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# **Science & Technology**

***China***

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# Science & Technology China

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4 January 1991

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### Information Technology To Be Top Priority of '863' Program

91FE0084B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 29 Sep 90 p 1

[Article: "Song Jian Pointed Out in Report-Back Meeting on Strategic Targets of Information Technology—We Should Exert All Effort in Developing Information Technology and Industries"]

[Text] Information technology is the prime area of the major targets in the '863' Program; we should exert all effort in developing our information technology and industries. Song Jian, member of State Council, chair of State Science & Technology Commission and head of the High Technology Planning and Coordination Group under the State Council, put emphasis on this point in a report-back meeting of the '863' Program on Strategic Targets of Information Technology, which closed today.

The meeting was convened on 25 September in Wuxi, Jiangsu, where over 100 experts examined and discussed strategic targets in three areas of the information technology field.

In an important speech delivered at the closing ceremony, Song Jian said that information technology, the focus of international competition, permeates and exerts an influence on every facet of modern life: From home appliances, factory automation to management decision-making, such information technologies as computers and microelectronics are relevant. In today's world, a major country like China with 1.1 billion people cannot enjoy the right of equal dialogue unless it achieves a certain degree of independence in information technology and industries. Therefore, rapid development in this area is the natural responsibility of our S&T workers. In discussing ways by which this can be done, Song Jian said that the history of countries in the world and China reveals that there are two impetuses for the development of high technology: the pull of the market and the push from technological development. For example, China's development of sophisticated technology in national defense provided the push for microelectronics and computer technology. But this kind of push alone is not enough to guarantee the rapid development of high-tech industries. In addition, it is necessary to strengthen application development, cultivate markets, create economy of scale, accumulate capital from the market, and then increase input. Song Jian said that history has proven that only with the combination of government planning and promotion and pull of the market can information technology develop at a relatively fast pace. Furthermore, to facilitate the pull of the market, it is necessary to introduce appropriate mechanisms of fair competition in the development of high-tech products to encourage enterprises to increase input, improve quality and lower costs, so that both domestic and foreign market can expand and market demand can grow. This is one necessary condition for the development of information technology and industry.

Song Jian also touched on the issues of self-reliance and international cooperation. He said that in the 90s we will continue to implement the policy of reform and openness and to strengthen our academic exchange with international colleagues, which is an important factor in the development of our high-tech industry. However, many high technologies, especially those in the information sector, are either not available for purchase, or can only be bought with many conditions attached. Therefore, only on the foundation of independence and self-strengthening can international cooperation on an equal basis be possible.

Others who attended this report-back meeting included Zhou Guangzhao, president of the Chinese Academy of Sciences, Zhu Lilan, vice-chairman of the State Science Commission and such famous scientists as Zhu Guangya, Yang Jiachi, Chen Fangyun, Shi Changxu and Lin Lanying.

An exhibition of some of the achievements in information technology was also held during the meeting.

### Focal Points of National S&T Achievements Expansion Plan

91FE0084A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 23 Sep 90 p 3

[Article by the S&T Achievements Bureau of the State Science Commission: "Several Issues Regarding the National S&T Achievements Expansion Plan"]

[Text] Recently, calls for S&T to be more integrated with production are getting louder. Although S&T achievements are growing at a pace of 10,000 items per year, less than 10 percent of these can be applied in a large area or on a large scale. While industrial and mining enterprises are short on replenishments of much-needed technology, projects that the research departments are eager to push often find no takers, and many S&T achievements are lost in the gap. To resolve these problems, the S&T Achievements Bureau of the State Science & Technology Commission has devised a "National S&T Achievements Expansion Plan" this year, the contents of which can be summarized as follows:

#### I. Purpose of the Expansion Plan

Its purpose is to create a favorable environment and conditions for the transfer of S&T results to production, so that a large number of sophisticated S&T findings can be applied to the battlefield of national economic construction systematically and orderly. Economy of scale can be achieved quickly by mobilizing tens of thousands of S&T workers and the entire society, who would then execute the plan in the countryside and the industrial and mining enterprises, covering a large area and a wide scope. Hence integration between S&T and the economy can be promoted; industrial structure can be adjusted and its technological level, heightened; in particular, the technological level of traditional production can be improved.

## II. Levels of the Expansion Plan

The plan is comprised of two parts: "National S&T Achievements Expansion Plan" and "Local S&T Achievements Expansion Plan." While the former is under the State Science Commission, the local plans will be organized and implemented by the local science commissions on their own. A small fraction of loans earmarked for the promotion of national S&T achievements will be awarded to local plans that are efficient and that covers a wide scope. After being implemented on the provincial or city level, these plans will be incorporated into the national plan.

## III. Goals of the Expansion Plan

Every year, about 1,000 S&T achievements will be included in the national and local-level expansion plans, reaching 3,000 to 5,000 implementation units. In 3 to 5 years, agricultural items will cover about 20 percent of the applicable technology and industrial items, about 25 percent.

## IV. Major Source of the Promoted Items

These items will receive priority: National S&T target items and recipients of national invention awards and S&T awards; items that have spin-off effect on related technologies, especially those that cut across boundaries between fields and departments; items that are significant to the development of traditional industries. Those results that are efficient and cover a wide area from the "Spark" and "Torch" Plans will be further promoted so as to foster an overall climate.

