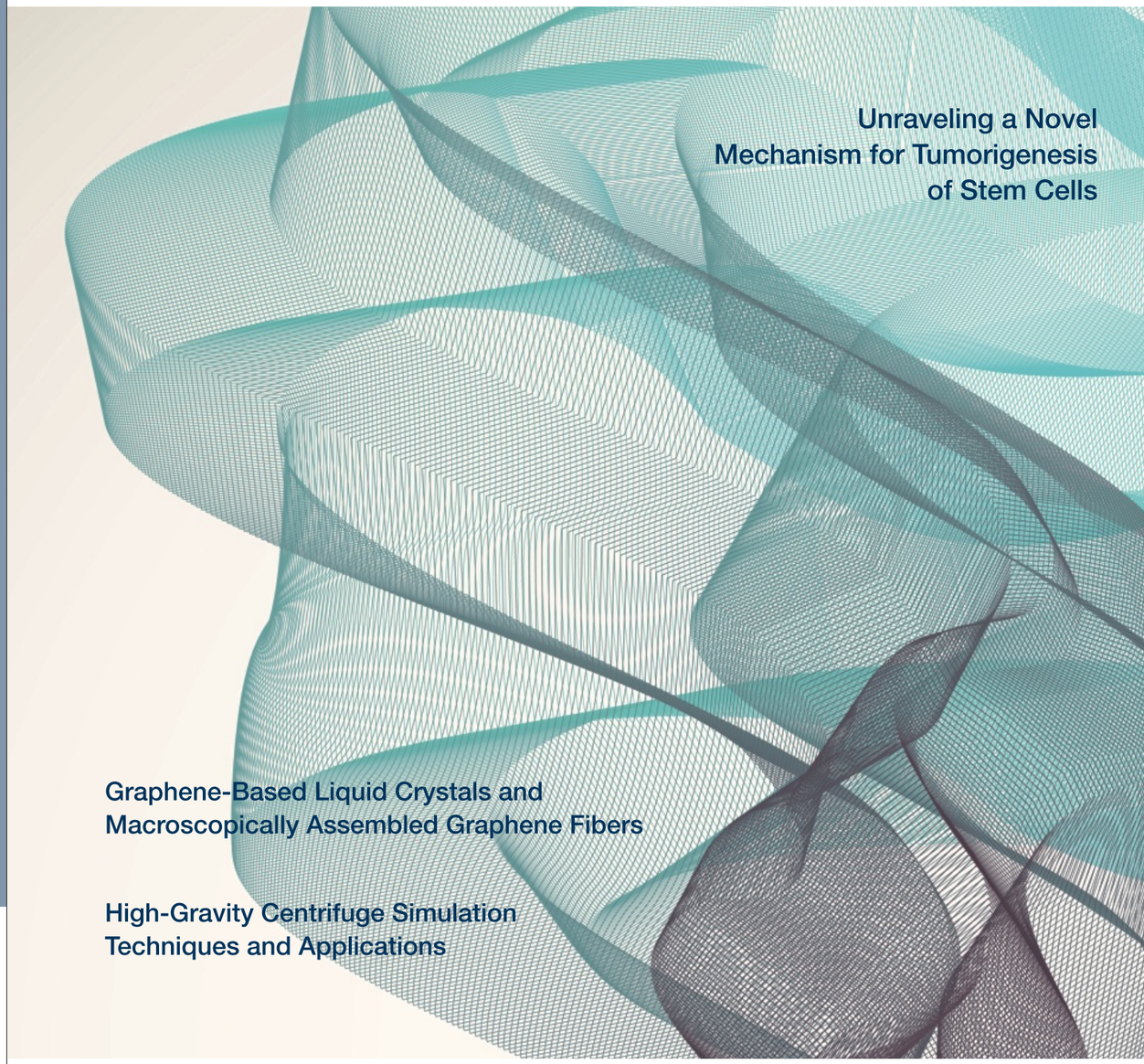
ZHEJIANG UNIVERSITY
ACADEMIC ANNUAL REPORT
2012



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ZHEJIANG UNIVERSITY ACADEMIC ANNUAL REPORT 2012

浙江大学学术年报 2012

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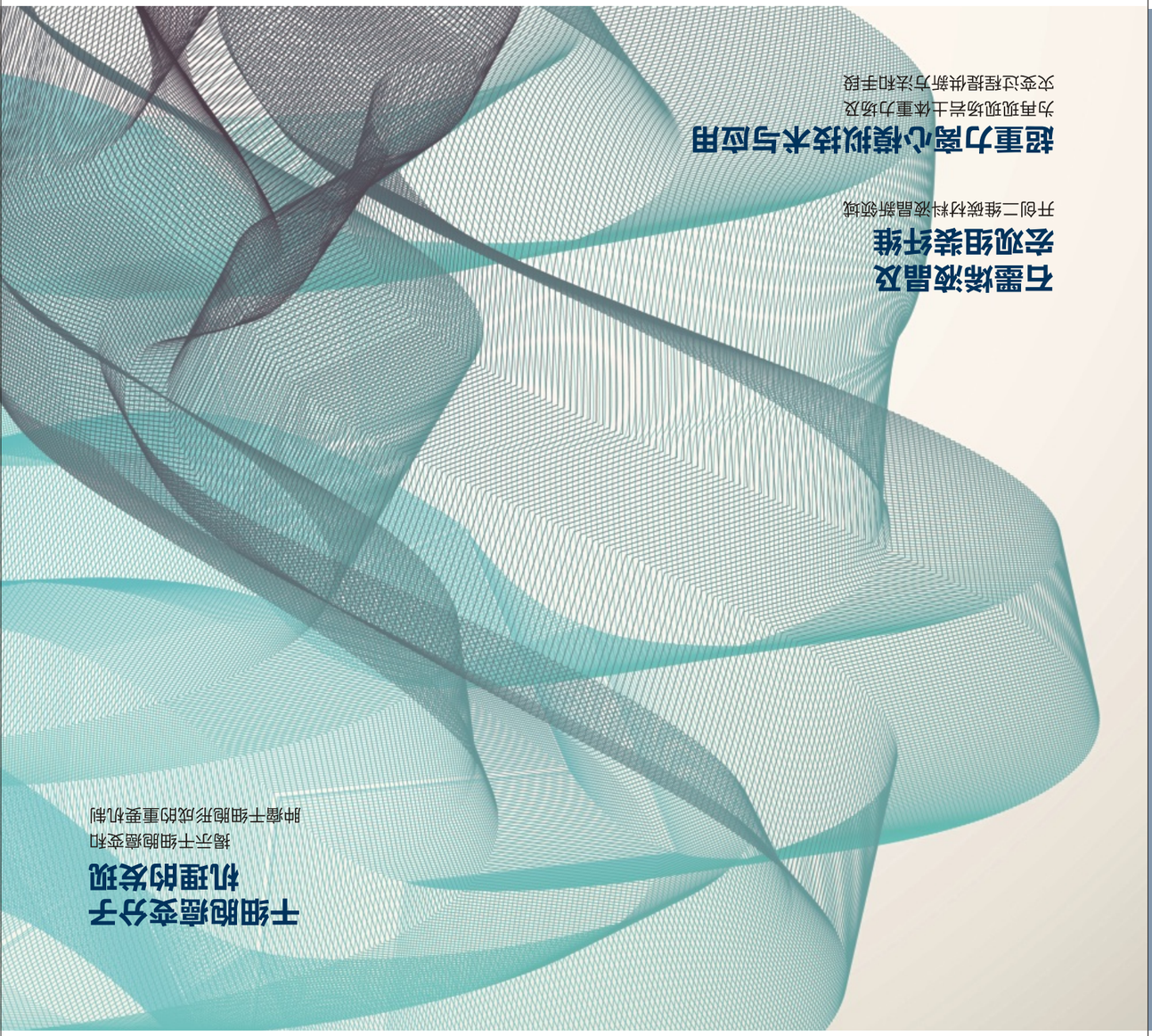

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ZHEJIANG UNIVERSITY ACADEMIC ANNUAL REPORT
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浙江大学学术年报

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2012

ZHEJIANG UNIVERSITY
ACADEMIC ANNUAL REPORT

PREFACE

Zhejiang University scored great achievements in academic research, academic development, academic exchange and cooperation at home and abroad with its arduous efforts in 2012.

The Annual Academic Report provides a review of the academic advances of Zhejiang University in 2012. The advances highlighted in the report, first recommended by schools, departments and faculties, or peer experts, and later selected by students and teachers alike through public voting on the intranet, reflect the academic achievements with innovative technologies and theories in the past year.

Academic studies, which entail creation and accumulation of knowledge, are a process of understanding and exploring the nature and law of objects. Scholars value the assessment from peer experts, and the prerequisite for assessment is a thorough understanding. Therefore, academic exchanges, or engendering in the public an understanding about science through popularization is necessary. In such a way, academic studies can promote social progress and economic development. The Annual Academic Report aims to attract the attention of students, teachers, other academics and the members of the public to the academic advances of Zhejiang University, thus creating a profound academic atmosphere.

Success in academic studies comes only by way of a difficult journey and endless pursuit. Academic achievements enable us to understand the Zhejiang University community, as it seeks to uphold the principle of "Seeking Truth", make pioneering innovations in academic studies, and better serve the nation and public with expert knowledge, innovation and discerning power.

Academic studies are the soul of a university. The fruit of research is the foundation for the wisdom, progress and reputation of a university. The Annual Academic Report, as a new endeavor, makes an annual record and collection of the achievements and footprints of Zhejiang University as it strives to be a first-class university.

Your encouragement and support for the work of the university which has led to the advances made and reported in this Annual Academic Report is highly appreciated.

Director of the Academic Committee, Zhejiang University

ZHEJIANG UNIVERSITY ACADEMIC ANNUAL REPORT 2012

The Academic Annual Report 2012,
Zhejiang University

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ACZJU THE ACADEMIC COMMITTEE OF ZHEJIANG UNIVERSITY

CONTENTS

Academic Development of Zhejiang University in 2012

Zhejiang University, with an enduring history of 115 years, is a comprehensive research-oriented university exerting great influence at home and abroad. Upholding the principle of “Seeking Truth”, Zhejiang University has made its contribution to the national prosperity, social development and human progress with its innovation in research and its cultivation of talent.

Zhejiang University boasts five campuses (Zijingang, Yuquan, Xixi, Huajiachi and Zhijiang), with 7 faculties and 37 schools (departments) in 12 disciplines: engineering, agriculture, medicine, sciences, management, philosophy, economics, law, education, literature, history and art. Currently, Zhejiang University hosts some 44,800 full time students, among whom are approximately 13,700 master candidates, 8,200 doctoral candidates and 22,900 undergraduates, and over 3,100 foreign students are admitted. In addition, there are over 3,200 full-time teachers, including 1,300 professors, with 13 academicians of the Chinese Academy of Sciences, 13 with the Chinese Academy of Engineering, 89 winners of the National Science Fund for Distinguished Young Scholars (NSFDYS), 88 chair professors of the Chang Jiang Scholars Program, 20 principal scientists for the “973 Project”, and 48 scholars of the national “Recruitment Program of Global Experts”.

2012 was a year Zhejiang University vastly accelerated its reform and development. With the strategy of “Focusing on Quality, Sharpening Strengths, and Expanding Reputation”, Zhejiang University has endeavored to promote the concerted development of “Quantity, Quality and Reputation”, achieving new advances in discipline development, academic studies, academic exchanges and cooperation at home and abroad, as well as the development of its discipline system.

I. Discipline Development

Based on the established 14 first-grade national key disciplines, 21 second-grade national key disciplines and 10 second-grade national key (cultivated) disciplines, Zhejiang University is dedicated to adjusting and optimizing discipline distribution while bettering quality and highlighting strengths. First, the University carried out the first-class discipline development of its “985 Project”, comparatively sharpening the edges of 10 disciplines or orientations, including physics, chemistry, engineering thermophysics, material science and engineering, management science and engineering, turning them into first class disciplines/orientations. Second, national key cultivated disciplines were strengthened, turning them into national key disciplines. Third, the fundamental disciplines of the natural sciences and humanities were improved for a concerted development of fundamental and applied disciplines. Fourth, disciplines were geared to mesh with national and regional economic development strategies. Marine science was developed as well.

Based on the ESI statistics of January 1st, 2013, Zhejiang University ranked 195 among the world’s academic institutions in cumulative citations in 2010, a rise of 36 ranks compared with 2009. Fourteen disciplines were among the world’s top 1% in ESI and their academic influence improved dramatically over the previous year, among which, agricultural science, chemistry, computer science, engineering, material science, medicine and pharmacology, and plant and animal sciences, were among the world’s top 100. Material science, chemistry and agricultural science ranked 26th, 38th and 43rd respectively.

II. Research Capacity

Zhejiang University boosted the quality and quantity of research by furthering its reforms on research management systems. In 2012, the total research funds amounted to 3 billion yuan, ranking 2nd among Chinese universities. In particular, funds coming directly from the national research, education and government departments exceeded 2 billion yuan. National defense research funds reached 361 million yuan (taking up 11.7% of the total research funds).

In 2012, Zhejiang University created a historical height in the number of key national projects. 763 projects in the National Natural Science Foundation of China (NSFC) were approved with contracted funds of 537 million yuan, an increase of 40% over 2011. A total number of 460 ordinary projects and 222 youth projects ranked Zhejiang University second among Chinese universities. 22 teachers won the Outstanding Young Science Funds, also ranking second nationally. In addition, two new National Innovative Research Group Science Funds and six “973” Projects were approved, reaching new historical heights for the University, and showing a significant upgrade in capacity in fundamental science research.

In 2012, Zhejiang University enhanced its capacity for major projects, conducting 107 projects with funds of approximately 10 million yuan in over 10 fields: stem cells and growth, high-end numerical control machine tools and manufacturing equipment, core electronic devices, high-end general-purpose chips, basic software products and integrated circuits, prevention and treatment of major infectious diseases, development and application of on-chip control systems oriented to industrial control, cultivation of new transgenic biological species, high-speed railways, development of large-scale plane digital assembling systems, technology of grading and utilizing coal in clean power generation, food processing and logistics, and digital medical engineering technology.

III. Academic Influence

Zhejiang University, by perfecting research policies, enhancing policy orientation and building up major platforms, has turned out some major high-level achievements, improved the quality of its scholars’ academic papers, and upgraded its academic influence.

Based on statistics from the Chinese Science & Technology Information Research Institute at the end of 2012, Zhejiang University ranked first nationally in seven scientific indexes in 2011: SCI papers, good-performance papers, international paper citations, cumulative citations in the past decade, journal papers with most influence in different fields, Medline papers, and international patent authorizations. Among them, 4,215 papers were included in the Science Citation Index, an increase of 9.5% over the previous year; and 3,325 papers in EI(The Engineering Index), an increase of 0.1% over the previous year. In addition, 1,449 papers were rated as good performance , an increase of 68.5% over the previous year, and accounting for 34.4% of the total number of papers. Three papers were rated as The Highest International Influence Academic Papers of China, Besides this, 172 papers were published in 158 journals with high influence in 176 fields of JCR （Journal Citation Reports） in 2011, ranking first among China's universities.

