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S&T Commission Launches 30 Major Projects

92P60430A Beijing ZHONGGUO KEXUE BAO
[CHINESE SCIENCE NEWS] in Chinese 21 Jul 92 p 1

[Article by Liu Maosheng [0491 5399 0524]]

[Summary] On 21 July, the State Science and Technology Commission launched the "Climbing Program" to revitalize and promote continuous progress of China's basic research. Thirty major research projects have been chosen based on these four criteria: The projects must be leading-edge projects which are capable of achieving breakthroughs by the end of the century; the projects must be urgently needed and having significant economic applications and are able to achieve significant S&T results; the projects must be able to fully utilize China's geological conditions, resources, and research capacity; and those projects which have already reached world advanced level and are expected to attain significant progress in the near future. The 30 projects are divided into five categories:

Category 1 includes seven projects in areas of mathematics, physics and astronomy.

Category 2 includes six projects in chemistry area.

Category 3 includes seven projects in areas of biology, agronomy, and medicine.

Category 4 includes five projects in area of earth science.

Category 5 includes five projects in technical science area.

The 30 major research projects chosen by the State Science and Technology Commission are:

1. High-temperature superconductivity
2. Theory and methodology of large-scale science and technology computing
3. Semi-conductor super-lattice physics and materials, and new device structure
4. Non-linear science
5. Machine certification and application
6. Nanometer material science
7. Cutting-edge projects in theoretical physics in 1990's
8. Multiwavelength observation and severe celestial movement
9. Important chemistry processes of life
10. Molecular technology of Function System
11. Basic physics of high molecules in coacervation state
12. Atoms and molecules in excitation state and state-state reaction kinetics
13. Rare earth science
14. Dominant strains of grain and cotton oil-producing male-sterile hybrids
15. Optimal nodule-formation and nitrogen-fixation control model of symbiosis-nitrogen fixation system
16. Network of passage systems (circulation system and nervous system)
17. Newly synthesized peptide chain and protein folding

18. Molecular biology of cardiovascular diseases and tumor pathogenesis
19. Physiology of important high-yield, disease-resistant crops
20. Brain function on cellular and molecular basis
21. Structure, function, molecular design and manufacture process of photo-electrical function materials
22. Femtosecond laser technology and superspeed process
23. Major problems of cognition science
24. Deep submicron-structure apparatus and interobservational physics
25. Coal and oil high-efficiency and low-pollution burning process
26. Climate kinetics and weather forecast theory
27. Forecast and strategy study on trends in living environment in the next 20-50 years
28. Crustal movement and kinetics of the earth
29. Formation, evolution, change of environment, and ecosystem of Qinghai-Xizang plateau
30. Basic research related to exploring large-scale mineral deposits

Complementary Policy for S&T System Reform

92P60430D Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese
11 Jul 92 p 1

[Article by Xiao Shi [2556 0670]]

[Summary] The State Science and Technology Commission recently issued its complementary policy for S&T system reform to speed up conversion and further application of S&T results and to perfect China's scientific research structure. According to the policy, during the Eighth Five-Year Plan period, the State S&T Commission will strengthen S&T legislation to officially define growth ratio and growth rate of S&T investment, establish an overall S&T funding system, and to grant special legislative authority to S&T units so that in a certain period of time these S&T units can legally enjoy the rights and benefits granted by law. The Commission will also promulgate policies to encourage S&T investment by offering industries a certain portion of profit for developing new products and allowing them to add this portion into their production cost and exempt from their income taxes. The Commission will also put out policies to assist industries to gradually enter into domestic and international markets by allowing S&T units to establish joint ventures with foreign countries, by officially defining registration capitals that are IPR (intellectual property rights) investment and also can be used as capitals for enterprise investment, by allowing tariff exemption on imported scientific research equipments, and by further perfecting policies of promoting S&T development.

Development of National Defense S&T System

92FE0757A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 13 Jul 92 pp 1-2

[Article by Xie Guang [6200 0342], Vice Minister of the Commission of Science, Technology and Industry for National Defense]

[Text] From 1949 to 1989, China developed its defense technology system and achieved remarkable accomplishments. A high standard defense science and technology contingent was formed and a comprehensive ability to independently develop new weapons systems has been established. China designed and produced a large volume of conventional weapons, developed medium range, medium to long range, and intercontinental guided missiles and nuclear submarines equipped with guided missiles. China successfully conducted 34 nuclear explosion tests and launched 25 satellites including research satellites, return type remote sensing satellites, communication satellites, and meteorological satellites. These accomplishments contributed greatly to the modernization of China's national defense, to the protection of China's borders and territorial sea and air, to the break of nuclear monopoly, and to world peace. At the same time, these achievements have also carried forward China's S&T development, economic construction, and improved China's international stature and reputation.

The Chinese defense industry was able to accomplish these major achievements because there was the correct policy and leadership of the Party Central Committee, the State Council and the Central Military Commission, the vision and planning of the senior revolutionaries, the cooperation of everyone involved, and the devotion and hard work of the vast number of workers in the defense S&T branches. Based on a decision by the Chinese Communist Party Central Committee and the Central Military Commission, the National Defense Science, Technology and Industry Commission organized the writing of the book "Contemporary Chinese Defense Science and Technology". The book was written to praise the numerous unsung heroes who had worked hard on defense S&T, to encourage the generation upon generation of defense workers, and to commemorate the thousands of people who were interested in the cause and had supported it. The great pioneer of China's defense S&T enterprise, Generalissimo Nie Rongzhen wrote a preface for the book. The 800,000-word volume contained a rich history of China's defense S&T development and major achievements in strategic nuclear weapons, aerospace technology and conventional weapons equipment. It described the correct policy decision to initiate and develop China's defense S&T made by the old generation of proletarian revolutionaries such as Mao Zedong, Zhou Enlai, and Nie Rongzhen. It described the major accomplishments and breakthroughs of 61 famous scientists and experts. It also told of the hard work and selfless devotion of 973 S&T technical workers, leadership cadres, laborers, and commanders of the PLA.

I. A Struggle To Initiate China's Own Effort of Defense S&T Development

In 1949 the People's Republic of China established itself and ended the repression of the Chinese people by the imperialists, feudalism, and the bureaucratic capitalists. However, it still faced the economic blockade, military encirclement and the threat of war. In order to protect the victory obtained with the bloc of millions of people, to support Korea in its war against the United States, to enhance defense construction, to change the chaotic and backward state of the weapons used by the PLA, and to establish a modern army as soon as possible, the Party Central Committee, the Central People's Government (which later became the State Council after 1954), and the Central Military Commission made defense industry a priority economic construction task in the first 5-year plan. Efforts were devoted to core industries such as weapons, space, electronics, and ship building. In the meantime, a Central Military Engineering Commission (headed by Zhou Enlai), a space Industry Management Commission (headed by Nie Rongzhen), and a Defense Industry Commission (headed by He Long) were formed to improve the unified leadership of the defense industry and military production. With the hard work of the vast number of defense workers, more than 100 large and medium-scale key industries were formed by 1959 in Shenyang, Beijing, Taiyuan, Xian, Chengdu, Chongqing, and Lanzhou. On the 10th anniversary of the People's Republic, domestically produced weapons were paraded in front of Tiananmen Square, including supersonic fighter planes, medium size tanks, 100 mm anti-aircraft artillery guns, and 122 mm howitzers. These achievements marked the great improvement of weapons used by the PLA and laid the foundation for China's defense S&T development.

In the 1950's, several developed nations in the world had atomic bombs and guided missiles. These countries constantly blackmailed and threatened the world with the nuclear weapons in their hands. The Chinese people, who had suffered through too many wars, desperately needed peace to revive and develop their backward economy. However, peace must be protected with weapons; we not only needed advanced conventional weapons but also our own strategic cutting-edge weapons. For this reason, Chairman Mao Zedong made the decision at the January 1955 central secretariat meeting to develop atomic energy and atomic bombs. In May 1958, the Central Military Commission, attended by Zhou Enlai also decided to develop guided missiles.

To carry out these major decisions, the party and the state issued the "Outline of the 1956-1967 science and technology development plan," in which atomic energy technology, propulsion technology, and electronics were given priority. The Defense Science and Technology Commission, headed by Nie Rongzhen, was established to provide centralized and unified leadership for the development of cutting-edge technology for national defense and conventional weapons. Research institutes for guided missiles, nuclear weapons, space, ship

building, and radio electronics were established to develop technology and to copy others. A number of defense S&T and Industry colleges were newly established to accelerate the training of technical personnel. Weapons testing bases were built for research, testing, and prototyping nuclear weapons, guided missiles, and weapons of the army, navy and air force. In addition, technical cooperation agreements were made with the Soviet Union.

After a period of hard work and breakthroughs, China was able to copy conventional weapons and, on that basis, ventured into independent design and exploration of the secrets of atomic bombs and guided missiles. Through practice, China gradually established its own approach to defense S&T development and laid a foundation for further advances.

II. Self-Reliance and Gaining Technology for Atomic Bombs and Guided Missiles

While China was moving forward smoothly in developing its defense technology, the Soviet Union Communist Party Central Committee, using various excuses, unilaterally scrapped the technical agreements between the two countries by notifying the Chinese Communist Party Central Committee in June, 1959. In August 1960, the Soviet Union withdrew all their experts, took away many important design charts and data, and stopped providing equipment, key components, and crucial materials needed in the development of defense technology. This brought major defense projects to a halt and caused grave difficulties for the fledgling technology development.

The breaching of the contract and withdrawal of aid by the Soviets did not shake China's determination to acquire the frontier technology and to establish self-defense strategic nuclear forces. Chairman Mao called for people to devote efforts to frontier technology with determination. In the meantime, in a meeting hosted by the Defense Industry Commission, He Long called for people to endure hardship, get rid of any thought of depending on others and achieve breakthroughs with our own forces. After careful study by Nie Rongzhen and responsible leaders in the Defense S&T Commission, Fifth Institute and the Second Ministry for Machine Building, it was concluded that it was entirely possible to gain the technology for the atomic bomb and guided missile in 3 or more years; this was reported to the Party Central Commission.

To achieve a breakthrough in the atomic bomb and guided missile technology, the Party Central Committee, the State Council, and the Central Military Commission formed a State Defense Industry Office, led by Luo Ruiqing, to manage the first-line work of the Second and Third Ministries of Machine-Building and the Defense Science Commission. Also formed was a Party Central 15-member Special Commission (later known as the Central Special Commission), led by Zhou Enlai, in charge of centralized leadership in the research, testing

and development of nuclear weapons and guided missiles and the organization, coordination and inspection of the results. Famous experts, professors and talented technical personnel were organized to conduct research and testing of atomic bombs and missiles. To carry out Chairman Mao's instruction of "big cooperation", a national effort was organized. A document entitled "Fourteen Recommendations for Natural Science Research Organizations (draft)" was issued to mobilize the initiative of the vast number of S&T workers. Based on the three-step concept of Nie Rongzhen, namely, test manufacture, design, and preliminary research, the work was organized in a systematic fashion.

Under the encouragement to develop the "two bombs" (atomic bomb and guided missile), the vast number of science and technology workers quickly made the breakthrough in technology. Short-range guided missile flight test and the first nuclear test were successfully conducted in June and October of 1964. In October 1969, a ground-to-ground strategic guided missile armed with real nuclear warheads was successfully tested. This showed that China passed the stage of plane-carried nuclear weapons and was in possession of guided missile nuclear weapons that can be used in an actual war. There has also been great progress in the development of conventional weapons; the variety and performance have both improved. By 1965, 50 percent of the more than 500 standard conventional weapons were designed by the Chinese. The Chinese people have the will and ability to master cutting-edge defense technology and achieve modernization of weapons and equipment with their own intelligence and skill.

III. Eliminate Interference and Step Onto a New Level of Defense Technology Development

In May 1966, China began its "Great Cultural Revolution"; the defense S&T system was not immune to the big disaster. A number of industrial and research departments were paralyzed, many leadership cadres and famous scientists were persecuted. Some tried and true S&T management systems were abandoned, research was delayed, military product quality dropped, and projects could not be completed on schedule. At this time, superpowers engaged in a heated arms race, continued to pursue a nuclear threat policy and China's borders and airspace were often invaded.

Faced with such a dangerous situation, the Party Central Committee and the Central Military Commission asked for a higher readiness and defense modernization in order to ensure national security. The older generation of proletarian revolutionaries took various actions to correct the chaotic defense industrial system and to minimize the interference and disruption of the "Great Cultural Revolution". More plans were made for nuclear weapons, guided missiles, carrier rockets, nuclear submarines, and artificial satellites and efforts were devoted to the development of major defense frontier projects. Based on the policy of defense against tanks, aircraft, and ships, the development plan for conventional

weapons was properly made. Telegrams and notifications were issued in the name of the State Council and the Central Military Commission in which the defense research and production units were forbidden to engage in circulation and production stoppage. Experimental bases under the jurisdiction of the defense science committee were directed to conduct, only positive education. To ensure normal progress of R & D regarding the hydrogen bomb and nuclear submarine, special orders were signed by the Chinese Communist Party Central Committee and the Central Military Commission. A name list was made for well known senior experts and key technical staff so that they were given high priority in protection and could proceed with their work normally. A central special commission meeting was called to solve the development and test problems of strategic nuclear weapons. The defense industry system was consolidated by eliminating the leadership group and restoring the normal leadership of the State Council Military Industry Office.

Under the adverse environment of the Cultural Revolution, the science and technical personnel, laborers, and PLA commanders adhered to the implementation of the defense S&T development plan issued by the Party Central Committee. Their hard work and selfless devotion elevated China's defense technology onto a higher level. In June 1976, China had a successful atmospheric test of the full-equivalent hydrogen bomb, which marked another jump in China's nuclear weapon development. In April 1970, China's satellite "Dongfanghong-1 broadcast the song "The East Is Red" loud and clear to the world and made a good beginning to China's aerospace technology. In April 1974, a torpedo-equipped nuclear submarine designed and built by the Chinese was delivered to the Chinese navy for service. From 1971 to the end of 1976, China launched one scientific research satellite, two return-type remote sensing satellites, three technical test satellites, and successfully recovered the return-type satellite. In addition, China also developed anti-aircraft and anti-tank weapons, developed the Jian-8 high altitude, high-speed fighter plane, warships including mid-size guided missile destroyer, and military electronic equipment built specifically for defense leading-edge technology and for conventional weapons.

IV. Readjustment, Rectification and Aspiration for Defense Leading-Edge Technology Development Target

After the Jiang Qing counter-revolutionary clique was destroyed in 1976, the Party Central Committee, the State Council, and the Central Military Commission made timely readjustment and rectification of the leadership organization and various leadership groups in the defense S&T industry; the management of S&T was strengthened, Defense S&T and industry colleges were organized and reinstated to speed up the training of defense S&T personnel. A decision was made to "accelerate the modernization of weapons of the PLA" and a comprehensive plan was made to coordinate the R & D of conventional and strategic nuclear weapons. National resources were mobilized to complete national priority

research and test projects. The leadership system for the defense science and technology industry was reorganized and a Defense Technology Industry Commission was formed to supervise activities in defense industry under the guidance of the State Council and the Central Military Commission.

Under the guidance of the policies determined in the Third Plenum of the 11th Party Central Committee, things began to look up in the defense industry, followed by several world renowned achievements. At the end of 1979, a fleet of tracking ships including the Wangyuan were built for monitoring and communication tasks in the launching tests of intercontinental guided missiles, submarine-to-land guided missiles, and communication satellites. In May 1985 China successfully conducted its full flight ICBM test and completed the entire serialization process of surface-to-surface guided missile R & D and testing; this gave China the ability to defend itself using strategic nuclear weapons. In October 1982, a submarine-to-surface guided missile was successfully launched from a submarine. This marked that China's strategic nuclear weapons had advanced from liquid to solid, from land to sea, and from fixed base to under-cover mobile base. In 1983 a nuclear submarine was developed and put into service. In April 1984 China launched a test communication satellite and succeeded in point fixing, which marked a breakthrough in China's aerospace technology. In the area of nuclear weapons, nuclear warheads were developed for the strategic guided missiles and nuclear tests have been moved from the atmosphere to underground.

In the same period, conventional weapons also enjoyed major breakthroughs. The army developed anti-tank and field anti-aircraft weapons and improved the power and mobility of weapons. Also improved was the ability of tanks to launch a surprise attack. The air force developed medium and high-altitude fighter planes and medium and short range bombers. The navy developed submarines, guided missile ships, anti-ship guided missiles, and anti-submarine torpedoes. The priority in military electronics was in the matching with strategic nuclear weapons, communication satellites, and conventional weapons. The development of the Yinhe [Galaxy] 100 million-instructions-per second (100 MIPS) computer showed that China has the ability to produce large computers. The accomplishment of the above defense S&T development targets has further reduced the gap of military technology with advanced countries and elevated China's stature as a country and as a military force.

