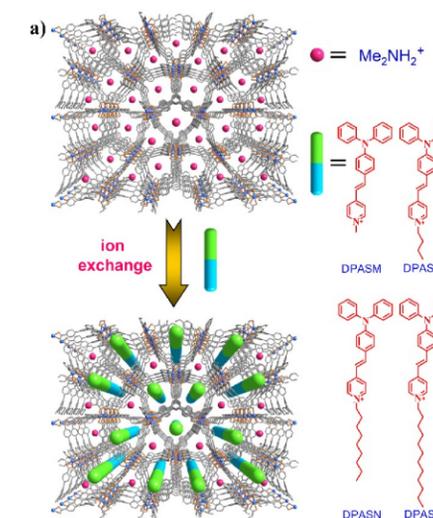
Metal-organic frameworks (MOFs) are highly crystalline inorganic-organic hybrid materials comprised of metal ions or clusters that form vertices of a framework and organic linkers that act as bridges. MOFs have attracted tremendous attention over the last decade due to their promising applications in gas storage, gas capture, and separations. However, the photonics applications such as luminescent sensing, nonlinear optics and lasers based on MOF materials have been scarcely reported. Furthermore, the assembly process and the influence mechanisms of the photonics properties of the MOFs are still difficult to effectively control and tune. Aimed on these key scientific problems, Qian's group developed a novel assembly method using lanthanide ions as metal centers to prepare the highly luminescent MOFs, and then realized the luminescence sensing of small organic molecules (such as traces of nitro explosives, bacterial spores, etc.), heavy metal ions and temperature. In addition, they demonstrated a novel approach through postsynthetic modification to construct photonics MOF materials with high second-order nonlinear optical activity and enhanced microcavity lasing emission.



(a)



(b)



They have published 18 scientific papers in premier journals including Chem. Rev., Nature Commun., Angew. Chem. Ed. Int., J. Am. Chem. Soc. and Adv. Mater., which have been cited 2363 times by other authors. Among these papers, 8 papers have been selected by ESI as Highly Cited Papers, and 1 paper as Hot Papers. 1 paper has been selected by the China Institute of Scientific and Technical Information as one of the 100 most influential international academic papers in 2012. The above results strongly promote originality and expand the development and application of MOFs in the field of photonics, which greatly improved the academic status and academic influence of Zhejiang University.

# Disordered Alloy Materials

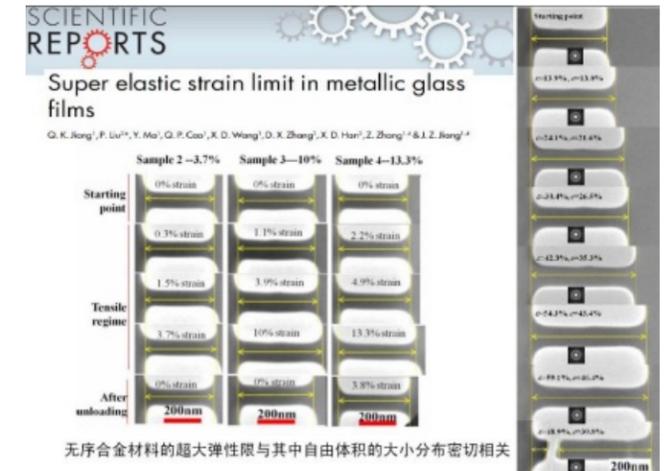
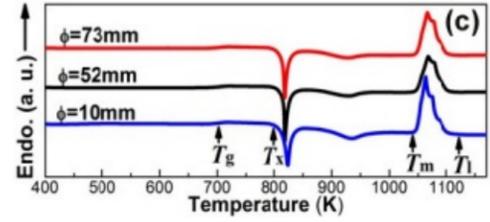
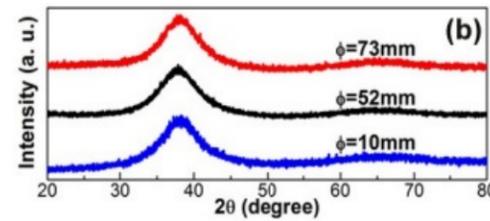
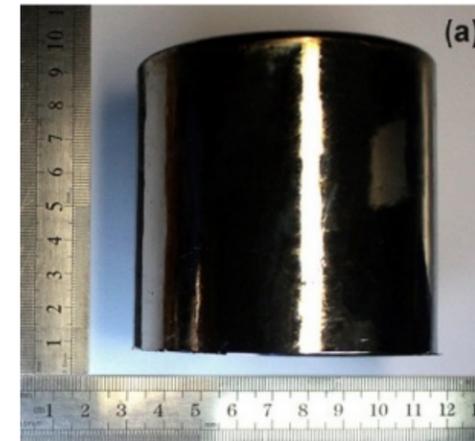
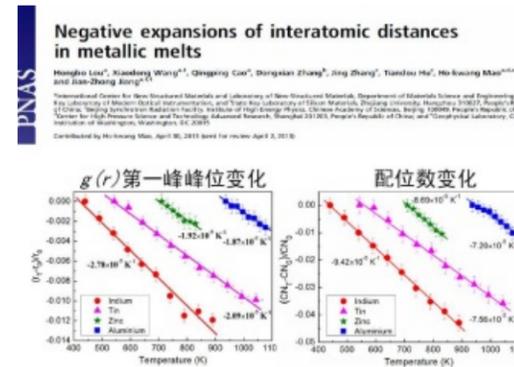


A team titled New-structured materials led by Jianzhong Jiang in the Zhejiang University has made several original contributions to the atomic structure, mechanical properties and new alloy development of disordered materials, unveiling many scientific issues on this new type of materials and winning world-wide known reputation in the community.

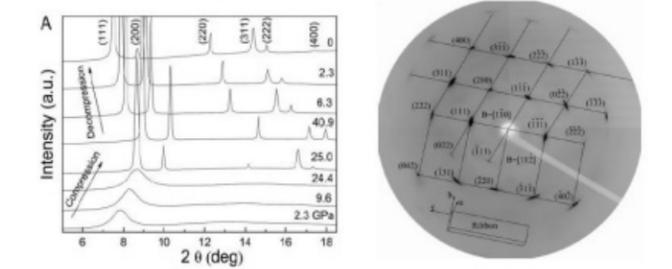
Project Leader: Jianzhong Jiang



Disordered alloys are currently one of the hottest issues in metallic materials. Without translational periodicity of atomic packing, they exhibit superior properties compared to their crystalline counterparts and wide dual-use applications. P.W. Anderson, a Nobel Prize winner, has ever pointed out in Science that understanding of the disordered materials is the most important and most difficult issue in condensed matter physics and materials science. It is commonly assumed that disordered materials have short-to-medium range order but free of long range order. The team of Jiang's group in the Zhejiang University first discovered that long range topological order can exist in disordered alloys, which changes people's traditional view to disorder structures. In crystalline materials, heating generally dilates the materials by increasing the atomic distance between the nearest neighbor atoms. However, the team uncovered that atoms in liquid metals form clusters, in which the distance between the center atom and atoms on the first shell decreases rather than increases with rising temperature. The finding of this new phenomenon makes one step forward in solving the fundamental issue of atomic structure of disordered materials. Normally, the elastic strain limit of metals is less than 1%. Whereas it can be 6.6%, the largest value for a newly-developed Ni60Ni40 disordered alloy by



**REPORTS**  
*Science* 332, 1404 (2011)  
**Long-Range Topological Order in Metallic Glass**  
 Qiaoshi Zeng,<sup>1,2</sup> Hongwei Sheng,<sup>3</sup> Yang Ding,<sup>2</sup> Lin Wang,<sup>2,4</sup> Wenge Yang,<sup>2</sup> Jian-Zhong Jiang,<sup>1\*</sup> Wendy L. Mao,<sup>1,5,6</sup> Ho-Kwang Mao<sup>1,2,7\*</sup>



**Ce75Al25 无序合金中静水压诱导非晶-晶体相变现象**

this group, which has potential applications in high elastic energy devices. Up to date, the disordered alloys that have 20 mm diameter are still quite few, seriously restraining their industrial applications. The team developed a Zr-based disordered alloy with 73 mm diameter, the largest size reported in the world so far by copper mould casting. This alloy has several good characteristics as follows: (1) large size, (2) good thermal stability with supercooled liquid region of 110°C, (3) high thermoplastic formability, (4) high strength and high corrosion resistance to sulphuric acid, especially showing prospective future in MEMS, nanoprining, etc. The related results have been published in international high-impact journals, such as Science, PNAS, PRL, and so on.

## Fracture Criterion of Crack Propagation Complete Process in Concrete and Green Cementitious Composites with Ultrahigh Toughness



Selected as The TOP 10 Academic Advances of the Year

Macro cracks in a concrete structure influence directly lifetime and safety of the structure. The theory of fracture mechanics and fracture criterion of concrete are important tools for understanding and controlling crack behaviors in concrete structures. Furthermore, in order to overcome the brittleness of concrete materials, developing a flexional concrete with high toughness is a beautiful goal.

Project Leader: Shilang Xu

Traditional cementitious materials such as concrete are typical quasi-brittle materials. Durability problems associated with the ease of cracking have reduced the service life of many existing structures, leading to significant waste of natural resources and energy. Every year, over 4 billion square meters of concrete are used in various engineering projects in China. The constructed infrastructures, including high-speed rails, nuclear power plants, high dams, long-span bridges as well as very tall buildings, are often designed for a service life of over 100 years. During service, cracks of different dimensions can form in concrete structures. Under adverse environmental condition and mechanical loading, crack tip stress concentration will lead to visible damage under nominal stresses well below the tensile strength of the material. Cracking is the major reason for durability of concrete structures to be greatly reduced, and is often the fundamental cause of serious safety issues under extreme conditions. For a long time, theoretical understanding of the complex fracture mechanisms in concrete has been rather poor. Since 1961, many scholars around the world



have conducted long-term investigations with their teams and come up with many new developments. However, due to the extreme complexity of the problem, there was no major breakthrough in the understanding of (i) basic mechanisms for crack propagation in concrete and (ii) the development of fracture criterion and analytical theory. Many researchers have tried to control concrete cracking through the addition of fibers, and a certain degree of success has been achieved. However due to the lack of theoretical guidelines, the toughness improvement has been rather limited. The replacement of conventional Portland cement with industrial wastes such as fly ash is a way to preserve natural resource and reduce environmental pollution. However, a high content of fly ash will significantly slow down the cement hydration reaction, resulting in low early strength.

In this project, the investigators have conducted over 35 years of continual research on concrete fracture and completed the fracture testing of many concrete specimens (with total weight around 200 tonnes). Based on systematic research studies combining theoretical fracture mechanics and numerical simulation, we have discovered the three-parameter law for describing toughness increase during crack propagation, and established the double-K fracture model for crack propagation in Mode I. In addition, using the J-integral technique, the analytical solution for the mode II stress intensity factor was derived for the double-edge notch strip under symmetric loading on one side of the notches. A new testing method for pure mode II fracture based on the double-edge notch specimen was then proposed. Our work has led to the development of proper fracture testing methods for quasi-brittle materials in both Mode I and Mode II. The implicit crack control mechanism of the material during crack propagation is also revealed. Then, in this project, research has been conducted on cementitious composites toughened with short fibers. The criterion for such materials to exhibit high tensile ductility and multiple cracking was derived. The balance of fracture energy during crack propagation was found to be the fundamental principle for the design of ultra-high toughness cementitious composites (UHTCC). Based on the measured Mode I and Mode II fracture parameters of quasi-brittle cementitious materials, and through the proper design of cement matrix composition and selection of fiber type/content, we have carried out research on UHTCC with high content of industrial wastes. Specifically we focused on the hydration reaction and strength development of cement containing fly ash, nanoscopic silicon dioxide powder and carbon nanotube. By forming reaction nuclei, nanoscopic silicon dioxide was an effective activator of the hydration reaction. On the other hand, the carbon nanotubes provide bridging stresses in micro cracks and enhancing the strength and toughness of interfaces. Through the proper design and selection of matrix and fiber, UHTCC with 3-6% tensile ductility was successfully developed with a great amount of cement replaced by fly ash and other active mineral admixtures. In addition, the functional grading concept for crack control, with the combined use of UHTCC and conventional concrete to produce crack resistant composite components, was proposed together with corresponding design methodologies. Our work has significantly enhanced the mechanical properties and durability of conventional cementitious composites.



The double-K fracture theory enables the safety assessment of cracks in structures, and provides an effective solution to this problem, which has troubled engineers for a long time. After the Professor Shilang Xu proposed the double-K fracture criterion in 1988, it received attention from the engineering profession and was employed to determine the stability of cracks in the Dongfeng Dam. In 2004, the double-K fracture theory was also employed by China Gezhouba Group and Tsinghua University to analyze the stability of cracks in the II Stage Engineering Project of the Three-Gorges Main Dam, for the assessment of dam safety. The results of this application were highly satisfactory. After obtaining results of double-K fracture parameters from a large scale experimental program on dam concrete, the double-K criterion was used as the scientific basis for toughness characterization and crack control of the III Stage Engineering Project of the Three Gorges Main Dam. For the first time, a high concrete dam with no visible cracking was constructed in China. The above examples indicate that the double-K theory has played an important role in engineering practice related to the control of cracks in high dams.

Based on the double-K theory, the China National Development and Reform Commission has issued the "Norm for Fracture Test of Hydraulic Concrete", which is the first standard specification on this topic in the hydroelectric and hydraulics engineering profession. RILEM, a major international organization focusing on construction material research and application, has set up a technical committee chaired by Prof. Xu to develop an international fracture testing standard based on the double-K approach.

# Large-Scale Fabrication and Applications of Polymeric Separation Membranes Modified by Amphiphilic Macromolecules



Membrane technology is playing a more and more important role in water treatments including clean water supply and wastewater treatment. The Laboratory of Membrane Materials and Technology designed and synthesized a series of amphiphilic macromolecules as the blending additives to improve the comprehensive properties of traditional polymeric ultrafiltration and microfiltration membranes. A major breakthrough has been achieved in the developments of high performance membrane materials for water treatments.