Furthermore, Zhejiang University, together with other institutes, secured 13 State Science and Technology Prizes in 2012, among which, 6 projects were headed by Zhejiang University. The project “The Development of Key Designing and Manufacturing Technology for Shield Tunnel Boring Machine,” conducted by the team led by Professor Yang Huayong from the Department of Mechanical Engineering, was granted First Prize among the 13. Zhejiang University also secured Second Prize among competitors competing for the National Award for Technological Invention, and four Second Prizes in the National Award for Technological Progress competition. In 2012 Zhejiang University got 2,244 authorized patents, an increase of 17.2% over the previous year, among which 1,515 were authorized invention patents, occupying 67.15% of all the patents, an increase of 22.8% over the last year, and ranking the first among Chinese universities nationally.

IV. The Development of Philosophy and Social Sciences

Zhejiang University continued to make breakthroughs in the funds, projects and achievements in humanities and social sciences in 2012, improving its contributions to decision-making for the higher authorities. The research funds amounted to 206 million yuan, among which 6 projects were approved as the key bidding projects, and 3 key projects and 27 fund projects for the National Social Sciences Fund. Two projects were approved as key brainstorm projects by the Ministry of Education of the PRC. The Journal of Chinese Language History and the Review of New Political Economics were included in 2012-2013 CSSCI source journals. In 2012, 245 papers were included in the Social Sciences Citation Index, an increase of 35%, 25 included in A & HCI, an increase of 39% over the precious year. 29 projects were awarded prizes in the Sixth Excellent Achievement Awards of Higher Schools (Humanities and Social Sciences), from the Ministry of Education, and one project ranked the first. The Twelfth Five-year Plan of the National Basic Public Service Systems was wholly compiled by Zhejiang University was officially approved by the State Council. Zhejiang University also partook in the compilation of Twelfth Five-year Plan of the National Civil Affairs Development, and Development Plan for Hohhot-Baotou-Yinchuan-Yulin Economic Zone, two national development plans. For furthering the prosperity of philosophy and social sciences, promoting the policies of developing humanities and their security system, Zhejiang University Conference of Humanities was held to help upgrade the organization for strengthening humanities research projects, enhance interdisciplinary cooperation and innovation, and perfect strategies for building a successful humanities leadership. In addition, the first Senior Professor of Humanities was elected in 2012.

V. International Academic Exchange and Cooperation

Zhejiang University attached great importance to international exchanges and cooperation by perfecting systems, investing more, advancing substantial international exchanges and cooperation and establishing long-term strategic partnerships. Guided by “First-class Disciplinary Partnerships”, Zhejiang University has so far tied knots with 40 overseas schools, 27 of them among the TOP 100 as rated by The Times, for example the Department of Physics at MIT, Princeton University, the School of Aeronautics and Space at Harvard University, the School of Medicine at UCLA, the School of Agriculture at Comell University, the University of Illinois Urbana Champaign, The University of California Davis; the School of Management at Oxford University, Cambridge University, Stanford University, the University of California Berkeley, and the School of Public Administration at the University of Chicago. Additionally, Zhejiang University highlighted the development of marine science by drawing from the most excellent management experience in marine science at international schools of education, exploring new partners and promoting cooperation with the top universities in marine science, such as the University of Strathclyde, the marine laboratory at the University of Plymouth, the marine center of the University of Southampton, all in the UK, and the University of Rhode Island and the University of Hawaii, in the United States.

At present, Zhejiang University has established cooperation with over 100 universities in 26 countries or regions and conducted a wide variety of exchanges and cooperative projects, including exchange programs of undergraduate and post-graduate students and teachers, jointly-held international symposiums, and cooperative research projects. In 2012, Zhejiang University held 79 international (bilateral) symposiums with 2,278 foreign representatives from 95 countries and regions, e.g. America, the UK, Canada, Australia, New Zealand, Japan, South Korea, Germany, France, Italy, Holland, Austria, Russia, Ukraine, Israel, Singapore, the Philippines, and India，with 4,026 contributing papers, among which, 1,664 came from foreign representatives.

On May 29th and 30th, 2012, upon the invitations from the (US) Library of Congress, , the World Bank, the US Asian Cultural Academy and the American Folklife Center, Zhejiang University conducted a series of significant visiting and academic exchange activities in Washington D. C. On November 7th, 2012, taking the “2012 Chinese-German Cultural Year” and “2012 Chinese-European Cultural Dialogue Year” as opportunities, Zhejiang University, together with Technische Universit?t Berlin, Freie Universit?t Berlin and Humboldt-Universit?t zu Berlin, held “German Zhejiang University Week” with plenty of activities: Chinese and German university president forums, academic exchanges, alumni face-to-face dialogues, photo exhibitions, concerts and book donations, attracting 12 German universities. “German Zhejiang University Week” spread the influence of Chinese education and culture in Europe, and furthered the substantial cooperation between Zhejiang University and famous European universities.

VI. Development of Academic System

For purposes of deepening the reform of its educational systems, tightening academic development and management, and promoting “professors’ management of academic events”, the Zhejiang University Academic Committee, a supreme academic organization made up of experts and scholars of the University, was established on November 23rd, 2012. The Committee is obliged to examineing, assessing, providing counsel for, and supervising the key academic events of Zhejiang University to exercise academic democracy, create a rigorous academic style, and promote academic standards while supporting the healthy development of education.

Academic integrity and norms help improve academic standards, academic exchanges and safeguard academic accumulation and innovation. In March 2012, after studying relevant specifications of internationally renowned publishing groups, Specifications for the Publication of Academic Works was published, with specific requirements for the standardization of formats, elements, procedures and layouts of manuscripts in publication after April 1st, 2012. This is the first book of its kind published by a Chinese publishing house.

The promotion of scientific principles, research integrity and academic norms has long been one major task of Zhejiang University. On September 22nd, 2012, as a part of the “Third Symposium on Chinese and American Scientific Integrity Cases” held jointly by the American Association for the Advancement of Science and the China Association for Science and Technology in Hangzhou, Zhejiang University held the Symposium on Scientific Integrity to popularize academic integrity in global academic circles with the participation of experts on research integrity from five American universities.

Looking to the future, by giving full play to the “Seeking Truth” principle and with unremitting arduous efforts, Zhejiang University will continue to contribute to the realization of the “Chinese Dream” of the Chinese nation in 2013 and beyond.

ACADEMIC ADVANCES OF ZHEJIANG UNIVERSITY IN 2012

THE ACADEMIC COMMITTEE
OF ZHEJIANG UNIVERSITY

Compilation of *A Complete Collection of Paintings of the Song Dynasty*

★ ★ ★ ★ ★

Awarded as The most Popular Academic Advance of the Year

Person in charge: zhang xi

Existing ancient Chinese paintings all over the world, a key component of Chinese cultural legacy, are featured with high historical, cultural and artistic values; in particular, the paintings of the Song Dynasty (960-1279), a prime time of ancient Chinese paintings, with their diversified themes, rich expressions, meticulous use of ink and superb artistic atmosphere, are the representation of the peak of Chinese paintings and the essence of traditional Chinese art. Therefore, in the rejuvenation of Chinese culture today, it is of great significance to organize and make studies on this precious legacy.

Under the guidance of "Instruction Committee for Zhejiang Cultural Studies Projects" headed by Secretary of Zhejiang Provincial Party Committee, a compilation leadership team came into being, with Zhang Xi, Secretary of Party Committee, team leader on humanities and social sciences, Editor-in-chief of the *Collection* of Zhejiang University as Director, Bao Xianlun, Director of Zhejiang Bureau of Cultural Heritage, Lai Maode and Luo Weidong, Vice Presidents of Zhejiang University as Deputy Directors, and other leading members from Academy of Social Sciences, Department of Art of Zhejiang University and Zhejiang University Press. The compilation committee was also set up, with Zhang Xi as Director, Bao Xianlun, Lai Maode and Luo Weidong as Deputy Directors, experts at home and abroad, scholars from relevant fields of Zhejiang University as members and Zheng Xinmiao, former President of the Palace Museum, Beijing as Consultant.

The Project, with the Zhejiang University Research Center of Ancient Chinese Calligraphy and Paintings as the principal part, has collected and organized the paintings and relevant literature and conducted the compilation of *A Complete Collection of Paintings of the Song Dynasty* in a team of about 20 members from School of Art, Research Institute of Chinese Art, Research Institute of Cultural Heritage, Museum of Art and Archeology of Zhejiang University and Zhejiang University Press.

After the meticulous sorting and classification of relevant materials and collections from 113 collection organizations all over the world, 30 in China, 20 in Europe and America and 63 in Japan, approximately 1,000 existing paintings of the Song Dynasty were collected and compiled into *A Complete Collection of Paintings of the Song Dynasty* upon the examination of experts.

A Complete Collection of Paintings of the Song Dynasty, comprising of 29 books in 7 volumes and one book of indexes with a total number of 500 thousand words, are full of refined pictures with captions and relevant literature. Most of the works in the *Collection* are re-photographed from original works, and some are high-precision negatives or literature in recent years.

The compilation is characterized in its academic innovativeness by its systemization, completeness and accuracy. Systemization refers to the investigation, collection and organization of available collection organizations all over the world based on the ancient and modern Chinese and overseas literature. Completeness means not only the works, but all the information and existing appearances of the works are highlighted. Accuracy stands for the high-precision restoration of painting images.

A Complete Collection of Paintings of the Song Dynasty, is indeed a large-scale, thematic and high-level organization and publication of the culture and art of the Song Dynasty after the publication of *A* Complete Collection of CI, a Classical SongPoetry, *A Complete Collection of Poems of the Song Dynasty, A Complete Collection of Writings of the Song Dynasty*. It filled in the gap in the organization of the paintings of the Song Dynasty and pioneered the collection of the paintings of the Song Dynasty, a particular dynastic period.

On December 28, 2008, the release ceremony of *A Complete Collection of Paintings of the Song Dynasty* was held in the Great Hall of the People, Beijing by the State Administration of Cultural Heritage and Zhejiang Provincial People's Government. In addition, over 20 state and regional media, e.g. Xinhua News Agency, CCTV, People's Daily, Guangming Daily, China Youth Daily, China Culture Daily, China Press and Publishing Journal, Wen Hui Bao, Zhejiang Daily, Xinhua Net, People Net, Guangming Net, China Economic Net and China Net, carried the news on the release of *A Complete Collection of Paintings of the Song Dynasty*.

In the following two years, many scholars on the paintings of the Song Dynasty sang high praises for *A Complete Collection of Paintings of the Song Dynasty* from different perspectives, history, culture and art, etc. Guangming Daily and China Art Weekly devoted a whole page and two pages respectively to the abstracts of interviewing seven well-known scholars: Ye Lang, Feng Yuan, Zhu Liangzhi, Tang Yijie, Li Xueqin, Yuan Xingpei and Pan Gongkai and the speeches made by over 40 famous experts from cultural organizations, museums and teaching institutes in a symposium. They all believed that the compilation by Zhejiang University, a preservation, rescue and inheritance of material and intangible cultural heritage, is definitely an achievement beneficial to the contemporary and future. Some experts and scholars said that the significance of its compilation was far beyond that of A Complete Collection of Ci, a Classical Song Poetry, *A Complete Collection of Poems of the Song Dynasty, A Complete Collection of Writings of the Song Dynasty*, as it was more unattainable than others.

A Complete Collection of Paintings of the Song Dynasty, with its profound academic and material values, has won the attention from museums and famous universities all over the world. It is calculated that libraries and research centers in over 30 famous American universities, e.g. UC Berkley, UCLA, Stanford University, Princeton University, Michigan University, Cornell University, Yale University, Brown University and Chicago University, have collected the book up to the beginning of 2013.

On May 31st 2012, President Yang Wei, on behalf of Zhejiang University, donated *A Complete Collection of Paintings of the Song Dynasty* to the Library of Congress, America.

In November 2012, Zhejiang University held "German Zhejiang University Week" in Berlin, Germany, introducing the academic advances of Zhejiang University in different fields and conducting various academic exchanges. On November 9th, Vice President Luo Weidong, on behalf of Zhejiang University, donated *A Complete Collection of Paintings of the Song Dynasty*, altogether 21 books to Barbara, Director of Berlin State Library. Professor Hermann, Director of Prussian Cultural Heritage Fund, also present at the donation ceremony, highly commended the significance of the *Collection* in the preservation of cultural heritage.

Assessment of Rule of Law and its Application in China Project

★ ★ ★ ★ ★

Project Leader：Qian Hongdao

The Assessment of Rule of Law Project, chaired by Professor Qian Hongdao, who recently proposed the establishment of the Practical School of China Rule of Law, made the following breakthroughs – Rule of Law Index, the Judicial Transparency Index, and the E-Government Development Index(collaborate with Good Governance International, Mei Gechlik is a co-chair). The Judicial Transparency Index is the first comprehensive test of judicial transparency, and the Chinese academic team utilized this Index to analyze and report the level of judicial transparency in China for the first time.

The research team is an interdisciplinary international team led by Zhejiang University, Chinese Academy of Social Sciences, Party School of the CPC Central Committee, National School of Administration, Ministry of Justice, National Bureau of Statistics, University of Hong Kong, Stanford University, Peking University, Tsinghua University, Chinese People's University, Fudan University, Shanghai Jiaotong University and other well-known institutions. Famous scholars, such as Jiang Ping, Li Buyun, Shi Taifeng, Li Lin, Hu Jianmiao, Wang Gongyi, Wu Shuchen, Zhang Zhiming, Zheng Chengliang, Sun Xiaoxia, Meng xiangfeng, Mei Gechlik, Wang Chenguang, Lin Laifan, Qiu Ben, and Dai Yaoting participated in the Project, as did U.N. experts and professors from Guanghua School of Law, including Zhu Xinli, Hu Wei, Xia Li'an,. And Liang Shangshang,etc.

The Project achievement Assessment of Rule of Law and its Application in China was published in the 2012 edition of China Social Sciences, and publication of this article in this most prestigious Chinese journal introduced the assessment of rule of law as a new field of law. In addition, each year the Project team drafts the section of the Blue Book of the Rule of Law entitled "China's Index of the Rule of Law ", and the Yuhang District, due to its implementation of the Project's Index of Rule of Law, has been the only district which published a report in the Blue Book of the Rule of law for four consecutive years.

The Project's research results have already proved very useful. Yuhang District in Zhejiang Province has implemented the Project's Rule of Law Index in each of the last five years. The Judicial Transparency Index was incorporated into the Zhejiang Provincial High Court's 2012 Work Report, and, since 2013, more than 100 Zhejiang courts (on three levels) have implemented the Project's Judicial Transparent Index Test. By the end of 2012, 13 district governments of Hangzhou had committed to test E-Government Development Index. The Yuhang District's

Experience in implementing the Rule of Law Index has provided valuable field studies regarding implementation of the rule of law, and officials from a number of other regions in China have visited the Yuhang District in order to study the District's implementation of the Project's Rule of Law Index.