## V. Target Areas

In agriculture, target areas are derived from actual production needs at present and in the immediate future. In light of the goals of increasing the per-unit yield of such primary products as grains, cotton and oil, quality improvement, reducing material waste and more efficient supply, the targeted S&T achievements are food grains, cotton, oil, sugar, poultry, fisheries, forestry and such generalized and multi-disciplinary areas as chemical fertilizers, pesticides, agricultural-use thin membranes, and farming machinery. In industry, the targeted areas stem from the needs of economic and social development, and focus on such much-needed fields as energy, transportation, communications and raw materials. Starting with the goals of augmenting labor productivity, strengthening integrative abilities, and increasing efficient supply, supplemented by the needs of adjusting both industrial and production structures, the targeted S&T achievements are energy-saving, reduction of waste, quality improvement, increased product lines, more export items and import-substitution items.

## VI. Expansion Policies

Pride of place will be given to the establishment and nourishment of organizations and systems that are capable of self-generating. Capitalize on the advantages

of integration in S&T achievements by importing complete sets. Insist on paid technological transfers. Further develop and consolidate expansion service systems. Use various ways that accord with local conditions to train human resources. Fully utilize existing tax breaks for tested and new products. Designate a fixed proportion from various S&T awards for outstanding items in the achievement expansion plan.

## Measures to Improve S&T Development Loan System

91FE0084C Beijing RENMIN RIBAO in Chinese  
14 Sep 90 p 3

[Article by Zhou Mubing, General Administration Research Office, Chinese Bank of Industry and Commerce: "High-Tech Industries Need Suitable Financial Environment"]

[Text] The support of capital is needed if S&T achievements are to convert successfully into competitive products in the domestic and foreign markets. In the past, S&T achievements suffered from a wide-spread problem of coexisting "excesses" and "shortages" (that is to say, an abundance of S&T findings that cannot be easily applied piling up in the academies and universities on the one hand, relatively low technological level and product quality suffered by many enterprises on the other). The major reason for this lies in insufficient capital input in the middle and follow-up stages of the "research—development—transfer" process; the entire process short circuits or collapses for lack of capital "energy." To better implement the "Torch" plan in the development of high-tech industries, we should pay full attention to the input of capital "energy" from the start.

With the continued reform of our S&T and financial systems, the Chinese Bank of Industry and Commerce was first to establish S&T development loans, which have been conducive to the vitality of S&T enterprises and the promotion of commercializing S&T achievements. To provide an appropriate financial environment for the development of high-tech industries, we should improve our existing system of S&T development loans in the following ways:

1. Increase the proportion of S&T development loans. At present, its share in the total loan provided by the Bank of Industry and Commerce is less than 1 percent, hardly meeting the needs of the development of high-tech industries. Taking the large capital requirement that characterizes high-tech industries into account, the proportion of S&T loans should be increased to provide for a larger capital input.
2. Adjust the structure of S&T development loans. Emphasize loans to high-tech industries by cutting back on general S&T loans, hence shifting the focus of S&T loans toward high-tech industries and products.
3. Extend the terms of S&T development loans. It takes a relatively long time for a new high-tech product to

move from R&D to production stage, but the present terms of S&T loans are limited to 1 to 3 years. Hence the bank is more likely to lend to items that are "short, cheap and fast," hardly conducive to the development of high-tech industries.

4. Reform management of S&T development loans. According to the present management rules, all S&T loans are listed under floating capital loans, and are not included in the fixed asset investment plans of the country. Since in practice, S&T development loans are

often used to cover fixed asset investment expenditures, they should be part of the fixed asset investment plan.

5. Combine S&T development loans with other loans. S&T development loans can be combined with technology reform loans and floating capital loans, using the former as lead and the latter as follow-up. As soon as a S&T loan-supported high-tech product is successful in gaining market share, the capital need for large-scale production that ensued can be met by technology reform and floating capital loans.

**Aerospace Industry Records Good Year***OW0612010490 Beijing XINHUA in English  
1640 GMT 5 Dec 90*

[Text] Beijing, December 5 (XINHUA)—China's aerospace industry has experienced its best year in 1990, recording the highest number of satellite launches and new types of aircraft.

China successfully launched five satellites and designed and made several new types of aircraft this year, Lin Zongtang, minister of aerospace industry, said at a press conference today.

Among the five satellites launched, Lin said, one was carried into orbit by the Long March 2-E launching vehicle, a Long March 2 rocket which is fitted with four boosters. This rocket, with a take-off thrust of 600 tons, carried the 9-ton satellite into a near-earth orbit.

The scientific experiment satellite launched and recovered last October is the 12th of its kind to be launched and recovered. All of these recoverable satellites have successfully returned to earth.

As for the new types of airplanes, Lin disclosed that several have been developed this year, including the JP-7 trainer and the Y-7 200B passenger plane. The trainer, a modification of a previous trainer, was built according to the needs of foreign clients, he said.