V. Change of Strategy and Efforts To Develop New Weapons and High Technology

In the mid 1980s, the international climate continued to ease. Under the guidance of the Chinese communist party line, China concentrated its efforts in economic development. The guiding thought in defense construction also changed from a readiness for war to peace time

construction. However, the world is not safe and competition in the military arena is still fierce. Faced with the ever changing revolutions in new technology, China's defense S&T industry adhered to a policy of reform, openness and military-civilian cooperation and changed its strategy. While serving the national economic development, the defense industry has followed Deng Xiaoping's conclusion that "Technology is the primary productivity" and gave top priority to the development of defense technology in the build-up of military equipment. China re-adjusted defense research and productivity and improved the level of research and test facilities. A research and strategy report entitled "China's Defense Science and Technology for the Year 2000" was organized and completed. This report served as the basis for making plans and for developing new technologies and weapon systems. A defense S&T "Seventh 5-Year Plan" was formulated and the development of conventional weapons, strategic weapons, and space technology was planned in a unified manner. The defense industry participated in the national high-tech development project (known as the 863 program) and strived to reach world standards in biology, aerospace, communication, automation, lasers, energy and new materials. To strengthen preliminary research, a plan called "Defense S&T Application and Basic Research Provisional Management Plan" was formulated. A law entitled "Military Product Quality Management Act" was issued to conduct quality control and monitoring of the entire development process of new weapons and equipment. A special committee under the State Council and Central Military Commission was formed and directed by Premier Li Peng for unified central leadership of major issues in defense S&T and military-civilian cooperation.

These major actions further elevated the management standard for developing new weapons and equipment. By 1989 conventional weapons enjoyed good progress and some of the items reached international standard and were awarded first prize or special awards for national S&T advances. Examples are the Hongqi-7 surface-to-air missile with low altitude and super-low altitude performance, the accurate Hongjian-8 anti-tank missile, and the Yingji-8 anti-ship missile that features high accuracy, super-low altitude, ocean-hugging flight, high power and multiple function.

In this period, China also launched ground-to-ground solid guided missiles from mobile launchers. Submarine-to-ground missiles were designed and sea-tested in September 1988. Nuclear tests were also made to verify new design principles for nuclear weapons. From 1984 to 1989, China launched nine more satellites and formed three large satellite systems: near earth orbit return-type remote sensing satellite system, earth synchronous orbit communication satellite system, and solar synchronous meteorological satellite system. Ground-to-sea guided missiles were built. China's satellite monitor and communication network technology approached that of the world and gained the ability to launch and monitor satellites for foreign countries. In addition, there were also new breakthroughs in high technology.

Over the last 40 years China has established its own defense S&T industry and attracted world attention in its achievements. It was a bright chapter in China's S&T development history. Looking back makes us very proud and looking forward makes us realize the heavy responsibility. China's defense S&T establishment will follow the guidance of the basic party line, adhere to reform and openness, conduct military-civilian cooperation, strengthen centralized leadership, unify the will and action in the continued struggle for more impressive achievements.

Sustained Development in Basic Research

92FE0757B Beijing RENMIN RIBAO in Chinese
11 Jul 92 p 1

[Text] China's basic research is entering a new stage of sustained stable development. Up to now the Chinese Academy of Sciences has 32 research institutes that engage mainly in basic research. There are close to 100 sizable research organizations in colleges and universities, most of them conduct mainly basic research. China has built 77 national key laboratories with standards above the medium international level. The ministries of industry, agriculture and health have also expanded existing or built new basic research organizations. The environment of basic research in China has enjoyed considerable improvement.

More than 10 years ago, China built a dozen major facilities including the Beijing electron-positron collider, the Lanzhou heavy-ion accelerator, the Hefei synchronous radiation accelerator, the high power laser facility, the controlled thermonuclear reactor HT-6H facility, the solar magnetic field telescope, the HL-1 device, the low-temperature nuclear heating reactor, and the tandem electrostatic accelerator. In 1988 the state provided operating funds and these large facilities began to play their role.

In order to further improve basic research, the State Council decided in 1986 to establish the state natural science foundation committee. In the ensuing 7 years the state allocation to the natural science foundation increased from the initial 80 million yuan to the present 220 million yuan. Various departments, provinces, and municipalities have also established special discipline science foundations, local science foundations, and youth science foundations to aid the national effort in basic research. In addition, beginning last year, major basic research projects with an impact on the national economic development and technology advancement were selected by the state and organized under state mandate. The plan is to organize 30 of these projects during the "Eighth 5-Year Plan". The emergence of these major projects will help to attract academic leaders, to form high standard research teams, and to achieve breakthroughs in certain advantageous areas.

Under the reform and openness situation, Chinese scientists are working at the forefront of basic scientific research. The academic standard is rising and the

national stature is also improving. China is among the first in the world in a number of research areas including the high critical temperature superconductivity, machine proof of mathematical theorems, the discovery of a number of functional crystals such as barium borate, five-fold symmetry and the discovery of titanium-nickel quasi-crystalline phase, the stability of differential dynamic systems, the research on non-intersecting Steiner ternary set, graphical theory of molecular orbits, synthesis of yeast alanine-transformation DNA, the modification of protein functional genes and the quantitative relationship to their biological activity. In the "Seventh 5-Year Plan" period there were 238 research results receiving the state natural science award; some of them also received high level international awards such as the Einstein award. The number of papers published by Chinese scientists in international journals has increased greatly year by year. At the same time, the rate of application of basic research results in production and in the society has also accelerated.

China has formed a high standard research team. Because of their outstanding achievements, scientists have received awards from international scientific organizations and academic groups. There are 364 Chinese scientists serving in international academic organizations and a number of outstanding scientists were bestowed fellow status in international research institutes. Data showed that there are about 100,000 people engaged in fundamental type of research and 30,000 of them are doing basic research. With the establishment of the doctoral graduate student system and the test of postdoctoral research system, a new flexible, democratic environment conducive to the emergence of new ideas and talents is being perfected. As basic research enjoyed sustained development, a strong research team led by middle-aged and young academic leaders is growing.

Industry-Academy Joint Development Program Launched

92P60430C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 11 Aug 92 p 1

[Article by Yang Lianghua [2799 5328 0553]]

[Summary] In an unprecedented strategic measure, the Industry-Academy Joint Development Program was recently launched in Beijing. The aim of the program,

which was jointly organized by the State Council Economic and Trade Office, the State Education Commission, and the Chinese Academy of Sciences, is to establish a closer and steadier exchange-cooperation system among large and medium-scale enterprises, higher learning organizations and S&T research institutes in order to speed up conversion of S&T results, strengthen market competition ability of large and medium-scale enterprises, promote S&T development and revitalize China's economy. According to the report, during the Eighth 5-Year Plan, 50,000 items of new technology and new products will be jointly developed and converted in the first stage of this program, and a group of experimental high-tech industries that are projected to produce more than one billion yuan sales annually will be established before 1995. The program will be carried out at both central and local levels, and two aspects, "item selection" and "profit-oriented operation" will be implemented.

Rice Genome Mapping Program

92P60430B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 22 Aug 92 p 3

[Article by Kong Xiaoning [1313 2556 1337]]

[Summary] The State Science and Technology Commission has launched an ambitious project called the Rice Genome Mapping Program, another major project following the "Climbing Program," designed to enhance China's basic research. According to Hong Guofan, a biology professor at the Shanghai Biochemistry Institute, the program aims at identifying all tens of thousands of genes on rice chromosome and mapping out the whole rice DNA sequence in the next 15 years, and finally studying the rice genetics in helping scientists to modify rice genes for producing more nutritious, high-yield, and disease-resistant strains. With an initial investment of 23 million yuan (\$4.26 million) from the State, eight top scientists including Chen Zhangliang, who won the Javed Husain Prize for Young Scientists last year from the United Nations Education, Science and Cultural Organization, have been appointed by the State Science and Technology Commission to lead the project. The research will be carried out in one central laboratory based in Shanghai, and several satellite laboratories located in Shanghai (Fudan University), Beijing (Beijing University and CAS Institute of Genetics), Wuhan (Huazhong Agricultural University), and Hangzhou (China Rice Research Institute).

Further Reports on Nanotechnologies

CAS Institute of Solid State Physics

92P60435A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 21 Aug 92 p 1

[Article by Huang Yong [7806 0516]: "Nanometer Materials Research Is World Class"; cf. JPRS-CST-92-013, 29 Jun 92 pp 46-47]

[Summary] Researchers at the CAS Hefei Institute of Solid State Physics have recently obtained a number of high-level results in the study of nanomaterials—achievements which have propelled the nation into a leading position worldwide in this field. In the past, these researchers have developed the nation's first inert gas evaporation apparatus for fabrication of nanoparticles and have fabricated bulk test samples of nanostructures via vacuum collection and vacuum pressurization. Recently, these CAS scientists have developed three new apparatuses for fabricating nanostructure bulk samples. Of these apparatuses, the laser-induced chemical vapor deposition (CVD) equipment has been used to fabricate nanostructural silicon nitride bulk materials with clean interfaces. In collaboration with colleagues at the China University of Science & Technology's Materials Department, the CAS researchers have employed chemical techniques to fabricate Al_2O_3 nanoparticles and bulk structures in the 8-10-nm range, with controllable variability of nanoparticle size.

CAS Beijing Vacuum Physics Laboratory

92P60435B Shanghai JIEFANG RIBAO in Chinese 17 Aug 92 p 3

[Article by Jiang Zaizhong [1203 0961 1813]: "China Develops an All-New Optoelectronic Conversion Thin Film, Arousing Enormous Interest Worldwide"]

[Summary] Beijing, 16 Aug (XINHUA)—A CAS Beijing Vacuum Physics Laboratory research group led by Prof. Wu Quande [0702 0356 1795] recently developed a totally new optoelectronic conversion thin film consisting of metallic silver ultrafine particles buried within a barium oxide semiconductor layer. Experts have agreed that this new breakthrough achievement in optoelectronic materials research takes a leading position worldwide. The new film can be left in the atmosphere, and when incorporated into vacuum instruments it will recover its optoelectronic emission; also, it can operate in high-temperature environments, with relatively high sensitivity. French scholar Dr. (Mei-ai) has called the new film a novel material with amazing characteristics, while U.S. electron accelerator and free electron laser experts have expressed hopes that this brand new material can be used in high-brightness electron beam injectors.

CAS Shanghai Institute of Nuclear Research

92P60435C Beijing RENMIN RIBAO [PEOPLE'S DAILY OVERSEAS EDITION] in Chinese 14 Sep 92 p 3

[Article by Zhang Xuequan [1728 1331 0536]: "Nation Pioneers New Technologies for Fabricating Nanomaterials"]

[Summary] Shanghai, 12 Sep (XINHUA)—A new nanomaterials-fabrication technology, the first of its kind worldwide, was recently unveiled by scientists at the CAS Shanghai Institute of Nuclear Research. On top of the four existing worldwide techniques—vapor deposition synthesis, wet chemical ultrafine-particle synthesis, amorphous crystallization, and laser heating—the Shanghai scientists have added a new technique, ion implantation and heating annealing, which can be used to fabricate nanometer-scale microcrystals on different substrates. The new technique permits control of nanoparticle size and 3D distribution in the substrate. Two examples of applications are the implanting of magnetic atoms into a substrate for manufacturing abrasion-resistant magnetic recording materials and the implanting of atoms sensitive to certain critical wavelengths for fabricating optically absorbent and optically reflective materials.

More on Beijing Vacuum Physics Laboratory

92P60440A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 18 Aug 92 p 1

[Article by Jiang Zaizhong [1203 0961 1813]: "Chinese Experts Pioneer New Technique for Vapor-Phase Synthesis of Diamond Microcrystals"]

[Summary] Beijing, 17 Aug (XINHUA)—A CAS Beijing Vacuum Physics Open Research Laboratory (BVPL) project entitled "Study of Vacuum Vapor-Phase Synthesis of Diamond Microcrystals" passed CAS-level appraisal today, as the appraisal experts successfully repeated on-site the achievements of the BVPL scientists. Heretofore, beginning in 1989, only the United States and Russia have reported the use of the vapor-phase technique to synthesize diamond microcrystals. The BVPL scientists specifically used a dc arc discharge plasma jet method to fabricate [50-100-nm-diameter] diamond microcrystals—a new technique judged to be at the worldwide state-of-the-art.

More on Institute of Solid State Physics

93P60003a Beijing ZHONGGUO KEXUE, Series A, in Chinese No 6, Jun 92 pp 653-657

[Article by Xie Cunyi [6200 1317 3015], Zhang Lide [1728 4539 1795], and Zhu Zhengang [2612 7201 0474] of the CAS Institute of Solid State Physics (ISSP), Hefei 230031 and Chen Zuyao [7115 4371 5069] and Li Yan [2621 3601] of the Department of Applied Chemistry, China University of Science & Technology, Hefei 230026: "Research on Low-Temperature Internal Loss Spectra in Nanometer ZrO_2 Solids"; MS received 5 Feb 91, revised 18 Jun 91]

[Abstract] The internal [energy] losses and moduli of nanometer-scale ZrO_2 bulk solids of various particle sizes are systematically studied from room temperature down to $-200^\circ C$. Three internal loss peaks have been found corresponding to various warming (or cooling) increments. The grain boundaries of the particles have also been studied. Sample preparation began with a mixture of 0.25 mol/L solution of $Zr(NO_3)_4$ and concentrated nitric acid, inserted into a polytetrafluorethylene high-pressure vessel, heated for 12 h at $150^\circ C$ and then cooled to room temperature, creating the white ZrO_2 nanoparticles. After cleaning with water and acetone and drying, the material was reinserted into the 0.2 GPa pressure vessel to form the $80 \times 4.5 \times 3$ mm samples. Particle size was measured with an H-800 TEM and X-ray diffractometer, which indicated that mean particle diameter was 5 nm. Four figures show various loss spectra and moduli for different temperatures.

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World-Class Polyolefin Engineering Plastics Developed

92P60409A Beijing ZHONGGUO KEXUE BAO
[CHINESE SCIENCE NEWS] in Chinese 17 Jul 92 p 1

[Article by Ke Xinwen] [2688 6580 2429]: "New Advances in Research on Polyolefin Engineering Plastics"

[Summary] A 4-year major NSFC-funded project entitled "Basic Research on Polymer Structural Materials Forming and Fracture" led by CAS Academic Committee member and Chengdu University of Science & Technology professor Xu Xi [1776 0296] and by CAS Institute of Chemistry research fellow Qi Zongneng [3344 1350 5174] has resulted in the development of a series of low-cost, high-performance polyolefin (polyvinyl and polyacrylic) engineering plastics. Developed in cooperation with researchers at other institutions—including Qinghua University, Beijing Institute of Chemical Engineering, the CAS Institute of Mechanics, and the Changchun Institute of Applied Chemistry—these new polyolefin plastics have been certified by Italian (Fiat) and German (Volkswagen Co.) engineers and by Japanese scholars as having a performance that meets or exceeds that of the comparable foreign-made products. Applications in the automotive industry include fuel and oil lines, safety caps, and fans—all requiring highly flexible, high-strength materials.

Detection of Viral Antigen in the Marrow Cells of Epidemic Hemorrhagic Fever Patients by Protein A-Gold Technique

40091021T Shanghai ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 10 No 2, May 92 pp 93-95

[English abstract of article by Cao Tinghua [2580 1694 5478], Wu Zhenou [1566 2182 2962], et al. of the First Affiliated Hospital of Hubei Medical College, Hubei]

[Text] Detection of viral antigen in the marrow cells of epidemic hemorrhagic fever (EHF) patients was performed by protein A-gold technique using electron microscope. Clear specific gold particles were observed. All marrow cells showed some degree of ultrastructure abnormalities such as degeneration and vacuolization. The above results suggested that the marrow cells served as a site of viral replication and accumulation, and thus resulted in deficiency of immune function in EHF patients.

Key words: Epidemic hemorrhagic fever; Marrow cell; Protein A-gold technique

Clinical and Bacteriological Aspects Associated With Chloramphenicol-Resistant Salmonella Typhi

40091021S Shanghai ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 10 No 2, May 92 pp 80-83

[English abstract of article by Tian Wei-quan [3944 4850 6898], Wu Yixian [6762 0076 6343], et al. of the Department of Infectious Disease, Affiliated Hospital of Bangbu Medical College, Anhui]

[Text] Forty-six patients with chloramphenicol-resistant salmonella typhi (CRST) were studied on clinical and bacteriological bases. The principal findings were as follows: 1) Onset of the attack was mostly sudden with chill or rigor. 2) Severe toxemia developed as the disease progressed. 3) Rose spots were more common. 4) Blood eosinophil would disappear in most of the patients. 5) Relapse and recrudescence were common. 6) Complications were often present and severe. 7) The mean period of defervescence was longer after treatment. 8) The bacteriophage of CRST was of M₁ type, in more than 90 percent, of the bacteriophage carried, carrying a transmissible R plasmid. 9) Norfloxacin or ofloxacin was the drug of choice in the treatment of CRST.