The media has published in-depth reports on the Project's innovative research and useful indices for testing judicial transparency and governments' compliance with the rule, and these media reports have generated vigorous discussion regarding three indices and implementation of the rule of law in China. For example, CCTV, People's Daily, the NPC network, the Chinese government network, the Chinese People's Political Consultative Conference network, Guangming Daily, Legal Daily, Liberation Daily and other important media entities have published articles regarding the success enjoyed by the Project to date, and, to date, the People's Daily has reported on the Project's work approximately 10 times and included full-page reports on several of those occasions. In fact, media outlets have reported so extensively on the Project that they have taken to referring to practice and discussion regarding the Rule of Law Index "the rule of law index phenomenon ". In addition, legal academics and media sources (e.g., the Guangming Daily and the Legal Daily) have starting referring to Professor Qian as the "Qian Index" (referring to Project Chairman Qian Hongdao).

Chinese government and judicial officials have likewise lauded the Project's efforts and results. By way of example, Luo Haocai, the former vice chairman of the National Committee of the Chinese People's Political Consultative Conference, made a special visit to the Yuhang district government in order to study its implementation of the Project's Rule of Law Index and the research study regarding this implementation. Zhou Qiang, President of the Supreme Court, declared that the Sunny Judicial Index evaluation system applied by Zhejiang Provincial Higher People's Court has significantly enhanced open justice and furthermore has provided valuable experiential lessons for the national courts. Shen Deyong, Executive Vice President of the Supreme People's Court, declared that the Zhejiang High Court's implementation of the Judicial Transparency Index and publication of its experience has provided valuable real-world data from which all other courts can benefit. Zhang Sujun, Deputy Minister of Justice, likewise made a special trip to Yuhang and stated that Yuhang will serve as a model for the assessment of the rule of law in China and furthermore its experience has launched the new legal field of "the practical rule of law". Finally, Zhao Hongzhu, Zhejiang Party Secretary, and Wang Guoping, Hangzhou Municipal Party Secretary, have instructed local governments and officials to learn from Yuhang's experience with the Project's Rule of Law Index.

The Project's Indices have also received a number of awards. For example, application of the Rule of Law Index in Yuhang won one of Zhejiang Province's 100 typical events in 30 years and Zhejiang Province's " first Public Management Innovation Award" and it was nominated for " China's Urban Management Progress Award" . Yuhang has been listed among districts and counties with the highest rule of law compliance ratings.

The Project's study of the practical rule of law has been well-received by the international community. Professor Qian Hongdao was invited to participate in the "International Anti-Corruption and Rule of Law " conference, and there he presented both the Project's theoretical work and the results of various governments' and courts' implementation of the Project's Indices in order to assess their compliance with the rule of law. The Project since has received numerous invitations to share the Project's findings at prestigious institutions, such as Stanford University and Yale University, as well as requests to visit China to observe first-hand the implementation of the Project's Rule of Law Index, its Judicial Transparency Index, and its E-Government Development Index.

In addition, the Project's research group for a number of years has invited scholars from the United States, Canada, Denmark and many other countries to participate in the China International Conference of the Rule of Law and China Rule of Law Forum. There, the participants have discussed their scholarship regarding a wide range of issues on the rule of law in general, the rule of law in China, and methods of assessing governments' compliance with various rule of law components.

Finally, based on all of the above, Professor Qian Hongdao's proposed to initiate a China School of Practical Rule of Law, by which he means a new school of legal theory. At the 2012 China Social Sciences Forum, Professor Qian Hongdao stated that "the China School of Practical Rule of Law is taking shape." Former Vice-President of the National People's Congress Luo Haocai said: "The Zhejiang experiment in the practical rule of law provides a very useful example of innovative academic thought and research." Similarly, Wu Shuchen, professor at Peking University, noted that "the practice of rule of law in China calls for a new school of thought, such as the China School of Practical Rule of Law. "


中国社会科学报

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中国法治实践学派正在

钱弘道

今天，中国社会对法治有强大的需求。中国政府官员、学者及社会各界走到一起，共同推动中国法治发展，其中，学者的角色尤为重要。以浙江省为例，在众多学者的参与下，浙江出现了法治指数、司法透明指数、电子政府发展指数等法治创新实践，为实现区域法治、善治作出了贡献。

法治指数成"法治系统工程"引擎

2006年2月8日，时任浙江省委书记的习近平同志在杭州专题调研建设"法治浙江"工作。此后，浙江在全国较早提出建设"法治浙江"，余杭启动了"法治系统工程"，并在全国推出第一个全方位的法治评估体系，出台中国内地第一个法治指数。

法治评估能培育公民的法治观念和精神，促进社会管理创新，促进社会的民主和法治水平。实践证明，以法治指数为引擎实施"法治系统工程"，余杭区的公民法治意识得到提高，法治余杭建设的责任感不断增强，公共权力得到更有效限制。

司法透明指数成司法改革突破口

2012年11月1日，浙江大学司法透明指数研究课题组发布了湖州市吴兴区法院司法透明指数。以指数形式评估司法公开程度，这在国内尚属首例。法治发展究竟到了什么程度，要看政府保护公众权利到了什么程度，公众享有的知情权、参与权、表达权、监督权落实到了什么程度。司法透明指数的落脚点，是要保护公众的知情权、参与权、表达权和监督权。司法透明指数是司法改革的一个突破口，是公众行使权力、监督司法的重要通道，是提高司法公信力、树立司法权威的长效机制。

电子政府发展指数可指导具体工作

2012年12月15日，杭州市电子

The Applicability of Civil Society Theory in China

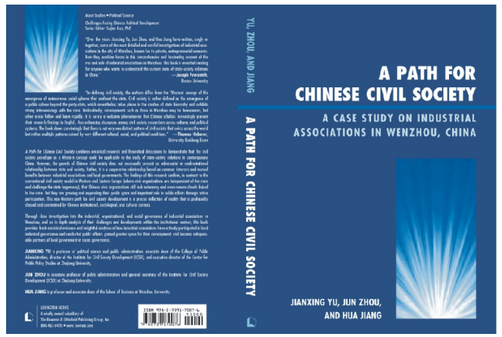
★ ★ ★ ★ ★

Project Leader: Jianxing Yu

It is a common pursuit of the people to establish an autonomous, self-government civil society which is broadly participating in and can balance the public power. However, what is and how to build the civil society are questions to Chinese academics lacking of reflection and criticism on the civil society theory rooted in the western historical context. In the past 10 years, the research team of this project led by Professor Jianxing Yu has made great efforts to review the civil society theory at home and abroad based on Chinese situations, to construct a Chinese civil society theory, and to contribute some theoretical resources for the development of civil society in China in reality.

This project considers that we can learn from the "spirit" of western civil society theories, but isn’t able to follow their developmental path of "getting independence firstly and then participating in public affairs", for China is totally different from the west in the aspect of “government-society relations”. Based on a long-term study on the business associations in Wenzhou and other civil society organizations, this project assumes that the society management innovation and public service system construction ongoing in China nowadays provides an opportunity for civil society organizations to participate in the public governance. The empirical analysis on the business association in Wenzhou and other civil society organizations reveals the microscopic interaction mechanism and interdependent relations in the cooperative governance, as well as the organizational development of civil society organizations, which demonstrates that civil society organizations can improve their governance abilities and functions in the cooperation with the government. So, this project puts forward a new theory framework which suggests that Chinese civil society may grow out of participating in public governance, and the framework is verified through a number of specific researches.

This project responses the debates whether the western theories of civil society are suitable for China or not, whether China has a civil society or not, and whether Chinese civil society should be constructed from "top-down" or from "bottom-up". This project also makes the civil society a concept of “being”, shows the different modes of civil society under different cultural, social and political background, and points out a path for reference for constructing Chinese civil society.



The book "Chinese civil society grows out of participation" reporting the core viewpoint of this project is highly appraised by the academic community at home and abroad soon after the publication. Some scholars regard it as "an example of the studies of Chinese social science’s autonomy”. In 2012, the book gets the first prize of the Sixth Higher School Scientific Research Outstanding Achievement（Humanities and Social Sciences）by the Ministry of education. In the same year, an English book based on the project which titled as 'A Path for Chinese Civil Society: A Case Study on Industrial Associations in China Wenzhou' was published by the American famous academic publishing group The Roman & Littlefield. Besides, over ten papers of this project are published in SSCI journals and Chinese top journals.

Research and Participate in the Preparation of the First National Basic Public Service System Planning

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Project Leader: Guping Zhou, Xianguo Yao

The core of basic public service is the responsibility government around the person's life should bear, from birth until death (defect intervention), the necessary public goods which the government will need to provide.And from the level of nation, before that it has not formed the systematic and institutional basic public service supply design. With the China's rapid economic growth and rapid social transformation, profound changes have taken place in the basic needs of our economic society. Profound changes in public demand and the rapid growth have become increasingly prominent contradictions with public services which are not in place, a serious shortage of public products. " Twelfth Five-Year Plan " period, take efforts to promote the equalization of basic public services, accelerate the establishment of basic public service system covering all the members of the society have become the urgent task for China's economic and social development.

Therefore, the establishment of <the national basic public services system of" Twelfth Five-Year plan"> is closely related to everyone and every family.

In July 2012, the State Council officially issued the China's first national planning of public services -- <the national basic public service system of" Twelfth Five-Year Plan"> the establishment of the planning and preliminary research support would be undertaken by the china academy of west region development of Zhejiang University.

This is the first national overall strategic planning research projects independently undertaken by Zhejiang University, it is also a major breakthrough for our faculty of Humanities and Social Sciences facing the major national strategic demand.

Leading by the china academy of west region development of Zhejiang University , more than 20 experts from the china academy of west region development of Zhejiang University , College of Public Management, faculty of social sciences, the platform of social sciences, College of humanities, College of education, College of economy, College of public health and other departments and research institutions set up interdisciplinary research group. Jointly with the National Development and Reform Commission related departments composed of the research group to study throughout the local parts of the country.

After careful study, organizational members and experts repeatedly demonstrated, the research group formed a high level research results which can not only serve the country strategic needs but also can show the academic level and high-level research result, it provides important support for the plan.

At the same time, some members of the project group was transferred to Beijing, to participate in < the national basic public service system of" Twelfth Five-Year Plan" > establishment work, including discussing and planning the outline, the draft to manuscript through drafting, modifying, coordinating and perfecting, on the basis of the formation of the text, and according to the approval procedure it will be submitted to the state council.

Planning marks the introduction of basic public services in our country that has risen from the basic idea to the national practice, the focus of the government work in China changes from economic development to pay attention to people's livelihood and transformation to a service-oriented government. The promulgation and implementation of planning directly promoted the social process of justice.

<"Planning"> the full text of a total of 30000 words, covered 8 other fields of education, employment services, social insurance, social services, health care, population and family planning, housing security, public culture and sports, and the basic disabled people public services, a total of 44 kinds of 80 basic public services, the system outlined various institutional arrangements about the national basic public services. It clears and defines the basic standards of the state with four aspects: the service items, service object, security standards, expenditure responsibility, covering level, it takes efforts to solve the most pressing problems of survival and development for the broad masses of the people, try to make all the people in reality "to education, to employment, to health, to pension, to housing ".

Preparation of Functional Supramolecular Polymeric Materials

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Selected as The TOP 10 Academic Advances of the Year

Project Leader: Feihe Huang

Currently polymeric material industry in the world is facing tremendous pressures from both environment and resources. Moreover, under multiple pressures (such as environment, resources, and technical barriers to trade), the polymeric material industry of China is striving for existing and developing. Severe competition from domestic and international markets and developmental predicament compel the industry to increase input in science and technology, expedite the step of innovation, improve the product quality, and develop green polymeric products and the related manufacturing technology, thereby realizing cleaner production of polymeric materials and comprehensive utilization of the related wastes. Supramolecular materials, dynamic materials by nature, are defined as materials whose components are bridged via reversible connections and undergo spontaneous and continuous assembly/disassembly processes under specific conditions. Supramolecular polymer chemistry is an interdisciplinary subject which is based on the elegant combination of supramolecular chemistry and polymer science. On account of the dynamic and reversible nature of noncovalent interactions, supramolecular polymers have the ability to adapt to their environment and possess a wide range of intriguing properties, such as degradability, shape-memory, and self-healing, making them unique candidates for supramolecular materials. At the 73rd Shuangqing forum on the frontiers of supramolecular polymeric science and materials sponsored by National Natural Science Foundation of China, Prof. Feihe Huang redefined the concept of supramolecular polymers as: “Supramolecular polymers, the product of the combination of supramolecular chemistry and polymer science, are the aggregates with typical macromolecular characteristics composed of polymeric or low-molecular-weight building blocks which are connected via reversible noncovalent interactions and/or dynamic covalent bonds. Their structural formation and functional exhibition depend on noncovalent interactions. Supramolecular polymer is an indispensable part and important research field of polymer science, which plays a vital role in the field of stimuli-responsive materials, self-healing materials, and biomedical materials”. During the last eight years, the Feihe Huang’s group has successfully combined supramolecular chemistry and polymer science to realize the construction of supramolecular polymeric materials with the functions of controlled-release and environment-protection based on noncovalent bonding connections. These research achievements have made crucial contributions to solve the urgent and vital scientific question of the 21st century, namely, “How Far Can We Push Chemical Self-Assembly” raised by《Science》in 2005.

The Huang’s group prepared a metal-coordination-cross-linked supramolecular polymer network, which was assembled by low-molecular-weight building blocks based on noncovalent interactions. This supramolecular polymer network not only shows quadruple stimuli-responsive gel-sol transitions, but also has controllable microstructures. Rheological experiments confirmed that the network has good viscoelastic and mechanical properties. This is the first example of elastomers prepared by low-molecular-weight molecules. Subsequently, they fabricated and synthesized a low-molecular-weight gelator with a crown ether unit. At room temperature, this molecule can form gels in common organic solvents at very low concentration. For example, it can form a gel in acetonitrile at a concentration of 0.06 wt% only. Moreover, the gel has shape-persistent property. On account of the gelator containing a dibenzo-24-crown-8 host moiety and a secondary ammonium salt guest unit, the multi-stimuli-responsiveness can be easily introduced to the gel system. Furthermore, it was demonstrated that the gel-sol transition can be induced by changing the pH and temperature, or adding metal cation and anion to the system.

This group also designed and prepared a dual-responsive supramolecular polymer gel by self-assembling a low-molecular-weight AB monomer. The responsive gel could be employed in the controlled release of rhodamine B. Moreover, it showed good stretchable property and could be pulled to make a transparent film. This successful preparation of a film from low-molecular-weight building blocks provided a new thought for solving non-degradable plastic film-induced “white pollution”.

Self-healing, an ability of biological or artificial systems to spontaneously repair their damage, is one of the most amazing properties of these materials. Therefore, the study on self-healing materials is being at the forefront of materials science. The Huang’s group designed and prepared a self-healing supramolecular polymeric gel by crown ether-based host-guest interactions. Owing to the reversibility of host-guest interactions, the gel showed 100% recovery even under 10000% strain in less than 60 seconds over several cycles.

The efficient detection of ammonia is important for the health of human beings and animals. The Huang’s group prepared a cross-linked conjugated supramolecular polymeric network, which was used to make a film on the glass. Exposure of this supramolecular polymeric film to ammonia leads to an increase of fluorescence, thereby realizing the detection of ammonia.