Project Leader: Baoku Zhu

In recent years, China has been experiencing the rapid urbanization and economic development. However, clean water is becoming more and more scarce, and serious water shortage is plaguing over 110 China's cities. The water crisis derives from two primary factors. The first is the greatly uneven distribution of precipitation water in time and space. The second one is the serious water pollution due to the enormous emission of municipal sewage and industrial wastewater. Deterioration of drinking water quality due to pollution continues to be a major problem in China. Membrane separation has been developed as one of the crucial techniques to solve water problems in the past decades. Actually, membrane technology is playing more and more important role in safe supply of drinking water and advanced treatments of wastewater. Membrane material is so vital that it is considered as the core of membrane technology. Both the performance improvements of available membrane materials and the developments of novel membrane materials are favorable in membrane technology.

Polymer membranes have been widely used in membrane separation process, especially in water treatments due to their low cost and the ease of processing. Despite their advantages in membrane separation, most synthesized polymer membranes are susceptible to membrane fouling due to their hydrophobic character and low surface energy. Some nonpolar solutes, particles, colloids, bacteria in the feed water are prone to be adsorbed onto membrane surface and pore walls, bringing rapid decline in permeation flux, substantial energy consumption and high operational cost. In order to develop some high performance membrane materials with high permeability and good antifouling ability, the Laboratory of Membrane



Fig.1 Group photo of the Lab of Membrane Materials and Technology

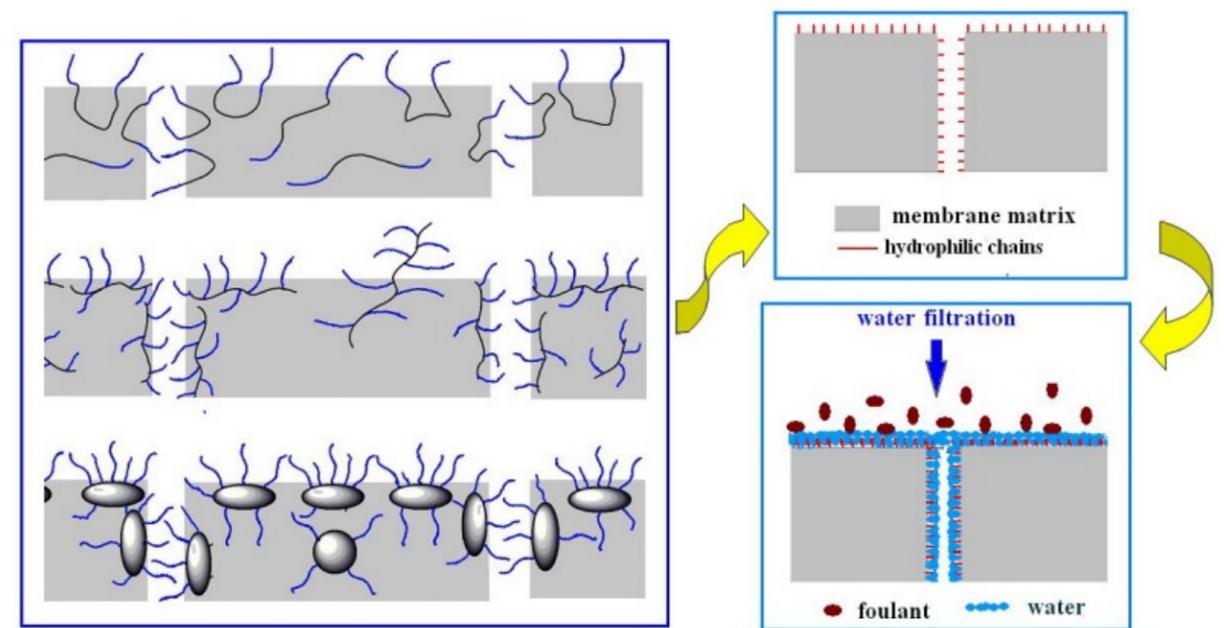


Fig.2 Mechanism of surface segregation of amphiphilic macromolecules with various architectures

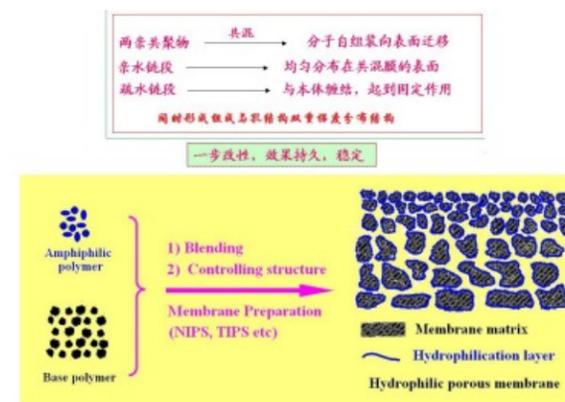


Fig.3 Fabrication route of amphiphilic polymer membranes

Materials and Technology in Zhejiang University has designed and synthesized a series of amphiphilic macromolecules for the surface modification of polymeric ultrafiltration (UF) and microfiltration (MF) membranes. Amphiphilic macromolecules are often composed of hydrophobic backbones and hydrophilic side/end chains. These synthesized macromolecules were designed as the blending additives of traditional phase inversion membranes such as polyvinylidene fluoride (PVDF), polysulfone

(PSF), polyvinyl chloride (PVC), polyethersulfone (PES) etc. The effects of amphiphilic macromolecules addition on membrane morphologies and properties were investigated in detail. The hydrophilic chains in amphiphilic macromolecules are often immiscible with host polymers and thus are segregated onto membrane surface spontaneously during membrane preparation due to microphase separation process. The hydrophobic part of amphiphilic additive is generally miscible with host polymer and able to anchor onto membrane surface. Based on the above work, a novel methodology has been established for the fabrication and modification of high performance membranes used in water treatment. The mechanisms of surface modification of water treatment membranes by amphiphilic macromolecules have been revealed. Some novel membrane materials were developed and applied in many occasions such as drinking water purification, wastewater treatment, biomedical separation etc.

From the above research results, more than 80 papers were published in the referred journals and 44 patents were licensed. The developed techniques have been widely applied in correlative membrane manufacturers. The production capacity of PVC, PVDF, PES, PP membranes totally reached 7 million square meter per year. This work has contributed greatly to the developments of membrane technology and water treatment. This research project was granted a second-class award for science and technology progress by the Ministry of Education in China in 2013.

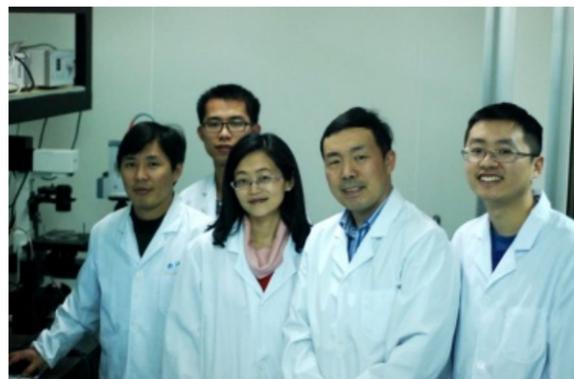
# Optical Super-Resolution Nanoscopy



Optical super-resolution imaging technology is regarded as one of the milestones in the development of light microscopy. Its corresponding achievements can directly propel the forward of nano-technology, biology, medicine and material researches.

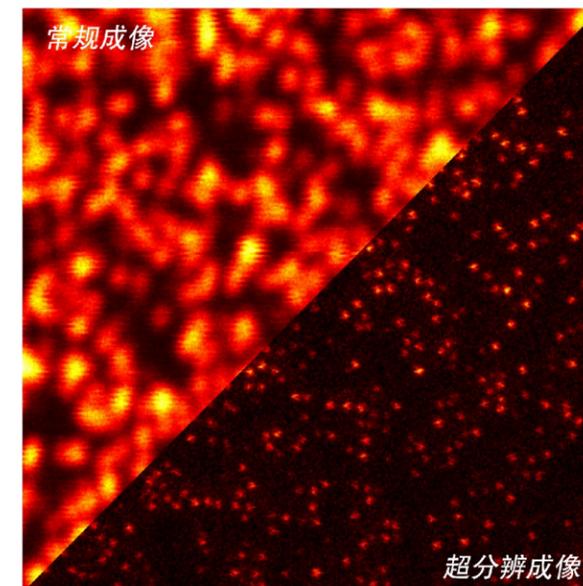
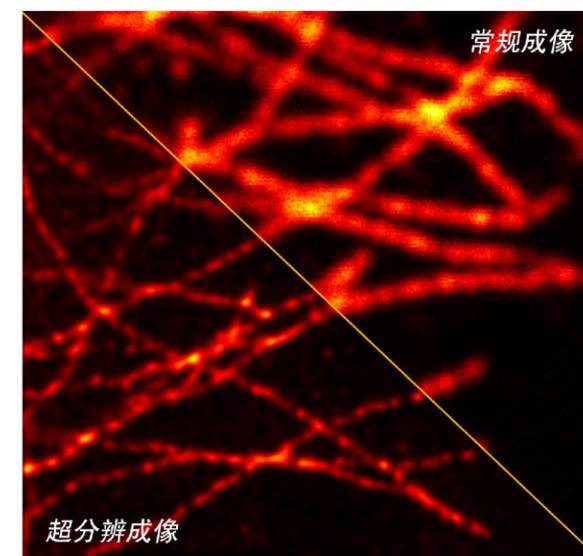
**Project Leader: Xu Liu**

The developments of the society and the technology open the window for the human beings to broaden our insight to the nature. The year of 2000 is always regarded as the beginning of a new era of nano-technology. For a long time, microscope and other optical imaging systems have earned the reputations of enabling the visualization of objects (or fine structures) that are usually invisible to the naked eye, thus shaping various disciplines such as biology, medicine, and materials science. However, the natural properties of light as a kind of electromagnetic waves have now become the bottleneck for the researchers to pursue higher resolution. Therefore, it is not surprising that breaking the limit of diffraction barrier has attracted the attention of researchers all over the world. Great endeavors have been made to propose new ideas for achieving a resolution of  $\lambda/10$ - $\lambda/20$ , and some improvements have been made. In a word, corresponding researches on optical super-resolution imaging are of great importance, and any improvements in this field will directly propel the forward of nano-technology, biology, medicine and material researches.



The joint research group in Zhejiang University which is led by Prof. Liu, Xu, Prof. Si, Ke and Prof. Kuang, Cuifang, is committing to the research on optical super-resolution imaging. Their research interests include the manipulation of light in near-field, the detection and conversion of fast signals, the acquisition of dynamic information, and the development of new devices and systems. To obtain sub-diffractive information and image the fine structures of the samples, they propose several innovative ideas and eventually acquire the new discoveries. Their works can be used to both fluorescent and non-fluorescent samples. For example, they setup the first g-STED (stimulated emission depletion) microscope in China and successfully use it to obtain a resolution of 38 nm ( $\sim\lambda/14$ ). They further enhance the resolution using the well-defined subtraction strategy. On the other hand, they also propose a frequency-shift based method to resolve 80 nm details ( $\sim\lambda/7$ ) on the surface of the sample that cannot be labelled. Compared with previous works, the novel methods proposed by this group stand out for their higher acquisition speed and more accurate resolution capacity. Presently this group are still exploring various new super-resolution approaches to enrich the functions and bring more practical applications to present microscope.

Since 2010, this group has published tens of peer-reviewed papers in the leading journals like scientific reports, optics letters and applied physics letters. Some of them are even selected as the cover ones by the editorial board. In 2013, the group was further invited to publish a review to summarize the recent improvements in corresponding field in the journal Light: Science & Applications (Nature Publishing Group), which is highly appraised by the colleagues. Moreover, the group also attempts to industrialize its achievement, for example, a cooperation agreement has already been signed between the group and Ningbo Yongxin Optics Co., Ltd.



# The Optical System for the Landing Camera of CE-3



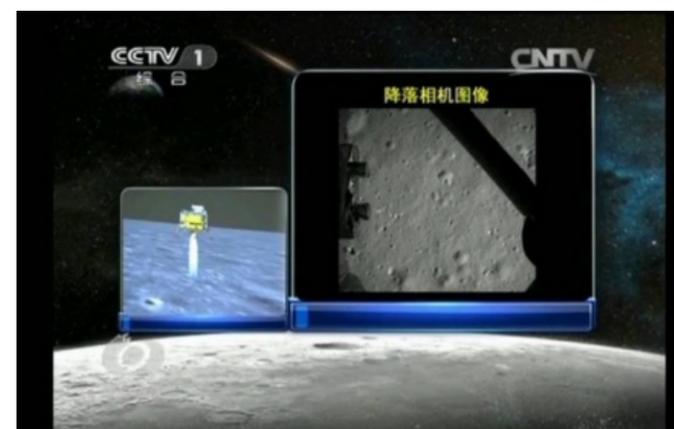
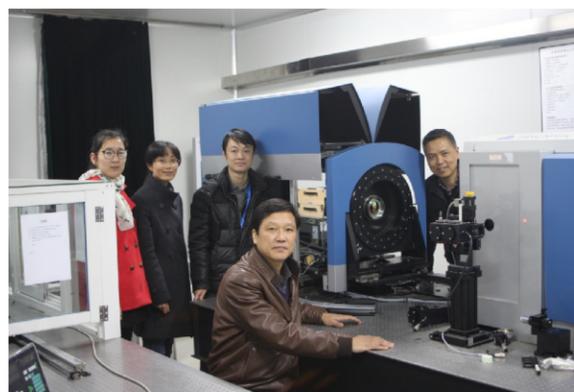
Selected as The TOP 10 Academic Advances of the Year

The ChangE-3(CE-3) successfully landed on the surface of the Moon at 21:11, December 14, 2013, for the first time in the history of China space exploration. The optical system of the landing camera developed by Professor Xu Zhihai team from Zhejiang University had an excellent performance in the soul-stirring landing process.