Key words: Typhoid fever, Chloramphenicol-resistant salmonella typhi (CRST); Aptimicrobial susceptibility test, Bacteriophage; R plasmid

Changes and Clinical Significance of Plasma β -Endorphin in Patients With Epidemic Hemorrhagic Fever

40091021R Shanghai ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 10 No 2, May 92 pp 76-79

[English abstract of article by Chen Qisheng [7115 0796 4141], Sun Zhijian [1327 1807 1017], et al. of the Department of Infectious Diseases, Nanjing Medical College]

[Text] Plasma β -endorphin-like immunoreactive substance (ir- β -EP) was dynamically studied in 28 patients with epidemic hemorrhagic fever (EHF). It was found that the concentrations of plasma ir- β -EP during hypotensive stage (133.33 \pm 57.74 ng/L in moderate patients, and 130.58 \pm 48.58 ng/L in severe patients) were significantly higher than those of normal subjects (33.78 \pm 20.62 ng/L, n = 14). Low dose of dexamethasone brought about marked decrease of plasma ir- β -EP (from 104 \pm 45.96 ng/L to 58 \pm 24.88 ng/L, P < 0.01). After intravenous administration of thyrotropin releasing hormone (TRH) (300 μ g), mean arterial pressure increased by 1.66 \pm 0.76 kPa although plasma ir- β -EP slightly elevated. These results show that there is relationship between circulatory collapse and elevated plasma ir- β -EP in EHF, and low doses of dexamethasone and TRH are helpful to improve circulation.

Key words: Epidemic hemorrhagic fever; β -endorphin; Cortisol; Cardionatin; Thyrotropin releasing hormone

A Study on the Interference Between Smooth and Rough Species of Brucella in Mice

40091021Q Beijing ZHONGHUA LIUXINGBINGXUE ZAZHI [CHINESE JOURNAL OF EPIDEMIOLOGY] in Chinese Vol 13 No 3, Jun 92 pp 143-146

[English abstract of article by Li Lanyu [2621 5695 3768], Shang Duqiu [1424 1795 4428], et al. of the Institute of Epidemiology and Microbiology, Chinese Academy of Preventive Medicine, Beijing]

[Text] Smooth-B. abortus 104M, B. melitensis Rev-1 and B. suis S₂ mixed with rough-B. canis RM6/66 respectively were injected into mice. The results demonstrated that s-species of Brucella suppressed R-species of B. canis RM6/66 in mice. The epidemiological phenomenon that R-species of Brucella were difficultly isolated in focus of s-species should be explained on the bases of the study.

Key words: Brucellosis, Brucella, Interference of antigens

Multilocus Enzyme Electrophoretic Types of *Neisseria meningitidis* Serogroup B and Their Epidemiologic Significances

40091021P Beijing ZHONGHUA LIUXINGBINGXUE ZAZHI [CHINESE JOURNAL OF EPIDEMIOLOGY] in Chinese Vol 13 No 3, Jun 92 pp 129-133

[English abstract of article by Li Xinwu [2621 2450 2976], Hu Xujing [5170 4872 2417], et al. of the Institute of Epidemiology and Microbiology, Chinese Academy of Preventive Medicine, Beijing]

[Text] In order to expound the epidemiologic relationship between the strains of *Neisseria meningitidis* serogroup B isolated from patients and carriers, 57 case and 45 carrier isolates were collected in 11 provinces and 2 municipalities of China since the 1970s and their multilocus enzyme electrophoretic types and clonal population structures were studied by multilocus enzyme electrophoresis. It was primarily found that the above strains could be divided into 69 electrophoretic types (ET) and 13 clones. Among others, the clone I was the most important one, because the clone I represented 63.7 percent of all strains tested and 77.2 percent of the case isolates and its district distributions were quite wide since the 1970s. In addition, it was an obvious tendency that more and more of the case isolates gathered up the clone I since 1984 and the predominant ETs also occurred in the complex ET 1 and ET 24 of the clone I. As compared with the case isolates, the above carrier isolates displayed more heterogenetic types. Only 40 percent of all carrier isolates belonged to the above clone I and predominant ETs.

Key words: *Neisseria meningitidis* serogroup B, Multilocus enzyme electrophoretic types, Clonal population structure

Preparation of Liposomes Entrapping Plasmid DNA and Linear DNA

40091021O Beijing ZHONGGUO YIXUE KEXUEYUAN XUEBAO [ACTA ACADEMIAE MEDICINAE SINICAE] in Chinese Vol 14 No 3, Jun 92 pp 220-224

[English abstract of article by Liu Qiguang [0491 0796 0342], Wu Min [0702 2549], et al. of the Institute of Oncology, Beijing]

[Text] Liposomes entrapping plasmids pSV2-neo DNA, pUC18-ras DNA, pSV2-neo-ras DNA and linear DNA were prepared. The liposomes were composed of DOPC/Chol/OA (4:4:3) and pH-sensitive DOPE/Chol/OA (4:4:3), respectively. The efficiency of DNA entrapment was about 50 percent. Gel electrophoresis analysis showed: Liposome-entrapped DNA was not digested by DNase; the entrapped DNA molecules were intact and stable for at least 5-6 months at 4°C. During preparation of pH-sensitive liposome, the pH must be kept at 8.0.

Specific Killing of Human Leukemic T-Cells by a Monoclonal Antibody Coupled to the Cytotoxin From Chinese Cobra

40091021N Beijing ZHONGGUO YIXUE KEXUEYUAN XUEBAO [ACTA ACADEMIAE MEDICINAE SINICAE] in Chinese Vol 14 No 3, Jun 92 pp 179-184

[English abstract of article by Chu Jiayou [5969 0857 0147], Zhang Hejun [1728 0735 0689], et al. of the Institute of Medical Biology, Kunming]

[Text] The immunotoxin (IT) was prepared by conjugating cytotoxin from Chinese Cobra (*Naja naja* Atra) venom with monoclonal antibody (McAb) Wu71 directed to human T-cells. First, calcium ions were used to suppress the cytolytic reaction while cell antigen was allowed to react with McAb. Then magnesium ions and the chelating agent EGTA were used to abolish the calcium inhibition. With this treatment, the IT showed high cytotoxicity for the leukemic cell line CEM, which was antigen positive (82.4 percent of the cells were killed at a concentration of 0.5×10^{-6} mol/L of IT), but very little cytotoxicity for the antigen negative cell line Raji (23.3 percent cells were killed at the same concentration). Under scanning electron microscopy, it could be seen that the cell membranes of CEM were broken by IT, and the cells had died. The results suggest that the McAb Wu71 plus cytotoxin IT has potential application in leukemia therapy.

Synthesis and Cloning of the Whole Human Erythropoietin (EPO) Gene

40091021M Beijing ZHONGGUO YIXUE KEXUEYUAN XUEBAO [ACTA ACADEMIAE MEDICINAE SINICAE] in Chinese Vol 14 No 3, Jun 92 pp 173-178

[English abstract of article by Cai Yinglin [5591 5391 2651], Chen Haiming [7115 3189 2494], et al. of the Institute of Haematology, Tianjin]

[Text] A 600 bp synthetic erythropoietin (EPO) gene encoding all 166 amino acids of the EPO protein and 27 amino acids of the signal peptide has been constructed. The whole gene was divided into three large fragments consisting of a total of 32 oligonucleotides. These oligonucleotides were synthesized by the solid-phase phosphoramidite method and ligated into three large fragments. These latter three were separately cloned into vector M13mp19 and then transformed into *E. coli* JM 103. Positive clones were screened with ^{32}P -labeled probes. The sequences of the fragments were confirmed by DNA sequencing, and the sequence of the whole synthetic EPO gene was confirmed by enzymatic digestion and sequencing. The results indicated that the nucleotide sequence of the synthetic EPO gene is identical to that of the original.

Amplification of cDNA Encoding Human Monocyte-Derived Interleukin-8 by PCR and Its Overexpression in *E. coli*

40091021L Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 12 No 3, Jun 92 pp 174-177

[English abstract of article by Zhou Baohong [0719 1405 1347], Ma Dalong [7456 1129 7893], et al. of the Department of Immunology, Beijing Medical University]

[Text] We have amplified the cDNA of human monocyte-derived interleukin-8 (MDhIL-8) with polymerase chain reaction (PCR) technique, and constructed a new plasmid vector pKPL-3a by which unfused cytokines could be expressed in *E. coli*. After insertion of the MDhIL-8 cDNA into the vector pKPL-3a, about 9 kD unfused MDhIL-8 was expressed with high efficiency in *E. coli*. The expressed MDhIL-8 represented more than 40 percent of total bacterial proteins. Experiments in vitro showed that the expressed MDhIL-8 had a full chemotactic activity for mouse peripheral blood mononuclear cells. In addition, a polyclonal antibody against hIL-8 could block the bioactivities of MDhIL-8.

Application of PCR in Gene Analysis of JEV

40091021K Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 12 No 3, Jun 92 pp 162-165

[English abstract of article by Rao Chunming [7437 2504 2494], Li Zuogang [2621 0146 0474], et al. of the National Institute for the Control of Pharmaceutical and Biological Products, Beijing]

[Text] It is essential to construct full-length infectious cDNA clone of Japanese Encephalitis Virus (JEV) in gene analysis of the virus (JEV). But it is difficult to obtain cDNA clone of JEV which contains the genome region close to the 5'-terminus. This paper reports the process of insertion of synthetic 5'-terminus DNA fragment of JEV into JEV cDNA clone AH28 which lacks 5'-terminus 14 bases of JEV by using Polymerase Chain Reaction (PCR) and molecular cloning technique. The application of PCR in gene analysis of JEV has been discussed.

Efficient Expression of Recombinant Plasmids for Colonization Factor Antigen 1 (CFA/1) in *Escherichia coli*

40091021J Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 12 No 3, Jun 92 pp 157-161

[English abstract of article by Zhang Zhaoshan [1728 0340 1472], Li Shuqin [2621 3219 3830], et al. of the Institute of Biotechnology, Academy of Military Medical Sciences, Beijing]

[Text] Two plasmids pZLH42 and pZLH88 which contain the structural and regulatory genes for colonization factor antigen 1 (CFA/1) have been constructed. pZLH42 and pZLH88 have the same size but the inserting direction of the structural gene is just opposite. The expressing level of CFA/1 measured by ELISA was of much difference in different *E. coli* K12 strains harbouring plasmid pZLH42 or pZLH88. The expression of CFA/1 in *E. coli* RR1 or C600 was 2-3 times higher than *E. coli* H10407. The expression levels of *E. coli* HB101 and *E. coli* H10407 were similar.

The CFA/1 recombinant plasmids in *E. coli* C600 and HB101 were very stable when cultured in antibiotic-free medium. The plasmids in *E. coli* RR1 showed instability. After 100 generations when cultured in nonselective medium, 70 percent of cells lose the plasmids. The rabbit ileal loop test for LT toxin activity and suckling mice test for ST toxin activity were negative. So the CFA/1 recombinant clone could be a good live vaccine for prevention of human diarrhea caused by ETEC bacteria.

Analysis of the Genetic Loci of Enterotoxins Produced by *Staphylococcus*

40091021I Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 12 No 3, Jun 92 pp 154-156

[English abstract of article by Li Qian [2621 0241] and Lei Zuorong [7191 4373 2837] of the Institute of Microbiology and Epidemiology, Academy of Military Medical Science]

[Text] Fifteen strains of staphylococcus aureus isolated in Beijing were assayed from their genetic loci of encoding enterotoxins. All these strains carried a large 54 kb plasmid which was resistant to ampicillin. Among these strains, 14 produced enterotoxins A, B, C and D at the same time. The enterotoxins were determined before and after elimination of the plasmids from the bacteria. And the enterotoxins produced from the transformants which were constructed by transferring the plasmids of staphylococci into *E. coli* HB101 were determined. The genetic locus of SEA were located in plasmid and that of SED were located in chromosome. The results suggest that the genetic loci for encoding enterotoxins of staphylococci were not as same as those reported in literatures. The reasons are discussed.

The Cloning and Identification of Phase I Antigen Gene of *Shigella Sonnei*

40091021H Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 12 No 3, Jun 92 pp 145-147

[English abstract of article by Luo Zhengze [5012 2182 7245], Gao Jieying [7559 2638 5391], and Su Xin [5685

2450] of the Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing]

[Text] The genomic DNA library of *S. Sonnei* phase I plasmid was constructed with the cosmid vector pJB8. For the lack of DNA probe, the laboratory screened the recombinants with immunological techniques. Two phase I⁺ strains were selected. The recombinants have been confirmed for the expression of specific O-antigen of *S. Sonnei* by the methods of BA-immunoblot assay, silver staining of LPS [lipopolysaccharide] and retransformation with recombinant plasmids. The phase I⁺ recombinants also showed good immunogenicity and immuno-protective effects in mice. This work will facilitate the study of protective antigen of *S. Sonnei*.

Study on Immunogenicity of *Shigella Sonnei* Polysaccharide-Protein Conjugate

40091021G Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 12 No 3, Jun 92 pp 141-144

[English abstract of article by Xu Xiaoping [1776 2556 1627], Chen Zhihua [7115 1807 5478], and Su Xin [5685 2450] of the Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing]

[Text] Polysaccharide (PS) derived from *S. Sonnei* lipopolysaccharide (LPS) was covalently coupled with bovine serum albumin (BSA) by using adipic acid dihydrazide as a spacer molecular in the presence of carbodiimide. Antigenic determinants of both PS and BSA were retained after conjugation as tested in a sandwich ELISA. Immunization of rabbits revealed that PS was nonimmunogenic, while the conjugate was able to induce high levels of antibodies reacting with *S. Sonnei* LPS and whole bacterial cell. A clear booster effect could be induced by the conjugate. Analysis of antiserum demonstrated the specificity of antibody was mainly to O-PS determinants. Anticonjugate serum of rabbit could afford protection against *S. Sonnei* challenge when passively transferred to mice.

Molecular Cloning and Sequence Analysis of Soybean Mosaic Virus 3'-Genome

40091021F Beijing SHENGWU GONGCHENG XUEBAO [CHINESE JOURNAL OF BIOTECHNOLOGY] in Chinese Vol 8 No 2, May 92 pp 201-202

[English abstract of article by Liu Junjun [0491 0193 0689], Peng Xuexian [1756 1331 6343], and Mang Keqiang [5462 0344 1730] of the Institute of Microbiology, Academia Sinica, Beijing]

[Text] The 3'-terminal genomic region of the Beijing isolate of soybean mosaic virus (SMV) has been cloned through technique of polymerase chain reaction (PCR). We have analyzed the nucleotide sequence of SMV

3'-genome (Beijing isolate). Comparisons of the nucleotide and deduced amino acid sequences of SMV (Beijing isolate) coat protein gene with those of SMV-N strain show 93.4 percent and 98.9 percent identity between them, respectively. Alignments of the 3'-non-coding sequence in pair with that of SMV-N strain show homology of 88.8 percent. These data indicate that SMV (Beijing isolate) is very close to SMV-N strain.

Expression of a New Acid Phosphatase Gene of *Kluyveromyces fragilis* in *Saccharomyces cerevisiae*

40091021E Beijing SHENGWU GONGCHENG XUEBAO [CHINESE JOURNAL OF BIOTECHNOLOGY] in Chinese Vol 8 No 2, May 92 pp 197-200

[English abstract of article by Lin Ying [2651 1758] of the Institute of Biotechnology, South China University of Technology, Guangzhou, and JungHwan Ko, Koji Yoda, and Makari Yamasaki of the Department of Agricultural Chemistry, The University of Tokyo, Japan]

[Text] An acid phosphatase gene of *Kluyveromyces fragilis* in *S. cerevisiae* has been cloned. The amino acid sequence had no homology to those of acid phosphatase of a closely related *S. cerevisiae*. To know the substrate specificity of the *K. fragilis* acid phosphatase, several efficient expression systems for the cloned gene in *E. coli* and *S. cerevisiae* were tested. In *E. coli* system, the acid phosphatase gene cloned on a multicopy plasmid was tried to be expressed under the control of tac or phoA promoter with varied distance between SD and the initiation codon or the sequence of signal peptide. Expected proteins and activities, however, were not detected in any trial. Then an expression system of *S. cerevisiae* was tested. The acid phosphatase gene was placed downstream of GAL7 promoter and subcloned on a YEp24 derived plasmid. *S. cerevisiae* (pho3, pho5) transformed with the plasmid secreted a distinct amount of acid phosphatase in the periplasm only when galactose was added as an inducer.

Construction and Expression of Divalent Vaccine Strain for the Prevention of Baby Animal Diarrhea

40091021D Beijing SHENGWU GONGCHENG XUEBAO [CHINESE JOURNAL OF BIOTECHNOLOGY] in Chinese Vol 8 No 2, May 92 pp 145-149

[English abstract of article by Li Fengsheng [2621 0023 3932], Rui Xianliang [5360 6343 5328], and Huang Peitang [7806 1014 1016] of the Molecular Genetics Center, Institute of Biotechnology, Academy of Military Medical Sciences, Beijing, and Zhong Sheng [6988 5116], Lu Xuexian [0712 1331 0341], and Wang Qingyuan [3769 1987 0337] of the Department of Biology, Jiamusi Medical College, Jiamusi]

[Text] The F41 gene was isolated, and then inserted into K99 gene-carrying plasmid pMGK99 and was partially digested by the same enzyme BamHI. The transformants were screened by F41 gene probe that was labeled with (α - 32 P) dATP by random primer method. One of the positive transformants was tested by dot blot and Southern-blot assay. The results have shown that the recombinant plasmid carried K99 and F41 gene fragments. The recombinant plasmid was designated as pMG611. By transformation of *E. coli* K12 strains HB101, RRI and C600, we got three strains HB101(pMG611), RRI(pMG611) and C600(pMG611).