The main research topic of the Huang’s group is the construction ofsupramolecular polymers based on host-guest recognition motifs. Their achievements were recognized not only in China but also in the world. They have published 45 research and review papers on supramolecular polymers in the mainstream journals of chemistry and materials science with impact factors > 5, including 6 J. Am. Chem. Soc. (IF=9.91) papers, 4 Angew. Chem. Int. Ed. (IF=13.46) papers, 2 Adv. Mater. (IF=13.88) papers, 1 Acc. Chem. Res. (IF=21.64) paper, and 3 Chem. Soc. Rev. (IF=28.76) papers. The leader of this group, Prof. Feihe Huang, was invited to give academic lectures at various world-class universities and institutes including University of Cambridge, Max Planck Institute for Polymer Research and National University of Singapore. He was also invited to give a talk at the 33 Australasian Polymer Symposium. The awards he received up to now include the Thieme Chemistry Journals Award and Humboldt Fellowship for Experienced Researchers. He is the winner of National Science Fund for Distinguished Young Scholars, the Fellow of Royal Society of Chemistry, a guest editor of Chem. Soc. Rev., and the advisory board member of Chem. Soc. Rev. and Chem. Commun. One of his doctoral students received the nomination award of National Excellent Doctoral Dissertation of China.

The Discovery of Early Permian Tarim Large Igneous Province

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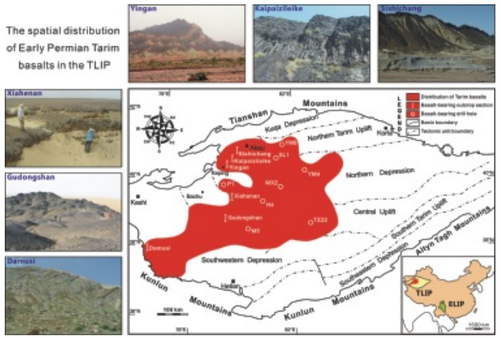
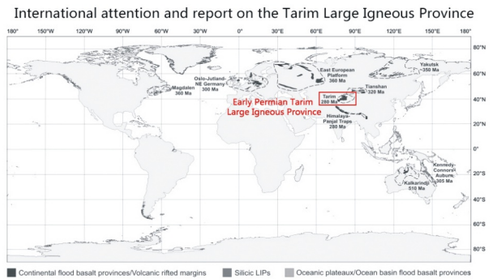
Project Leader：Shufeng Yang





The Early Permian Tarim Large Igneous Province discovered by Prof. Shufeng Yang and his research team was listed as one of the typical LIPs in the world during 275~550 Ma by Bryan SE and Ernst RE in a review paper (Revised definition of Large Igneous Provinces (LIPs)) published on the most famous international geological journal of Earth-Science Review (IF = 6.59).

Large Igneous Provinces (LIPs) are massive magmatic events with areal extents greater than 100,000 km^2. They have huge impacts on the Earth's climatic and environmental changes, the evolution of life and the formation of oil, gas and mineral resources. For example, the formation of the Deccan LIP in India has close genetic links with the dinosaur extinction in the end of the Cretaceous. Therefore, the formation and evolution of LIPs and their resources and environment effects have always been one of the key scientific issues in the Earth Sciences.

By nearly 20 years' geological survey and research, the research team led by Professor Shufeng Yang from the Department of Earth Sciences, Zhejiang University, has discovered an Early Permian (about 290 million years ago) Large Igneous Province in the Tarim Basin of Xinjiang Uygur Autonomous Region with an area of over 250,000 km^2, which is called the Tarim Large Igneous Province (TLIP). Precise geochronological studies show that the voluminous volcanic eruption of the TLIP mainly occurred during 290~285 Ma, belonging to the rapid eruption LIP magmatic event. Combined with the geological, geophysical and geochemical studies, the research team proposes that the formation of the TLIP is related to the mantle plume activity from the deep Earth, and establishes the third LIP genetic model for the TLIP which differs from other LIPs in the world. In this new model (the TLIP model), the basalts were produced by the lithospheric melting in the early stage and the intrusive rocks were produced by the mantle plume melting in the late stage. The research team also proposes that the formation of the second largest Fe-Ti-V oxide ore in China　the Wajilitag Fe-Ti-V oxide ore in Tarim was controlled by the magmatic events of the TLIP.

The discovery of TLIP has received widespread attention from both domestic and foreign geologists, and now the TLIP has become a hot area of geological research. In 2006, the Large Igneous Provinces Commission reported the TLIP on their official website, and listed it as the "Large Igneous Province of the Month" in June. The TLIP is the second identified LIP in China after the discovery of Emeishan LIP (ELIP) in southwest China. These research findings greatly promote the study of the Late Paleozoic mantle plume and the LIPs in China, enrich the genetic theory of LIPs, and also provide an important theoretical basis for the exploration and development of large oil and gas fields and super large Fe-Ti-V oxide ore in the Tarim Basin, which have been attained great attention from China National Petroleum Corporation and other enterprises.

The Development of Key Designing and Manufacturing Technology for Shield Tunnel Boring Machine

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Selected as The TOP 10 Academic Advances of the Year

Project Leader：Huayong Yang

1. The project background

The shield tunnel boring machine (shield TBM) is a complete set of large tunnel excavating equipment, which accomplishes tunneling processes such as soil cutting, soil discharging and lining installation etc. at the same time under protection of a large steel cylinder known as "shield". The shield TBM is in urgent need for basic construction such as subway, highway, railway, water conservancy and national defense etc. With the acceleration of urbanization and industrialization, our country has become the largest country in the shield TBM requirements, accounting for 60% of the global market. The disharmony with the large requirements was that the key technology dominated by foreign company, the TBM products relied on imports and the price kept in high level. So it is necessary to master the key designing and manufacturing technology independently and develop our own shield TBM industry by making use of the market opportunity.

Foreign shield TBM technology has experienced three development stages: the first is hand digging shield TBM represented by Bruneau structure; 2nd generation is the mechanical digging and pneumatic pressure balance type shield TBM; 3rd generation is pressure balance shield TBM with the characteristic of a working chamber including earth pressure balance and slurry balance. It is the pressure balance shield TBM that makes the tunneling under the crowded structure possible in urban area. The geological environment tunneling through is extremely complex, uncertain and unintellectual, that makes a shield TBM need to constantly adjust the tunneling parameters according to the geological conditions.
The common feature of the third generation of shield TBM technology is that it needs operating persons to manually adjust the tunneling parameters.
It means the quality of tunneling depends on the person's experience.
Consequently the three main problems appeared frequently during tunneling: interface instability caused by chamber pressure imbalance results in surface deformation or even ground settlement accidents; key components failure caused by sudden change load results in shutdown accident; misalignment caused by shield tunneling direction deviates from the design axis affects the quality of tunnel and even leads to tunnel abandoned.

The project studied the main problems about the instability, failure and the misalignment mentioned above. The key technology of designing and manufacturing shield TBM independently was overcome and 3 types of shield TBM of earth pressure balance, slurry pressure balance and composite were developed.
These achievements have formed the independent design and manufacture ability, realized the industrialization of shield TBM in China.

" The development of key designing and manufacturing technology for shield tunnel boring machine" won the first class prize of 2012 annual national scientific and technological progress prize.

2. The main innovative results

1) To the problem of interface instability caused by chamber pressure imbalance which may results in surface deformation or even ground settlement accidents, this project put forward a solve method that makes the pressure inside the work chamber balance to the soil pressure on excavating interface to avoid the surface deformation or ground settlement. The main difficulty lies in that the porous discontinuous medium flow state is complex in the chamber filled with mud, water, sand, gravel and other, that the pressure distribution are difficult to express in mathematical model, and that the pressure fluctuation range can't be accurately controlled. The project revealed the pressure distribution rule in the chamber, invented the dynamic pressure control technique in working chamber of multi-parameter coupling, broken through the multiple subsystems coordinated control technique of soil cutting, soil discharging, thrusting and rectification etc., and developed the chamber pressure control system of dynamic balance. These techniques can obviously improve the interface stability, and prevent the ground surface from deforming. The results of application showed that the chamber pressure control precision was ± 0.008 MPa, and the minimum surface deformation was less than 2 mm.

2) To the problem of key components failure caused by sudden load change which may results in shutdown accident, this project put forward a innovation solve method that changes the thrust speed according to the geological and excavating load, reduces the impact load, transforms the impact energy into hydraulic energy at the same time by changing the stiffness of mechanism and hydraulic system, and then realizes the protection of key components. The main difficulties doing so lies in the system design of variable stiffness and how to precisely control the thrusting speed according to the sudden change load. The project proposed the shield TBM compliance design method for the first time, invented the electric hydraulic drive technique of whole system power adaptability, developed the cutter head, thrust and drive subsystem based on the compliance design method. These techniques can make the sudden change load impacting to the equipment be reduced by more than 30%, and protect the key components from failing due to overloading. The results of application showed that the system failure rate reduced to 2%, and the highest driving speed reached 655 meters/month.

3) To the problem of deviating from the design axis caused by tunneling direction misalignment, this project put forward a innovation solve method that keep tunneling direction accurate through predicting the shield TBM posture accurately and rectifying the tunneling direction timely. The main difficulty doing so is that the misalignment is random and uncertainty when shield TBM drives through complicated geological which make the force on interface uneven, and it makes to accurately forecast and determine the parameters for the adjustment become challenging. The project proposed a new thrusting control method based on tunneling posture prediction for the first time, which predict and rectify the change trend of the tunneling posture in real-time through the extraction of detection data of shield TBM posture and the characteristics of load distribution on interface. The project also invented the thrust rectifying technique of pressure/flow composite control, developed a thrust system of shield TBM. On these techniques the tunnel excavation with high precision is realized. The results of application showed that the tunnel axis error was within ±3 mm, and the minimum turning radius is 380 m for the slurry pressure balance shield TBM with the diameter of 11.22 m.

Based on the techniques above 77 invention patents have been authorized, 16 softwares have been registered, 2 items of national or industry standards have been issued, and 190 SCI/EI papers and 3 books have been published.

3. The application and the technology industrialization

All the technology achievements of the project have been applied to design and manufacture the different kinds of shield TBM mainly including earth pressure balance, slurry pressure balance and composite shield TBM in Shanghai Tunnel Engineering Co., Ltd., China Railway Tunnel Group Co., Ltd., China Railway Tunneling Equipment Manufacturing Co., Ltd., and Hangzhou Boiler Group Co., Ltd.

A shield TBM is quite different from other engineering machinery. Almost every set of shield TBM should be especially designed according to the specific geological and engineering conditions. The shield TBM product and industry development relies on the basic design theory and technology. So it has the characteristics of technology and industry combined together tightly. The achievements of this project has supported the main leading companies in China such as Shanghai Tunnel Engineering Co., Ltd., China Railway Tunnel Group Co., Ltd., China Railway Tunneling Equipment Manufacturing Co., Ltd., Hangzhou Boiler Group Co., Ltd. to design and manufacture the shield TBM, and made the main performance of the shield TBM meet or exceed the similar international one. The local made shield TBM products gradually replaced the imported ones and exported to Singapore, India, Malaysia, Thailand and other countries. Cumulative production of various kinds of shield TBM has reached 290 sets. According to the statistics 132 sets of shield TBM were made, which brought newly output value of 6.283 billion yuan and profit of 1.447 billion in the near three years (2009 ~ 2011), and occupied the domestic market share of 61% in the year of 2011. The shield TBMs designed and manufactured by this project independently have been widely used in Hong Kong, Beijing, Shanghai, Guangzhou, Tianjin, Chongqing, Hangzhou, Zhengzhou, Nanjing, Dalian, Xi 'an and other 26 cities at home and abroad. They played an important role in more than 300 subway, highway, railway, water conservancy, national defense and other kinds of tunnel construction engineering. This project has obtained the remarkable economic and social benefits, promoted the progress of science and technology of large excavating equipment manufacturing industry, and realized spanning development of the shield TBM industry in our country.

High-Gravity Centrifuge Simulation Techniques and Applications

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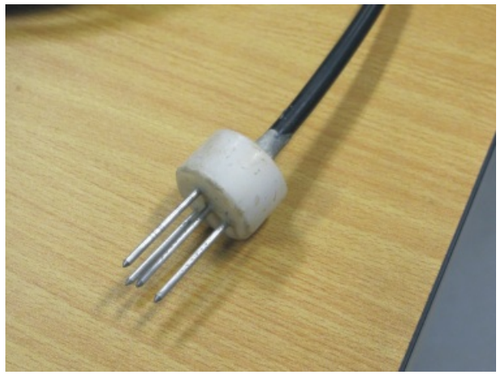
Selected as The TOP 10 Academic Advances of the Year

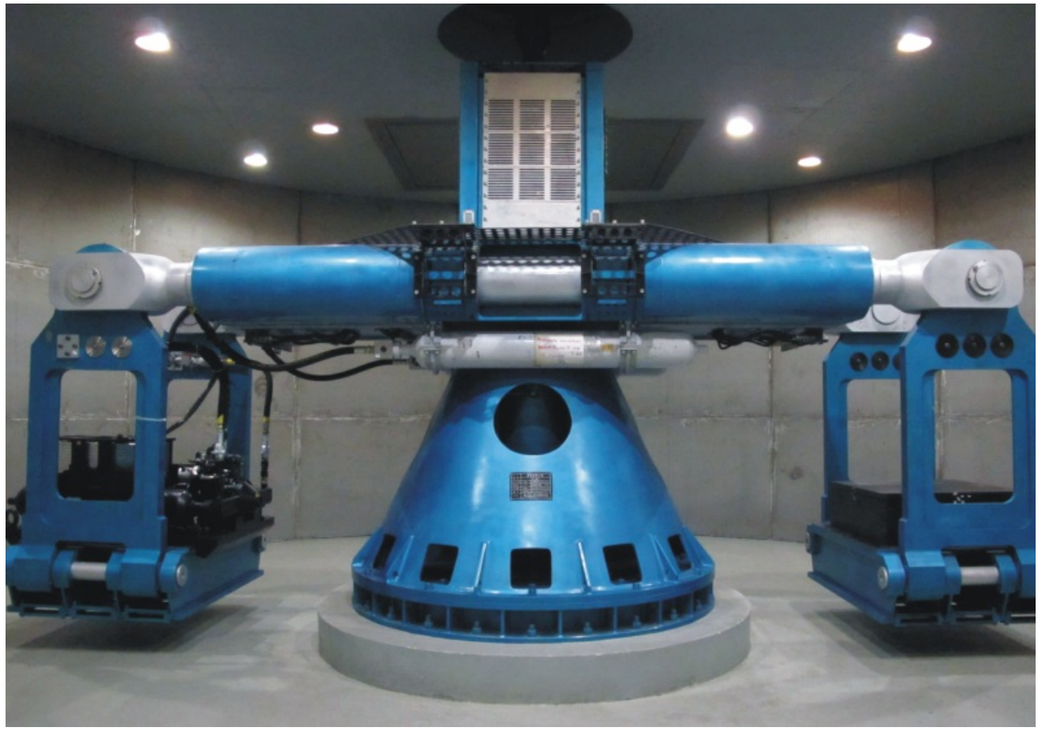
Project Leader: Chen Yunmin

Catastrophes such as landslide, debris flow, soil and ground water pollution, are resulted from human and natural activities including earthquake, industrial construction and production. These catastrophes have serious threats to human security. It is extremely hard to observe the whole process of a soil disaster due to its enormous space and long duration. Gravity governs soil movement, fluid flow and contaminant transport. Small-scale model tests under normal gravity are not able to reproduce the real effect of gravity in prototype. Therefore, the real disaster process cannot be reproduced. Centrifuge can produce high gravity conditions which is hundreds times of normal gravity. A condense of the original space and time scales can be achieved for scaling modeling of prototype. Centrifuge modeling has become a revolutionary technique to study geotechnical problems for which gravity is a primary driving force. Under the auspices of 211 Project, 985 Project and NSFC etc., following achievements have been gained through more than 10 years' work:

(1) A centrifuge called ZJU-400 has been designed and established, which has a maximum capacity of 400 g.ton, a maximum acceleration of 150 g and an effective radius of 4.5 m. The facility can be used to simulate catastrophes of rock and soil with a time scale of hundred years and a spatial scale of 100 meters. A centrifuge-based in-flight shaker has also been designed and built with a maximum centrifugal acceleration of 100 g, a maximum loading acceleration of 40 g, a frequency range from 10 Hz to 250 Hz, and a maximum load of 500 kg to realize the simulation of seismic disaster with a long earthquake duration and a spatial scale of hundred meters. The measurement technology of shear wave velocity using piezoelectric ceramic bending elements is developed, which works well under high gravity and noisy conditions, to realize real-time monitoring of shear wave velocity during centrifugal model preparation and testing. In general, it has been considered that the ZJU-400 centrifuge as well as the developed testing devices reached the international advanced level, and the modeling technology of earthquake and the earthquake disasters reached the international leading level.