**Project Leader: Zhihai Xu Huajun Feng**

The ChangE-3(CE-3) successfully landed on the surface of the Moon at 21:11, December 14, 2013. This meant that CE-3 had accomplished the most important step for its mission, and China had become the third country which can send its space craft to the Moon and safely land on its surface. The optical system of the landing camera developed by Zhejiang University had an excellent performance in the soul-stirring landing process. The landing camera acquired the first picture of the Moon surface from CE-3, and successfully recorded the video of the whole breathtaking landing process. It also provided information of the Moon landscape around the landing point, which would be very important to plan the later Yuetu vehicle's exploration route. The optical system of landing camera made significant contribution to the China space-craft landing on a celestial body beyond the Earth for the first time in the history.

Professor Xu Zhihai team from Zhejiang University has cooperated with Beijing Institute of Space Mechanics & Electricity China Academy



of Space Technology (CAST) since 2006, and developed a series of mini-optical systems for space exploration, especially for the China lunar exploration program in the past 6 years. The team has made breakthrough on the key technologies on the design, manufacture, assembly and calibration of mini-optical lenses for space applications, and obtain a lot of China patents in this research work.

The first optical lens for landing camera was developed in 2009, and was onboard ChangE-2(CE-2), which was launched in October, 2010. A full test was performed while CE-2 orbiting on the Moon. It successfully took pictures to the surface of the Moon. Further optimizations of the landing camera system has been performed after the experiment of CE-2, and the field of view, focal length and relative aperture of the lens for CE-3 mission have been determined. During 2011 to 2012, Xu Zhihai team re-designed the landing camera lens elaborately, and manufactured it in high-precision. After a series of rigorous tests, the optical system for proved to achieve high imaging quality, high reliability, light weighted (60g), and can suitable to take high resolution pictures in the environment of deep space and near the surface of the Moon, completely meet the demand of the landing mission of CE-3.

# Environment Perception and Navigation for Vision-Based Lunar Rovers



Selected as The TOP 10 Academic Advances of the Year

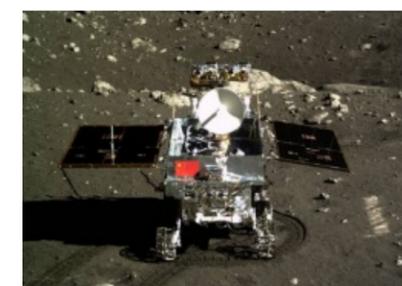
Remote control of guidance, navigation and control for the lunar rover is one of the seven key technologies for the Chinese Chang'e 3 mission to the Moon. Prof. Jilin Liu and his team have been studying on the related technologies since 2005. In 2013, the team bid the project "GNC Remote Control for the Yutu Rover" from Institute 502 and finished the work successfully, making a contribution to the Chinese Chang'e 3 mission.

**Project Leader: Jilin Liu**

On 15 December 2013, the Yutu lunar rover was separated from the Chang'e 3 stationary lander in the Chinese Chang'e 3 mission. With the remote control sent from the China National Space Administration, they successfully took pictures of each other after the rover navigated to certain places. The rover's navigation is achieved by a series of operations, which include lunar environment perception, 3D mapping and localization, path planning, etc. These functions were developed by Prof. Jilin Liu and his team in 2013.



Remote control of guidance, navigation and control (GNC) for the lunar rover is one of the seven key technologies for the Chang'e 3 mission to the Moon. Prof. Jilin Liu and his team have been studying on the related technologies since 2005. During the past eight years, they worked on a series of fundamental problems, which include wide-angle camera calibration, stereo-vision, 3D reconstruction, lunar surface modeling, visual odometry, etc. More specifically,



they conquered two extremely challenging problems: the high-precision 3D reconstruction of lunar surfaces and the lunar rover's simultaneously localization and map building. In 2013, the team bid the project "GNC Remote Control for the Yutu Rover" from Institute 502 and finished the work successfully, making a contribution for the Chang'e 3 mission.

At the end of 2013, a technical evaluation panel investigated the achievements of the project. The panel members concluded that the developed technologies are in the state-of-the-art. Particularly, the techniques of stereo-vision based visual odometry for Lunar surface are at a world-leading level. The research achievements have been successfully applied to the remote control of Yutu rover. They can also be potentially applied to Mars exploration rover in the future.

# Technique Research on Intelligent Humanoid Robot



Selected as The TOP 10 Academic Advances of the Year

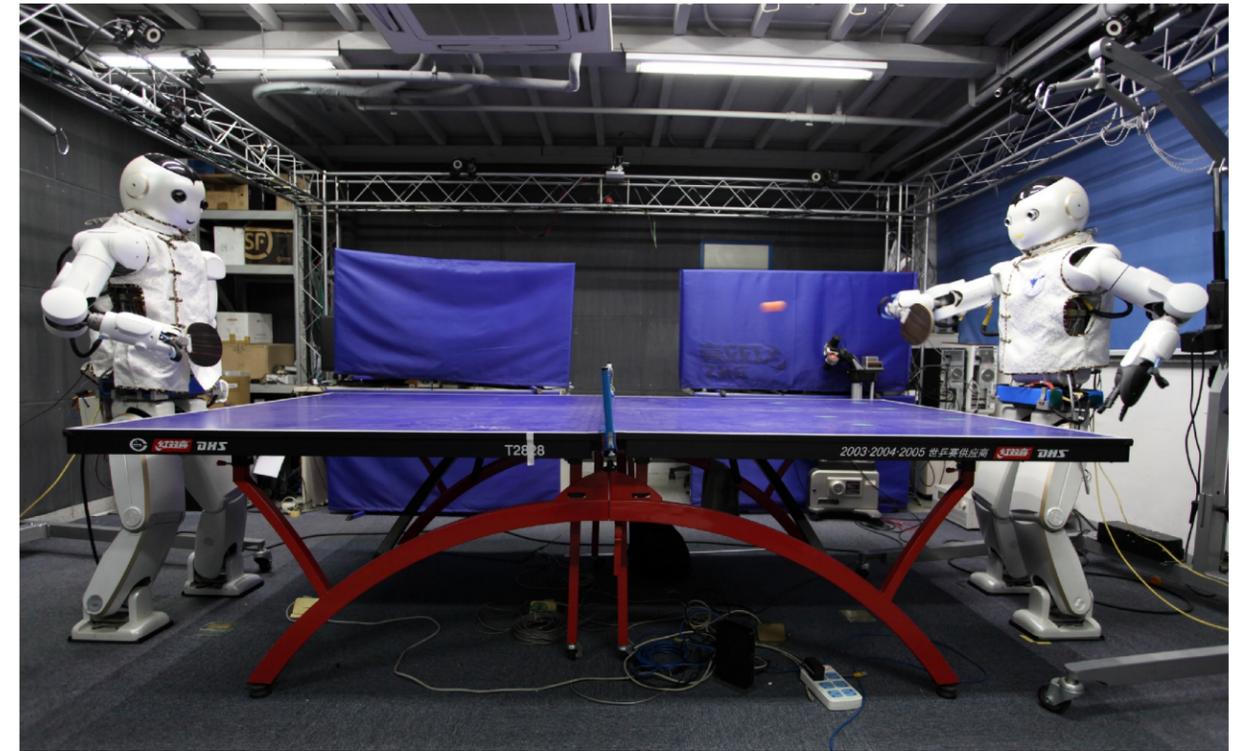
Basing on key technological breakthroughs in fast object recognition and prediction, autonomous coordinative motion planning and stability control, a humanoid robot system that can play table tennis repetitively is developed independently. It is the first humanoid robot in the world that is capable of fast response to the environment accurately and repetitively.

Project Leader: Rong Xiong

Robotics has been widely considered as strategic burgeoning industry by many countries, while current generation of commercial robot products generally lacks intelligence and autonomy. The state-of-the-art industrial robots are capable to operate according to predefined trajectory and carry out repetitive tasks with no adaptation to the changes in the environment and the task. Special robots for military, exploring and medical use mostly adopt teleoperation as the main control approach. And commercialized civil service robots designed for dynamic environment are mostly slow in response and poor in functionality.

Humanoid robot concerns most key technological research aspects in robotics, and is the commanding height of the advancement in robotics technology. To promote and lead the development of robotics technology and industry, many countries fund humanoid robot related research projects. Honda of Japan developed ASIMO which can walk fast and serve people tea. The national institute of Advanced Industrial Science and Technology(AIST) of Japan developed the dancing robot HRP-4C. The Defense Advanced Research Projects Agency(DARPA) of the United States announced a robotics challenge competition in 2012 that demands robots be capable to clear debris and close valves, etc.

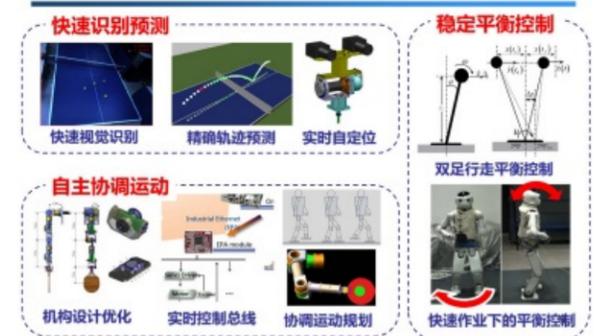
The robotics research group of the Department of Control Science and Engineering started research on humanoid robots and related technologies since 2008 under the support of the National 863 Key Projects. The research project aimed to extend the ability of the robot in fast interaction with the environment and chose table tennis playing as the verification



scenario to verify the validity and advancement of technologies. Compared with dancing, the table tennis playing requires online recognition, prediction of the flying ball accompanied with coordinative motion planning. Making a comparison with tea serving, debris clearing and door opening, table tennis playing is featured with its higher requirement for the rapidity in sensing, response and movement speed.

The robotics research group has made a series breakthroughs in key technologies in fast object prediction, autonomous coordinative motion planning, balance control, etc. The group successfully improved the speed and accuracy of object recognition and localization, achieved the observation of ball spinning state, and reduced the error in ball trajectory prediction. Novel mechanical structure and real-time field bus are proposed which provide better performance in both strength and reaction speed. Real-time motion planning approach for robotic arms with redundant DOFs is studied to enlarge the operation space of the robots. The group also published researches on the balance maintenance for biped walking and fast manipulation tasks and implemented stable motion and accurate manipulation under unknown external force disturbance. The table tennis playing humanoid robot system developed by the group achieved continuous and repetitive table tennis rallying between two robots and between a human player and a robot, and is the first humanoid robot system that is capable of fast response to the environment repetitively and accurately.

## 核心关键技术



The research results are highly praised in the human-robot interaction global assessment by the National Science Foundation of the United States. The Reuters, the Associated Press, the Fuji Television and other international media press came to the laboratory to take special report sessions. The related technology has been extended to industrial application such as autonomous inspection in power plant, filling and seeding production line and other industrial automation system and autonomous service robot system. The project "Commercialization of Table Tennis Playing Humanoid Robot and related Technologies" has been granted the first place of the Science and Technology Invention Award of Zhejiang Province.

# Development and Application of the Novel Preventive Techniques Against Infectious Bursal Disease

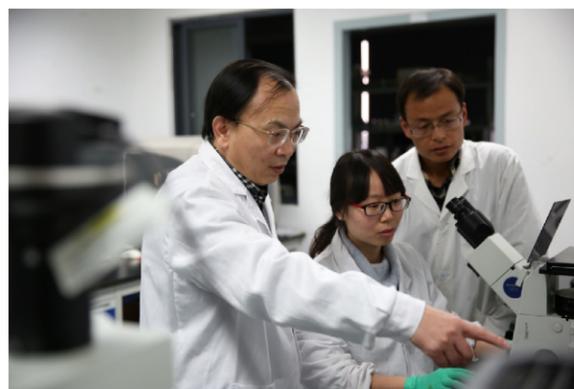


We developed the novel preventive techniques against infectious bursal disease, an immunosuppressive disease, especially the subunit vaccine against infectious bursal disease and novel diagnostic techniques. These techniques provide the novel clues on the development of safe and high efficient vaccine in poultry industry.

**Project leader: Jiyong zhou**

Infectious bursal disease virus (IBDV) is the pathogen of infectious bursal disease (IBD), causes the destruction of poultry central immune organ and immunodeficiency diseases, leads to serious economic loss in the poultry industry. It is important that we explore the mechanism of IBDV variant, proteome changes of IBDV infected cells and specific biological markers of IBDV infection for creation of safe and effective vaccines and the development of scientific prevention and control strategies. Upon the support of National Natural Science Foundation of China, National Basic Research program of China "973 program", National High-Tech Program of China "863 program" and national R & D program of Chian, Professor Jiyong Zhou's team, from the key laboratory of animal virology of Ministry of Agriculture, Zhejiang University, has conducted a systematic study and exploration of the basic science issues surrounding IBDV pathogenicity and prevention.

Upon improvement of immunogen gene code and novel techniques of bioengineering, our



These results revealed that in IBDV infected cells the viral proteins were found with different isoelectric points, the expression of dissociation inhibitor of Rho proteins were inhibited, while the polyubiquitin proteins were over-expression, and the structure of skeletal vimentin and tubulin in IBDV infected cells were destroyed.

Using the acquired proteomics data of IBDV infected cells, we firstly discovered that the antibody against IBDV non-structural protein VP4 is an indicator discriminating pathogenic and nonpathogenic IBDV infection in chickens, non-structural protein VP5 was the biomarkers for distinguishes live vaccine with compete gene, engineering vaccine and wild virus infection. We create a method for detection of IBDV vaccine virus or wild virus infection.

The research results revealed the nature reassortment phenomenon of IBDV infection, explored the molecular mechanisms of cell signaling pathways interfered by virus infection and solved the methods discriminating vaccine and wild virus infections. All these provided a new theory and technology strategies to prevent and control of infectious bursal disease. These results were published in a series of journals and widely cited, such as Molecular & Cellular Proteomics, Proteomics, Molecular immunology and other publications as research papers. Our project was permitted as a second prize of State Technological Invention Awards.

team created the subunit vaccine against infectious bursal disease.