These stains can produce two kinds of antigens which were proved by using MRHA [Mannose-resistant hemagglutination], side agglutination and Western-blot assays. The molecular weight of K99 and F41 protein subunits were estimated by SDS-PAGE and they are the same as wild fimbriae subunits, 17200 and 29800 Da, respectively.

Double antibody sandwich ELISA was established for detecting the expression levels of both K99 and F41 antigens. The levels of K99 and F41 fimbriae expressed by HB101(pMG611) were higher than their corresponding parent strains. Expression conditions of both antigens were studied. The results of rabbit ileal loops test have indicated that HB101(pMG611) and RRI(pMG611) have no enterotoxigenicity.

It is concluded that the recombinant vaccine strains can express both K99 and F41 antigens effectively and can be used for the vaccine candidate of the prevention of the neonatal animal diarrhea caused by ETEC [Enterotoxigenic *E. coli*].

Cloning Par Region and the Effect of Par Region on Stability of pUC9

40091021C Beijing SHENGWU GONGCHENG XUEBAO [CHINESE JOURNAL OF BIOTECHNOLOGY] in Chinese Vol 8 No 2, May 92 pp 134-139

[English abstract of article by Zhang Zhiyi [1728 1807 3015] and Wu Ruping [0702 3067 1627] of the Shanghai Institute of Materia Medica, Chinese Academy of Sciences, Shanghai, and Wang Yang [3769 2799] and Yang Shengli [2799 0524 0448] of the Shanghai Center of Biotechnology, Chinese Academy of Sciences, Shanghai]

[Text] The par region of plasmid pSC101 was cloned into vector plasmid pUC9. A recombinant plasmid pEC302 was obtained. The stability of pEC302 and pUC9 in *E. coli* HB101 was tested on M_9 medium to determine the effect of par region on the plasmid stability. After 40 generations of culture, pUC9 was almost lost, while pEC302 was 100 percent maintained in host cells. The purpose of this experiment is to find a stable engineered bacterium to be used in large-scale fermentation production.

Construction of Genetic Engineering Strain Producing Propionylspiramycin

40091021B Beijing SHENGWU GONGCHENG XUEBAO [CHINESE JOURNAL OF BIOTECHNOLOGY] in Chinese Vol 8 No 2, May 92 pp 128-133

[English abstract of article by Li Yuan [2621 0337], Liu Boying [0491 0130 5391], et al. of the Institute of Medicinal Biotechnology, Chinese Academy of Medical Sciences, Beijing]

[Text] The propionylacylase gene cloning and expression of *S. mycarofaciens* mutant in *S. lividans* TK54 has been conducted. This paper reports the transformation of pIJM9 recombinant plasmid containing propionylacylase gene into spiramycin producer *S. spiramyceticus*. The results of colony hybridization and Southern hybridization showed that components of transformant No. 61 harbor the pIJM9 recombinant plasmid. The TLC and bioautography showed that the Rf value of one component of transformant No. 61 is similar to propionyl spiramycin. The HPLC retention time of components of transformant No. 61 and propionylspiramycin are also similar. (FAB)-MS (m/z 943 M +) result showed that component similar to propionylspiramycin II is also found in the fermentation products. All these results showed that transformant No. 61 is a genetic engineering strain which produces propionylspiramycin.

High Level Expression of Recombinant Protein A in *Escherichia coli*

40091021A Beijing SHENGWU GONGCHENG XUEBAO [CHINESE JOURNAL OF BIOTECHNOLOGY] in Chinese Vol 8 No 2, May 92 pp 123-127

[English abstract of article by Cai Shiyang [5591 0099 5391], Liu Yaxia [0491 0068 7209], et al. of the Institute of Basic Medical Sciences, Academy of Military Medical Sciences, Beijing, and Qiang Boqin [1730 0130 0530] of the Institute of Basic Medical Sciences, Chinese Academy of Medical Sciences, Beijing]

[Text] A high expression plasmid pPA-3 was constructed, which yielded up to 20 percent of soluble cell proteins as recombinant protein A in *E. coli* DH5a strain by heat shock induction. The recombinant protein A only contained the five IgG Fc part binding domains of native protein A. The molecular weight of recombinant protein A expressed in *E. coli* was determined to be 33, 32.2, 29.5 and 28.6 kDa by SDS-PAGE and Western blotting. The diversity of molecular weight may be due to proteolysis, and a possible cleavage site is proposed. Some of the protein was purified with solid human IgG by one-step affinity chromatography. The reactivity of the protein was compared with native protein A. The results show that the protein could bind more IgG than native protein A in equal quantities of proteins.

Cloning and Expression of a *Bacillus subtilis* β -1,3-1,4-Glucanase Gene (bglS) in *Saccharomyces cerevisiae*

40091022B Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 32 No 3, Jun 92 pp 176-181

[English abstract of article by Huang Xingqi [7806 5281 1142], Song Daxin [1345 1129 2450], Zheng Weijun [6774 0251 6511], Yang Fan [2799 1581], and Chen Yongqing [7115 3057 7230] of the Department of Microbiology and Microbial Technology, Fudan University, Shanghai]

[Text] A 2.7kb EcoRI DNA fragment carrying a *Bacillus subtilis* endo- β -1,3-1,4-glucanase gene (bglS) from the *E. coli* plasmid pFGI. was cloned into an *E. coli/S. cerevisiae* shuttle vector to construct a hybrid plasmid YCSH. The hybrid plasmid was used to transform the *Saccharomyces cerevisiae* and expressed the β -1,3-1,4-glucanase activity. The difference of the β -1,3-1,4-glucanase activities between two recombinants (YCSH1 and YCSH5) with two different insert orientations was up to 2.3 fold. Analysis of substrate specificity and optimal pH of the enzyme showed that the β -glucanase enzyme coded by YCSH (bglS) was identical with that found in *Bacillus subtilis* (bglS) but the expression level of the bglS gene in *S. cerevisiae* (YCSH) was much lower than that in *E. coli* (YCSH).

Expression of Neuraminidase of Influenza A Virus in Insect Cells

40091022D Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA et BIOPHYSICA SINICA] in Chinese Vol 24 No 3, May 92 pp 201-205

[English abstract of article by Lin Yuexin [2651 6460 9515] of the Department of Biology, Fujian Teachers University, Fuzhou, E. Roggen, W. Min Jou, and W. Fiers of the RUG-Laboratory for Molecular Biology, State University of Ghent, Belgium]

[Text] The neuraminidase (NA) gene of influenza A virus was inserted into baculovirus expression vectors under the control of the polyhedrosis gene promoter. Recombinant baculoviruses were obtained by cotransfection of insect cells with recombinant plasmid DNA and wild type baculovirus AcNPV genomic DNA and plaque assays. Upon infection of insect cells with recombinant virus, the enzymatic activity of neuraminidase was detected in the culture medium of insect cells. The expression level of NA in insect cells was estimated as 6.8-7.5 $\mu\text{g}/10^6$ cells by ELISA. 76 percent of NA was secreted into the culture medium.

The Properties of an HBV Surface Antigen Protein Carrying the (preS1) Binding Site for the Receptor of Hepatocytes: Its Coexpression With the Major Surface Antigen Protein in COS-M6 Cells

40091022E Shanghai SHENGWUHUAXUE YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA et BIOPHYSICA SINICA] in Chinese Vol 24 No 3, May 92 pp 225-231

[English abstract of article by Yu Xianming [0205 6343 2494] of the Shanghai Institute of Biochemistry, Academia Sinica, 200031]

[Text] When the surface antigen protein with the hepatocyte receptor-binding region, at its N-terminus (S309 protein) and the major surface antigen protein (S protein) of hepatitis B virus were coexpressed at a molar ratio of 1:8 in the monkey kidney cell line COS-M6, the efficiency of secretion of the S309 protein increased to about 40 percent as compared to the secretion efficiency of 10 percent when S309 protein was the only expressed surface antigen protein in the cells. Seventy two hours after cotransfection of COS-M6 cells with plasmids expressing these two proteins at a molar ratio of 1:4 or 1:8, the amount of the secreted surface antigen (HBsAg) was comparable to that when S protein was expressed alone. Isopycnic CsCl gradient centrifugation and immunoprecipitation showed that coexpressed S309 and S proteins could form secretable subviral particles, the density range of which was broadened as the heterogeneity of the composition of the HBsAg in the culture medium increased.

Studies on the Tissue Schizonticide of Malaria Parasite: Synthesis of 5-Trifluoroacetylprimaquine and Its Derivatives

40091022G Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 27 No 6, Jun 92 pp 423-427

[English abstract of article by Zheng Xianyu [6774 6343 5148], Chen Chang [7115 2490], and Fang Wen [2075 2429] of the Institute of Parasitic Diseases, Chinese Academy of Preventive Medicine, Shanghai, 200025]

[Text] Primaquine was acylated with trifluoroacetic anhydride to give 6-methoxy-8-(4-trifluoroacetamido-1-methylbutyl) aminoquinoline (compound 2 in Table) and 5-trifluoro-acetyl-6-methoxy-8-(4-trifluoroacetamido-1-methylbutyl)-aminoquinoline (compound 6), bis (trifluoroacetyl) primaquine, which was subsequently hydrolyzed to yield 5-trifluoroacetyl-6-methoxy-8-(4-amino-1-methylbutyl)-aminoquinoline (compound 11), 5-trifluoroacetylprimaquine or trifluoroacetoprimaquine, coded M8506. Similarly, compounds 1, 3-5 and 7-10 were also prepared.

Among them, compound 11 appeared to be the most effective by evaluation in mice infected with sporozoites of *Plasmodium yoelii*. With intragastrical dosage of 0.75

mg/kg/d x 3 d of compound 11 to monkeys infected with sporozoites of *P. cynomolgi*, the radical cure rate of the compound was 92.3 percent, while that of primaquine was 55.6 %. The acute toxicity of compound 11 was two times as low as that of primaquine in mice. The compound did not appear to have mutagenicity, embryotoxicity and chromosomal aberration. When rats received intragastrical doses of 15, 30 and 60 mg/kg/d of compound 11 for 14 and 28 consecutive days respectively, no change was found in histopathological examination at the two lower doses. However, reversible changes were observed at the highest dose. Compound 11, trifluoroacetoprimaquine, was shown to be a promising tissue schizonticide of malaria parasite.

Studies on the Tissue Schizonticide of Malaria Parasite: Synthesis of Derivatives of 2-Substituted Phenoxyprimaquine, 4-Methylprimaquine and Quinoxaline

40091022F Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 27 No 6, Jun 92 pp 418-422

[English abstract of article by Chen Chang [7115 2490], Zheng Xianyu [6774 6343 5148], and Guo Huizhu [6753 1920 3796] of the Institute of Parasitic Diseases, Chinese Academy of Preventive Medicine, Shanghai, 200025]

[Text] 2-Substituted phenoxy-, 4-methyl-6-methoxy-8-aminoquinolines and 7-methoxy-5-aminoquinoxaline were condensed with 1-phthalimido-bromo-alkane to yield 2-substituted phenoxy-, 4-methyl-6-methoxy-8-(1-phthalimidoalkyl)-aminoquinolines (compounds 7-10 and 15-20) and 7-methoxy-5-(1-phthalimidoalkyl) aminoquinoxalines (28-30) which were subsequently reacted with hydrazine hydrate to give 2-substituted phenoxy-, 4-methyl-6-methoxy-8-(1-aminoalkyl)-aminoquinolines (11-14 and 22-27) and 7-methoxy-5-(1-aminoalkyl) aminoquinoxalines (31-33), respectively. The 2-substituted phenoxy-6-methoxy-8-aminoquinolines (4-6) were afforded by reduction of the corresponding 8-nitroquinolines (1-3) which were obtained by condensation of 2-chloro-6-methoxy-8-nitroquinoline and substituted phenols.

Among them, compounds 25 and 24 were the most effective when evaluated in *Plasmodium yoelii* infected mice, no parasitemia was observed after a single oral dose of 10 mg/kg.

Modification and Expression of Insecticidal Protein Structural Gene of *Bacillus thuringiensis* var. aizawai 7-29

40091022A Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 32 No 3, Jun 92 pp 167-175

[English abstract of article by Guo Sandui [6753 0005 1018], Hong Zhaoyang [3163 2600 7122], Wang Jinghong [3769 0079 4767], Wang Mingbo [3769 2494

3134], Yu Meimin [0205 2734 2404], and Fan Yunliu [5400 0061 0362] of the Lab. of Molecular Biology, Biotechnology Research Centre, Chinese Academy of Agricultural Sciences, Beijing]

[Text] The regulative region (181bp) and the fifth toxic active domain (217bp) were removed from the insecticidal protein gene of *Bacillus thuringiensis* var. *aizawai* 7-29. After the synthesis of the adaptor (15bp) that contains initiation codon (ATG) and the PCR synthesis of the fifth toxic active domain (229bp) that contains stop codon (TAA), were inserted into on 5' truncated and 3' truncated of the coding fod N-terminal peptide's DNA fragment, that to become a modified structural gene. The modified structural gene can play initiation translation-function and stop translation-function during translation of insecticidal protein. The insecticidal protein was determined by western blotting, showed the expression of modified structural gene in *Escherichia coli* JM 103. The bioassay of insecticidal proteins showed the 3' truncated and 5' truncated of insecticidal gene was higher toxic active than the 3' truncated of insecticidal gene in *Escherichia coli* JM 103.

Studies on Polypeptides

40091022H Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 27 No 6, Jun 92 pp 428-433

[English abstract of article by Mao Feng [3029 1496], Wang Chao [3769 6389], and Cheng Tieming [4453 6993 2494] of the School of Pharmacy, Beijing Medical University, Beijing]

[Text]

IX. Synthesis and Antigen Specificity of Pre-S Region Fragments of Hepatitis B Surface Antigen

In order to find a synthesized polypeptide vaccine against hepatitis B, seven peptide fragments of HBsAg Pre-S region have been synthesized by liquid phase and solid phase methods. All peptide fragments were linked to protein carrier by carbodiimide and glutaraldehyde methods. The antigen specificity of the peptide-protein conjugates was assayed by anti-HBsAg polyclonal antibodies and anti-"a" monoclonal antibody. P₁ and P₅ were found to have higher antigen specificity.

Hybridoma Cell Lines Secreting Monoclonal Antibodies Against Recombinant Human Interferon- γ

40091022I Beijing TSINGHUA DAXUE XUEBAO [JOURNAL OF QINGHUA UNIVERSITY—NATURAL SCIENCE] in Chinese Vol 32 No 3, Jun 92 pp 109-116

[English abstract of article by Cong Jinyang [0654 6651 7122], Ding Baoyu [0002 1405 3768], and Shen Jinyu [3088 6855 3768] of the Department of Chemical Engineering]

[Text] Three hybridoma cell lines secreting monoclonal antibodies against recombinant human interferon-gamma (IFN- γ) have been established by fusion of myeloma cells sp2/0 with B lymphocytes derived from immunized BALB/c mice. All these cell lines remain stable in secreting high titer of monoclonal antibodies during more than two years' continuous culture. The monoclonal antibodies are specific for binding both IFN- γ and new types of interferon-gamma. They are expected to be suitable for immunoaffinity purification of interferon-gamma.

A New Rabbit Virus Isolated

40091022C Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 32 No 3, Jun 92 pp 198-203

[English abstract of article by Zheng Hong [6774 4767], Zhao Lin [6392 2651], and Sun Fulin [1327 1381 2651] of the Wuhan Institute of Virology, Academia Sinica, Wuhan]

[Text]

II. Study on Morphological Structure and Some Physico-Chemical Properties of a Strain of Rabbit Hemorrhagic Disease Virus

A strain of Rabbit Hemorrhagic Disease Virus (RHDV) was isolated and purified from the infected rabbit livers with a method of using chloroform, two-phase of polyethylene-glycol-dextran sulfate sodium and sucrose density gradient centrifugation. Purified virus was nonenveloped, icosahedral symmetry with a triangulation number of 3, and 33-37 nm in diameter. The capsid was composed of 32 capsomeres with central holes in an outer diameter of about 9 nm. Two types of viral particles having different sedimentation coefficient, 130s and 166s could be identified after sucrose density gradient centrifugation. Probably no less than four virion proteins with molecular weight of 66.4, 65.0, 63.5, 41.0 x 10³ dalton were detected by SDS-polyacrylamide gel electrophoresis. Viral nucleic acid was extracted from purified virus by acridine orange as well as the curves of thermal denaturation showed that this kind of virus had a single-stranded DNA. The molecular weight of the ssDNA was approx 2.1 x 10⁶ dalton as determined by electron microscopy.

Data indicate that the RHDV may like the parvovirus of the family Parvoviridae.