(2) By using the ZJU-400 high-gravity centrifuge and the in-flight shaker, the time-space evolution of liquefaction catastrophe of weak ground is properly simulated, and the physically meaningful correlation between liquefaction resistance and shear wave velocity is revealed as $CRR=[\kappa_N \rho / F(e_{min})]^2 V_{s1}^4$, which provides a reliable method for liquefaction evaluation and mitigation in highly seismic active zones. The proposed initial liquefaction based liquefaction





evaluation method by shear wave velocity was published in J. Geotech. Geoenviron. - ASCE, and cited as “Zhou-Chen” approach by the USGS principle investigator in soil liquefaction, Dr. Robert Kayen, who pointed out that the Magnitude Scaling Factor and the critical shear wave velocity in this study agree well with the global earthquake database containing 422 liquefaction case histories. This approach was successfully applied in the liquefaction mitigation of thermal power plant in Central Java, Indonesia. After completion, this project was struck by strong earthquakes with magnitude as high as Mw 7.9 and Mw 8.2, whereas no liquefaction damage found. Thus the long-existing bottleneck of constructing large thermal power plant in highly seismic area is broke through. This approach was also used for liquefaction evaluation and site safety assessment in Qingchuan County during the recovery construction after the 2008 Wenchuan earthquake. “Shear Wave Velocity-Based Characterization of Soil Structure and Its Effects on Dynamic Behavior” was awarded national excellent doctorial dissertations in 2010.
“The key technologies and engineering applications of catastrophe control of structural weak ground” was awarded second prize of national science and technology progress award in 2009.

(3) Landfill failures induced by leachate and underground contamination due to leachate breakthrough of liners are reproduced via the ZJU-400 centrifuge and model tests. On this basis, methods of assessment of liner breakthrough time, modes of leachate-driven landfill failures and approaches of calculating warning landfill leachate level are proposed, and solved the key technical problems of environmental disaster control for municipal solid waste landfills. The achievement "Key technology of environmental soil mechanics mechanism and disaster control of municipal solid waste landfills and application" has been applied successfully in 112 landfills in 23 provinces and municipalities. The paper published in Geotextiles and Geomembraines" is the journal "The Most Cited Article" on the SciVerse Scopus database. A keynote lecture on "Development of leachate mounds report and control of leachate-related failures at MSW landfills in humid regions" was invited in the Sixth International Congress on Environmental Geomechanics (6th ICEG). The achievements were served as the core content of the national standard "Technical code for geotechnical engineering of municipal waste sanitary landfill" (CJJ176-2012). The proposed approach of calculating warning landfill leachate level is accepted as a mandatory implementation in this standard. "Municipal solid waste landfill technology mechanical environment dump mechanism and disaster prevention and control and application" won the National Science and Technology Progress Award (2nd class), 2012.

ZJU-400 high-gravity centrifuge and test system provide new methods and apparatuses for scientific researches, which help to discover the failure mechanism of soft soils, establish the liquefaction evaluation methodology, develop the assessment methods of liner breakthrough time, and clarify the leachate-driven failure modes of landfills. Thus the key technical challenges of the earthquake hazards and landfilling of municipal solid waste have been successfully addressed based on these methods, and substantial economic, social and environmental benefits have also been achieved. What's more, the proposed "1300g.t High-Gravity Centrifuge Simulation and Testing System" was listed as a scheduled project by "the mid to long-term planning of national major scientific and technological infrastructure construction (2012-2030)" (State Department [2013] file No. 8, PRC).

Clean Combustion Technology and Industrial Application of Coal Water Slurry as Replacement for Oil

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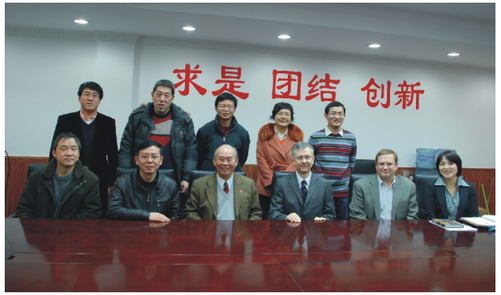
Selected as The TOP 10 Academic Advances of the Year

Project Leader: Cen Kefa

The energy reserves of China are characterized by rich coal, meager oil, and little gas. These characteristics indicate that coal remains one of the main energy sources of China. This energy consumption pattern will last for the long term. The rapid development of the Chinese economy and the improvement in the living standards of the people have resulted in a rapid increase in the demand for oil, thus causing the oil demand and supply gap to become larger. In 2011, the oil import dependence rate of China reached 57%. Given the increasingly serious oil demand and supply situation as well as the uncertainty in oil price, China has a particularly urgent need for a clean, low-cost, and feasible technology to replace oil relative to the overall economic development situation and based on the resource, technology, and economic conditions of the country.
The development of the economy, improvement in the standard of living, and increase in environmental awareness requires the development and application of clean energy. Evident environmental advantages during storage, transportation, and combustion emissions have made coal water slurry (CWS) an appropriate technology for oil replacement, environment protection, and energy saving in the present stage of China. The advantages of using CWS meet the requirements of the long-term stable development strategy of China in terms of energy and emission reduction.



Our achievements with completely independent intellectual property rights include the successful development of a clean combustion technology for CWS replacement of oil and the corresponding key equipment, which apply to various power station boilers, industrial boilers, and furnaces. These achievements have been successfully promoted and applied to realize energy savings, emission reduction, and oil replacement. Moreover, a highly efficient and low-pollution combustion technology for various slurry fuels, including slime water slurry, paper-making black liquor coal water slurry, and petroleum coke water slurry, has been successfully developed, providing a new approach to industrial waste recycling and environment pollution control. The characteristics and academic merits of these achievements are as flows:

(1) A complete set of basic theories about the combustion, flow, heat transfer, and gasification of CWS is first proposed
To improve atomizing efficiency, strengthen ignition, stabilize combustion, and promote burn-out of the highly viscous liquid – solid two-phase flow, a complete set of basic theories about the combustion, flow, heat transfer, and gasification of CWS is first proposed; the basic theories and mathematical models of rheological property, heat transfer for turbulent flow in tube, burning property of single particle, atomization and combustion in boiler, and convective and radiant heat transfer are established; the atomization process of the two-phase flow, gas phase reactions of heterogeneous products, and the combustion and flow process of gas and

solid phases are precisely simulated using a numerical calculation method.

(2) Many key combustion technologies for CWS-fired boilers are first initiated, the problems in strengthening ignition and promoting burn-out for the slurry fuel with high water content are solved, and many technical achievements reach the international leading level.
To solve these difficult problems, including the difficulty in ignition because of the high water content of the CWS, difficulty in maintaining a steady combustion attributed to the low combustion temperature, and difficulty in burning out because of prolonged combustion duration, our achievements first initiate many key combustion technologies for CWS-fired boilers, which are then applied to a number of CWS-fired boilers, including the largest international boilers, the design slurry input of which is 670 t/h.

(3) An impact multistage atomizing nozzle for the highly-viscous liquid – solid two-phase flow is originally produced
CWS is a highly viscous non-Newtonian liquid – solid two-phase flow, and realizing highly efficient atomizing is important. An impact multistage atomizing nozzle for CWS is originally produced, combining Y-type, T-type, and impact atomizing. This nozzle is characterized by good atomization performance and low vapor consumption rate. The maximum volume capacity reaches 6 t/h to 8 t/h, whereas the current international maximum value is 6.5 t/h.

(4) Low NOx burner for various high-water-content slurry fuels and reburning denitrification technology are successfully developed
Our achievements include multiple ignition and combustion strengthening methods for CWS and thus facilitate the supply of reasonable air, strengthen ignition, stabilize combustion, and promote burnout. This burner has been applied to burn nine types of fuel, the most varieties of slurry/liquid fuel at home and abroad, including six CWSs, petroleum coke water slurry, heavy oil, and coal tar.
CWS reburning denitrification technology is also successfully developed and first used in a 200 MW power plant boiler, with an in-furnace NOx reduction rate reaching 30% to -50%.

The clean combustion technology of CWS for replacing oil has long held the highest proportion of domestic market share. The current CWS combustion technology widely used in China stems mostly from the achievements of Zhejiang University. Our achievements have been applied to more than 500 boilers and furnaces throughout 20 provinces. The application covers seven energy-intensive industries: electricity, petroleum, chemical engineering, coal, metallurgy, glass and ceramic industry. Multiple technologies in our achievements have successively passed 14 provincial or ministerial appraisals. Among these achievements, three items achieved the international leading level, three items achieved the international advanced level, three items were initiated at home and abroad, and two items achieved the domestic leading level. In 2006, the overall achievement of "clean combustion technology and industrial application of coal water slurry as replace-ment for oil" passed the appraisal. The panel of experts, chaired by academician Qin Yukun, agreed that the achievements reached the international leading level. A comprehensive and also the sole international monograph (approximately 1.7 million words) on the combustion theory and application technology of CWS was published, including more than 170 published research papers, three authorized patents, as well as 22 doctors and 50 masters graduates.

The incomplete financial statistics supplied by 17 application units show that the three-year economic benefits reach RMB 5.36 billion, and approximately 2.5 million tons per annum of oil are saved. Thus significant benefits of replacing oil, saving energy, and protecting the environment are obtained. China has become the most advanced and the most prolific user of CWS technology in the world and ranks as the world leader in the field in terms of international reputation, influence, and market competiveness. By employing our technology, the first international CWS-fired boiler burning Indonesian brown coal, which was invested by Japan JGC Co., has been designed and operated; the design of transforming two 320 MW and four 160 MW oil-fired boilers into CWS-fired ones, entrusted by Italy Edipower Co., has been completed; and two 150 t/h and one 65 t/h CWS-fired boilers have been first put into operation in Taiwan region. Moreover, we have signed technology exportation contracts with companies in developed countries, including Russia OOO Inalmet Mining Company and Ukraine North Donetsk Thermal Power Plant, and are exporting technology to many countries, including Pakistan, the Philippines, Thailand, and Mauritius. After an investigation, the US Department of Energy has identified our technology as one of the two most remarkable technologies in the field of clean coal utilization in China.

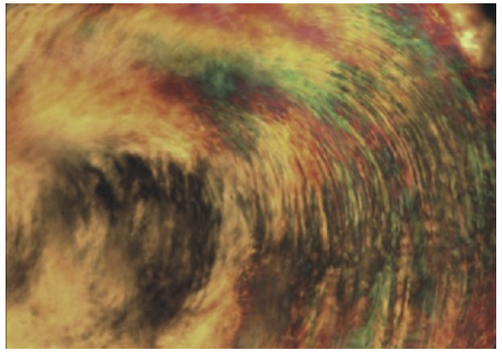
Graphene-Based Liquid Crystals and Macroscopically Assembled Graphene Fibers

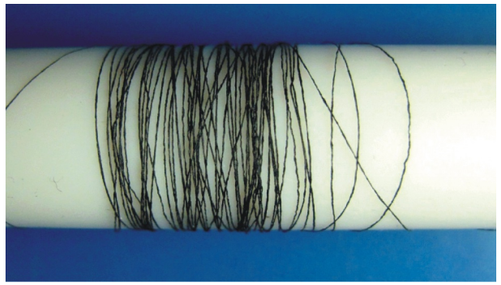
★ ★ ★ ★ ★

Selected as The TOP 10 Academic Advances of the Year

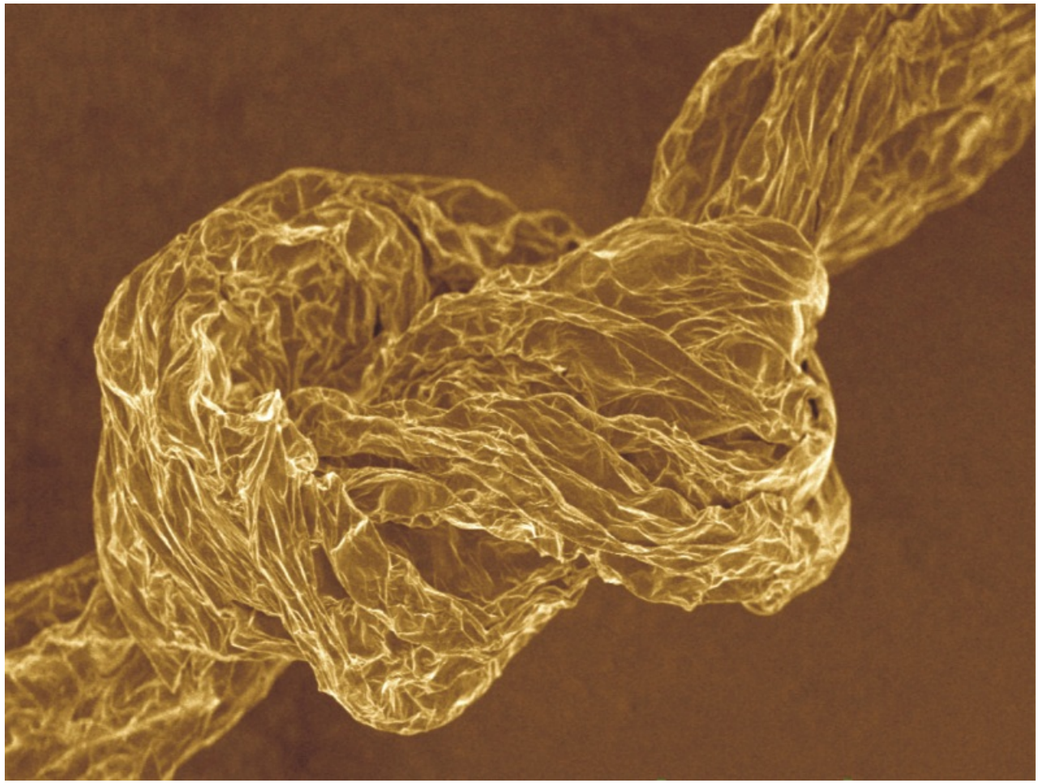
Project Leader: Chao Gao

Graphene represents single-layered graphite. Since its first exfoliation in 2004, graphene has emerged as a paradigmatic two-dimensional (2D) carbonaceous nanomaterial and attracted considerable attentions because of its outstanding electrical, thermal and mechanical merits. The magical graphene can be produced from the ordinary natural or artificial graphite by tons just using simple chemical process. It is vital to extend the use of graphene into the high-performance macroscopic materials, in order to prospectively promote the graphite-based high-technology and to effectively harness the extremely abundant graphite mineral in our country. Accordingly, the nanopolymer research group in the Department of Polymer Science and Engineering in Zhejiang University, led by Professor Chao Gao, presented a novel strategy, spinning graphene liquid crystals into graphene fibers, to directly convert natural graphite to high-performance graphene fibers.