This vaccine has been licensed to product by China government since 2007. Up to now, this vaccine was used to prevent chicken's IBD in all region of China. This widely used subunit vaccine decreases the potential biosecurity risks of variant IBDV formation and provides a chance to clean infectious bursal disease in poultry farm. With the virus plaque cloning, virus replication capabilities on embryo and cells and virulence determination, whole genome sequencing techniques, we discovered a new reassortment IBDV strains. Furthermore, using modern biotechniques, we firstly analyses of dynamic proteomics of IBDV infected cells and tissues.

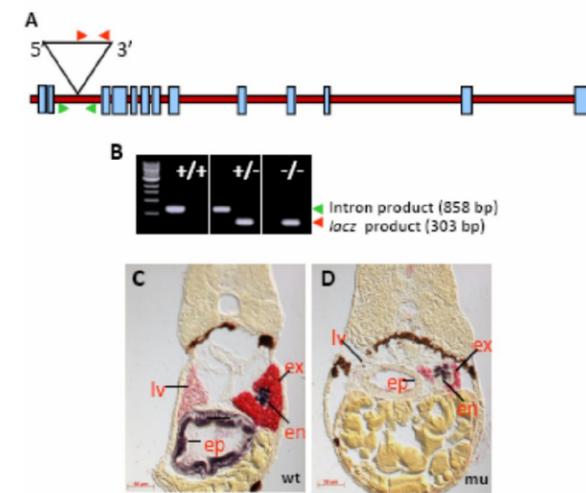
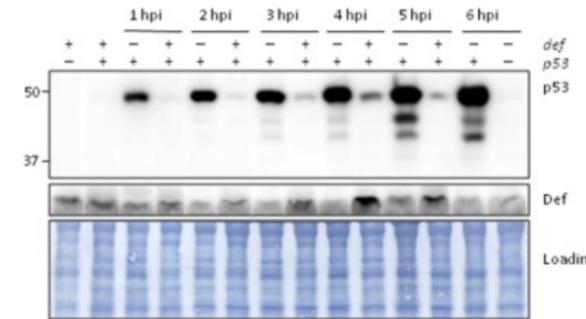
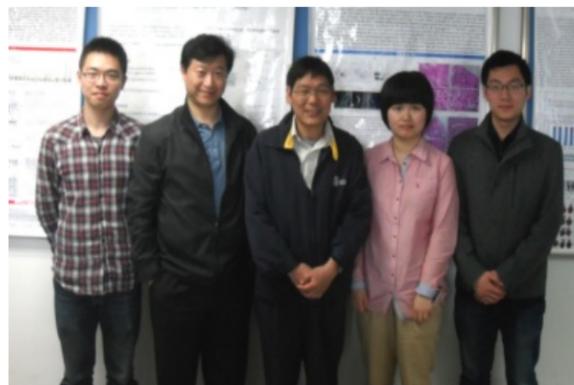
# Def Defines a Conserved Nucleolar Pathway that Leads p53 to Proteasome-Independent Degradation



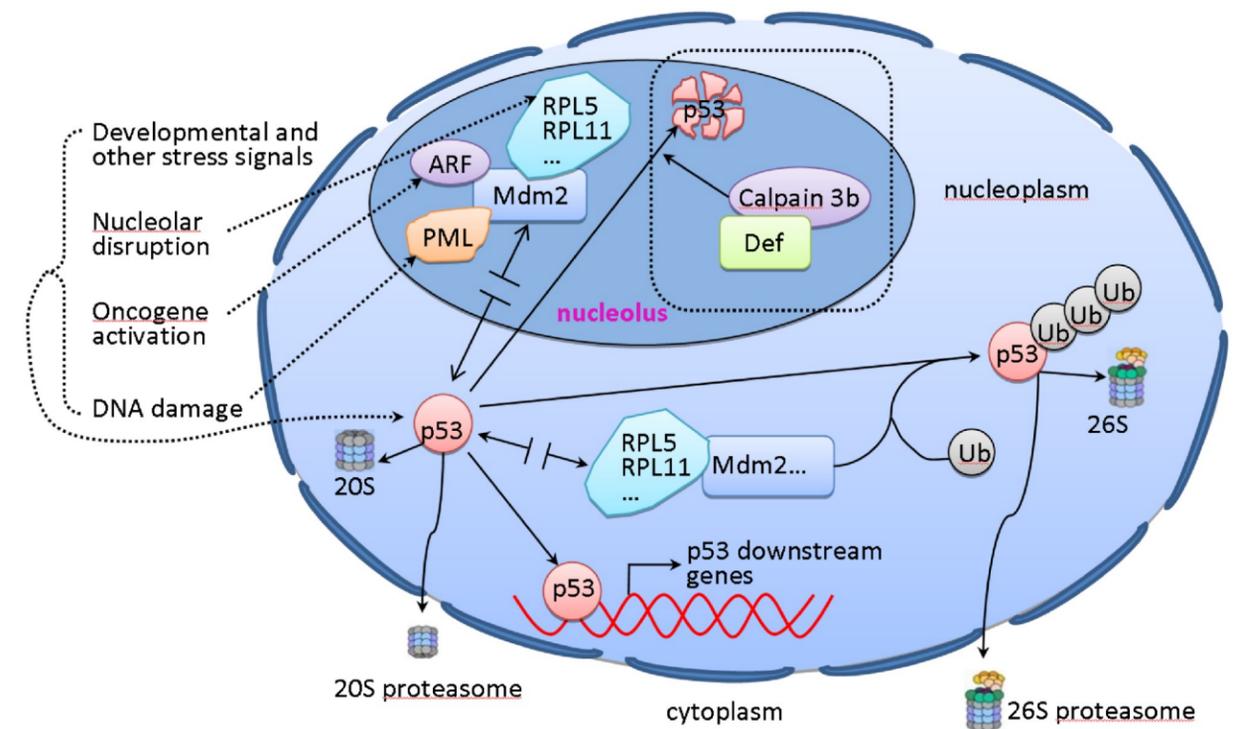
This work for the first time demonstrates that the Def-Calpain3 complex represents a novel protein degradation pathway which specifically operates in the nucleolus and demonstrates that p53 is one of the substrates of the Def-Calpain3 pathway. This new discovery opens a new avenue to understand how nucleolar proteins are involved in regulating cell proliferation and death to control the development and growth of organs.

Project leader: Jinrong Peng

p53 protein turnover through the ubiquitination pathway is a vital mechanism in regulation of its transcriptional activity, however, little is known regarding p53 turnover through proteasome-independent pathway(s). The nucleolus is also involved in regulating the function of p53. Disruption of the nucleolus in a cell in response to either internal or external stress normally activates the p53 pathway. In most cases, the activation of p53 is due to the binding of Mdm2 by factors such as ARF, PML, RPL5 or RPL11, which results in physical separation of Mdm2 from p53, thus preventing p53 from degradation by the ubiquitination pathway. The digestive organ expansion factor (Def) protein was first identified as a pan-endodermal-enriched factor that is essential for the growth of digestive organs in zebrafish. Def belongs to a novel protein family that is evolutionally conserved from yeasts to humans



And is a component of the ribosomal small subunit (SSU) processome in the nucleolus. In zebrafish, loss-of-function of Def selectively up-regulates the transcriptional expression of p53 response genes, which raises a question as to what is the relationship between Def and p53. We report here that Def is a nucleolar protein and that loss-of-function of Def leads to the up-regulation of p53 protein that surprisingly accumulates in the nucleoli. Our extensive studies have demonstrated that Def can mediate the degradation of p53 protein and that this process is independent of the proteasome pathway, but is dependent on the activity of Calpain3, a cysteine protease. Our findings define a novel nucleolar pathway that regulates the function of p53, which will advance our understanding of p53's role in organogenesis and tumorigenesis.



# Molecular Mechanisms of Innate Immunity and Inflammation

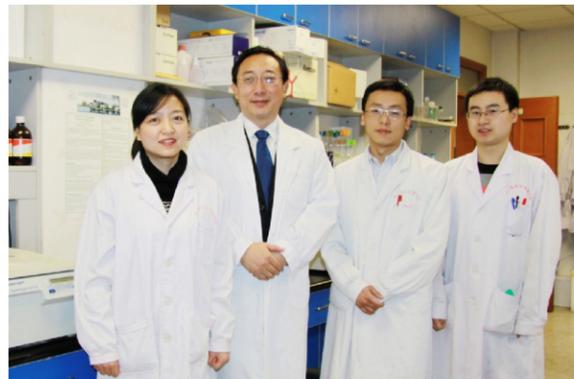


Selected as The TOP 10 Academic Advances of the Year

The project focused on the innovative research of the innate immune recognition and inflammation regulation. New molecular mechanisms of innate immunity and inflammatory regulation were demonstrated from different aspects. Systematic research results were published on the *Cell*, *Immunity*, *Nature Communications* and other international famous academic journals.

## Project Leader: Xuetao Cao

Pathogenic microorganism infection is the biggest threat to human health, infectious diseases such as hepatitis, AIDS, tuberculosis has been a serious threat to human life and health. Innate immunity is the first line of host defense against pathogen infection. However, the molecular mechanisms of innate immune cells specifically recognizing pathogen to induce inflammation and pathogen escaping of innate immunity to even cause chronic infection are still not very clear. For the scientific questions, Chinese academician of the Academy of Engineering, Xuetao Cao, led research team from Institute of immunology of Zhejiang University to study the regulation mechanisms of innate immune recognition and inflammation. In 2013, Systematic research results were published on *Cell* (IF=32), *Immunity* (IF=20), *Nature Communications* (IF=10) and other international famous academic journals.



## Induction of Siglec-G by RNA Viruses Inhibits the Innate Immune Response by Promoting RIG-I Degradation

Weilin Chen,<sup>1,4</sup> Chaofeng Han,<sup>2,4</sup> Bin Xie,<sup>1,4</sup> Xiang Hu,<sup>2</sup> Qian Yu,<sup>2</sup> Liyun Shi,<sup>1</sup> Qingqing Wang,<sup>1</sup> Dongling Li,<sup>2</sup> Jianli Wang,<sup>1</sup> Pan Zheng,<sup>3</sup> Yang Liu,<sup>3</sup> and Xuetao Cao<sup>1,2,3,\*</sup>

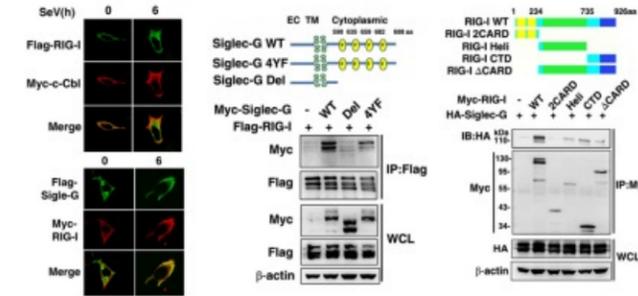
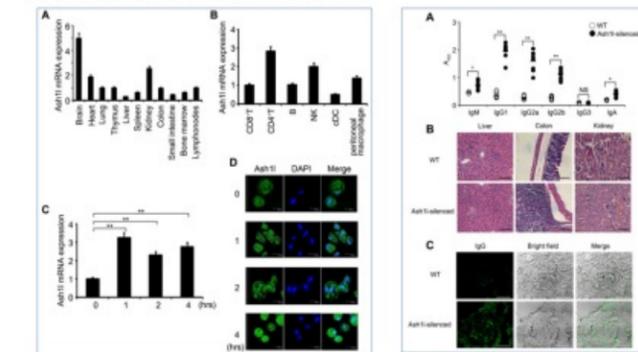


Figure 6 Siglec-G Interacts with SHP2, c-Cbl, and RIG-I. 6D(left);6E(middle);6F(right). (*Cell* 2013;152: 467-478)

曹雪涛课题组揭示RNA病毒逃逸天然免疫的新机制

## Histone Methyltransferase Ash1 Suppresses Interleukin-6 Production and Inflammatory Autoimmune Diseases by Inducing the Ubiquitin-Editing Enzyme A20

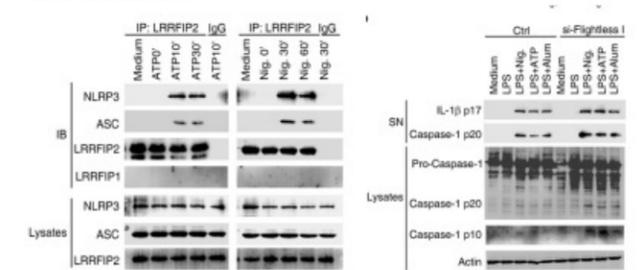
Meng Xia,<sup>1,2,5</sup> Juan Liu,<sup>2,6</sup> Xiaohui Wu,<sup>3,5</sup> Shuxun Liu,<sup>2</sup> Gang Li,<sup>3</sup> Chaofeng Han,<sup>2</sup> Lijun Song,<sup>2</sup> Zhiqing Li,<sup>1</sup> Qingqing Wang,<sup>1</sup> Jianli Wang,<sup>1</sup> Tian Xu,<sup>3</sup> and Xuetao Cao<sup>1,2,4,\*</sup>



曹雪涛课题组发现调控炎性自身免疫病的新机制

## LRRFIP2 negatively regulates NLRP3 inflammasome activation in macrophages by promoting Flightless-1-mediated caspase-1 inhibition

Jing Jin<sup>1,2,\*</sup>, Qian Yu<sup>2,\*</sup>, Chaofeng Han<sup>2</sup>, Xiang Hu<sup>3</sup>, Sheng Xu<sup>2</sup>, Qingqing Wang<sup>1</sup>, Jianli Wang<sup>1</sup>, Nan Li<sup>2</sup> & Xuetao Cao<sup>1,2,3</sup>



曹雪涛课题组发现调控炎性复合体的新分子

Using different models of anti-viral and anti-bacterial infections, the project team found the new regulation mechanisms of inflammation and anti-infection immune and autoimmune diseases. The research team found RNA viral infection specifically up-regulated Siglec-G expression in macrophages by gene chip screening technique and Siglec-G-induced recruitment of the E3 ubiquitin ligase c-Cbl to RIG-I leads to RIG-I degradation via K48-linked ubiquitination by c-Cbl and confirmed a negative feedback loop of RIG-I signaling. Histone modifications play important roles in multiple physiological processes by regulating gene expression. The research team also found Ash1-mediated H3K4 methylation at the *Tnfaip3* promoter is required for controlling innate IL-6 production and suppressing inflammatory autoimmune diseases. In addition to IL-6, inflammatory cytokines IL-1 $\beta$  plays an important role in innate immunity. The NLRP3 inflammasome is the most characterized inflammasome activated by cellular infection or stress, which is responsible for the maturation of IL-1 $\beta$ . The research team demonstrated that LRRFIP2 inhibits NLRP3 inflammasome activation by recruiting the caspase-1 inhibitor Flightless-1, thus outlining a new mechanism for negative regulation of NLRP3 inflammasome.