**Research on Electrolytic Reduction Pulsed
Extraction Columns for Nuclear Fuel Reprocessing**

92FE0832 Beijing TSINGHUA DAXUE XUEBAO
[JOURNAL OF QINGHUA UNIVERSITY] in Chinese
Vol 32, No 3, Jun 92 pp 94-108

[Article by Tai Derong [6733 1795 2837], Wang Xinchang [3769 2946 2490], Liu Jun [0491 0193], Lin Dengcai [2651 4098 1752], Mao Zongqiang [3029 1350 1730], Ma Xuquan [7456 2700 3123], and Yang Lichun [2799 4539 2504] of the Qinghua University Nuclear Energy Technology and Design Research Academy and Zheng Shaoqiang [6774 4801 1730] of the Beijing Nuclear Engineering Research and Design Academy: "An Electrolytic Reduction Pulsed Screen Plate Column For Reprocessing Power Reactor Nuclear Fuel"^[*]; (manuscript received 15 August 1990)]

[Excerpts] Abstract: We did research on the effect of the plate section structure, operating conditions, technical parameters, control modes, and other factors on two-phase flow characteristics and uranyl nitrate electrolytic reduction performance in an electrolytic reduction pulsed screen plate column and developed a mathematical model for an electrolytic pulsed column. The results show that under the effects of an electrical field, the dispersed phase droplets exhibited definite coalescence phenomena and the flooded flux was 80 percent higher than in common pulsed columns. Under normal conditions, the uranium (IV) output rate is 1.5 to 2.4 g/A/h, the electrical current efficiency is 50 to 80 percent, the hydrazine consumption rate is 15 to 20 percent, and the hydrazoic acid and hydrogen gas concentrations are far below the stipulated safety limits. The relevant parameters can be readjusted for easy estimation of the required valence-4 uranium concentration based on the relevant formulas.

Introduction

The Purex process for reprocessing irradiated nuclear fuel requires several instances of regulation of the valence state of plutonium to separate it from the uranium and purify the plutonium. The traditional chemical reduction method has several shortcomings^[1,2], and for several years people have tried to find an economical and effective uranium/plutonium oxidation, reduction, and separation method. Beginning in the 1970's, the United States, West Germany, and others did a great deal of R&D work on uranium/plutonium electrolytic reduction^[2,3]. They did "local" electrolytic reduction of uranium and plutonium in extraction equipment, especially in developing and using electrolytic reduction pulsed columns, that had major importance for nuclear safety, reducing reprocessing costs, and improving product quality in the reprocessing process.

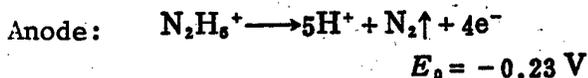
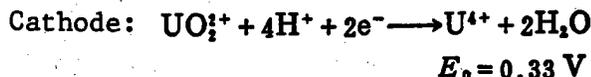
Electrolytic reduction pulsed columns are devices that combine an electrolysis tank with a pulsed screen plate column and are capable of simultaneously carrying out electrolytic reduction and mass transfer to achieve the required material separation. This article provides a

rather systematic study of the basic performance of electrolytic reduction pulsed columns and establishes a mathematical model for electrolytic reduction pulsed columns that provides a foundation and experience for the design and operation of electroreduction pulsed columns for use in hot experiments.

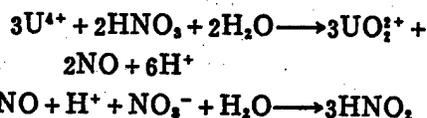
I. Basic Principles of Electrolytic Reduction

Electrolytic reduction in electrolytic reduction pulsed columns involves potentializing a DC voltage on the electrodes so that the UO_2^{2+} and other cations are reduced at the cathode while a corresponding oxidation of several ions occurs simultaneously at the anode. Generally speaking, the more positive the electric convection at a standard potential, the easier the reduction at the cathode, whereas the more negative the electric convection at a standard potential, the easier the oxidation at the anode. Based on the superpotential of different ions at the electrode, control of the potential or current can be used for quantitative reduction of UO_2^{2+} .

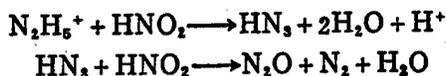
In the $UO_2(NO_3)_2-HNO_3(H_2O)$ system, a series of electrochemical reactions can occur^[1,4]. Usually, a chemical compound that contains an ammonia base ($-NH_2$) (such as hydrazine, oxyammonia, etc.) is used as a reduction support agent for concurrent destruction of the nitrous acid generated in the system. In the system being studied, by maintaining a sufficient concentration of hydrazine, controlling the appropriate cathode potential, and selecting a suitable cathode material, the primary electrode reaction in the system is:



The primary electrolytic product is valence-4 uranium and nitrogen gas. E_0 is the standard oxidation-reduction potential relative to the standard hydrogen electrode (SHE). In addition, the following reaction occurs in the cathode electrolytic liquid and produces nitrous acid:



The nitrous acid that is generated continually undergoes the following reaction and is destroyed:



II. Two-Phase Flow Characteristics of the Electrolytic Reduction Pulsed Screen Plate Column

2.1. Structure, material, and experiments for the electrolytic reduction pulsed column

Structure of the electrolytic pulsed column: the plate section of the electrolytic pulsed column is composed of a glass tube section with an internal diameter of 5 cm, with sampling ports between the tube sections, while the upper and lower expansion sections are glass tubes 15 cm in diameter. The plate section is 1.5 m high. The spacing of the plates is 50 mm. The screen plate is a titanium plate 1 mm thick with an aperture of 3 mm and a diameter in free cross-section of 23 percent. The screen plate also serves as a cathode. The central anode is a platinum-plated titanium rod 6 mm in diameter and the cathode and anode are insulated with polytetrafluoroethylene rings. Figure 1 shows a simplified diagram of the electrolytic pulsed column.

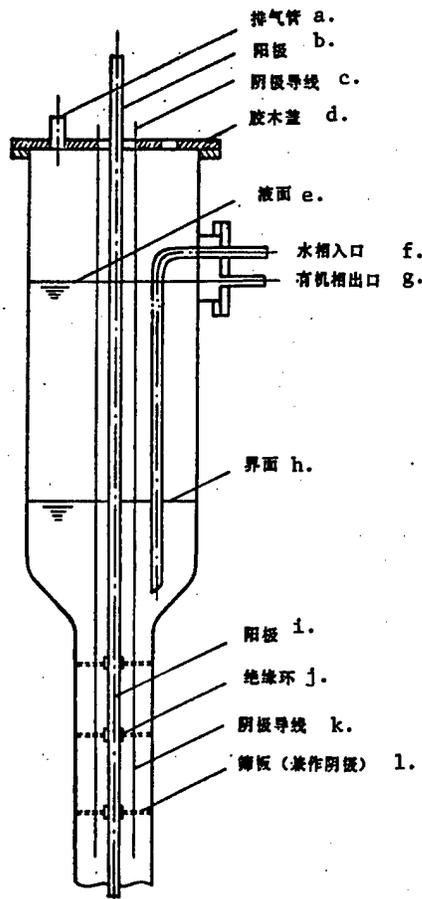


Figure 1. Simplified Diagram of Electropulse Column

Key: a. Exhaust tube; b. Anode; c. Cathode conductor; d. Bakelite cap; e. Liquid surface; f. Water phase inlet; g. Organic phase outlet; h. Boundary; i. Anode; j. Insulating ring; k. Cathode conductor; l. Screen plate (also used as cathode)

Material: Organic phase: 30% TBP (240# kerosene); 0.34 mol/L

$\text{UO}_2(\text{NO}_3)_2$ 30%

TBP (240# kerosene)

Water phase: 0.5 mol/L HNO_3

For the non-uranium system, there is two-phase pre-saturation and no mass transfer prior to the experiment; for the uranium-containing system, there is mass transfer.

Experiment: The water phase is used as the continuous phase. Local phase inversion appearing on the plate section and abrupt changes in the residual fraction are used to determine flooding. The static pressure method and boundary differential method are used to determine the residual fraction. [passage omitted]

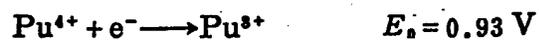
III. Electrolytic Reduction of Uranyl Nitrate in the Electropulse Column

3.1. The electrolytic reduction and mass transfer process in the electropulse column

Cathode reduction of uranium (VI) is a complex multi-stage, multiphase reaction process. The speed of electrolytic reduction is slower than homogeneous phase chemical reduction. The conduct of this process is determined by the components in the electrolytic liquid and the cathode material, cathode potential, electrolytic liquid mixing conditions and temperature, and other things. For this reason, the reduction speed for uranium (VI) is related to many factors that affect mass transfer.

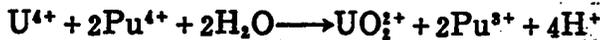
In the electropulse column, the water phase is the continuous phase. The water phase containing hydrazine and acid and the organic phase containing uranium enter the expansion sections at the top and bottom, respectively, of the column and the pulse action causes a two-phase counter-current. At this time, part of the uranium (VI) is stripped to the water phase. After potentializing the electrical field, part of the water phase uranium (VI) is reduced to uranium (IV) and the concentration of uranium (VI) in the water phase continually declines. Because of the dynamic equilibrium in the extraction process, the uranium (VI) in the organic phase continually enters the water phase. The stabilizer hydrazine is oxidized at the anode into nitrous oxides and N_2 . For a specific electrolytic liquid component and at a specific cathode potential and operating conditions, the electrolytic column forms a stably uranium (IV) concentration cross-section.

It should be pointed out that:



This is a more positive electrode reaction than the uranium (VI) oxidation-reduction potential in that the plutonium (IV) is reduced more easily than the uranium (VI) at the cathode. Moreover, in a Purex process 1BX

column, the uranium (IV) generated by reduction of the uranium (VI) is a strong reduction agent and carries out added reduction of the plutonium (IV) according to the following formula:



It can be expected that uranium/plutonium electrolytic reduction in a 1BX column is more easily achieved.

3.2. Experiment

The experimental flow process is illustrated in Figure 4. The previously described plate section 1.5 m tall glass electropulse column is the number I column. The two other column sections are the plate section 1.5 m tall titanium column and the plate section 3.0 m tall glass column that are termed the number II column and number III column, respectively. Below, with the exception of annotations, all of the experimental results are for the number I column. The experimental process includes extraction, electrolytic reduction, oxidation, evaporation, feed adjustment, and so on.

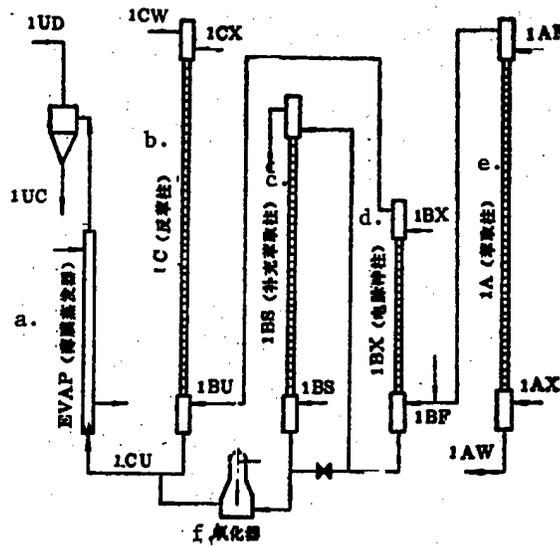


Figure 4. Simplified Diagram of Experimental Flow Process

Key: a. EVAP (Membrane evaporator); b. 1C (Stripping column); c. 1BS (Supplementary extraction column); d. 1BX (Electropulse column); e. 1A (Extraction column); f. Oxidizer

Experiment system:	Organic phase	0.24 to 0.42 mol/L $UO_2(NO_3)_2$ - 0.06 to 0.20 mol/L HNO_3 - 30% TBP(OK)
	Water phase	0.5 mol/L HNO_3 - 0.20 mol/L $N_2H_5NO_3$
Operating conditions:	Flow ratio	Dispersion phase/continuous phase (O/A) = 5/1(40L/h/8L/h)
	Pulse amplitude	25 mm, frequency 60 min^{-1}
	Operating temperature	32 +/- 3°C, cathode potential -700 mV
Analytical method:	See article [7] for uranium (VI), uranium (IV), nitric acid, nitrous acid, hydrazine, hydrazoic acid, and electrolytic process gas analysis.	

[passage omitted]

V. Conclusion

1. The structure of the electrolytic reduction pulsed column used in the Purex process which utilizes a standard structure titanium screen plate string (or column casing) as a cathode, a platinum-plate titanium core rod as an anode, and polytetrafluoroethylene ring insulators between the poles is feasible. It is characterized by a simple structure and convenience in disassembly and assembly.

2. Under the effects of the electrical field, there are obvious coalescence phenomena of the dispersed phase droplets. The flooding flux of the electrolytic pulsed column is more than 80 percent higher than common pulsed columns and the flooding flux when the system contains uranium is even higher.

3. The flow conditions appropriate for the electrolytic pulsed column are:

a. The water phase as the continuous phase and the uranium-containing organic phase as the dispersed phase;

b. A flow ratio (O/A) of 4/1 to 5/1, a total flow rate of 250 L/h/dm²;

c. A pulse amplitude of 25 mm, a pulse frequency of 60 to 70 min^{-1} ;

d. Operating temperature 30 to 35°C;

e. Cathode potential -600 to -700 mV (SCE).

4. The relational formula for the flow appropriate for this column model is:

$$\frac{V_d}{x} + \frac{V_o}{1-x} = V_o(1-x)e^{kz}$$

5. Under the technical conditions of the 1BX column used in the Purex process for reprocessing nuclear fuel

from power reactors, the hydrazine concentration in the BX is 0.15 to 0.20 mol/L and the uranium (IV) concentration near the electrolytic column water phase inlet can reach 4 to 9 g/L and it has an appropriate uranium and acid concentration cross section. It is expected that under these conditions, Pu (IV) is capable of self-reduction and of additional reduction by the uranium (IV), so it has rather good uranium/plutonium separation results.

6. The main factors that affect the uranium (IV) yield are cathode potential, cathode area, organic phase uranium (VI) concentration, water phase acidity, pulse strength, temperature, and so on. Under normal conditions, the uranium (IV) yield is 1.5 to 2.5 g/A/h and the current efficiency is 50 to 80 percent. In the actual process, the uranium (IV) yield rate can be estimated on the basis of relational formula (1).

7. Under suitable technical conditions, the hydrazine consumption rate is 15 to 20 percent (≈ 0.013 mol $N_2H_4/A/h$). The maximum hydrazoic acid concentration is 5.6×10^{-3} mol/L in the organic phase and 1.3×10^{-3} mol/L in the water phase, which is lower than the hydrazoic acid safety limit (0.05 mol/L) and far below the explosive limit of 4.7 mol/L (17 percent) in the water soluble liquid. The primary gaseous products during the electrolysis process are N_2 , a small amount of O_2 , and an extremely small amount of H_2 . The gas discharge rate is about 4 to 5 L/h (for a 5 cm column), which has no effect on the operation of the electrolytic column.

8. The electrolytic reduction and mass transfer process in the electropulse column can be described by taking into consideration the diffusion model for the electrochemical reaction:

$$E_z \frac{d^2x}{dh^2} - (V_o - \beta\Omega) \frac{dx}{dh} - K_{ox}a(x - x^*) = 0$$

$$E_y \frac{d^2y}{dh^2} + V_a \frac{dy}{dh} + K_{ox}a(x - x^*) = 0$$

9. The constant-current method and constant-potential method can both effectively control normal operation of the electropulse column, and the constant-current method is simpler and better-adapted to process control under actual operating conditions.

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(*) This project was funded by the China Nuclear Industry Corporation

Longyuan Exports Over 4000 Computers to FSU, Hungary, Romania

92P60441B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 28 Aug 92 p 1

[Article by Xie Ning [6200 1337]: "Longyuan Company Strives To Open International Computer Market"]

[Summary] In the past few years, Beijing Longyuan [7127 3293] Electronics S&T Ltd. has succeeded in making inroads into the computer markets in the Former Soviet Union (FSU) and Eastern Europe. As of the end of 1991, this company had sold over 4000 of its "DL" series of microcomputer systems to customers in the FSU, Hungary, Romania, and other countries. This amounts to foreign exchange earnings of almost US\$25 million, making Longyuan one of the largest domestic exporters of microcomputer systems. Longyuan achieved this noteworthy feat not only by a careful analysis of the market potential in the FSU and Eastern Europe, but also by being the first to take advantage of information that MOFERT officials had signed contracts with various Eastern European countries for exports of microcomputers to those countries. The units sold in the FSU can handle English and Russian input, and come with Russian-alphabet keyboards, Russian-language LANs, Russian-language operating systems, and so on. Longyuan has also been engaged in manufacture of special-purpose computer floppy disks via imported production line(s), and is co-producing state-of-the-art artificial [kidney] dialysis machines with a U.S. medical equipment company.