The team has made two important seminal achievements. The first one is the discovery of graphene liquid crystals including nematic and chiral phases. In fact, the report of graphene chiral liquid crystal is the first record about the formation of complex chiral mesophase of two-dimensional colloids. The finding of graphene liquid crystals opened an avenue to fabricate highly ordered graphene-based macroscopic materials. And the graphene is considered as an ideal two-dimensional colloidal model because of its monolayer thickness and controllable dimensions, to reveal the in-depth study of colloidal liquid crystal.
The other one is the continuous spinning of high-performance graphene fibers from graphene liquid crystals. The graphene fibers have high mechanical strength, robust flexibility, and excellent electrical conductivity. More importantly, the toughness of graphene fiber is comparable to that of the commercial carbon fiber (T800), revealing a completely new methodology to make the next generation carbonaceous high-performance fibers especially with both high toughness and high strength. Moreover, nacre-mimetic continuous fibers have been initially proposed and accessed for the first time by wet spinning of polymer-coated graphene liquid crystals. The as-prepared graphene fibers are of high strength, good toughness, good conductivity, showing potential applications in the defense industry and aerospace fields. These results demonstrated that 2D macromolecules and nanoparticles can also form continuous fibers by a manner



of “plate-by-plate stacking” except the chain entanglement of conventional linear polymers, breaking new ground for design and fabrication of novel materials.

Since the first paper on graphene liquid crystals, the group has published 10 peer-reviewed papers in high-rank journals, such as《Nature Communications》、《Advanced Materials》、《Scientific Reports》and《ACS Nano》, attracting wide attention of scientists and media. The result about graphene oxide nematic liquid crystal was published in ACS Nano, and was highlight by “NPG Asia Materials” with a title “graphene oxide: a new order”. The comment said, “a liquid crystal-like transition between isotropic and nematic phases in liquid suspensions of graphene oxide holds promise for a range of applications…Their finding could lead to the development of materials consisting of long-range-ordered assemblies of graphene oxide sheets…The discovery is also interesting from a fundamental research perspective in that graphene oxide can now be explored as a model system for liquid crystal theory and simulations with potential for new insights in colloidal fluid physics”. The work on graphene chiral liquid crystals and macroscopic assembled fibers was published in Nature Communications, and highlighted or commented by many domestic and foreign media. For example, Nature News, entitled as “graphene spun into metre-long fibres”, commented that “the strong, flexible fibres, which can be tied in knots or woven into conductive mats, could be the key to deploying graphene in real-world devices such as flexible batteries and solar cells”. This report was reproduced in full by a well-known popular science magazine Scientific American. Nature Asia Pacific also gave a highlight entitled “spinning graphene into fibres”: These could lead to their use as functional textiles with high conductivity… The fibres can be knitted into a range of designs, and offer an alternative approach for fabricating carbon fibres. At the end of 2011, the image of the graphene fiber knot was selected by《Nature》into “The images of the Year 2011” gallery, illustrating the great importance of graphene fibers. It was named as “unforgettable”, and described as “this 400- μ m-long knot in graphene, tied by Zhen Xu and Chao Gao at Zhejiang University in China, shows exquisite control at the nanoscale. Xu and Gao spun flat liquid crystals of graphene oxide into flexible fibres metres long, and then converted them into graphene threads.”

When the ultrastrong fibers assembled from giant graphene oxide sheets was online published in Advanced Materials, WileyMaterialsViewChina gave a highlight entitled “continuous ultrastrong graphene fiber assembled from graphene sheets”. The comment said, “the multifunctional graphene fibers showed wide potential applications in multi-functional fabric, flexible wearable sensors, supercapacitors, graphite bombs, light weight cables and other fields”; “this method paved the way to high performance graphene fibers from natural graphite”.

These systematic works opened a new research direction of graphene liquid crystals and macroscopic assembled fibers. The result is of originality, of significance, and of wide usefulness.

The Electromagnetic Invisibility Cloak Mechanism and Experimental Study

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Selected as The TOP 10 Academic Advances of the Year

Project Leader: Hongsheng Chen

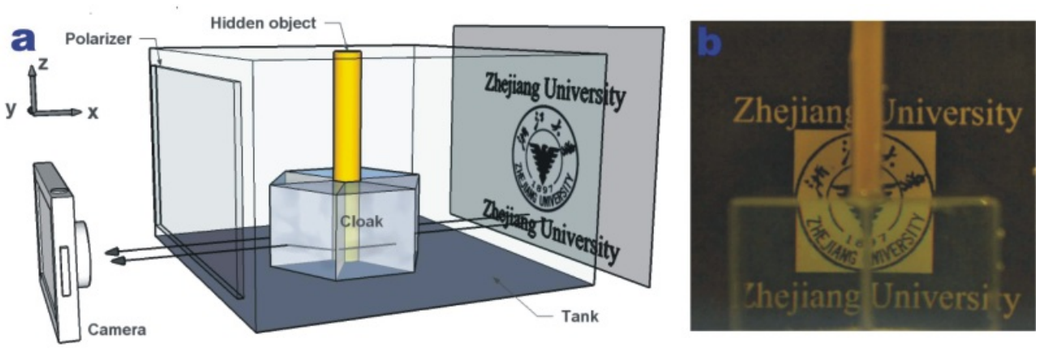

Fig.1

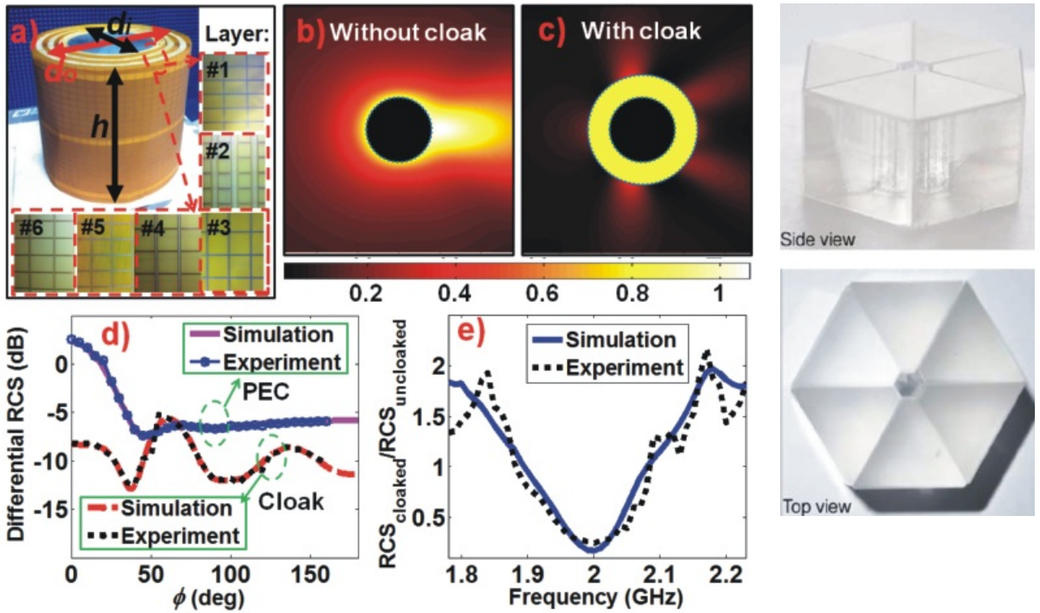

Fig.2

Invisibility has been a long-cherished dream of human being. Hiding a man from sight is very fantastic but only exist in science movies, fictions, and fairy tales in past years. Nowadays, with rapid progress in science, invisibility devices becomes possible in practice.

Generally, when electromagnetic waves incident onto an object, the waves are scattered to all directions. As a result, the object will be detected when the scattering waves are received by the observer. The current stealth technology is mostly achieved by painting some absorbing material on the object surface to efficiently reduce the reflective waves, and thus is able to avoid being detected. However, this kind of stealth technology is not the real invisibility. In order to realize the complete invisibility, in 2006, J. B. Pendry, a professor in Imperial College London, and his colleagues developed a method of coordinate transformation to design the cloak. Following Pendry's theory, D. R. Smith, working in Duke University, firstly fabricated a simplified cylindrical microwave invisibility cloak with his colleagues. The measurement results show that both the forward and backward scatterings are reduced, verifying the performance of the invisibility cloak. Since then, great progress has been reported. Invisibility was named one of the top ten breakthroughs by Science magazine, and is now one of the hottest research areas in electromagnetism, physics, photonics, materials science, and related inter-discipline. However, it is still a very challenging work to design and implement an invisibility cloak. The constitutive parameters obtained through coordinate transformation method are often inhomogeneous and include extreme values. This increases the difficulty in experimental realization, in particular, to obtain the required parameters in visible light spectrum. In addition, for natural dispersive materials, the constitutive parameters vary with frequency, leading to a narrow working frequency band, which becomes the main obstacle to develop broad band cloak.

In 2012, Prof. Hongsheng Chen's team at Department of Information Science and Electronic Engineering of Zhejiang University proposed a theoretical design and experimental demonstration of an isolated polygonal cloak at visible spectrum (Fig. 1). The constitutive parameters of the proposed cloak, designed through a linear homogeneous transformation method, are homogeneous and contain no extreme values. Using natural anisotropic materials, a simplified hexagonal cloak, working for six incident directions, is fabricated.
The performance is experimentally validated in a broadband visible spectrum. Furthermore, based on the scattering theory with an optimization algorithm, the team also experimentally demonstrated a free space microwave cylindrical invisibility cloak (Fig. 2) without phase superluminal propagation phenomenon over a relatively broad bandwidth with anisotropic metamaterial. All of these work are promising to reduce the complexity of cloak and to overcome the bottleneck of narrow-band. These works are very helpful to push forward the visible light invisibility cloak from theory to practical applications. The related researches have been published in Nature's Scientific Reports and Physical Review Letters, and were highlighted by Nature Scientific Reports's Press Release, COSMOS, German Public Radio, and Tokyo TV, etc.

Key Technology of Integrated Automatic Control and Optimization System in Major Oil Refining and Chemical Engineering

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Project Leader: Chu Jian

Oil refining and chemical industry is the pillar industry of the national economy, with characteristics such as large-scale, complex process, high temperature and high pressure, and flammable or explosive. Automatic control system is the brain to ensure the security, stability, and optimal operation of the refinery and chemical plant. For a long time, China's automation and control systems and optimization software for major oil refining and chemical projects are basically foreign monopoly, which has brought great risk to our strategic security. The energy consumption of the petrochemical industry accounts for 22.6% of the total industrial energy consumption. Energy conservation space is great. It is extremely important to develop the automation and control software/hardware system with independent technology.

We conducted a comprehensive research on the security and reliability technology，the energy saving optimal control technology，and the control and optimization of integration technology for large-scale control system, and made the original breakthrough in core technologies. The large-scale joint automatic control system with high reliability is successfully developed. The software systems with large closed-loop optimal operation based on performance evaluation has been applied in major projects in the oil refining and chemical engineering. We are the first to achieve the industrialization of integrated automatic control and optimization system engineering solution in major oil refining and chemical engineering.
The key indicators of project achievements have reached the international advanced level. The indicators of redundancy, real-time control and optimization control technology, are better than mainstream foreign products.

The project realizes high reliability, high adaptability, high safety for automatic control equipment. The average efficiency loss of board is reduced to 0.32% in industrial applications. The system has reliable operation capability of -20 ~ 70 ℃. The system long-life operation is guaranteed. The safety, stability, long, full and excellent application requirements are satisfied. A comprehensive solution is presented for stability control at the device level, optimal control at workshop level, and the large closed-loop coordinated control at whole process level.

More than 70 major projects in China Petroleum and other enterprises have applied the results. The results play an important role for the safe operation and energy conservation of process industry. It will break the blockade of foreign technology, protect national industrial security, and achieve remarkable economic and social benefits.

Knowledge Service System for Chinese Engineering Science and Technology

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Project Leader: Yunhe Pan, Yueting Zhuang

Welcome to the Age of Big Data! As reported in The New York Times in February 2012, Big Data is going to bring out an unprecedented impact on science, technology, economy and sociality. The decision-making of the governments and enterprises will be increasingly based on the analysis of Big Data, rather than simply rely on experience and intuition. Data is becoming a new class of economic asset, like currency or gold. Governments have attached great importance to gather vast amount of data and discover its hidden value from them. In March, 2012, the U.S. government announced the Big Data Research and Development Initiative to improve the U.S. government's ability to extract knowledge and insights from large and complex collections of digital data, and then to accelerate the pace of discovery in science and engineering, strengthen our national security, and transform teaching and learning.

The Chinese government also paid much attention on big data analysis and mining. In March, 2012, China Knowledge Center for Engineering Science and Technology was launched in Beijing. It plans to use 9 years to gather vast amounts of data in the field of engineering science and technology, to build professional knowledge service systems (PKSS) for each field, which will provide comprehensive knowledge services for strategic consulting, professional education and etc.

Zhejiang University, as the core participant, proposed an overall framework for knowledge center based on Data Ocean, integrated data aggregation, deep analysis, knowledge reconstruction, deep search and many other innovative technologies, created a reliable platform to support data aggregation and knowledge services. Nowadays, based on this platform, we have processed and integrated massive data from digital library, networks and database, and built several professional knowledge service systems for Consulting Research, Chinese Herbal Medicine and Engineering Books to meet the knowledge needs of engineering science and technology.

Take the professional knowledge service system of Chinese Herbal Medicine as an example. When a user searches 'ephedra' in the system, he will obtain some dominant and recessive knowledge about herb, prescription, disease, symptom and chemical composition. He can find property-similar herbs in the system, and analyze the difference in many aspects, such as herb property and chemical composition. In addition, herb compatibility analysis, herb property analysis and prescription comparative analysis will help researchers to carry out drug screening and drug discovery more efficiently.