The project revealed a negative feedback loop of RIG-I signaling and provided mechanistic insight into epigenetic modulation of immune responses and inflammation. also identified a new negative regulator of NLRP3 inflammasome. The study is great helpful to understand the relationship between immune response and inflammation, to find new strategy of vaccine development and related immune drugs in clinical disease diagnosis and treatment.

# The Etiology, Clinical Diagnosis and Treatment of H7N9 Avian Influenza



Selected as The TOP 10 Academic Advances of the Year

Human infection with H7N9 avian influenza virus is dangerous with high mortality and greatly endangers people's life and health in our country. The team led by Academician Lanjuan Li have tried best to response, done hard research and acquired significant achievements.

Project Leader: Lanjuan Li

Great discoveries have been made in etiological structure, molecular characterization and origin of H7N9. It was firstly reported internationally that poultry market was the origin of H7N9 avian influenza virus, firstly discovered that key genes mutation of H7N9 led to transmission of the virus from birds to people and "cytokine storm" was the critical reason of severe H7N9 infection. Research achievement was published as front-page headline in international top journal "Lancet" and provided scientific basis for decision-making of government, intervention of poultry market and control of infection source, which also supplied guidance for global prevention and treatment of H7N9 avian influenza virus. Good effect had been achieved and the increase of new cases had been restrained in a short time.

The treatment strategy of "four resistances and two balances" was proposed systematically and artificial liver technique was used creatively to block "cytokine storm", in order to save patients with severe H7N9 infection. Remarkable



Achievements had been obtained and mortality rate had been minimized.

Achievements and experience of clinical diagnosis and treatment in H7N9 avian influenza virus were summarized timely. Research achievement was published in top international medical journal "N Engl J Med" on May 22, 2013, firstly revealed globally the clinical characteristics and incidence regularity of H7N9 avian influenza virus and firstly proposed the indications of artificial liver in treating patients with severe H7N9 infection.

The group had also developed China's first H7N9 influenza virus vaccine strain successfully and rapid test kit of H7N9 influenza virus. One national invention patent was applied and one national medical device registration certificate had been acquired.

Chinese party and state leaders fully affirmed the achievements obtained in major outbreak of H7N9 avian influenza virus from the group of Lanjuan Li. Premier Keqiang Li also stressed that the experience in diagnosis and treatment of H7N9 from the first affiliated hospital of Zhejiang University should be shared in China. Vice Premier Yandong Liu inspected Key Laboratory for Diagnosis and Treatment of Infectious Disease of Zhejiang University on April 13, 2013, and spoke highly of the outstanding contributions in fighting against H7N9 avian influenza virus from the group of Lanjuan Li. Doctor Fukuda, the assistant director-general of WHO, said that prevention and control of H7N9 avian influenza virus epidemic in China was exemplary. US ambassador to China Wenlong Wu and experts from US CDC had came to the Key Laboratory for Diagnosis and Treatment of Infectious Disease for several times to learn the experience, which can be acted as policy basis for America to deal with avian influenza in the future.

The research achievements have got access to "China's top ten technological advances in universities in 2013" and elected to "China's top ten technological advances of academician selection in 2013"



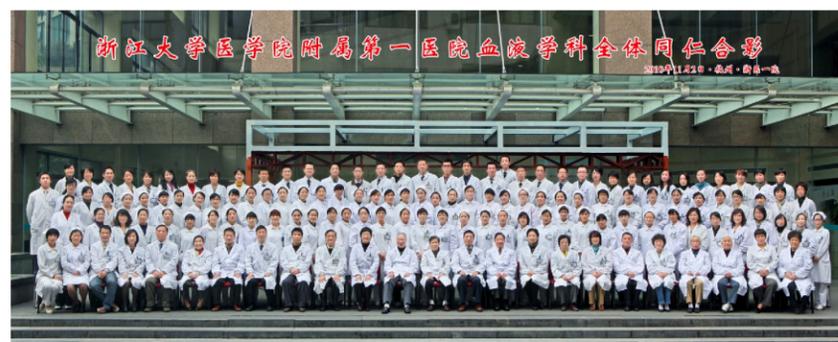
# Homoharringtonine-Based Induction Regimens for Patients with De-novo Acute Myeloid Leukemia



Selected as The TOP 10 Academic Advances of the Year

Treatment of acute myeloid leukemia is a great challenge currently facing the medical world. The new HAA chemotherapy regimen, with high efficacy and low cost, has been adopted as a new first-line therapy!

Project Leader: Jie Jin



Acute leukemia, commonly referred as "blood cancer", is the most common and the highest mortality type of malignant tumor in children and adolescents. Without treatment, it can be fatal within a few months. Currently, although some progress has been made, novel treatments with higher efficacy, lower cost and side effects are still the major challenges for hematology researchers in the world.

Homoharringtonine is a natural plant alkaloid derived from *Cephalotaxus* species and has been assessed by Chinese investigators in the



treatment of myeloid neoplasms for more than 30 years. The research team under the director of professor Jin Jie has carried out series of extensive and in-depth exploration on Homoharringtonine in both basic and clinical trials for the treatment of leukemia. As early as in the late 90s, the team found the high efficacy of the new Homoharringtonine-based regimen which consisting of Homoharringtonine, aclarinomyacin and cytarabine (HAA regimen) on the treatment of acute myeloid leukemia. Some of the results were published on the journal "Leukemia", one of the top journals in the area of hematology. And it attracted a great attention of other domestic and foreign counterparts.

Based on the previous single center studies, in 2005, professor Jin Jie began to design and perform a multicenter, randomized, controlled phase 3 clinical trial. This study was done between September, 2007, and July, 2011 in 17 top authoritative hematological centers in China, including the First Affiliated Hospital, Zhejiang University School of Medicine, Shanghai Ruijin Hospital, Tianjin Institute of Hematology etc.. A total of 620 patients with acute myeloid leukemia across the country were enrolled in the study. With the five years of investigations and follow-up, the study demonstrated a complete remission rate of 73%, 3-year event-free survival rate of 35% in the new HAA arm. Comparing to the classic standard chemotherapy regimen (DA

arm:daunorubicin plus cytarabine), the HAA arm showed a significantly higher response rates. The new regimen has at least three major advantages: the low cost, low treatment-related mortality and the high efficacy. Professor Jin's team won the 2011 second prize of National Science and Technology Progress Award for the promising work of "The biological characteristics of acute myeloid leukemia and the application and dissemination of a novel chemotherapy regimen. Thus, the HAA regimen was recommended as one of the first-line therapies in the Chinese guidelines.

The results were published as a research article in the world 's most famous medical journal" The Lancet Oncology " on ( May 2013 ). Professor Farhad Ravandi, an international leukemia expert from American MD Anderson Cancer Center ,commentary in the journal: "Compared to international standards program, program from China with better therapeutic effect ; homoharringtonine should be welcomed by physicians involved in treatment of patients with acute myeloid leukemia".

In summary, the projects not only achieved good social and economic benefits, but also provided a success model of translational medicine by the pathway of clinical - experimental - clinical transforming.

## Prof. Huahao Shen Research Group Named a New Phenotype of Asthma—Chest Tightness Variant Asthma (CTVA)

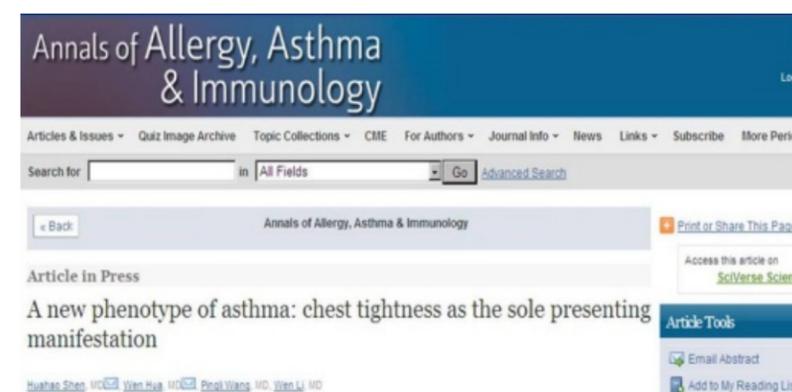


Selected as The TOP 10 Academic Advances of the Year

Prof. Huahao Shen named a new phenotype of asthma -- Chest Tightness Variant Asthma (CTVA). This is another phenotype of asthma following Cough Variant Asthma and Potential Asthma that reported by Chinese scientist.

### Project Leader: Huahao Shen

The typical symptoms for asthmatics are recurrent episodes of wheezing, breathlessness, chest tightness and coughing. For patients who have recurrent chest tightness as their sole presenting manifestation, cardiovascular disorders are usually considered, but asthma is not often included in the diagnosis. A research team led by Prof. Huahao Shen from the department of Respiratory and Critical Care Medicine, Second Affiliated Hospital of Zhejiang University School of Medicine, presented a new group of patients with asthma who had chest tightness as their sole presenting manifestation. 24 cases with recurrent chest tightness as their unique complaint were recruited for this study. Other diseases associated with chest tightness were excluded in all patients, including cardiac, toxic, haematologic, neurogenic and myogenic diseases. All patients had airway hyperresponsiveness, variability and reversibility in airflow limitation, which are characteristic physiological abnormalities of asthma. Airway



biopsies also demonstrated pathological manifestations consistent with asthma, including eosinophilic infiltration, thickened basement membrane, epithelial and subepithelial inflammation, vascular dilatation, and glandular hyperplasia. These patients showed a good response to either inhaled corticosteroid (ICS) or ICS plus long-acting  $\beta_2$

agonist (LABA) treatment. Therefore, we believe that these patients represent a new phenotype of asthma- Chest Tightness Variant Asthma (CTVA). Compared with classic asthma patients, CTVA patients had higher rates of anxiety and depression. A special attention to this new type of asthma is necessary since these patients are likely to be under- or misdiagnosed.

The above findings were published in Ann Allergy Asthma Immunol on September, 2013. This is another new phenotype of asthma since Cough Variant Asthma that named by Richard Irwen in 1979 and Potential Asthma that reported by Nanshan Zhong in 1992. This new concept of CTVA has aroused widespread concern. Both chairmen of Global Initiative for Asthma guidelines (GINA), Eric Bateman and Paul O' Byrne, gave a high evaluation to this finding. It was reported as a key news in the official website of national Natural Science Foundation of China. Xinhua, People, Health News, Science and Technology Daily, China Medical Tribune and other mainstream media also reported this new discovery. CTVA has been incorporated into the newly updated textbooks of Internal Medicine and Respiratory Disease.



# Molecular Mechanisms and Therapeutic Strategies of iron Deficiency Anemia



Selected as The TOP 10 Academic Advances of the Year

Dr. Wang and his team discovered the first anemia vulnerable gene, *TMPRSS6*, is associated with iron deficiency anemia. Further, the team made groundbreaking discoveries of *Caulis Spatholobias* and black soybean seed coat extract could serve as novel therapeutics for anemia via inhibition of hepcidin expression. The findings have been highlighted as "a new era of medical nutrition for human to overcome iron deficiency anemia".

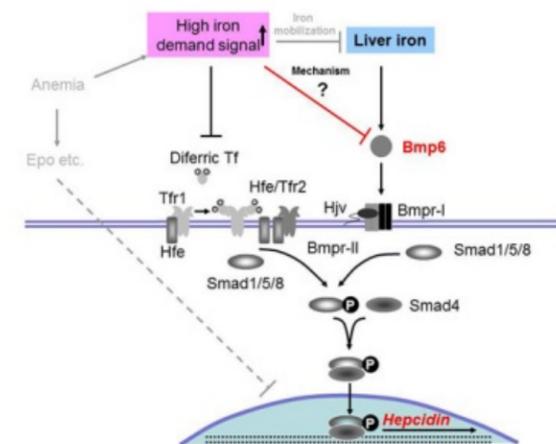
## Project Leader: Fudi Wang

Iron is an essential trace element in maintaining human health. Disruption of iron homeostasis could induce anemia, hemochromatosis, and many more other metabolic diseases. In developing countries, especially in China, iron deficiency anemia is one of the most important public health problems. However, the molecular mechanism and effective safe preventive strategy against iron deficiency anemia remains an unresolved question worldwide. Hepcidin (HAMP), a circulating hormone that is produced and excreted by liver, has been recognized as a major regulator of iron homeostasis. As a result, the hepcidin-ferroportin axis and its related pathways may serve as promising targets for iron disorders.

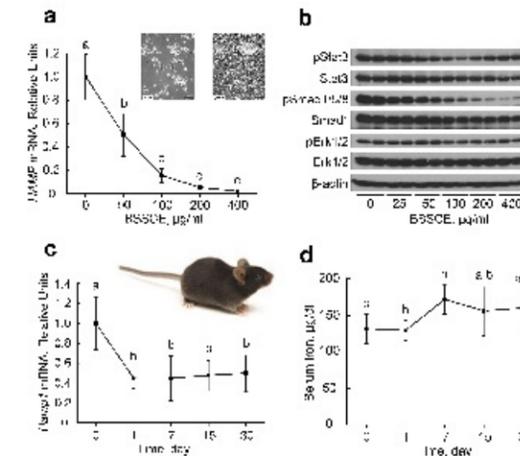


To better understand molecular mechanisms of how hepcidin is regulated in maintaining iron homeostasis, Dr. Wang and his team recently made series of groundbreaking discoveries. First, Dr. Wang team identified a novel mechanism of hepcidin regulation. Besides liver iron, they discovered hepcidin is also regulated by reduced expression of BMP6 when cellular iron demand is high (PLoS ONE, 2014). Second, Dr. Wang team, for the first time, linked multiple genetic variants, including *TMPRSS6*, with iron deficiency anemia in the high risk. These studies were carried out in a well-controlled large cohort of Chinese population. The findings provide a plausible explanation of why the prevalence rates of anemia were high for Chinese. In addition, it may pave ways for further understanding the functional roles of *TMPRSS6* in other iron deficiency induced diseases (Human Molecular Genetics, 2012).

