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SPECIAL ISSUE

China's S&T Heyday

XU Heping, Director of Chinese Ministry of Science and Technology Survey Office, recently presented an array of statistics showing China's S&T strength, in the following areas:

- 1) In 2006, China has registered a total S&T expenditure worth RMB 450 billion, and a total R&D expenditure of RMB 300.31 billion, or 5th place in the world, or 1.42% as a proportion of China's GDP. At present, China has an S&T population of 35 million, ranking 1st place in the world. In the same year, China had R&D personnel of 1.42 million, sitting in 2nd place next to the United States.
- 2) China's international paper has risen from 15th place in 1991 to current 4th place in the world, in terms of total number, and has taken 7% of the papers collected by three major searching systems, namely SCI, EI, and ISTP. China has made laudable

proprietary innovations in numerous cutting edge areas, including manned space flight, high performance computer, super integrated circuit, international standards for 3rd generation mobile telecommunication, and advanced defense weapons.

- 3) China has registered a domestic patent application that exceeds international application for three consecutive years. The application for trademark, utilities, and design has been in 1st place of the world for a number of years in a row. In 2006, China's invention patent application sat in 4th place of the world.
- 4) In recent years, China has witnessed a greatly enhanced technological innovation capability in the area of basic industry, processing and manufacturing industry, and emerging industries. Novel technologies have provided powerful support for the construction of Three Gorge project, power transmission from the west to the east, natural gas piping from the west to the east, south-to-north water diversion, and Qinghai-Tibet railway. S&T advancement in the area of agriculture has found technical solutions for addressing three major problems in the rural areas. An array of technological breakthroughs has produced key enhancements for super hybrid rice, corn, and GM cotton. In the area of energy, innovative gas and oil prospecting equipment, large coal liquefaction facilities, and utilization of new energy such as hydraulic power, and associated equipment, has created a ground for readjusting energy composition and ensuring energy security. In the area of mineral resources, enhanced mineral recovery and resources utilization has made China on the right track of using its natural resources. China has developed needed key technologies for improving its ecological environment and disaster prevention and preparedness, including environment monitoring, atmospheric pollution control, and soil restoration. It has also established a comprehensive surveillance and forecast system to deal with weather, earthquake, and floods related natural disasters.
- 5) China has enjoyed a boom of private S&T industry from some 7000 enterprises two decades ago to 150,000 enterprises in 2006. More and more private S&T enterprises have developed their proprietary technologies, with numerous start-ups in the area of electronics and telecommunication, power generation equipment, new energy, and transport.
- 6) China's high tech industry has produced an output worth RMB 3.4367 trillion, securing a 15.5% contribution to the growth of manufacturing industry. In 2006, China's high tech import & export registered a volume of USD 528.75 billion. 53 national high tech parks have sustained a growth rate of 30% for their major economic indicators. In 2006, 53 national high tech parks produced a business revenue worth RMB 4.33199 trillion. In the first half of 2007, 54 national high tech parks and Suzhou industrial park have registered a business revenue of RMB 2.58918 trillion, industrial output RMB 2.18732 trillion, industrial added value RMB 502.16 billion, profits RMB 120.47 billion, and tax paid RMB 115.77 billion.
- 7) China's national labs and national key labs have been equipped with internationally advanced equipment. China has built up a well functioned S&T infrastructures consisting of research centers, large scientific instruments, natural S&T resources, scientific data, and S&T literatures, with some areas reaching or approaching an internationally advanced level. China has established an information and

communication trunk network covering the entire country, with both its scale and technologies topping the world. As of the end of 2006, China has possessed 830 million telephone subscribers, and 480 million mobile phone subscribers, both ranking 1st in the world. China has 137 million online aliases, and 59.4 million online computers, with 35.3 million computers having access to broadband, ranking 2nd place in the world.