Foundation Laid for Major Floppy Disk Production Plant

92P60441A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 33, 26 Aug 92 p 1

[Article by Ru Yi [1172 0001]: "Beijing-Hong Kong Joint Venture To Build Major Floppy Disk Production Plant in Beijing"]

[Summary] The foundation for Beijing Weiwang [1218 2598] Magnetic Message Ltd., a joint venture composed of the China Electronics Import/Export Corporation's Beijing Co., the Beijing Tong Xian [county] Chengguan [1004 7070] Industrial Corp., and Hong Kong Kam Hing Magnetic Message Ltd., was formally laid in Beijing's Tong Xian area on 15 August. This new joint venture, with a gross investment of US\$20.40 million and registered capital of US\$12.00 million, will occupy a 52,800-square-meter site, including a 44,000-square-meter plant. Scheduled for formal completion and initial operation by the second quarter of 1993, the new joint venture will have an annual production capacity of 228 million computer-use floppy disks, with over 70 percent—an annual export value of over US\$50 million—to be exported. Targeted annual business volume is 500 million yuan RMB—an amount which [if reached] would make it one of the largest floppy disk production facilities in the world. Basic construction engineering is

being handled by MMEI's No. 10 Design Institute. Currently, Hong Kong Kam Hing Magnetic Message Ltd. is the world's largest producer and seller of floppy disks, with annual production of 600 million disks, amounting to a 20 percent share of the world market for this product.

Protocol Research of Local Area Computer Network for Warship

40100080A Shenyang XIAOXING WEIXING JISUANJI XITONG [MINI-MICRO SYSTEMS] in Chinese Vol 13 No 8, Aug 92 pp 46-51

[English abstract of article by Yang Yongtian, Jiang Wenhua, and Yin Zhiwei of the Harbin Shipbuilding Engineering Institute, 150001; (MS received 27 Dec 91)]

[Text] Selection of Local Area Computer Network protocol suitable to warship command automation system is described. The design of the network interface card completed in our research is presented in detail on hardware as is the software supporting lower levels of the protocol. Some new ideas used in the design, such as dual buffers, no inquiring of free buffer, setting up and maintenance of logic ring, are introduced. Based on the adopted protocol, the methods of calculating the real transmission speed and network delay are given at the end of this paper.

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Introduction to a Real-time Multitasking Operating System YRMX51 Based on MCS-51

40100080B Shenyang XIAOXING WEIXING JISUANJI XITONG [MINI-MICRO SYSTEMS] in Chinese Vol 13 No 8, Aug 92 pp 52-57

[English abstract of article by Yang Qianbang of the Changzhou Automation Research Institute of Central Coal Mining Research Institute, Changzhou 213015; (MS received 29 Dec 91)]

[Text] The fact that a microprocessor application system (MAS) becomes more complicated makes parallel processing, timing operating and high-speed responding often required. The fact that MAS becomes more popular makes it more and more significant to reduce the cost of software and to enhance the software transplantability. In this paper, YRMX51, a multitasking real-time

operating system is introduced with the emphasis on its design thoughts, structure and features. In addition, through comparative study, the viewpoint is verified that the multitasking design method is an effective way to arrive at the above requirements by eliminating the defects of the conventional sequential program design method.

**Intelligent Robot Vision/Hearing System
Developed**

92P60442B Beijing ZHONGGUO DIANZI BAO [CHINA
ELECTRONICS NEWS] in Chinese 24 Aug 92 p 3

[Article by Tan Guoping [6151 0948 1627]: "China University of Science and Technology Develops Intelligent [Robot] Audiovisual Perception System"]

[Summary] The "intelligent robot vision/hearing system" developed by specialists in the Electronic Technology section at China University of Science and Technology (CUST) recently passed appraisal in Hefei. The CUST robotics specialists have incorporated a number of advanced technologies—including computers, image processing, speech recognition and synthesis, and automatic control—into two new teaching and industrial-use robot models, HEYOI and RHINO, which have vision and hearing functions as well as movement control functions. Tests of robots installed with the new system show that they can in real time recognize 156 commands with an accuracy of over 95 percent. The RHINO model, via perceptual fuzzy recognition techniques, can accurately recognize simulated workpiece modules placed in arbitrary positions on a flat surface, and moreover can follow instructions to pick up a certain module from among a number of modules of different size and shape. The HEVCI [as published] model also has an ultrasonic range-finding sensor and incorporates fuzzy control techniques;

in a known work environment, it can determine an [appropriate] movement path or—via spoken command—send the modules into RHINO's field of view. The RHINO model also accepts spoken commands.

**Jinan Plant Signs Contract with DEC for CIM
System**

92P60442A Beijing JISUANJI SHIJIE [CHINA
COMPUTERWORLD] in Chinese No 32, 19 Aug 92 p 3

[Article by Sheng Shi [4141 0013] and Liang Yu [5328 3768]: "DEC Signs First Major CIM Contract in China"]

[Summary] Representatives of the well-known U.S. networked computer systems, software, and services firm DEC and of Jinan First Machine Tool Plant (JFMT) recently signed a US\$2.5 million contract for JFMT to import an advanced computer integrated manufacturing (CIM) system from DEC. The contract includes about \$1.3 million for services, \$500,000 for networking costs, and over \$600,000 for consulting. Hardware products to be provided to JFMT include three UNIX systems (two DECSystem 5000/900 and one DECSystem 5000/240) and four MicroVAX 3100/80 computers. The hardware will use 10 kilometers of fiber optic cable for interconnections (including five LANbridges, nine repeaters, and 40 DECserver 700 servers). Software to be provided includes the first advanced CIM software and other applications software to be installed by DEC in Asia.

**More on Completion of First Domestic
EMW-Pumped FEL Experimental System**

93P60004 Beijing KEJI RIBAO [SCIENCE AND
TECHNOLOGY DAILY] in Chinese 9 Sep 92 p 2

[Article by Gao Zhu [7559 2691]: "Nation's First Electromagnetic-Wave-Pumped Free Electron Laser Experimental System Completed"; cf. earlier report in JPRS-CST-92-008, 30 Apr 92 p 68]

[Text] The nation's first electromagnetic-wave-pumped (EMW-pumped) free electron laser (FEL) experimental system, now formally completed at

Chengdu's University of Electronic Science & Technology of China (UEST), recently passed the technical appraisal organized by the Sichuan Province S&T Commission. The UEST-developed EMW-pumped FEL uses a 600 KV, 3-5 KA tubular electron beam injected into a relativistic microwave apparatus to generate high-power (over 100 MW) microwave radiation. These microwaves are then reflected to function as a pump source, which interacts with the same electron beam to create a 3-mm-band FEL. The FEL radiation so far observed with this experimental system has an output power of over 10 KW, meeting mid-to-late-eighties international standards.

Eight New Hybrid ICs Developed by Institute 43 Certified

92P60443A Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 17 Aug 92 p 3

[Article by Wu Ruisheng [0702 3843 3932]: "Eight Achievements of Institute 43 Pass Appraisal"]

[Summary] Eight scientific research achievements of MMEI's Institute 43 recently passed technical appraisal. The immediate product of this research is eight new hybrid integrated circuit varieties with specific applications in radar, navigation and positioning systems, electronic countermeasures, communications equipment, automatic control systems and other military equipment, as well as numerous civilian areas. These eight new hybrid ICs are as follows: the HTC-100 precision temperature converter, the HTAD-I single-row transistor array driver, the HTC601 switch voltage-regulator power output circuit, the HM201 motor crystal oscillator phase-locked-loop control circuit, the HRDC2112 rotary transformer/digital converter, the HTSL5136B dual S/D converting fine/coarse combination coder, the HFX15 bit-error-rate detector, and the RM2010 sheet resistor.

On Development of ASICs for Telecommunications

92P60443B Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 19 Aug 92 pp 1, 3

[Article by Prof. Feng Zhongxi [7458 6850 3556] of the Department of Electronic Engineering, Qinghua University: "On Development of Application-Specific Integrated Circuits as a Basis for Boosting the Communications Industry"]

[Excerpt] [Passage omitted]

III. Pilot Applications at Qinghua's Communications ASIC Joint Laboratory

At a 1985 conference of Ministry of Electronics Industry communications and broadcast TV engineers, experts recommended the formation of a telecommunications-oriented ASIC joint laboratory at Qinghua University's Department of Electronic Engineering. With the financial support of 14 plants, institutes, and institutions of higher learning, the laboratory was set up, with a goal of giving industry and institute engineers experience in ASIC design and pilot applications. Over a 3-year period, over 100 designers were trained and four types of ASICs using 1.5 μm CMOS technology were developed. These ASICs, fabricated at Japan's Fujitsu and at America's Harris [Semiconductor] Company, contain up to 60,000 elements integrated onto each chip; they come in 68-pin packages and have an operating speed of almost 90 MHz. This project permitted China's fiber optic communications equipment to begin to catch up to the current [worldwide] state-of-the-art for such products. Spurred on by this laboratory's experience, several large domestic firms and institutes have by now invested their

own funds to purchase imported CAE [computer-aided engineering] workstations and have begun to use them for computer-aided design of multi-layer printed [circuit] boards, complex dies, transceiver circuits, and ASICs. [Passage omitted]

Report on 2nd National ASIC Conference Held in Beijing

92P60407A Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 20 No 6, Jun 92 pp inside back cover, 71

[Unattributed article: "Second National Application-Specific Integrated Circuit (ASIC) Academic Conference Held in Beijing"]

[Summary] The subject of ASIC design, fabrication, and testing has received much attention in China in recent years. Throughout the nation, there are over 20 ICCAD systems in use, including systems for logic design, physical design, and PCB layout. There are now 2 or 3 processing lines in the nation capable of stable production of 3 μm -accuracy 4 mm x 4 mm chips with a yield exceeding 10 percent. These chips are at a 1-kilogate level in terms of gate density.

At the 2nd National ASIC Conference, held 12-15 April 1992 in Beijing and sponsored by the China Electronics Society, over 140 representatives from 98 domestic organizations attended. Conference attendees delivered and exchanged 67 formal papers, of which 27 covered ASIC design and testing, 11 covered ASIC fabrication techniques, and 29 covered ASIC development. Of the papers on design technology, 10 introduced specific systems, such as the SOLO1400 system, an FPGA [field-programmable gate array] development system, the [domestically developed] PANDA system, and a PLD [programmable logic devices] design system. Among papers on ASIC fabrication techniques, three covered exploratory research on construction of a standard production line (Fountry) and eight covered ASIC encapsulation, multilayer wiring, aluminum leads, and related topics. Of the papers on ASIC development, eight covered design of a 4-bit single-chip computer, A/D converter, D flip-flop, and other circuits; five covered design of industrial circuits for automotive and process-control applications; five covered design of ICs for color TV remote control systems; and 11 covered circuit design for communications, radar, and electronic countermeasures (ECM) equipment. Two papers were judged outstanding: "Optimized Design of ASICs for Radar and ECM Receivers," delivered by Xidian University professors Sun Xiaozhi [1327 5135 1311] and Wang Xudong [3769 2485 2639] and "SFSA: A New Speech Synthesis Technique Applicable to ASICs," delivered by Qinghua University Microelectronics Institute researchers Zhang Jianren [1728 1696 0086], Zhou Xiangqun [0719 0686 5028], and Sun Yihe [1327 5030 0735].

ASIC development systems developed, imported, and/or manufactured by MMEI's Institute of Automation, the Ministry of Aerospace Industry's Microelectronics Center, and the U.S. firms Imagine, Mentor Graphics, and Modern Devices were demonstrated at the conference.

Structure Design for GaAlAs/GaAs Multiquantum-Well Lasers

40100081A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 13 No 8, Aug 92 pp 463-468

[Article by Zhang Jingming, Xu Junying, et al. of the Institute of Semiconductors, CAS, Beijing; (MS received 16 Apr 91, revised 15 Jun)]

[Text] Abstract: The structure design for multiquantum-well lasers, the influence of quantum-well structure on excited wavelength and the dependence of optical limited factor on aluminium mole fraction χ in waveguide cladding layer are detailed. The optical gain was calculated by linear optical gain expression developed with density-matrix theory. According to the threshold condition, the optimal cavity length and the optimal well number were obtained. The optimal structure design for the multiquantum-well laser was provided by this method.

Phase Changes in Semiconductor Total-Internal-Reflection Waveguide Optical Switch

40100081B Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 13 No 8, Aug 92 pp 469-474

[Article by Wang Dehuang of the Semiconductor Institute Region, Integrated Optoelectronics Laboratories of China, Department of Physics, Beijing University, 100871; (MS received 6 May 91, revised 22 Aug 91)]

[Text] Abstract: The phasing in semiconductor total-internal-reflection waveguide optical switch is analyzed. The phase changes of TE mode and TM mode, δ_s and δ_p , and their phase difference $\Delta\delta$ in 1.3 μm In GaAsP/InP total-internal-reflection waveguide optical switch are calculated numerically. It shows that the δ_s , δ_p , and $\Delta\delta$ are remarkably dependent on the refractive index change Δn , on the absorption coefficient α in switch region, and on the propagation angle θ_p . There are nonlinear variations between them. Besides, the total-internal-reflection waveguide optical switch may be a device with polarized character, because there is a relative phase difference between the reflective TE mode and reflective TM mode.

Neural Placement Algorithm for Gate Array

40100081C Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 13 No 8, Aug 92 pp 487-492

[Article by Liu Jun, Lan Jialong, and Wang Zhaoming of the University of Electronic Science and Technology, Chengdu, 610054; (MS received 30 Apr 91, revised 6 Jul 91)]

[Text] Abstract: A neural network is used to solve the placement problem for [VLSI] gate array. At first, the mapping relation of the gate array placement optimization problem to the energy function of the neural network is found. Then, the dynamic property of this network is used to solve the placement problem. Because of the large-scale parallel computation of the neural network, this algorithm has the parallel processing property.

Investigation of Mg⁺ Implantation Into InP and GaAs

40100081D Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 13 No 8, Aug 92 pp 499-503

[Article by Shen Honglie, Yang Genqing, et al., of the Ion Beam Laboratory, Shanghai Institute of Metallurgy, CAS, Shanghai 200050; (MS received 12 Apr 91, revised 10 May 91)]

[Text] Abstract: The electrical properties and the behavior of radiation damage in Mg⁺ implanted InP and GaAs have been studied. The results of Van der Pauw/Hall measurements and electrochemical C-V measurements show that rapid thermal annealing is better than conventional furnace annealing for improving activation, and coimplantation of P⁺ in conjunction with rapid thermal annealing can reduce the redistribution of the implanted Mg species, which would result in a greatly enhanced activation. The analysis of Rutherford backscattering spectroscopy channeling spectra shows that the damage produced by high-dose implantation in InP is much larger than that in GaAs for the same radiation condition, and could not be wholly removed by thermal annealing even at high temperature.

Monolithic Integrated 16 x 16 bit Multiplier Operating in Parallel and Pipeline

40100081E Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 13 No 8, Aug 92 pp 511-514

[Article by Hong Zhiliang of the Department of Electronics Engineering, Fudan University, Shanghai, 200433 and Zhang Xinyuan of the Beijing IC Design Center, Beijing, 100016; (MS received 28 Apr 91)]

[Text] Abstract: The principle of a 16 x 16 bit multiplier operating in parallel and pipeline and controlled by two

nonoverlapping pulses is described. With standard cells, the circuit was designed by CAD and fabricated in 2 μm CMOS process with double metallizations. The chip includes more than 7,000 gates has an area of $8,758 \times 8,878 \mu\text{m}^2$. The measured results show that it has the expected functions and can complete a multiplication operation of 16×16 bits at a speed of 7 MHz.

High-Detectivity GaAs/AlGaAs Multiquantum Well Long-Wavelength Infrared Detector

40100081F Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese
Vol 13 No 8, Aug 92 pp 515-517

[Article by Zhong Zhantian of the Laboratory for Surface Physics, CAS, Beijing, 100080 and the Institute of Semiconductors, CAS, Beijing, 100083, Zhou Xiaochuan, Du

Quangang, and Jiang Jian of the Laboratory for Surface Physics, CAS, Beijing, 100080 and the Institute of Physics, CAS, Beijing, 10080, Li Chengfang, Wang Sen, Wu Ronghan, and Xu Junying of the Institute of Semiconductors, CAS, Beijing, 100083, and Zhou Dingxin and Yu Meiyun of the Shanghai 803 Research Institute, the Ministry of Aero-Space Industry, Shanghai, 200233; (MS received 20 Feb 92)]

[Text] Abstract: High-detectivity ($D^* = 6.2 \times 10^{10} \text{ cm} (\text{Hz})^{1/2}/\text{W}$), high-responsivity ($9.7 \times 10^5 \text{ V/W}$) GaAs/ $\text{Al}_x\text{Ga}_{1-x}\text{As}$ multiquantum-well detector, sensitive in the long-wavelength infrared band at $\lambda = 9.2 \mu\text{m}$ (operating at a temperature of $T = 77 \text{ K}$), is reported. The detector structure consists of 50 periods containing GaAs quantum wells and $\text{Al}_{0.3}\text{Ga}_{0.7}\text{As}$ barriers, and the detector was fabricated by etching a $320\text{-}\mu\text{m}$ -diameter mesa.

Shanghai Eighth 5-Year Plan Targets for Optical Fiber, Cable Released

92P60408A Beijing DIANXIN JISHU
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 6, Jun 92 p 25

[Unattributed news brief: "Shanghai Stresses Fiber Optic Communication Industry as Major Development Task"]

[Summary] The Shanghai Municipal Government has singled out the fiber optic communications industry as a major development focus. In the Eighth 5-Year Plan, the municipal production target for optical fiber is 100,000 km, and that for fiber optic cable is 3000 km. Production of optical communications equipment will also be stepped up [see JPRS-CST-92-014, 24 Jul 92 p 43], and in the Caohejing High-Tech Development Zone several new joint ventures for production of optical fiber and fiber optic cable will be founded. In addition, the scale of production of digital fiber-optic terminals at Shanghai AT&T Communications Equipment Ltd. [see JPRS-CST-91-024, 23 Dec 91 p 26] will be increased.