Most importantly, to explore potential novel therapeutics for iron deficiency anemia, focusing on targeting hepcidin in iron metabolism, Dr. Wang and his team functionally screened a large scale library of medicinal



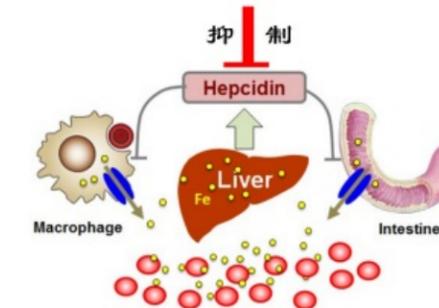
铁稳态代谢网络Hepcidin-Bmp6调控模式图:  
首次发现, 铁代谢核心因子Hepcidin并不完全依赖于肝脏铁调控, 仍受到机体对铁需求的调控



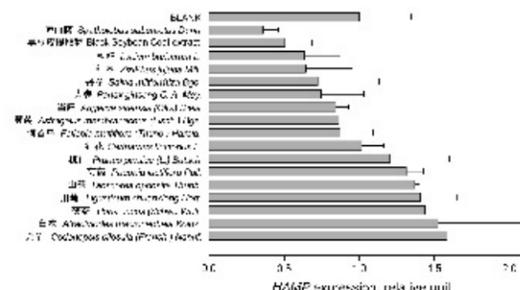
Groups of mice for a diet containing 0% BSSCE for the indicated number of days.

	Day 0	Day 1	Day 7	Day 15	Day 30					
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HAMP (mRNA)	0.90 <sup>a</sup>	0.21	0.91 <sup>a</sup>	0.29	0.91 <sup>a</sup>	0.27	0.77 <sup>a</sup>	0.58	0.87 <sup>a</sup>	0.59
Fe (μmol)	123.17 <sup>a</sup>	2.23	136.41 <sup>a</sup>	0.43	146.82 <sup>a</sup>	1.72	144.41 <sup>a</sup>	3.78	148.51 <sup>a</sup>	2.75
Fe (μmol)	41.22 <sup>a</sup>	0.82	42.31 <sup>a</sup>	1.18	47.26 <sup>a</sup>	1.31	44.39 <sup>a</sup>	1.05	41.75 <sup>a</sup>	0.88
MCV (fL)	40.14	0.46	42.73	0.78	46.69	0.41	45.53	0.4	46.19	0.99

首次发现黑豆皮提取物能通过降低Smad1/5/8的磷酸化水平, 有效抑制Hepcidin表达, 进而降低血清铁水平, 改善贫血。因此, 中国传统食物黑豆有望成为防治铁缺乏性贫血的安全有效新途径。



基于Hepcidin的代谢调控网络, 我们首次从传统中草药寻找到Hepcidin的抑制物——鸡血藤, 并在国际上首次报道膳食食物(黑豆提取物)能有效抑制Hepcidin, 为铁代谢紊乱疾病的防治提供了养生的新思路。



以Hepcidin为靶点的植物成分研究: 从17年传统“药食同源”饮食中草药中, 筛选出鸡血藤、黑豆的提取物能抑制Hepcidin表达。

plant extracts. They identified the Chinese medicinal plant, *Caulis Spatholobias*, functions as an effective hepcidin inhibitor. Remarkably, the team observed *Caulis Spatholobias* could significantly enhance iron absorption in mouse models (Journal of Nutrition, 2013). Moreover, the team, for the first time, made another breakthrough, which is that black soybean seed coat extract could regulate iron metabolism by inhibition of hepcidin expression, and thereby boosting haematopoiesis. (British Journal of Nutrition, 2014). Interestingly, black soybean seed coat extract could make the cellular iron exporter ferroportin get more iron through suppression of hepcidin. Currently, standardized treatment for iron deficiency anemia is iron supplements, which has been reported to have some adverse effects, including cytotoxicities and iron-induced gastrointestinal diseases. In comparison, our findings provided safer treatment options for iron deficiency anemia with almost zero side effects. These discoveries led to two patents for inventions, which provides a strong intellectual property protection for subsequent industrialization. For the first time, the whole world realized that a dietary could regulate iron metabolism by inhibition of hepcidin expression. These discoveries are highly appreciated by experts in the field and also by multiple media. As highlighted by Dr. James P. McClung, a world leading nutritionist, "These findings would be a new era of medical nutrition for human to overcome iron deficiency anemia" (British Journal of Nutrition, 2014).

Taken together, Dr Wang and his team made significant contributions to the discovery of novel therapeutics in iron deficiency anemia as reflected by 4 peer-reviewed research articles and 2 approved patents for inventions. These groundbreaking discoveries revolutionized the concept of traditional treatment of iron deficiency anemia. "Making impossible possible" sets an excellent model for scientists to be open-minded for translating basic findings into clinical testing.

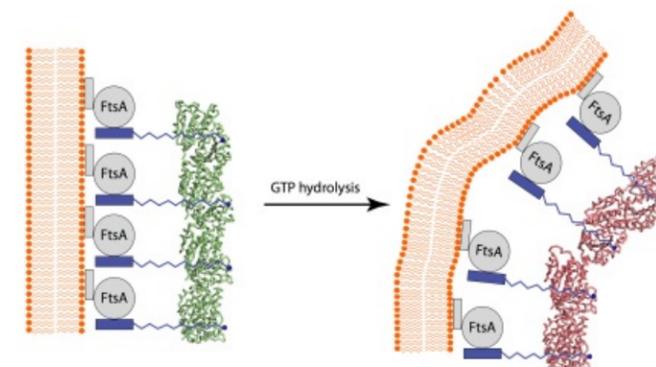
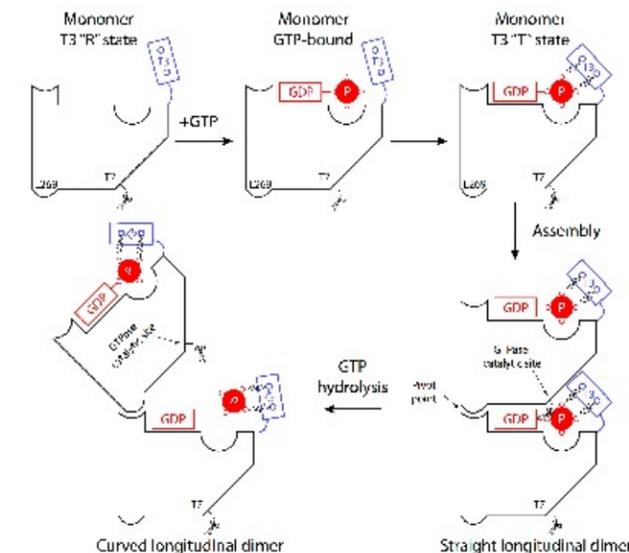
# The Study of the Mechanism of Bacterial Cytokinesis



This study addresses the mechanism that how Z-ring can transform the chemical energy from the GTP hydrolysis to the constrictive force for the cell division in the prokaryotic cytokinesis field. What's more, the results can provide the exact and straightforward structural information for the design of new antibiotic drug targeting the bacteria division protein.

Project Leader: Sheng Ye

The bacterial cytokinesis is initiated by the constriction of Z-ring at the center of a cell, formed by the major cytoskeletal protein FtsZ, a GTPase which can self-assemble into protofilaments. During the division, the Z-ring exerts a constrictive force on the membrane by utilizing the chemical energy of guanosine triphosphate (GTP) hydrolysis, with the diameter contracting till the division completion. Although multiple crystal structures of FtsZ in different nucleotide states as monomers or protofilaments are available, little is known about the structural mechanism underlying a hydrolysis-mediated conformational change.



**FtsZ Protofilaments Use a Hinge-Opening Mechanism for Constrictive Force Generation**  
 Ying Li et al.  
 Science 341, 502 (2013); DOI: 10.1126/science.1250248

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 Updated information and services, including high resolution figures, can be found in the online version of this article at:  
<http://www.sciencemag.org/content/341/6144/502.full.html>  
 Supporting Online Material can be found at:  
<http://www.sciencemag.org/doi/suppl/10.1126/science.1250248>  
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<http://www.sciencemag.org/doi/abs/10.1126/science.1250248>

10.1002/anie.201304272

The MtbFtsZ-GDP subunits in the determined structure arrange longitudinally in a head-to-tail manner and assemble into two continuous polymers that intertwine to form a left-handed, antiparallel, double-stranded structure. Sheng Ye's group designed a series of interfacial mutations based on the structure, with in vivo complement assay, GTPase assay and in vitro EM study demonstrating the mutations indeed disrupt the relative functions of FtsZ. Through these studies, they prove that the longitudinal interface is important for FtsZ function and highlight a hydrolysis-dependent conformational switch at the T3 loop that leads to longitudinal bending between subunits, which can generate sufficient force to drive cytokinesis.

More specifically, through the superposition between the straight SaFtsZ protofilaments and the curved MtbFtsZ protofilaments, they discover that GTP  $\gamma$ -phosphate stabilizes the T3 loop conformation in a compact state (tension or T state) in the straight filaments while a relaxed conformation (R state) in our GDP-bound curved structure. Because both  $\beta$  and  $\gamma$ -phosphates are negatively charged, the release of  $\gamma$ -phosphates by hydrolysis may trigger the T3 loop conformational transition from the T state to R state, driving the hinge-opening event around the pivot point (L269 in MtbFtsZ).

Additionally, FtsZ contains a flexible C-terminus that binds FtsA, which is attached to the membrane through its C-terminal amphipathic helix. Thus, in the context of FtsZ division function, the straight-to-curved transition can exert constrictive forces on the envelope.

# Role of CRL4 Complex in Female Reproduction



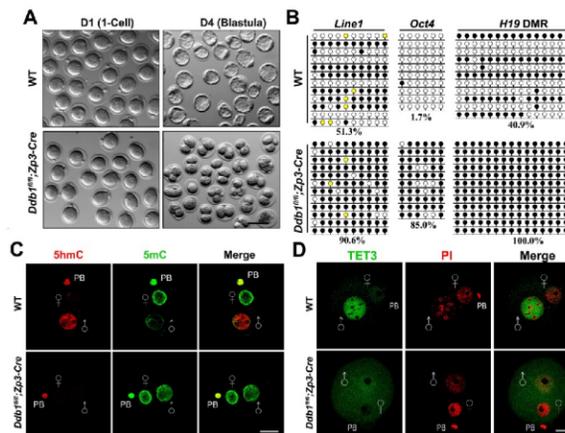
This study revealed the physiological and mechanical role of CRL4 E3 ubiquitin ligase CRL4VPRBP complex in the maintenance oocyte survival, which added new knowledge to female fertility as well as premature ovarian insufficiency.

## Project Leader: Hengyu Fan

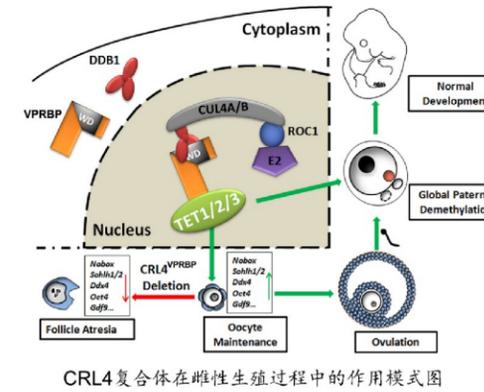
In female mammals, oocytes are generated early in life before birth and entered a resting state, which forms the primordial follicle reserve containing about 100,000 oocytes. No new oocytes were regenerated thereafter. Thus the duration of a woman's reproductive period is determined by the size and persistence of the dormant follicle reserve. Specific oocyte genes are essential for follicle maintenance and female fertility. Mutations of these genes were found in human patients of premature ovarian insufficiency (POI). However, the mechanisms that regulate the expression of these fertility-maintaining genes in oocytes are poorly understood. Here we found that a cullin-ring finger ligase-4 (CRL4) complex was crucial for the expression of these oocyte specific genes as well as oocyte survival by activation of TET family proteins.