- 8) China has landed major breakthroughs in combating major diseases and epidemics, including cardiocerebrovascular diseases, tumors, AIDS disease, viral hepatitis, SARS, and highly pathogenic bird flu. It has also made important progresses in developing new drugs, modernization of traditional Chinese medicine, and digital medical equipment.
- 9) China has so far established S&T cooperation ties with 152 countries and regions, and inked intergovernmental cooperation accords with 100 of them. China is part of ITER, Galileo satellite navigation system, the Human Liver Proteome Project (HLPP), and other large international projects. Up to date, China has become a member of 350 international S&T organizations, and 206 Chinese scientists are working for these organizations.

RESEARCH AND DEVELOPMENT

More Progresses for HIRFL-CSR

Lanzhou HIRFL-CSR observed on October 7, 2007a beam storage intensity exceeding the design indicator, a top international record for both highest energy and beam intensity.

HIRFL-CSR is an extension of HIRFL, built with an investment worth RMB 293.5 million. It is scheduled to be completed in five years. It mainly works on radioactive beam physics, including drip lines, properties of nuclear matters under high temperature and high density, high ionized Z physics, and high quality heavy particle beams/radioactive beams. Chinese researchers have harvested a number of internationally advanced findings in the said four areas, which makes China an important part of heavy particle study in the world. Meanwhile, the construction of the project has spurred up the development of associated high technologies for accelerator, super vacuum, and electronic cooling.

Started in December 1999, the project is consisted of a number of sub-systems, including injection beam line, major ring (CSRm), beam splitter, experimental ring, experimental detecting device, and transformation of original devices and facilities of HIRFL. Upon its completion, the HIRFL-CSR will become an advanced device comparable to other world class devices, such as GSI in Germany, GANIL in France, and RIKEN in Japan. The large science project will also provide advanced experimental facilities for China's basic researches in the area of nuclear physics, hadron physics, atomic physics, and high energy and density physics, benefiting a range of applied areas, including heavy particle radioactive material, heavy particle based cancer treatment, and space radiation study.

More Progresses for HTSC Study

In collaboration with a study team headed by P.C. Dai of Oak Ridge National Laboratory, a research team, led by WEN Haihu of State Key Laboratory for Superconductivity, CAS Institute of Physics and Center for Condensed Matter, has made important progresses in understanding the high-temperature superconductor mechanism of PrLaCeCuO, and unveiled a linkage between spin fluctuation and high-temperature superconducting. The finding was published in a recent issue of the *Proceedings of the National Academy of Sciences*.

The team led by WEN Haihu has been working on the subject for some years, with a number of laudable results. For example, it has found that some high-temperature superconductors possess Fermi arc, which means they will leave a new energy gap on the surface of Fermi arc in a superconducting state. Its size reflects the scale of superconducting energy. This model has been reconfirmed by other technical means, and has become a hot spot for research. In the study, researchers selected a mixed superconductor of PrLaCeCuO. They obtained high quality superconducting data in the broad temperature area, and accurately worked out the evolution of condensed energy in the magnetic field. At the same time, its US collaborators have observed a resonance peak in a neutron scattering experiment, and found that it has a magnetic field suppression identical to the variation of condensed energy in the magnetic field. The condensed energy and resonance peak would simultaneously disappear, when the magnetic field was higher than the critical magnetic field. Instead, an antiferromagnetic ordering would appear. These findings have confirmed the fact that there is a close relationship between HTSC and magnetic intensity. In addition, researchers also found that the competition between superconducting and antiferromagnetic ordering would result in two different basic states. These findings will improve people's understanding of HTSC.

China First Monoclonal Targeting Drug for Liver Cancer

Iodine[131I] Metuximab, China's first proprietary monoclonal antibody targeting drug granted with a national class I new drug certificate two year ago, has been put into clinical application in both Shanghai and Guangzhou.