Guangzhou-Beijing, Guangzhou-Haikou, Guangzhou-Nanning Fiber Optic Cables To Be Built

92P60408B Beijing DIANXIN JISHU
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 6, Jun 92 p 40

[Unattributed, untitled news brief]

[Summary] MPT has approved funds for construction of three overhead fiber optic cables originating in Guangzhou: one leading to Beijing, one to Haikou, and one to Nanning. These three fiber optic lines, totaling 4500 km in length, will be laid by the end of this year and put into operation in 1993. The new lines will add 9600 circuits to the inter-provincial level-one trunkline; of these circuits, 1920 will be for the Guangzhou-Hunan-Hubei-Henan-Hebei-Beijing route and 3840 will be for the Guangzhou-Haikou route.

Beijing-Wuhan-Guangzhou Fiber Optic Cable Construction Progressing

92P60438B Beijing DIANXIN JISHU
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 8, Aug 92 p 47

[Unattributed, untitled news brief]

[Text] First-phase construction of the Wuhan-Changsha segment of the Beijing-Wuhan-Guangzhou overhead fiber optic cable was recently completed when the final poles were put in place on Rongan Mountain in Puqi County, Hubei Province. This first-phase construction included all work involving renovation, re-routing, and stiffening of the fiber optic cable running between Wuhan and Changsha.

Details of HJD-04 High-Capacity SPC Digital Switch Provided

92P60408C Beijing DIANXIN JISHU
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 7, Jul 92 pp 2-4

[Article by Technical Dept., China P&T Industrial Corporation: "Introduction to HJD-04 Digital Stored-Program-Controlled Telephone Switch"; cf. earlier brief report in JPRS-CST-92-004, 20 Feb 92 pp 37-38]

[Summary] The domestically developed HJD-04 stored-program-controlled (SPC) digital telephone switch, designed for the nation's digital-analog hybrid networks as well as for pure digital networks, has a capacity of 60,000 equivalent lines, suitable for a 16,000-line tandem office or a 30,000-40,000-line metropolitan telephone office, and a BHCA [busy hour call attempts] processing power of over 2 million. The digital switching network has a distributed duplicate-T-type single-T network structure, the dual-tone multi-frequency (DTMF) signal receivers incorporate real-time multiplexed spectral analysis technology, system hardware design (using less than 20 circuit boards) is modular, normal-load call loss is 10^{-11} , and 20-percent-overloaded call loss is less than or equal to 0.005. The module processing unit uses an MC68000 quasi-32-bit microprocessor. The digital switching network element currently has 2048 ports, which in the future will be expanded to 3072 ports. The module communications processing unit has a 64 kbps transmission rate and a 2.048 Mbps receiving rate.

The HJD-04 high-capacity digital SPC telephone switch is designed for C5, TM, C4, and C3 switching centers, and has C2 switching center functions as well. The HJD-04, certified by MPT on 8 December 1991, is now in trial operation at public-network experimental offices, and will soon be put into mass production.

Changde Digital SPC PBX Production Line Passes Acceptance Check

92P60436A Beijing ZHONGGUO DIANZI BAO
[CHINA ELECTRONICS NEWS] in Chinese
10 Aug 92 p 1

[Article by Yang Yusong [2799 3768 2646]: "Changde Stored-Program-Controlled Switch Technological Transformation Project Completed"]

[Text] The Changde [1603 1795] Wired Communications Equipment Manufacturing Company's digital stored-program-controlled private branch exchange (SPC PBX) Seventh 5-Year Plan technology transformation project—the first to involve a Chinese firm's contract to import advanced foreign technology of this type—passed ministry-level completed project acceptance check on 31 July. This State Seventh 5-Year Plan electromechanical technology transformation key project was based on the 1988 importation of an advanced production line from the Netherlands's Philips Co. at a gross investment of 29.83 million yuan. The

product is [Philips'] SOPHO-S series of digital PBXs, with a wide capacity range, strong composite network ability, complete digital functions, and ability to be directly hooked up to an ISDN [integrated services digital network]. All technical indicators conform to CCITT recommendations and to national standards, including the State Outstanding-Grade Switch Standard. Composite annual production capacity is 117,000 lines.

**First Domestically Made 10,000-Line
Toll/Municipal/Rural Digital SPC Telephone
Switch Certified**

92P60438A Beijing DIANXIN JISHU
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 8, Aug 92 p 47

[Unattributed, untitled news brief]

[Summary] The nation's first domestically made 10,000-line toll/municipal/rural digital stored-program-controlled (SPC) telephone switch recently passed the

appraisal organized by MPT in Dayong County, Hunan Province. This equipment, now being installed for trial use in MPT end offices in Laizhou, Shandong Province, and in Dayong County, was developed and is manufactured by MPT Institute 10.

**Shandong Province's First Satellite Earth Station
in Trial Operation**

92P60438C Beijing DIANXIN JISHU
[TELECOMMUNICATIONS TECHNOLOGY]
in Chinese No 8, Aug 92 p 47

[Untitled news brief by Fan Ji [5400 6549]]

[Text] Shandong Province's first satellite earth station—the Qingdao Satellite Earth Station—has now been put into trial operation. This new station should greatly relieve the overcrowded conditions now prevailing in telecommunications between Qingdao and major cities such as Beijing, Guangzhou, Urumqi, and Hohhot.

Reports on New Nuclides**Pt-202 Discovered by Institute of Nuclear Research**

92P60439A Beijing ZHONGGUO KEXUE BAO
[CHINESE SCIENCE NEWS] in Chinese 18 Aug 92 p 2

[Article by Shang Gong [1424 0364]: "China Is First To Discover the New Nuclide Platinum-202"]

[Summary] Shanghai (ZHONGGUO KEXUE BAO wire report)—Scientists at the CAS Shanghai Institute of Nuclear Research (SINR) recently formally announced their discovery of a new nuclide, platinum-202 (Pt-202). Nuclides, which are usually "created" by artificial means, have enormously important applications as radioisotopes [in medical research]. Of the over 2,000 nuclides so far discovered worldwide, Pt-202 is the first discovered by mainland Chinese scientists. The new nuclide was found with an independently designed experimental apparatus incorporated into a domestically made accelerator in a 300-continuous-hour experiment in June 1991. In further improvements and testing since that time, the SINR scientists have assembled a large mass of data on Pt-202, including determination of its half-life (43.6 plus or minus 15.2 hours).

Hg-208, Hf-185 Synthesized by Institute of Modern Physics

92P60439B Beijing RENMIN RIBAO [PEOPLE'S DAILY OVERSEAS EDITION] in Chinese 17 Sep 92 p 3

[Article by Xi Yongnian [6741 3057 1628]: "Another Major Achievement in Domestic Basic Research in Atomic and Nuclear Physics: World's First Synthesis of Two New Nuclides"]

[Summary] Lanzhou, 16 Sep (XINHUA wire report)—Scientists at the CAS Lanzhou Institute of Modern Physics (LIMP) recently were the first worldwide to synthesize and verify detection of two new nuclides: mercury-208 (Hg-208) and hafnium-185 (Hf-185), an achievement receiving the highest praises of [Party] General Secretary Jiang Zemin on his visit to the institute. This research, encouraged and financially supported by the State S&T Commission and by the Natural Science Foundation of China, is a major Eighth 5-Year Plan achievement for the CAS, and is the result of intense effort begun over 2 years ago after the completion of the Lanzhou Heavy-Ion Accelerator. The neutron-abundant nuclide Hg-208 was synthesized in the accelerator by bombarding a thick Pb target with a carbon-12 ion beam having a single-nucleus energy of 30 MeV, and its half-life was determined to be 42 minutes. The LIMP scientists then proceeded to use a 14 MeV neutron beam to irradiate a tungsten target, creating the new nuclide Hf-185, and measured its half-life to be 3.5 minutes; they also noted that this element decays into gamma rays.

Controlled Fusion Update

92FE0802B Beijing ZHONGGUO KEXUE BAO
[CHINESE SCIENCE NEWS] in Chinese 21 Jul 92 p 1

[Article by Li Qiming [2621 0796 2494] and Deng Xianchun [6772 6343 2504]: "Controlled Fusion Device Successfully Developed"]

[Text] A suction barrier (diaphragm) used in controlled fusion research was successfully developed by the Southwest Institute of Physics as a "863" national high-technology project. It was certified by experts recently.

The suction barrier is an experimental device on a controlled fusion apparatus. It is primarily used to control the plasma density and impurity required for controlled fusion. In addition, it may be used in the ash removal system of the next-generation controlled fusion facilities and fusion reactors. It was designated as an "863" high-technology project in 1987 and the responsibility of its development was given to the Southwest Institute of Physics of the Ministry of Nuclear Industry.

This project is difficult from the standpoint of theory and technology. Regardless, the researchers worked very hard from conceptual design. They explored and modified numerous schemes and made over 500 sketches. In terms of technology, experimental studies were done to overcome more than a dozen technical hurdles. Finally, the device was successfully developed to a world-class level. It is being used on the largest controlled-fusion apparatus in China, i.e., the HL-1.

Experts believe that this device fills a void in China. It can be easily disassembled and can move radially. Moreover, it is easy to deliver gas and the device can be connected to a low-temperature pump. It puts China among the leaders in the world in this subject; furthermore, it provides a solid foundation for the design and selection of the ash removal system of the next-generation controlled fusion apparatus and fusion reactor.

Hefei National Synchrotron Radiation Source Detailed

92FE0802A Beijing WULI [PHYSICS] in Chinese No 5,
May 92 pp 257-262

[Article by He Duohui [0149 1122 1979] of China University of Science and Technology: "Hefei National Synchrotron Radiation Source"]

[Text] Light, or more generally speaking electromagnetic radiation, is a necessary tool to observe and study nature. Synchrotron radiation, an electromagnetic radiation with many unique features, is no exception. Although only discovered not too long ago, it is widely used in many technical areas and is responsible for a great deal of progress in science and technology. China began planning to construct its own synchrotron radiation source, i.e., the Hefei National Synchrotron Radiation Source. It is comprised of an 800 MeV electron

storage ring and a 200 MeV linac injector. Construction began in November 1984 and finished in April 1989. The results obtained in June 1991 show that its major specifications have met advanced levels worldwide. This paper introduces key points of the Hefei National Synchrotron Radiation Source and also discusses some basic issues regarding synchrotron radiation and synchrotron radiation sources.

I. Synchrotron Radiation and Synchrotron Radiation Sources

If you ever saw the Crab Nebula, a supernova first observed by the Chinese in 1054, in the clear night sky, do you know the nature of its glow? It is synchrotron radiation, i.e., the electromagnetic radiation emitted tangentially by relativistic electrons moving in a magnetic field. Since it was theoretically predicted that synchrotron radiation exists in a ring-shaped accelerator, it was first observed for the first time by the naked eye on a 70 MeV synchrotron at General Electric in 1947. Hence, it is also called synchrotron radiation.

The device that generates synchrotron radiation is a synchrotron radiation source. A synchrotron radiation source must provide two basic functions. First, it accelerates electrons to a sufficiently high energy level; close to the speed of light. Second, it makes these near-light-speed relativistic electrons rotate in a magnetic field. The first task is done by an injector. Usually, it is made of a linac, a synchrotron, or a cyclotron. The second function is accomplished by a synchrotron or an electron storage ring. Nevertheless, because of consistency of beam energy, high beam-current intensity and high beam quality, a storage ring produces better synchrotron radiation. Therefore, all modern synchrotron radiation sources are storage ring sources and synchrotrons are used as injectors.

The loss of energy due to synchrotron radiation is the major obstacle preventing synchrotron energy from going higher. It is considered as a hurdle in high-energy physics. However, synchrotron radiation has many unique features and is widely used in many technical fields. These features are as follows:

First, the spectrum of this high-energy electron emission is continuous. Based on the energy of the electrons, it covers infrared to vacuum ultraviolet, soft X-rays, hard X-rays, and even γ rays. Its characteristic wavelength is usually defined as $\lambda_0 = 4\pi R/3\gamma^3$, where R is the turning radius of the electron in meters and γ is the ratio of electron energy to its rest energy. The higher the electron energy is, the shorter its characteristic wavelength becomes. From $0.2 \lambda_0$ to infrared, the intensity of the spectrum does not vary much. Experimentally, it is possible to continuously scan over a desired wavelength range with a monochromator. Furthermore, a synchrotron radiation spectrum can be accurately calculated and used as a standard to calibrate a radiometer.

Second, synchrotron radiation intensity is very high. A modern storage-ring-based synchrotron radiation source

generates several thousand to several hundred thousand watts of synchrotron radiation. For instance, the power of the X-rays it produces is a few hundred thousand times stronger than that of a conventional X-ray source.

Third, the power of synchrotron radiation is concentrated in a very small solid angle in the direction of electron motion. The magnitude of the solid angle is approximately equal to the ratio of the rest energy to the total energy of the electron. For instance, the synchrotron radiation emitted by a 1 GeV electron is concentrated within a 0.5-mrad solid angle. Therefore, synchrotron radiation is inherently collimated.

Fourth, synchrotron radiation is polarized light. On the plane of electron motion, it is completely polarized; $\frac{2}{3}$ of the total power radiated is planarly polarized.

Fifth, due to automatic phase stabilization in the storage ring, the rotating electrons are gathered into several bunches. Hence, synchrotron radiation has a pulse structure. The pulse duration and interval can be varied by changing the accelerator parameters.

Sixth, synchrotron radiation is emitted by free electrons. It is independent of any atomic or molecular processes. Stored electrons are in ultrahigh vacuum, a very clean environment. There is no possibility of contamination of the test specimen by the light source.

Because of these unique features, synchrotron radiation is widely used in many technical areas, such as surface physics, solid state physics, atomic physics, molecular physics, life science, material science, chemistry, medicine, geology and mining, radiometry and ultra-fine machining, and numerous accomplishments have resulted. There is increasing interest in building more synchrotron radiation sources. To date, more than 50 facilities are either in operation, under construction, or being planned. A synchrotron radiation source is costly to build; the technology involved is complicated and the construction cycle is long.

Synchrotron radiation sources can be divided into two categories: dedicated light sources and non-dedicated light sources. An electron-positron collider designed and constructed for high-energy physics experiment also produces synchrotron radiation when electrons and positrons are rotating in the storage ring and is considered as a non-dedicated light source. For instance, the Beijing Electron-Positron Collider (BEPC) is a good example. An electron storage ring specially designed and constructed to produce synchrotron radiation, such as the facility described in this paper, is a dedicated light source. The design of a dedicated light source is optimized for synchrotron radiation. Its synchrotron radiation characteristics are far more superior to those of a non-dedicated light source. A dedicated light source operates according to the energy and mode requirements of the synchrotron radiation experiment most of the time. A non-dedicated light source, however, operates based on the energy and mode requirements of the high-energy physics experiment. It is difficult to meet the

needs of the synchrotron radiation experiment. Therefore, dedicated synchrotron radiation sources are being constructed by a number of countries.

Synchrotron radiation sources are divided into two types of wavelength: i.e., vacuum ultraviolet sources and X-ray sources. Although a high-energy electron storage ring can simultaneously produce X-rays and vacuum ultraviolet light, there are disadvantages to use its vacuum ultraviolet light to perform an experiment. First, most of the power received by the optical components is from X-rays. It is not only useless but also produces a deleterious heat load on the optical components. As a result, cooling is required. Second, the beam is long and requires a larger first optical element for reception of light of identical milliradians. Third, the degree of polarization is low in the vacuum ultraviolet. Therefore, everyone is building a dual-band light source: a 2 GeV high-energy electron storage ring mainly as an X-ray source and a hundred MeV to 1.5 GeV low-energy electron storage ring primarily as a vacuum ultraviolet light source.

II. Hefei National Synchrotron Radiation Source

The synchrotron radiation source at the Hefei National Synchrotron Radiation Laboratory was constructed by China University of Science and Technology. It is China's first dedicated synchrotron radiation source for vacuum ultraviolet light and X-rays. The source is an 800 MeV

storage ring and the injector is a 200 MeV linac. Figure 1 is a sketch of the device. Electrons from the electron gun are accelerated to 200 MeV by the 35-m linac. They are transported to the pulse switching magnet in a beam transport line. The switching works like a railroad switch. Based on its polarity, it can send electrons to the right in a 55-m-long injection line to inject them into the 66-m-circumference ring, or to the left into a magnetic analyzer to measure the energy spectrum of the electron. When the magnetic field strength is zero, the forward current is either discarded or deflected to the nuclear physics laboratory building by the bending magnet.