On May 15, 2012, the UNESCO Director-General Irina Bokova had a visit to Zhejiang University for the international knowledge center initiative. She said the idea of the Knowledge Center for Engineering Science and Technology has a lot in common with the development of the UNESCO. The knowledge center will contribute to the aggregation and sharing of knowledge, to promote the usage of engineering science and technology in society, and it will be promoting the development of society.

Xu Kuangdi, Honorary Chairman of the Governing Board of the Chinese Academy of Engineering (CAE), said that it is at the right time to build the knowledge center for engineering science and technology. Cloud computing provides the technical feasibility of the center. In addition, with the rapid development of engineering science and technology in recent years, China has accumulated a large amount of data of engineering science and technology, and needs a system to share the data. The large number of engineering and technical personnel also has an urgent need for new tools to discover new knowledge and laws from big data.

Monkey Control Robot Hand Through Brain Activities

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Selected as The TOP 10 Academic Advances of the Year

Project Leader: Xiaoxiang Zheng

Research Background

Brain machine interfaces (BMIs) can restore the lost motor function through directly reading the motor intents from brain (bypassing damaged peripheral nerves) and translating them into the commands of artificial auxiliary equipment to complete alternative movement. The technology allows the disabled to regain the ability to live independently, greatly improving the quality of life. Meanwhile, this study also has important scientific significance to understand the mind of cognitive processes, intelligent information processing, which will help promote the new, highly complex data-aware technology, pattern recognition technology, integrated circuit research and development. So, BMIs have been the research hot spot in this century. And many BMI research results have been published in high quality journals, such as Nature and Science.

Reaching out to grasp different shaped objects is the most common and important function of the hands in our daily of life, the loss of which, will result in serious physiology and psychological barriers. Due to the complexity of the skeletal muscles of the hand and the uncertainty of brain control network, repairing the hand grip function using BMIs is rarely reported. Based on non-human primate BMIs, Qiushi Academy for Advanced Studies (QAAS) in Zhejiang University works on the motor cortical representation and decoding of reach and grasp movement, realizes a practical BMIs system that enabled the monkey control a robot hand to grasp different objects using neural signals. This result implies new rehabilitation for motor disabled people.

Introduction of the Project

Current state of arts has specified the grasp related brain areas and some offline decoding results, however, online decoding grasp movement and real-time neuroprosthetic control have not been systematically investigated, especially using the signals from dorsal premotor cortex (PMd). For the robot hand control using brain signals, one had to succeed in capturing and deciphering the signals from the monkey's brain and interpreting them into the real-time robotic finger movements. This study, using the discrete strategy, presents our work on asynchronously decoding of four gestures and a resting state using neural ensemble signals from the dorsal premotor cortex of a monkey. All experimental procedures in this study conformed to the Guide for the Care and Use of Laboratory Animals (China Ministry

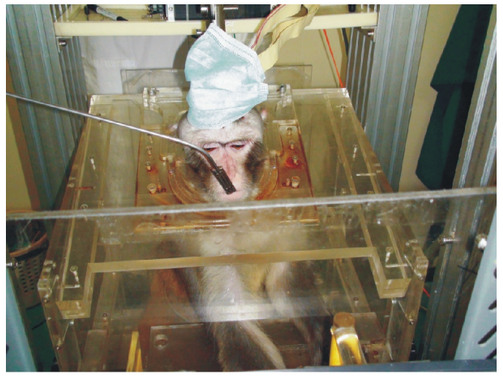


Figure. Monkey control robot hand through brain signals

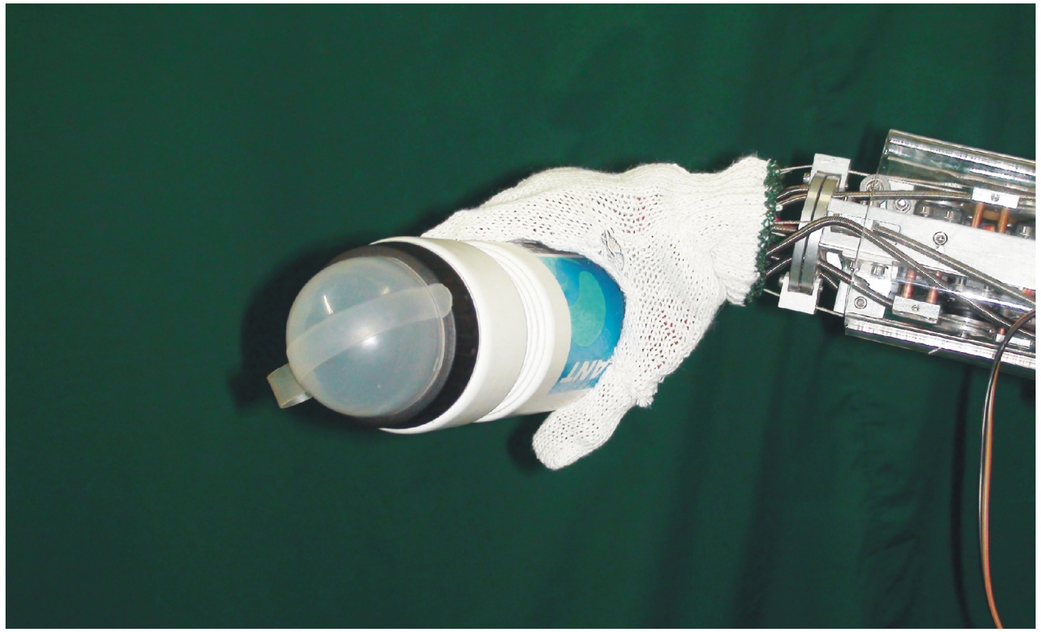


Figure. Robot hand grasps objed

of Health) and the Directive on the Protection of Animals used for Scientific Purposes (Directive 2010/63/EU of the European Parliament and of the Council).

In this study, two monkeys were trained to complete different reach and grasp movement. We obtained neural data from the PMd when monkey reaching and grasping one of four differently shaped objects following visual cues. The four grasp gesture types with an additional resting state were classified asynchronously using a fuzzy k-nearest neighbor model, and an artificial hand was controlled online using a shared control strategy. The results showed that most of the neurons in PMd are tuned by reach and grasp movement, using which we get a high average offline decoding accuracy of 97.1%. In the online demonstration, the instantaneous status of monkey grasping could be extracted successfully to control the artificial hand, with an event-wise accuracy of 85.1%. Overall, our results inspect the neural firing along the time course of grasp and for the first time enables asynchronous neural control of a prosthetic hand, which underline a feasible hand neural prosthesis in BMI applications.

This result was reported by many media at home and abroad, such as CCTV, NewScientists, and so on. The study of QAAS realized online grasp decoding and prosthetic hand control for the first time. There is still a long way to go for a practical usage, but this is a significant step and the technique promises a glamorous prospect. The next thing we are focusing on is connecting the arm with the hand to conduct daily life tasks for the disabled. The pioneering research offers hope to those needing to control artificial limbs.

Research Team

Prof. Xiaoxiang Zheng has been working in the area of biomedical engineering and interdisciplinary research including microcirculation, physiology of cell, drug screening and neural engineering. As the leader of the biomedical engineering at Zhejiang University, she built the multi-level cardio-cerebral vascular and nervous system physiology quantitative technology platform, and achieved a large number of innovative work in biomedical quantitative methodology. In 2006, Qiushi Academy of Advanced Studies was established under the leadership of Prof. Zheng. One of the main research areas of the institute is the brain machine interfaces, including the basic theory of neural engineering and the key techniques in the non-invasive brain machine interfaces and invasive brain machine interfaces.

The research group has established the invasive brain machine interfaces platform on rats and primates, the human-computer interface for clinical rehabilitation, and the development of sports rehabilitation aids. The group has made important achievements on rat navigation in complex environments, P300 based Chinese typewriter, bi-directional brain computer interfaces on rats, rat motor neural control, monkey wrist motion decoding system and invasive neural control on robot hand by monkey's motor neural signals.

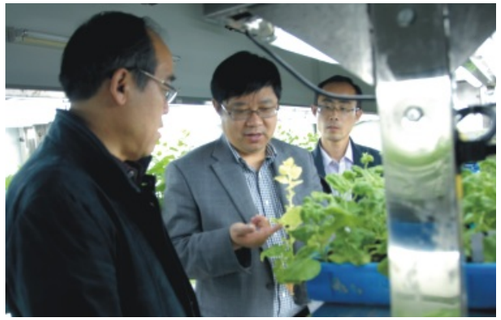
Suppression of Plant Defence by a Virus Promotes Its Mutualism with Insect Vectors

★ ★ ★ ★ ★

Awarded as The most Popular Academic Advance of the Year

Project Leader: LIU Shu-Sheng, Zhou Xue-Ping

The number of species of plant viruses recorded to date is about 1100. Plant virus diseases are regarded as "cancer" for plants, and cause an estimated US$60 billion loss in crop yields worldwide each year. Virus infection of crops depends on transmission by vectors. About 80% of all plant viruses are mainly or exclusively transmitted by small insects such as aphids and whiteflies. Thus, the population abundance of these vector insects affects directly the epidemiology and pandemics of plant virus diseases. Based on the observation that some recent invading insects not only attack plants by feeding, but also transmit important crop viruses, this research team has been conducting pioneering studies in the field of interactions between plant viruses and vector insects, with the ultimate objective to provide new knowledge to promote agricultural production in this country and worldwide.



In 2007, this research team found that when an invasive whitefly has transmitted a virus to a crop and then feeds on the virus-infected plant, it can increase its population more rapidly, and the higher abundance of the whitefly in turn promotes the disease pandemics. In this way the vector insect and the plant virus establish a kind of indirect mutualistic relationship via their shared host plant, facilitating outbreaks and damage by both types of pests. Since then, the team has continued research in this area, and after five-year's joint effort, the team has made a breakthrough in unraveling the physiological and molecular mechanisms underlying the mutualistic relationship between the vector insect and the virus. The team found that, while tobacco plants are relatively poor host plants for the whitefly *Bemisia tabaci*, tobacco's suitability to the whitefly was substantially increased when infected by the begomovirus *Tomato yellow leaf curl China virus*. The change in suitability was associated with depressed jasmonic acid-related plant defence and reduced terpenoid release by virus-infected plants. Through experiments with gene over-expression and/or gene silencing, the team further demonstrated that the pathogenicity factor βC1 encoded in the betasatellite of the virus is responsible for the initiation of suppression on jasmonic acid related plant defenses, and virus infection reduces the expression of terpenoid-related pathway genes and the synthesis of terpenoids. Thus the suppression of plant defences promotes the plant-mediated mutualistic relationships between the vector insect and the plant virus.

To our knowledge, this team is the first to unravel important physiological and molecular mechanisms underlying the plant-mediated mutualistic relationships between insect vectors and plant viruses. In view of observations that jasmonic acids are widespread hormones in higher plants that mediate plant defence to insects and terpenoids are the most numerous and structurally diverse plant secondary metabolites, these new findings not only have provided novel knowledge on the tripartite interactions between viruses, vector insects and plants, but also will stimulate novel thoughts on how to seek for ways to interfere with the virus-plant relationship and to make sufficient use of plant resistance in management of vector insects and plant viruses.

The team has published 20 papers related to this research in the last five years, of which two major papers are published in *Molecular Ecology* and *Ecology Letters*, two of the most prestigious journals in the fields of evolutionary biology and ecology.

Four laboratories from Zhejiang University participated in this joint research. The leaders of these laboratories are: (1) Professor LIU Shu-Sheng, the leader scientist of the Innovative Research Group "Biological Control of Agricultural Insect Pests" accredited and supported by the National Natural Science Foundation of China, the Institute of Insect Sciences; Professor ZHOU Xue-Ping, Outstanding Professor of the Cheung Kong Scholars Programme, Ministry of Education of China, and National Outstanding Young Scientist accredited by the National Natural Science Foundation of China, the Institute of Biotechnology; (3) Professor LOU Yong-Gen, Chief Scientist of a project supported by the National Basic Research Programme, the Institute of Insect Sciences; and (4) Professor ZHU Guo-Nian, Institute of Pesticide and Environmental Toxicology. Dr. Linda Walling, Professor of Genetics and Divisional Dean of Life Sciences, College of Natural and Agricultural Sciences, University of California Riverside, USA, collaborated in this project. The research achievement was a result of a long-term cooperation between several laboratories with international recognition in the fields of entomology, plant pathology, ecology, chemical analysis and plant genetics using a multidisciplinary approach.

Molecular Mechanism Governing T Cell Development

★ ★ ★ ★ ★

Selected as The TOP 10 Academic Advances of the Year

Project Leader: Linrong Lu

The body's immune system relies on a spectrum of highly differentiated immune cells to combat external microbial infections. T lymphocytes play important roles in the immune responses, including directly killing of virus-infected or tumor cells and helping B cells to generate antibodies. T cell dysfunctions are coupled with a variety of diseases: congenital T-cell deficiency in infants increases susceptibility to fungi, viruses, protozoa and other infections; Individuals who have abnormal T cell function were 100-300 times more susceptible to tumor occurrence.

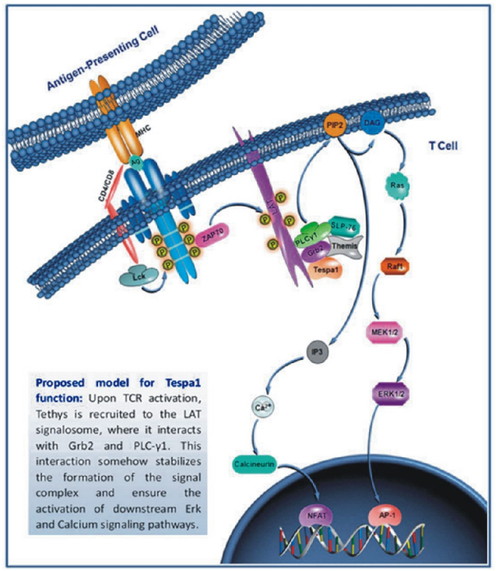
Therefore, the development, differentiation and maturation mechanisms of lymphocytes have long been important field of the basic immunology research. Our research team for the first time discovered and named a new molecule named Tespa1 which is involved in T cell development, which uncovered a new mechanism in regulating of T cell development.

In this project, we utilized various modern molecular biology and immunology technologies, including cytometry analysis and sorting, co-immunoprecipitation, small RNA interference and transcriptome sequencing.

During their development process, T lymphocytes undergo two important stages termed positive and negative selection in order to develop into mature and self-tolerant CD4 or CD8 single positive cells before migrating to the peripheral immune organs. This process is dependent on TCR complexes on cell surface. Our results showed that, Tespa1 is involved in the formation of LAT complex downstream of TCR signaling. In Tespa1 deficient mice, the number of both mature CD4 and CD8 single positive cells significantly reduced. Further analysis suggested that Tespa1 deficiency led to blocked TCR signaling and improper assembly of LAT complex. These results confirmed that Tespa1 is a key molecule in regulating of T cell development.

This work has been published on 《Nature Immunology》(IF=26) in May 2012.

Immunologist Nicholas Gascoigne for Scripps Research Institute commented on our study on the same issue of《Nature Immunology》, he said that it is a surprising finding in the field. This research extends our understanding on T cell development and T cell signaling, thus might provide a new therapeutic target in clinical diagnosis and treatment of T lymphocyte-associated diseases.