In July and August 2007, Shanghai No. 10 People's Hospital and Guangzhou PLA 458 Hospital has used the new therapy to treat advanced primary liver cancers. According to a briefing, the previous clinical trials have shown that the new therapy produces a fine therapeutic effect. In the clinical application, doctors directly inject the drug into the arteries that feed blood to liver cancers via a tube, which produces a strong kill to the cancerous cells. Doctors found that the therapy can easily lead to relieved symptoms, such as pains, fever, and abnormal body temperature. Doctors told reporters that population-based studies are needed in order to further confirm the therapeutic effects of the new therapy.

Conducting Hollow Spheres of Polyaniline

Researchers at the Center of Molecular Sciences, part of the Institute of Chemistry under the Chinese Academy of Sciences, have recently achieved new progresses in developing multifunctional conducting hollow spheres of polyaniline. The finding was published in the recent issue of journal *Advanced Materials* as a cover story.

Based on the template-free synthesis approach developed by the Institute, researchers rolled out conductive and superhydrophobic rambutan-like hollow spheres of polyaniline, through self-assembly, using perfluorooctane sulfonic acid as a dopant, soft template, and superhydrophobic agent at the same time. The results show that the approach used is not only simple, but also that the hollow spheres have a large specific area and exhibit physical properties that are required for many applications in nanotechnology. It enhances the stability of conductivity of polyaniline, while protecting the biological materials inside from being contaminated, or damaged. The novel hollow spheres are of broad application perspectives in numerous areas, including energy-loss free transmission, micro reactor, and controllable separation and release.

Relaxor Ferroelectric Study

Shanghai Institute of Applied Physics under the Chinese Academy of Sciences, in collaboration with National Synchrotron Radiation Lab, part of the University of Science and Technology of China, and CAS Shanghai Institute of Ceramics, has made important progresses in understanding the spatial structures of relaxor ferroelectric materials, using synchrotron radiation approach. Researchers found that the reorientation of PNR polarization is important for forming the macro polarization of relaxor ferroelectric body. The finding was published in a recent issue of *Applied Physics Letters*.

Researchers with Shanghai Institute of Applied Physics have for the first time observed the X ray scattering images reflecting the phase change of relaxor ferroelectric body, and obtained important parameters on PNR scale, using home made high temperature and pressure unit, and enhanced experimental devices. The experiment was made at NSRL in Hefei. Shanghai Institute of Applied Physics provided the PMN-PT monocrystalline materials. Experimental results show that in a zero electric field, PNR distributes in an oval shape, with a long and short axis respectively of 17nm and 10nm. The external electric field in the axial direction (100) is able to redirect the long axis of PNR. The reorientations mainly occur along the diagonal $(1\pm 1\pm 1)$. PNR polarization and associated reorientation is important for forming the macro polarization of relaxor ferroelectric body.

NEWS BRIEFS

42 Key Basic Research Projects

China will kick off 42 key basic research projects in the area of protein, quantum manipulation, nanotechnology, and development/reproduction, disclosed at a meeting held on September 26, 2007 by the Chinese Ministry of Science and Technology (MOST) to implement the National 973 Program. Up to date, 82 key projects have been employed in the four areas on a combined basis. The 42 projects deployed this year are 8 projects for protein, 4 for quantum manipulation, 16 for nanotechnology, and 14 for development/reproduction.

MOST is responsible for the overall coordination of the Program, and the Ministry of Education and the Chinese Academy of Sciences implement the Program.

Nanocarrier Cross Brain Barrier

Targeting nanocarrier drug and its application in treating cerebral diseases, a basic research project, has been established and entered the implementation phase. JIANG Xinguo, a research fellow at the Fudan University School of Pharmacy, said that the research will aim at four major brain diseases: brain tumors, cerebral infarction, dementia, and Parkinson's disease. Chinese scientists will develop novel, safe, and efficient targeting nanocarrier drugs to improve the effectiveness of cerebral disease treatment and accuracy of diagnosis, using modern nanotechnology, pharmaceutical techniques, and molecular biology.

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