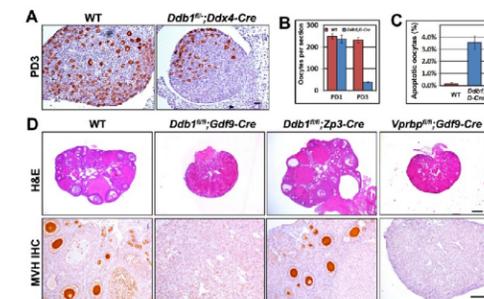
To start, we found that components of the CRL4 E3 ubiquitin ligase (CUL4, DDB1, ROC1 and VPRBP) are highly expressed in mouse oocytes. Utilizing the Cre-loxp based conditional knockout system, we crossed *Ddb1* or *Vprbp* flox mice with *Gdf9*-Cre transgenic mice and deleted DDB1 (Damaged DNA binding protein, the unique linker protein of CRL4) or VPRBP (one of the substrate receptor) specifically in oocytes. Interestingly, both DDB1- and VPRBP- deleted females are infertile by a 5-month fertility test. Complete primordial follicle loss and gonadotropin level increases were observed in these mice within 3 months after birth, showing the premature ovarian insufficiency (POI) phenotype. Previous studies have reported that specific oocyte genes (*Nobox*, *Sohlh1/2* and *Lhx8*) are essential for follicle maintenance and female fertility, lacking of which led to POI. We then found global down-regulation of mRNA level



CRL4的活性对雌原核基因组去甲基化和早期胚胎发育非常关键



CRL4复合体在雌性生殖过程中的作用模式图



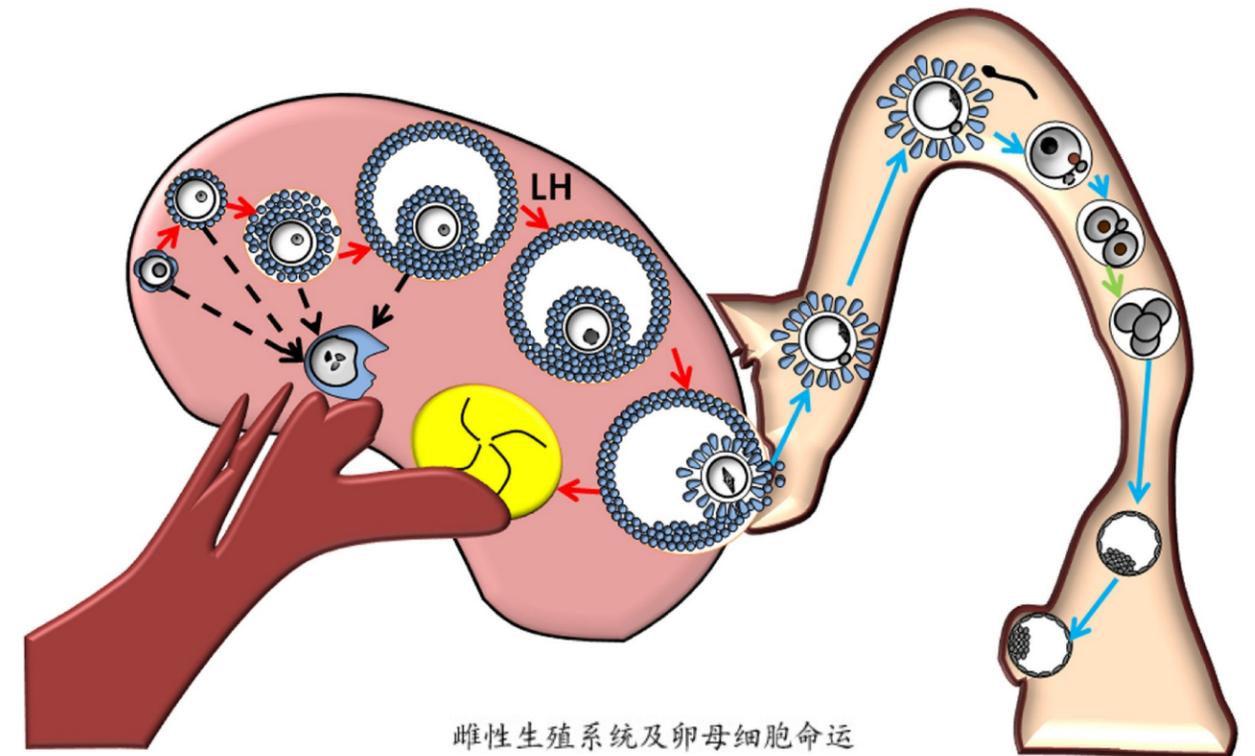
CRL4活性缺失导致小鼠青春期卵巢早衰

In DDB1/VPRBP deleted oocytes, as well as elevated methylated CpG sites within *Gdf9*, *Figla*, *Nobox* and *Ddx4* promoters and imprinting region, H19 DMR.

We also found that CRL4 complex is crucial for thereprogramming of paternal DNA after fertilization. Most DDB1-deleted oocytes failed to develop beyond the 4-cell stage after fertilization. Demethylation of markers for successful paternal DNA reprogramming (*Line1* and *Oct4*) was also impaired in DDB1-deleted oocytes. These results suggested that CRL4VPRBP was a maternal factor required for zygotic genome activation. We next examined the interaction of CRL4VPRBP complex and TET family proteins in HeLa cells. DDB1 or VPRBP overexpression increased endogenous 5hmC levels, while RNAi depletion of CRL4VPRBP in HeLa cells markedly decreased their endogenous 5hmC levels. Co-IP results also indicated that TET1/2/3 bound to VPRBP through their C-terminal catalytic domain. These results indicated that CRL4VPRBP was required for TET-mediated 5hmC generation both in oocytes and somatic cells.

Hence, in this study we demonstrated that CRL4VPRBP ubiquitin ligase is a guardian of female reproductive life in germ cells, and a maternal reprogramming factor after fertilization by regulating the activity of TET family dioxygenases.

These results were published on Science on Dec 20, 2013, and draw many audience of general interest. After publication, our study was highlighted by Biology of Reproduction, in which emphasized the importance of our findings.



雌性生殖系统及卵母细胞命运

# The Research of Rule of Law Assessment in China



The book *Experiment of Rule of Law Assessment* marks the forming of a new research area in the domestic legal field. The rule of law assessment represents a change in the law research method.

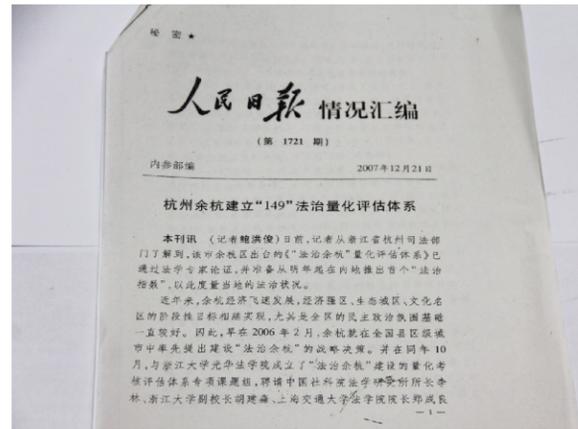
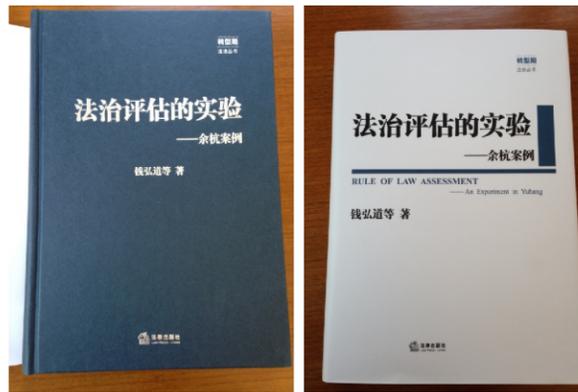
## Project Leader: Hongdao Qian

The project *Assessment of Rule of Law in China* chaired by Professor Qian Hongdao has made a widespread impact at home and abroad.

It has filled several gaps in these areas of study the System of Rule of Law Assessment, Rule of Law Index, Judicial Transparency Index, E-Government Development Index, and China Practical School of Rule of Law established by Professor Qian Hongdao which represents a new school of legal theory. The results of the projects have been adopted in the *Decision of the CCCPC on Some Major Issues Concerning Comprehensively Deepening the Reform*.

The book *Experiment of Rule of Law Assessment* marks the forming of a new research area in the domestic legal field. The rule of law assessment represents a change in the law research method.

Research results have been successfully applied in practice. They have been used in annual evaluations in the Rule of Law Index of Yuhang District in Zhejiang Province since 2007, the Judicial Transparent Index of more than 100 Zhejiang courts since 2013, and the E-Government Development Index of 13 district governments of Hangzhou since 2012. In particular, Yuhang District's implementing the Rule of Law Index has been a valuable experiment and attracted officials from a number of other regions to visit Yuhang as a study example.



Media has published in-depth reports on the project's innovative research and useful indices on measuring judicial transparency and governmental compliance with the rule of law. The media coverage has been so extensive and has generated so much vigorous discussion that the term "the rule of law index phenomenon" has been coined referring to practice and discussion regarding the Rule of Law Index. Legal academics and the press have been referring to Professor Qian as "Qian Index".

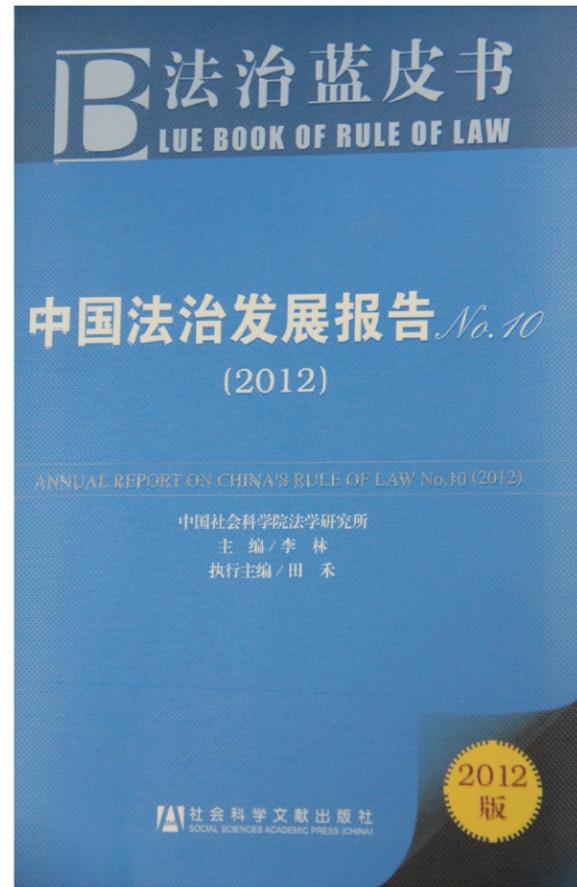
The project has received a number of awards for its indices. For example, the Rule of Law Index was listed as one of *Zhejiang Province 100 Typical Events in 30 Years, won Public Management Innovation Award*, and was nominated for China's Urban Management Progress Award. Yuhang has been rated in the

first tier in *National Advanced Cities and Counties on Rule of Law*.

On the basis of a series of experimental, empirical, practical and interdisciplinary researches regarding the Rule of Law Index, the Judicial Transparency Index and the E-Government Development Index, Professor Qian Hongdao stated that China Practical School of Rule of Law was taking shape. He believes that the birth of China Practical School of Rule of Law has been the theoretical response to the great practice of China's Rule of Law. Great practice requires great theory. An unprecedented event like the development of rule of law in China will definitely give rise to a unique theory. The emergence of China Practical School of Rule of Law is a manifestation of the confidence in its own theory.

And now the practice of China's Rule of Law offers us the best chance to craft our own thoughts theory, system and style.

It is to be expected that China Practical School of Rule of Law will make a meaningful contribution to China's rule of law. It has been proved by facts that China Practical School of Rule of Law is coming into being. Empirical facts show that a large group of theorists and practitioners, who echo the values of China Practical School of Rule of Law, has already been making a noticeable contribution to China's development of rule of law. It is reasonable to expect that future development of rule of law is not going to bypass the accomplishments of China Practical School of Rule of Law.



# Principle of "Small Population"

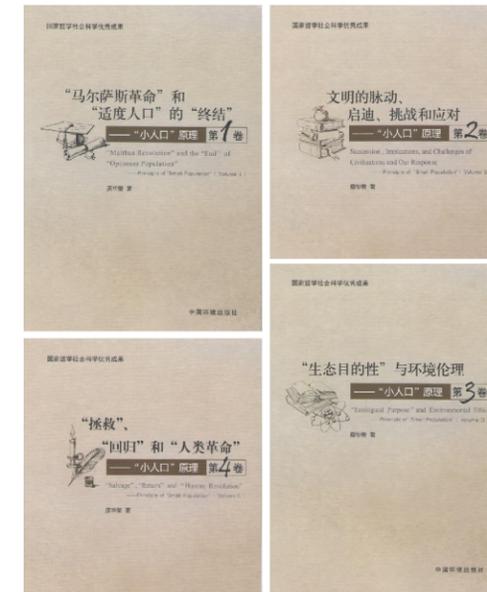


Under the guidance of system theory, Principle of "Small Population" makes use of multidisciplinary theories and knowledge to study the relation between human beings and the nature, and the historical role of population size in civilization succession, subvert traditional cognitions, build the principle of "small population" and focus on morality, continuity and salvage of "small population".

## Project Leader: Huarong Yuan

Principle of "Small Population" is written by the author after 10 years of painstaking researches and systemizations (the author brought forward the concept of "small population" in 1981), under the auspice and support from National Philosophy and Social Science Foundation (03BRK005, Excellent Achievement), Zhejiang University Social Sciences Academy China Academy of West Region Development, Research Institute of Population and Development, and Research Institute of Environment and Resources. Published by China Environment Publishing House in 2013, it has 4 volumes, 30 chapters, 123 sections, 373 items and 103 appendices, with 1.63 million Chinese characters in total. The framework of the whole book, proposal/argument, main original and subversive thoughts, systems and view points are as follows:

Malthus Revolution" and the "End" of "Optimum Population" (Volume I): Relation among "Malthus Revolution", "Effective Demand", "Getting Older" of Malthus and "An Essay on the Principle of Population" Abandoned by Keynes; Inverse Correlation between Land Carrying Capacity and Ecological/Environmental Stability; the Key of Sustainability Is Not Equilibrium But Scale;



End" of "Optimum Population"; Who Will Be the Real Winner in the 21st Century?

Succession, Implications and Challenges of Civilizations and Our Response (Volume II): Prescription of "Environmental Lifespan" on the Rise and Fall of Civilization; "High State Low Income Level Equilibrium Trap"; "Driving Force" of Population Fluctuations to "Erosion-Repair" Cycle of Social and Environmental Bases of Agricultural Civilization; Constraint and Adjustment of Land Rehabilitation to Civilization Succession; Demographic Source of China's "Century of Humiliation"; Civilization History Viewpoint about Population Fluctuations (Mechanism of the First Motive Force of History).

Ecological Purpose" and Environmental Ethics (Volume III): "Space Pre-adaptation Mechanism" of Biological Evolution; "Ecological Purpose"; Origin of Species Equality; Essential Externality and Inequality of Human Beings; Nature being "Kind in Essence" and Human Beings being "Evil in Essence"; New Cornerstone of "Natural Right to Life" and "Right of Ecological Obligations"; Subversive "Eco-ethics".