Proposed model for Tespa1 function: Upon TCR activation, Tethys is recruited to the LAT signalosome, where it interacts with Grb2 and PLC-γ1. This interaction somehow stabilizes the formation of the signal complex and ensure the activation of downstream Erk and Calcium signaling pathways.

The paper has ranked second of the 10 articles in the monthly downloads on Nature Immunology website in the month of its publication.

In "Faculty 1000" website, several famous scientists in the field of T cell development, including Professor Nicholas Gascoigne from Scripps Research Institute, Professor Amnon Altman from La Jolla Institute's of Allergy and Immunology and Professor R my Bosselut from NIH-NCI, wrote special comments on our work, noting that our study revealed a new member involved in regulating T cell development, suggesting that the regulation mechanism of T-cell differentiation and development is a far more complicated than we thought.

This work was carried out entirely by domestic researchers. Corresponding author of this paper is Professor Linrong Lu from the Immunology Institute and PMCB. The first author is Associate Professor Di Wang and PhD student Mingzhu Zheng. Other co-authors include graduate student Lei Lei, Jian Ji, Yunliang Yao, Yuanjun Qiu, Lie Ma, Jun Lou, Chuan Ouyang, Xue Zhang, Xuetao Cao, Lie Wang and Jianli Wang.

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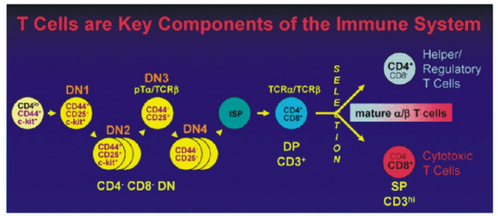
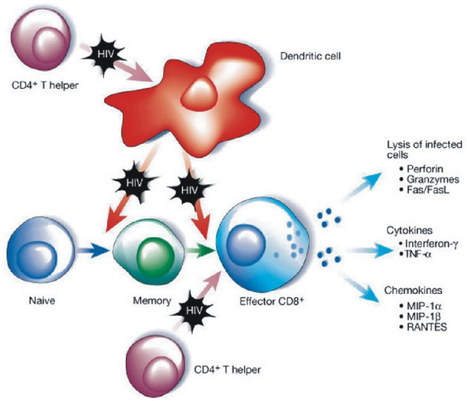
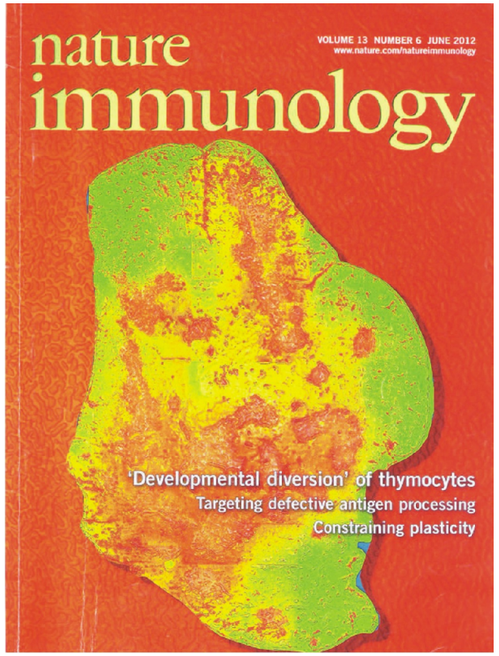






Digital Health Pushes Healthcare Reform Forward and Boosts Health Service Capability

★ ★ ★ ★ ★

Selected as The TOP 10 Academic Advances of the Year

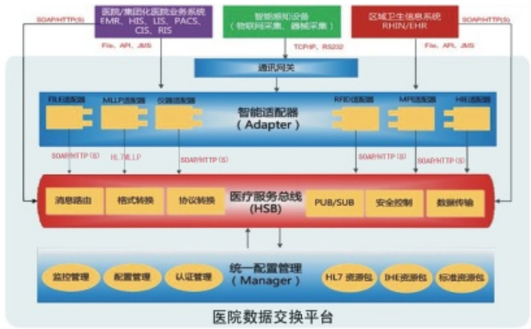
Project Leader: Lanjuan Li

Healthcare information technology is one of the key technologies for the target of healthcare reform: everyone has the right to enjoy basic healthcare services. Since the 1990s, Zhejiang, Shanghai, Jiangsu and other provinces began the exploration of the medical and health information construction. After more than 10 years of development, the level of China's healthcare information has made considerable progress. However, with the development there are a series of problems presented: lack of standardized electronic health records and electronic medical records; lack of standards-compliant national, provincial, city and county health information platform; lack of business collaboration and information sharing among provincial hospitals, municipal hospitals, county hospitals and community health agencies; lack of integration and communication between hospital card, social security card, farmer's insurance card and bank card system. Thus there are barriers for the communication between each of the public health service system, medical services system, new rural cooperative system, essential drug system and comprehensive office management information. The resulting is islands of information systems, thus it is difficult to harness the technology advance and to share and to collaborate between different subjects and services.

In 2007, Professor Lanjuan, Li, the vice president of the Chinese Institute of Health Information, also the member of Chinese Academy of Engineering, jointed number of famous experts, academicians and scholars, and traced the trends of modern healthcare, and seek the actual needs of China's medical reform, then initiated the "healthy face-to-face "plan of action: by using of computers and the new generation of network technology, she conducted research and application of the digital health model to construct regional healthcare information system, and to achieve a high level of healthcare system performance. In 2009, the Eleventh Five-Year key project of National Science and Technology Support Program - National Digital Health key technologies and regional use of demonstration "project was officially approved, professor Li was assigned as the project leader.

This project focused in bringing the computers and the new generation of network technology to the current healthcare system to build refreshing regional healthcare information based system.

(1) From the actual needs of the healthcare information standardization the project developed a series of suitable healthcare information standards, which fulfilled the demand for healthcare system. There were 66 standards developed, which can be classified into 13 classed. Eight of the standards were adopted as industry standards released by the Ministry of Healthcare, and Eight of them were released as provincial local standards. These standards can be used to guide the development of new medical and healthcare information system.



(2) For the first time, the project created ten key nodes electronic healthcare records (EHR) which covered every aspects of person throughout life-long and such kind of EHR have been applied in the demonstration area. Since the deployment of the new EHR system, there have been uploaded more than 16 million copies of standardized electronic health records in the demonstration area. At present, all of 90% of the residents in the demonstration area have their own EHR, and achieved the goal of standardized management of the residents' health information.

(3) The project created standardized clinical pathways and knowledge support hospital information systems which made use of the technology of "the Internet of Things". After using the creation, the whole healthcare process in hospital was standardized, well refined, and integrated. The level of diagnosis and treatment were greatly enhanced, and the quality of medical services was under control. The clinical pathway oriented hospital information system integrated with 92 clinical paths, and with 168 kinds of diseases embedded. Such hospital information systems have been deployed in more than 100 hospitals across the country.

(4) For the first time the project build a unified, standardized regional health information platform system for three administrative levels: province, cities in the province, and counties in a city. The platform was first applied to Zhejiang Province, and thus covered the Zhejiang provincial level, also a district city and 22 different counties in the province, achieving more than 16 million residents of electronic health records and electronic medical records which uploaded from more than 108 secondary hospitals. And so a new area wide healthcare information service pattern is emerging: the regional health information platform serve as the hub, resident card as a link terminal, the resident electronic health records and electronic medical records serve for the core repository of health information, aftwards, healthcare information sharing among medical business collaboration service agencies become smoothly.

(5) Practice new healthcare patterns, such as remote intensive cases consultation, remote continuous monitoring, remote virtual beds, remote booking service, remote medical education, remote departments cooperation, health examination regional hospitals, three-level bilateral referral services, etc. And the project established an open third-party operating mechanism for the formation of many-to-many network medical services platform, to achieve high-quality medical resources sharing, to optimize the use of resources, and to promote the urban and rural medical and health services equalization. These patterns had been used to connect the province's 10 provincial level hospitals, more than 150 cities and counties hospitals, more than 500 community health service institutions. A total of more than 20,000 cases of the remote critical illness consultation, and more than 1,000 times remote education are conducted.

(6) Laid the foundation for the innovation capability of China's medical and health research in the field of information technology. Made a series of research progress in the medical comprehensive information management, clinical pathway ontology modeling method, electronic clinical data exchange, the key technology reached the international advanced level. The project pioneered the process control theory PDCA cycle process in the design of electronic medical records system, and firstly proposed clinical pathway ontology modeling, clinical data exchange and communication, standardization, interoperability and other technical problems, as well as privacy protection, the legal environment, the insurance system, different language translation and other non-technical problems, all of these issues have innovative solutions and experimental verifications.

In addition, the project also achieved 55 national software copyright registrations, published 11 "Digital Healthcare Series" books, and published 99 papers in the magazines including "JAMIA". The success of the project wined the praise of leaders from domestic and foreign experts at all levels, key technologies and the products of the projects have been widely used in the province of 22 demonstration zones and also used in other demonstration provinces such as Jiangxi, Guizhou, Sichuan , Hubei, Xinjiang, Liaoning, Qinghai, etc.

The application of the project effectively enhanced disease prevention and control, emergency public health affair response capacity, and improved the quality of medical services, healthcare services equality and advanced the healthcare reform. The project help to achieve the breakthrough in information fragmentation, to integrate medical resources, to optimize service processes, to improve the efficiency of medical treatment, to reduce medical costs, to harmonize relationship between doctors and patients, to protect the health of the public, and to achieve the goal of universal equally access to basic health services in the demonstration area. For the first time the healthcare information in the province was organized as a whole unit, the success of the project was benefit from the top-level design of key technologies and achievements of the projects, and also benefit from intensive cooperation among the multidisciplinary field of experts majored in healthcare, information and communications, public administration, standards, with their collaborative innovation and diligent research and development of health information system. The widely propagations of the project will reach far-reaching impact, really play the role of technical support for health care reform, health services, and promote healthcare level into a new generation.

Unraveling a Novel Mechanism for Tumorigenesis of Stem Cells

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Selected as The TOP 10 Academic Advances of the Year

Project Leader: Ying-Jie Wang

Pluripotent stem cells are immortal and multipotential 'seed' cells in the human body. When defects arise, they will be quickly removed or converted via apoptosis or differentiation processes to ensure the propagation of healthy and normal 'seeds'. However, if the defected stem cells somehow overcome the apoptotic barrier and become tumorigenic, they can give rise to a small subgroup of hard-core tumor cells known as 'cancer stem cells' that are highly resistant to both chemotherapy and radiotherapy. Accumulating experimental evidence has demonstrated the existence of cancer stem cells and their critical roles in the occurrence, progression, metastasis and relapse of various cancers, and there is a growing consensus that targeting cancer stem cells hold the promise for eradicating cancer. Surprisingly though, little was known about the underlying mechanisms that trigger the transformation of normal stem cells to cancer stem cells. On November 30th, 2012, a research team jointly led by Prof. Ying-Jie WANG at the First Affiliated Hospital of School of Medicine and Prof. Binghui SHEN at the College of Life Sciences, Zhejiang University, reported their findings as a Featured Article in Molecular Cell entitled Reciprocal regulation of Akt and Oct4 promotes the self-renewal and survival of embryonal carcinoma cells , unraveling a novel mechanism for tumorigenesis of stem cells.

The research team discovered that the master pluripotency factor Oct4 can be phosphorylated by Akt in embryonal carcinoma cells, the malignant counterpart of embryonic stem cells and a model for cancer stem cells at the embryonic stage. Oct4, one of the markers for embryonic stem cells, plays an essential and indispensable role in maintaining the self-renewal of pluripotent stem cells as well as in inducing iPS cells. Moreover, accumulating literature has documented the detection of Oct4 mRNA and protein in a variety of cancer cell lines and solid tumor specimens but Oct4's mechanism of action remains largely unclear. Akt is a serine/threonine kinase that can suppress cell apoptosis and promote cell survival via phosphorylating a vast array of its target proteins. Aberrantly activated Akt and its signaling pathway has been found to be frequently associated with various cancers, testifying its central position in cancer cell biology. The current project has established a novel connection between Oct4 and Akt, the two central regulators in stem cell and cancer cell biology, showing that Akt phosphorylated Oct4 at threonine 235. This site-specific phosphorylation remarkably promoted the pluripotency and self-renewal of embryonal carcinoma cells by enhancing the stability of Oct4 protein, the interaction between Oct4 and Sox2, and the binding of Oct4 to its target genes.

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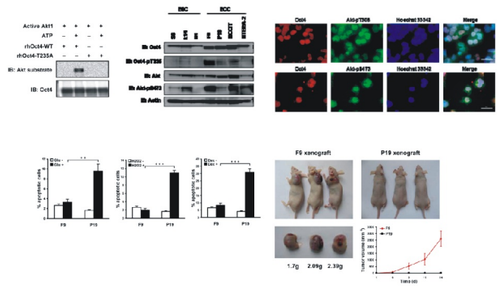

Once phosphorylated by Akt, Oct4 can activate the transcription of AKT gene in a positive feedback manner, thereby reinforcing the 'Akt-Oct4 regulatory circuit' that led to strengthened anti-apoptosis and survival of embryonal carcinoma cells. The elucidated reciprocal regulation of Akt and Oct4 revealed a novel connection between the self-renewal and apoptosis of stem cells and explained the main cause why malignant stem cells can escape from apoptosis. It unraveled a novel and important mechanism underlying the tumorigenesis of stem cells and the formation of cancer stem cells and therefore represents a major breakthrough in cancer stem cell research.

This work was soon reported as a front-page story and subsequently listed as one of China's top sixteen major life science discoveries in year 2012 by China Science Daily. It was also widely reported by the national and local mainstream media such as China Daily and Zhejiang Daily. The article used to be ranked as No. 1 most-read article published during November and December 2012 in Molecular Cell and attracted numerous attentions worldwide. Nature China highlighted this finding with a title of Stem cells: Caught in the act , pointing out: such enhancement of self-renewal and survival would explain why cancer stem cells are so difficult to eradicate using conventional chemotherapies. More importantly, Akt could well offer an effective drug target for killing cancer stem cells. The discovery was also highlighted by Science Signaling and Chinese Journal of Cell Biology. Prof. Ying-Jie WANG was invited to present this work at the 4th Annual City of Hope International Stem Cell Symposium, the 3rd Annual Conference on Chinese Stem Cell Research and the 5th Guangzhou International Conference on Stem Cell and Regenerative Medicine, respectively.

This work was conducted by a research team at Zhejiang University jointly led by Prof. Ying-Jie WANG and Prof. Binghui SHEN, and financially supported by an internal grant from the State Key Laboratory for Diagnosis and Treatment of Infectious Diseases, a start-up fund for Thousand Talents Program Scholar, Zhejiang University, and a 863 project of Ministry of Science and Technology of PR China. The researchers at the Colleges of Animal Sciences, Life Science Institute, Zhejiang University, and the international collaborators at the University of Pennsylvania and City of Hope National Medical Center also contributed to the work. Yuanji LIN, Ying YANG and Qi CHEN at Zhejiang University were listed as the co-first authors for the above-mentioned article.