1. Injector and Transport Line

The injector of the light source is a 200 MeV traveling-wave electron linac. It is comprised of an electron gun, a pre-buncher, a beam buncher, and nine pieces of 3-m disk waveguide acceleration tubes. Because of radiation shield requirements, it is located in an underground tunnel. The microwave power supply is installed in a klystron corridor. The 2,856-MHz microwave signals generated by the main oscillator are first amplified by the power klystron and then divided into five channels to excite five high-power klystrons to 15 MW each. They are then fed into the pre-buncher, buncher, and nine segments of 3-m disk waveguide acceleration tubes from a power distributor and a waveguide. Electrons emitted by the electron gun form a ps

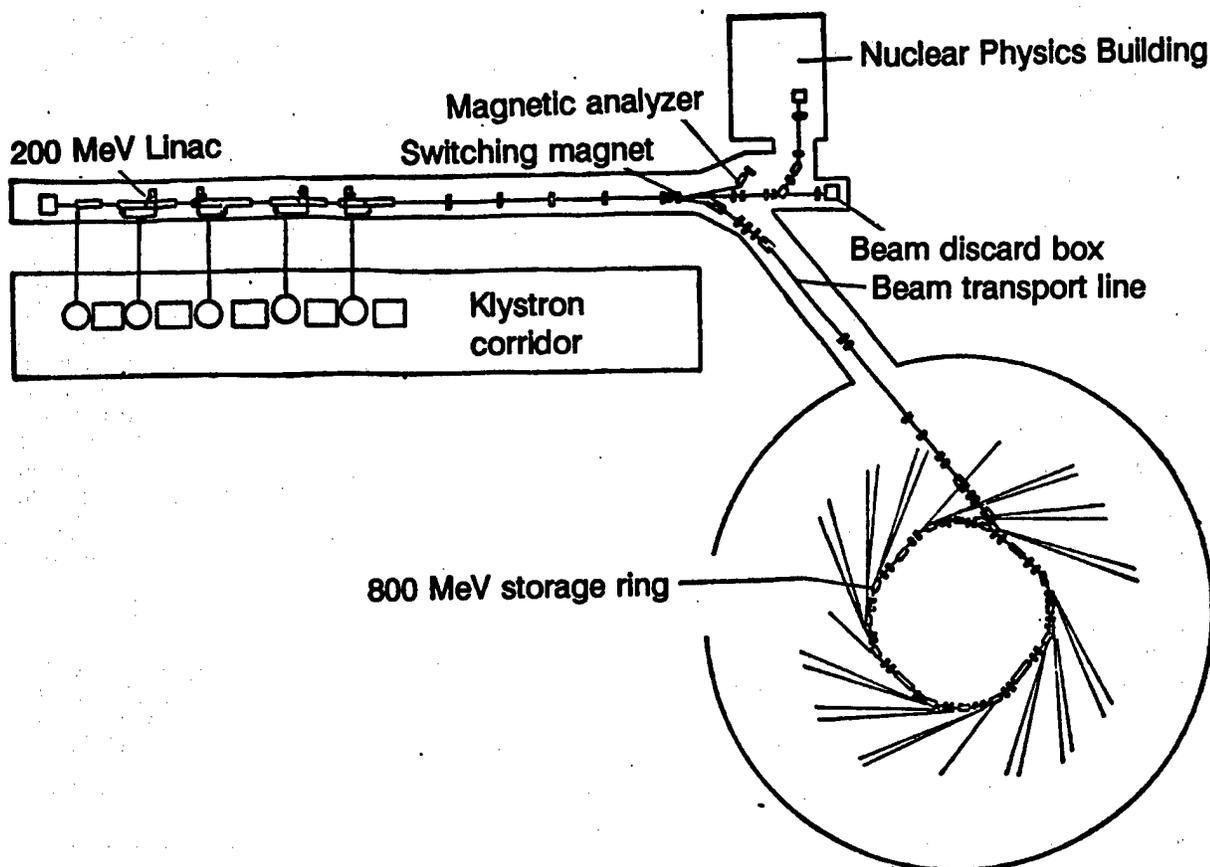


Figure 1. Layout of the Hefei National Synchrotron Radiation Source

bunch after going through the pre-buncher and buncher in each period of the 2,856-MHz signal. The microwaves that enter the disc waveguide acceleration tubes create a traveling-wave accelerating electric field which moves at the speed of light. The electron bunch is accelerated to near light speed

over a short distance inside the acceleration tube. Then, the bunch rides on the peak of the accelerating electric field and moves at the same speed as the traveling-wave electric field. It is accelerated to 200 MeV by nine consecutive tubes. Table 1 shows the major parameters of the linac.

Table 1. Major Specifications of the 200 MeV Linac

Parameter	Design Value	Attained Value
Electron energy	220 MeV	225 MeV (50 mA)
Beam current (pulse)	50 mA	130 mA (195 MeV)
Current pulsewidth	0.2-1 μ s; 2-4 ns	
Beam energy dispersion	plus or minus 1%	FWHM < 0.8%
Klystron output power	15 MW	
Number of klystrons	5	
Microwave frequency	2,856 MHz	2,856.2 MHz
Operating mode	$2\pi/3$	
Acceleration structure	Constant impedance	
Filling time	0.83 μ s	
Microwave electric field	120 kV/cm	
Field attenuation constant	$\alpha = 0.178/m$	
Accelerator length	35.128 m	
Accelerator tube vacuum	5×10^{-7} Torr (w/o beam); 5×10^{-6} Torr (with beam)	$< 1 \times 10^{-6}$ Torr; $< 5 \times 10^{-8}$ Torr

The beam transport line is used to transport the electrons to the required location and to achieve phase matching; it does not accelerate electrons. It is primarily composed of several magnetic quadrupoles and dipoles. The quadrupoles work as a series of lenses in an optical system; they keep the electron beam focused so that it is not scattered during transport. A dipole is used to deflect the beam either horizontally or vertically, as required.

2. Storage Ring

The 800 MeV electron storage ring is a separated focusing structure. Figure 2 shows its layout. Tables 2 and 3 list its parameters. It is comprised of the following major components:

(1) Vacuum System

A 66-m-circumference vacuum loop (chamber) connects various components of the storage ring. Stored electrons are rotating in the center of the tube (i.e., in storage). In

order to minimize collision loss between electrons and residual gas molecules, 23 concentrated and 12 distributed sputter ion pumps are used to create a 10^{-10} mmHg ultrahigh vacuum in the vacuum chamber.

(2) Magnets

The storage ring uses 12 bending dipoles, 32 quadrupoles and 14 hexapoles. They are all made of laminated iron. The magnetic dipole is used to deflect the electron beam. Each dipole bends the beam by 30°. The electron trajectory in 12 dipoles is a circle with a radius of 2.22 m. The bent electron beam emits synchrotron radiation. The electron energy stored is 800 MeV and the bending magnetic field strength is 1.2 T. The characteristic wavelength of synchrotron radiation is 24 Angstroms. The useful wavelength range is 5 Angstroms to far infrared. The quadrupole is used to focus the beam. The hexapole is used to calibrate chromaticity and to stabilize the leading and trailing edge of the beam.

Table 2. Basic Parameters of the 800 MeV Storage Ring

Electron Energy	800 MeV	Ring Circumference	66.1308 m
Average current	100-300 mA	Mean radius	10.525 m
Electrons stored	$1.47-4.41 \times 10^{11}$	Electron cyclotron frequency	4.5333 MHz
Energy radiated per cycle	16.3 keV	High frequency	204.0 MHz
Total radiation energy (bending magnet)	4.89 kW	Operating vacuum	2×10^{-9} Torr
Synchrotron radiation characteristic wavelength	25 Angstroms		

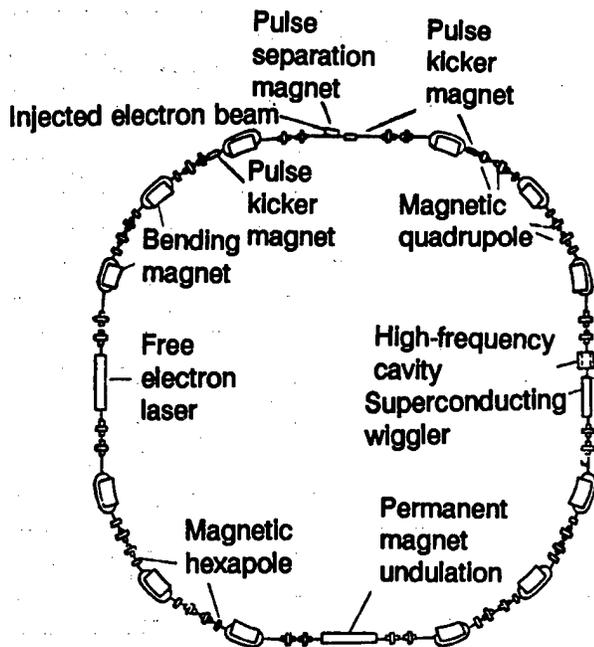


Figure 2. 800 MeV Electron Storage Ring

(3) High-Frequency System

Due to synchrotron radiation, the stored electrons are losing energy. If this energy is not replenished, the radius of the orbit will decrease and electrons will be lost because of collisions with the vacuum chamber wall. The high-frequency system is used to replenish energy to the electrons. It consists of a high-frequency cavity, a high-frequency unit and a control system. The high-frequency power generated by the high-frequency unit is sent into the cavity to establish a traveling-wave accelerating field. When electrons pass through the cavity, they are accelerated to regain their energy. The energy obtained from the high-frequency system per cycle is equal to that lost to synchrotron radiation. This makes the electrons maintain the same orbit. The high frequency of the 800 MeV storage ring is 204 MHz. Compared to the electron cyclotron frequency, the ratio is 45. It can store 1-45 bunches and the duration of the light pulse is approximately 100 ps. Depending on the number of bunches stored, the interval between pulses is tunable from 5 ns to 220 ns.

To inject electrons from the transport line into the storage ring is a complicated physical process. The storage ring employs three kicker magnets to make the rotating electrons form a local concave pulse. A kicker spacing magnet is used to deflect the electrons from the transport line in such a way that they are injected at a certain angle in a specific location to coincide with the pulse. The injected electrons are rotating with those injected earlier and captured in the ring.

The 800 MeV storage ring has four linear sections. The first linear section is used to place the injection spacing

magnet and kicker magnet. A portion of the second linear section is for the high-frequency cavity. The remaining part and the third and fourth sections are used for inserted elements. These inserts are a series of magnets placed tightly along the axis in a periodic fashion with polarity perpendicular to the axis. The electron beam passes these inserts along the axis in a zigzag manner. Inserts are placed in the storage ring to produce specially requested radiation. The nature of the inserts is expressed by a deflection parameter $K = 0.934 \lambda_0 (\text{cm}) B_0 (\text{T})$, where λ_0 is the period of the magnet and B_0 is the peak magnetic field of the magnet. The characteristic wavelength of synchrotron radiation produced by an insert with a strong field and a long period, i.e., $K \gg 1$, is shorter than that produced by the main bending magnet in the storage ring. In addition, it is also more intense. Such an insert is called a wiggler. A short-period, low-field insert with $K \leq 1$ can produce a quasi-monochromatic radiation of extremely high intensity over a very narrow bandwidth at certain wavelengths. The synchrotron radiation spectrum is no longer continuous. Such an insert is known as an undulator. A 6-T superconducting wiggler is installed in the second section of the 800 MeV storage ring in order to produce X-rays with a characteristic wavelength of 5 Angstroms and shortest useful wavelength of 1 Angstrom. A permanent magnet undulator is installed in the third section to produce tunable high-intensity quasi-monochromatic light ranging from a few dozen to several hundred Angstroms. A free electron laser is installed in the fourth linear section.

The storage ring was designed for 100-300 mA of beam current with an injection energy of 200 MeV. Usually, the injection time is a few minutes. After injection is stopped, the degree of synchronization will rise. The magnetic field strength, high-frequency accelerating voltage and electron energy will increase. Over a period of 2-3 minutes, electrons will be slowly accelerated to 800 MeV. They are stored at this energy level for the long term. After a few hours, the current intensity will fall to less than half of its initial level due to spontaneous decay. The remaining current is then discarded and new electrons are being injected into the ring again.

3. Beam Measurement and Control

Because electrons are moving at close to the speed of light, it only takes approximately 0.4 μs to travel from the electron gun through the linac and transport line to reach the storage ring. Electrons stored in the ring are rotating more than 450 million times per second. The acceleration, transport, injection, slow acceleration and storage of electrons involve many complicated physical processes. Beam measurement and control is a very difficult task. Various probes are installed along the linac, transport line and storage ring to measure the intensity, position, cross section, length, energy spectrum, emissivity and oscillation frequency of the beam. The control system is a distributed computer control system consisting of a central computer, a communications microcomputer and a number of local control microcomputers.

Table 3. Focusing and Optical Parameters of the 800 MeV Storage Ring

Parameter	Symbol	GPLS Mode	HBLS Mode	
Transverse oscillations per cycle	ν_x	3.58	5.82	
	ν_y	2.58	2.42	
Maximum values of β and η (m)	$\beta_{x\max}$	22	22	
	$\beta_{y\max}$	13	13	
	η_{\max}	1.6	0.85	
Beam emissivity (horizontal, nm-rad)	ϵ_{x0}	166	26.87	
Momentum tightening factor	α	0.0444	0.0116	
Natural chromaticity	ζ_x	-6.13	-17.72	
	ζ_y	-2.41	-4.47	
Lateral oscillation coupling index	κ	1.0	0.1	
Bunch cross sections at the center of the bending magnet and wiggler (mm)	σ_{x1}	0.44	0.17	
	σ_{y1}	1.03	0.115	
	σ_{x2}	0.82	0.2	
	σ_{y2}	0.35	0.14	
	σ_{x3}	0.44	0.22	
	σ_{y3}	1.03	0.95	
	σ_{x10}	1.34	0.116	
	σ_{y10}	0.53	0.177	
	Bunch length (mm)	σ_1	32.6	17.3
		B_{r1}	4.4×10^{13}	1.01×10^{15}
B_{r2}		6.9×10^{13}	0.7×10^{15}	
B_{r3}		4.4×10^{13}	0.95×10^{15}	
B_{r10}		2.8×10^{13}	0.96×10^{15}	

4. Progress in Engineering of the Hefei National Synchrotron Radiation Source

In view of the fact that significant progress has been made in synchrotron radiation elsewhere, Chinese scientists recommended the construction of its own synchrotron radiation source in 1977. In 1978, the Chinese Academy of Sciences decided to put China University of Science and Technology in charge of the planning work. Between 1978 and 1981, preliminary study and physical design were completed. On April 8, 1983, the State Planning Commission officially approved the construction of a national synchrotron radiation source at China University of Science and Technology under the supervision of the Chinese Academy of Sciences. Ground breaking took place in November 1984. By November 1987, the 200 MeV linac began to produce electron beams with energy and current exceeding the design specifications. The 800 MeV storage ring stored its first beam and produced synchrotron radiation for the first time on April 26, 1989. In June 1991, the tuning of the storage ring was completed. The ring stores 800 MeV electrons at more than 200 mA. The maximum current is 267 mA. Compared to comparable devices in the world, its major specifications have reached advanced levels worldwide.

III. Potential Applications of the Hefei National Synchrotron Radiation Source

When electrons are bent by a magnet, they produce synchrotron radiation. Light beams are piped from windows on the vacuum chamber to the laboratories to be irradiated onto samples. The function of the light pipe is to split the light beam, keep it monochromatic and maintain its focus. The vacuum chamber of each bending magnet has a 120-mrad window and an 85-mrad window. The light from each window can be split into two. The entire ring has 12 bending magnets and a total of 24 windows. The three inserts have a window each. The entire ring can accommodate more than 50 light beams for more than 50 experiments simultaneously. The storage ring building is a 50-m-diameter circular hall. The diameter of the storage ring at the center of the hall is 20 m. The light pipes and laboratories are located around the ring.

Presently, five light pipes and five laboratories have been completed. Their capabilities are as follows:

(1) Optoelectronic Energy Spectrum Beam and Laboratory

This is used in the study of free surfaces of semiconductors and crystals; metal-semiconductor, semiconductor-semiconductor and semiconductor-insulator interfaces;

amorphous and organic semiconductors; and multi-purpose optoelectronic energy spectrum.

(2) Time-Resolved Spectrum Beam and Laboratory

This is used to study the energy transport of rare-earth materials, to investigate the fluorescent lifetime of amorphous and laser materials, to determine low-temperature protein fluorescent spectra for fluorescent lifetime and energy transport studies, and to investigate high-energy excitation in solids.

(3) Photochemistry Laboratory

This is used to study atomic and molecular absorption spectra and fluorescent spectra, chemical reactions of high electronically excited molecules, and reactions involving molecules and ions.

(4) Soft X-Ray Lithography Beam and Laboratory

This is used in the study of millimeter-wave device lithography, surface ultrasonic device lithography, metric grating lithography, ultra-fine machining, and VLSI lithography.

(5) Soft X-Ray Microscopy Beam and Laboratory

This primarily is used for soft X-ray microscopy, light element (including biological specimens) microscopic analysis and microstructure analysis, soft X-ray diffraction, and the fabrication of masks for soft X-ray lithography.

More light beams and laboratories will be constructed as more investment is made to serve more users in a variety of technical fields. This synchrotron radiation source will play a more critical role in the advancement of science and technology in China.