Salvage", "Return" and "Human Revolution" (Volume IV): Scale Problem without Technology and System Solution; Disaster of "Technological Salvage"; "Post-agricultural Society" and "Food-oil Strategy"; Finite and Infinite: "Self-certification" and "Self-denial"; Necessity of "Contingency" and Determination of (Space-time) Dimension of "Necessity" and "Contingency".

According to experts, up to now, this book is China's the first uncommon and landmark theoretical masterpiece that centers on environmental ethics and demonstrates population development prospect with multidisciplinary theories from multiple aspects. With intensive and consistent arguments, the grand book stands out as a unique, rare, ultra technological and empirical research achievement, and boasts theoretical shock power. Therefore, this book will surely turn into a new topic explored and argued by young scholars, and inspire more people to think and criticize.

# The Outstanding Achievements of Zhejiang University in 2013

No.	Project Title	Achiever	Award Type	Levels	Department
1	Research and Application of Design and Development Platform for Advanced Control Equipments and Systems	Youxian Sun, Wenhai Wang, Chunjie Yang, Xinggao Liu, Jianmin Huang, Jiangang Lu, Tinggang Jia, Xinrong Seng, Zhengguo Xu, Ping Wu, Yueqiang Ji, Yinan Zhang, Zhengbing Yan, Wei Zhou, Tiejun Wu	National Award for Science and Technology Progress	First Prize	State Key Laboratory of Industrial Control Technology, Institute of Industrial Process Control, Department of Control Science and Engineering
2	Theoretical innovation and technological breakthrough on diagnosis and treatment of severe hepatic diseases	Lanjuan Li, Shusen Zheng, Zhi Chen, Jun Li, Yingjie Wang, Kaijin Xu, Xiao Xu, Yu Chen, Hongyan Diao, Weibo Du, Weilin Wang, Hangping Yao, Jian Wu, Hongcui Cao, Xiaoping Pan	National Award for Science and Technology Progress	First Prize	The First Affiliated Hospital of Medicine School
3	One-dimensional nanomaterials of semiconductors: controllable synthesis and their growth mechanisms	Deren Yang, Hui Zhang, Ning Du, Jian Sha, Xiangyang Ma	National Award for Natural Science	Second Prize	State Key Laboratory of Silicon Materials, Department of Materials Science and Engineering
4	Geometry representation and computing theory and methods for complex objects	Hujun Bao, Kun Zhou, Ligang Liu, Jiwen Zhang, Hongwei Lin	National Award for Natural Science	Second Prize	State Key Laboratory of CAD&CG, College of Computer Science and Technology
5	Environmental interface behaviors of typical organic pollutants and their regulating mechanisms	Lizhong Zhu, Baoliang Chen, Kun Yang, Daohui Lin	National Award for Natural Science	Second Prize	Institute of Environmental Pollution and Control Technology, College of Environmental and Resource Sciences
6	Key technologies and equipments of aircraft digital assembly	Ke Yinglin, Li Jiangxiong, Jiang Junxia, Fang Qiang, Dong Huiyue, Liu Gang	National Award for Technological Invention	Second Prize	The Institute of Manufacturing Engineering, Mechanical Engineering Department
7	Grain boundaries restructuring and key techniques for high performance and low cost NdFeB magnets	Mi Yan, Wei Luo, Tianyu Ma, Xiongfei Fan, Yuliang Yao, Xinhua Wang	National Award for Technological Invention	Second Prize	The institute of Metallic Materials, Department of Materials Science and Engineering
8	Construction and application of the novel preventive techniques against infectious bursal disease	Jiyong Zhou, Lian Yu, Jun Rong, Yuanzhao Du, Jue Liu, Taiping Cheng	National Award for Technological Invention	Second Prize	Key Laboratory of Animal Virology of Ministry of Agriculture, College of Animal Sciences
9	Remediation technique for the saturated soft foundation under long-term cyclic loading and engineering application	Yuanqiang Cai, Yufeng Gao, Jun Wang, Changjie Xu, Jifu Liu, Honglei Sun, Zhongxuan Yang, Jianguo Zheng, Jingze Yin, Teng Huang	National Award for Science and Technology Progress	Second Prize	College of Civil Engineering and Architecture, Research Center of Coastal and Urban Geotechnical Engineering
10	Development and integrated application of critical storage and logistics techniques for Chinese bayberry and loquat fruits	Kunsong Chen, Changjie Xu, Jun Sun, Chongde Sun, Li Li, Zehuang Zhang, Guoliang Jiang, Jintu Zheng, Bo Zhang, Kangqiang Wang	National Award for Science and Technology Progress	Second Prize	College of Agriculture & Biotechnology, Institute of Fruit Science

11	Molecular mechanisms and new diagnosis and treatment technologies application of asthma	Huahao Shen, Nanshan Zhong, Jinping Zheng, Shandong Wu, Kai Wang, Wen Li, Aihuan Chen, Pingli Wang, Jun Xu, Jing Li	National Award for Science and Technology Progress	Second Prize	The Second Affiliated Hospital of Medical school
12	Mechanisms of geminivirus-plant interaction	Xueping Zhou, Qi Xie, Xiuling Yang, Qingtang Shen, Yan Xie, Changjun Huang, Zhonghui Zhang, Yajuan Qian, Hongye Li, Jianbin Lai, Hao Chen, Zhenghe Li	Natural Science Award of University in China	First Prize	Institute of Biotechnology, College of Agriculture and Biotechnology
13	Semantic graph-based knowledge service technologies and applications in traditional chinese medicine	Zhaohui Wu, Xuesong Liu, Huajun Chen, Meng Cui, Xiaohong Jiang, Min Yao	Award for Technological Invention of University in China	First Prize	College of Computer Science and Technology
14	Key techniques, strategy and the utilization for the control of soil sickness in the commercial production of major fruit vegetable	Jingquan Yu, Yanhong Zhou, Xiefeng Wang, Zhiqiang Sun, Fengzhi Wu, Mingfang Zhang, Kai Shi, Hanrong Wang, Shuancheng Chen, Ming Wei, Jiaojian Xia, Li Fang, Jinghua Yang, Airong Liu	Technological Award of University in China	First Prize	College of Agriculture & Biotechnology
15	Key techniques and industrialization of cold-stretching of austenitic stainless cryogenic vessels	Jinyang Zheng, Binan Shou, Li Ma, Weiming Zhou, Chunfeng Liu, Caixing Shi, Zhaohui Chen, Cunjian Miao, Haoming Wang, Yongxin Luo, Ping Xu, Liang Sun, Jianjun Ye, Jian Yang, Yang Yang, Pengfei Liu, Wei Wei, Chaohua Gu, Tao Li	Technological Award of University in China	First Prize	Department of Chemical and Biological Engineering, Institute of Process Equipment
16	The research of mechanism of target organs function damage and protection methods in organ transplantation	Tingbo Liang, Xueli Bai, Weihua Gong, Wei Chen, Tao Ma, Xuefeng Xia, Liang Liang, Fei Xue, Guodong Xu, Yun Zhang, Linyan Wang, Hao Liu, Jinlin Hu, Pingtong Huang	Technological Award of University in China	First Prize	The Second Affiliated Hospital of Medical school
17	Novel strategy of Risk-assessment, prophylaxis and treatment for major complications after allogeneic hematopoietic stem cell transplantation	He Huang, Yi Luo, Haowen Xiao, Xiaoyu Lai, Yamin Tan, Jimin Shi, Zhen Cai, Aiyun Jin, Xiaorong Hu, Shuiyun Chen, Weiyan Zheng, Yuanyuan Zhu, Yanlong Zheng, Yongxian Hu, Gongqiang Wu	Technological Award of University in China	First Prize	The First Affiliated Hospital of Medicine School
18	Research and application of the key technology of drinking water safety assurance in WDS	Tuqiao Zhang, Tingchao Yu, Yan Zhang, Jingqing Liu, Miaomiao Ye, Jinghua Wang, Jianqun Jiang, Xinwei Mao, Yiping Zhang, Weiyun Shao, Weiping Cheng, Cong Li, Yongchao Zhou, Yunjin Hu, Lei Fang	Scientific & Technological Award of Zhejiang Province	First Prize	Municipal institute, College of civil engineering and architecture

19	Preparation technologies of nano toughened silicon carbide ceramics and its application in mechanical seals	Hui Yang, Xingzhong Guo, Pu Zheng, Lingjie Zhang, Zhirong Zheng, Peixin Fu, Lihua Gao, Zhiqiang Li, Haimiao Li, Xiaoyi Zhu, Lin Zhu	Scientific & Technological Award of Zhejiang Province	First Prize	Institute of Inorganic Non-metallic materials, Department of Materials Science and Engineering
20	Controlled micro-nano structure, tailored property and applications of large-area oxide thin films	Gaorong Han, Yongliu, Gaoling Zhao, Qian Gao, Junbo Liu, Qiyang Liu, Yankai Ge, Molong Xiao, Yongjie Zhang, Chenlu Song, Piyi Du, Ge Shen, Yinhua Wo.	Scientific & Technological Award of Zhejiang Province	First Prize	Institute of Inorganic Non-metallic materials, Department of Materials Science and Engineering
21	Research, Development and Technique Applications of Humanoid robots Playing Table Tennis	Rong Xiong, Jian Chu, Qiuguo Zhu, Yifeng Zhang, Hongbo Zheng, Jun Wu, Yong Liu, Yichao Sun, Yikun Tao, Zhenhua Shen	Scientific & Technological Award of Zhejiang Province	First Prize	Institute of Cyber Systems and Control, Department of Control Science and Engineering
22	Key technologies and application of pico-satellites	Zhonghe Jin, Zicheng Chen, Yangming Zheng, Yuelin Wang, Xiaojun Jin, Hao Wang, Changju Wu, Huiquan Wang, Chunhui Wang, Chaojie Zhang, Tao Meng, Jian Bai, Yuetong Xu, Dong Li, Xiang'e He	Scientific & Technological Award of Zhejiang Province	First Prize	School of Aeronautics and Astronautics, Microsatellite Research Centre
23	The key technologies for controlling safety of raw milk and upgrading quality of infant formula milk powder	Donghong Liu, Guanghua He, Xianqian Ye, Xiaojun Chu, Tao Huang, Jianwei Zhou, Dan Wu, Hang Lu, Rongfa Guan, Jiakai Hua, Zhen Liu, Linfei Mo	Scientific & Technological Award of Zhejiang Province	First Prize	School of Biosystems Engineering and Food Science
24	Basic and clinical study on pathogenesis of ischemic heart disease	Jian'an Wang, Meixiang Xiang, Hong Ma, Shuqin Ying, Yan Lin, Chunna Jin, Li Shen, Dan Yang	Scientific & Technological Award of Zhejiang Province	First Prize	The Second Affiliated Hospital of Medical school
25	Evaluative system for predicting recurrence of primary diseases following liver transplantation	Shusen Zheng, Lin Zhou, Xiao Xu, Limin Wu, Haiyang Xie, Feng Zhang, Guoping Jiang, Min Zhang, Jian Wu, Xiaowen Feng, Weilin Wang, Yan Sheng, Jun Cheng	Scientific & Technological Award of Zhejiang Province	First Prize	The First Affiliated Hospital, School of Medicine, Zhejiang University
26	Establishment and application of early screening technology and early intervention strategy for 30 inherited metabolic diseases in neonates	Zhengyan Zhao, Xuefan Gu, Xinwen Huang, Jun Ye, Rulai Yang, Lianshu Hai, Qiang Shu, Wenjuan Qiu, Shiqiang Shang, Fan Tong, Huaqing Mao, Jianbin Yang, Xiaoxiao Chen	Scientific & Technological Award of Zhejiang Province	First Prize	Children's Hospital of Medicine School
27	The establishment of new risk adapted therapy schema and applied research of multiple myeloma	Zhen Cai, Jingsong He, Xiaoyan Han, Qing Yi, Jimin Shi, Gaofeng Zheng, Xiujin Ye, Wanzhuo Xie, Maofang Lin, He Huang, Yi Luo, Xiaojian Meng, Weiyan Zheng	Scientific & Technological Award of Zhejiang Province	First Prize	The First Affiliated Hospital of Medicine School
28	Chinese Civil Society "Growing by Participating", A Case Study on Industrial Associations in Wenzhou, China	Jianxing Yu	The Sixth Outstanding Achievements of Universities in China (Humanities and Social Sciences)	First Prize	School of Public Affairs

## The ZJU100 Papers of Zhejiang University in 2012

[1] Z. Y. Zhang, J. Wang, H. Y. Zha; Adaptive Manifold Learning. IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE. 2012, 2, 253.

[2] H. Zhang, X. D. Zhang, G. N. Ge; Optimal Ternary Constant-Weight Codes With Weight 4 and Distance 5. IEEE TRANSACTIONS ON INFORMATION THEORY. 2012, 5, 2706.

[3] G. Bao, J. S. Lin; Imaging of reflective surfaces by near-field optics. OPTICS LETTERS. 2012, 24, 5027.

[4] Q. Mo, Y. Shen; A Remark on the Restricted Isometry Property in Orthogonal Matching Pursuit. IEEE TRANSACTIONS ON INFORMATION THEORY. 2012, 6, 3654.

[5] S. X. Li, F. Gao, G. N. Ge, S. Y. Zhang; Deterministic Construction of Compressed Sensing Matrices via Algebraic Curves. IEEE TRANSACTIONS ON INFORMATION THEORY. 2012, 8, 5035.

[6] M. Z. Zhu, G. N. Ge; Quaternary Constant-Composition Codes With Weight 4 and Distances 5 or 6. IEEE TRANSACTIONS ON INFORMATION THEORY. 2012, 9, 6012.

[7] C. H. Gao, L. Jian, S. H. Luo; Modeling of the Thermal State Change of Blast Furnace Hearth With Support Vector Machines. IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS. 2012, 2, 1134.

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