The Y-7 200B passenger plane is a modification of the Y-7 100. Compared with its prototype, the new plane is 500 kg lighter, flies 300 km farther, consumes seven percent less fuel, and uses 300 meters less runway, Lin explained.

**Head of Space Technologies Research Institute  
Outlines Future Satellite Applications***91FE0053A Beijing HANGTIAN [SPACE FLIGHT]  
in Chinese 26 Sep 90 pp 2-3*

[Article by Min Guirong [7036 2710 2837]]

[Text] As a second strategic target of China's socialist construction program, China's gross national product is expected to double in the 1990's. In order to achieve this target, we must rely on science and technology; in particular, we must pay a great deal of attention to the development and application of advanced technologies. One of the advanced technologies that would have a profound effect on economic and social development is application satellites. Because of its wide area coverage, a satellite can transmit information to every corner of this country, producing enormous social and economic benefits. Many of China's social problems such as problems in education and culture, transportation and communication, population and natural resources, environment and natural disasters, can be solved using satellites. Therefore, the promotion and application of artificial satellites at various levels will be an inevitable trend of the future.

In recent years, the demand for applications satellites by different organizations has been growing rapidly. An analysis of the society's needs indicates that satellite applications in the following areas are of the highest priorities and will produce the greatest payoff in terms of social and economic benefits.

**Satellite Television Education System.** It is well known that education is one of the major problems facing China today. At the present time, many Chinese people in the work force are illiterates, even more are completely ignorant in the area of science; opportunities for higher education are very limited. To rely on traditional methods to solve today's education problem is not a feasible approach from the point of view of financial expenditure and time. But, by deploying a multi-channel, high-power television satellite which covers a large number of cities and villages, it is possible to employ a small number of highly qualified instructors to offer classes at various levels, thereby greatly enhancing its social benefits. For example, a small-scale satellite TV education program has been in operation in recent years with outstanding results. Today, the program has as many as 10 million students and has trained more than 1 million high-school and grade-school teachers; training the same number of teachers by conventional methods would take 20 years longer.

**Satellite Communications System.** The backward status of China's communications industry greatly hinders its economic development. The availability of telephones in this country is far below world average. Study has shown that if communications were more developed, many business activities can be conducted by telephone without having to travel; this will relieve the overloaded transportation system by reducing the passenger volume by one-third, which translates into an annual saving of 10 billion yuan. Today, the total amount of funds being transferred through the financial community reaches 50 to 60 billion yuan per year, and the average transit time is 6 days. A 20 percent increase in transmission speed corresponds to 10 billion yuan of additional funds in circulation.

Therefore, developing satellite communications and broadcast systems would provide a fundamental solution to the problems of education and communications. In the 1990's, we must develop high-capacity, high-power, multiple-beam and long mission-life communications and broadcast satellites. In order to meet the growing requirements for television education systems, fixed and mobile communications systems, as well as data, voice and video transmission systems, the satellite should have a frequency spectrum covering not only C-band but also Ku-band and L-band. Once the high-capacity "Dong Fang Hong-3" satellite, which is currently under development, becomes operational, it will provide an effective means for promoting and improving China's multi-layered TV education system. It will also contribute to China's communications and broadcast industry by improving its efficiency, and stimulate the development of China's national defense and national economy.

**Satellite Transportation Control System.** Transportation is the life-blood of the national economy. The current status of China's transportation system suffers from an inadequate shipping network and poor efficiency. The railroad transportation system which carries both passengers and cargoes is severely overloaded; the losses due to cargoes in transit total 54 billion yuan per year. On the other hand, the trucking system has an unfilled capacity of 47.9 percent, which corresponds to a loss of 5.9 billion yuan per year. To remedy this situation requires the use of advanced technologies. By developing a satellite transportation control system, the operation and allocation of various vehicles (ships, ground vehicles, aircraft) around the country can be scientifically controlled to improve speed and efficiency. For example, a 10 percent improvement in the speed and scheduling of the railroad system would correspond to the construction of thousands of kilometers of new railroads and a saving of 10 billion yuan in shipping cost per year.

**Satellite Disaster Prevention and Rescue System.** Because of China's complex geographic environment, it suffers from natural disasters year after year. Statistics show that China's losses from natural disasters average tens of billions of yuan annually; last year, the loss was more than 50 billion yuan. There are predictions that the 1990's will be an era of major global disasters. For this reason, the United Nations and China have both organized "10-year disaster mitigation" teams and are planning effective measures for disaster prevention and rescue. The use of satellite disaster prevention and rescue system is a very powerful approach to achieve this goal. A satellite system not only can provide enhanced disaster forecasting capability, but can also command and organize rescue missions when disasters have already struck, thus greatly reducing the severity of losses. Indeed, as a result of the reliable information provided by weather satellites in recent years, the losses caused by wind, flood and fire have been significantly mitigated. Therefore, developing satellite disaster prevention and rescue systems is one of the society's urgent needs.

**Satellite Environment and Resources System.** One of the major problems facing China's social development is over-population and lack of natural resources. The amount of cultivable land, forests, fresh water and mineral resources in this country are very limited compared to the world average. A more serious problem is the considerable misuse and waste of valuable resources due to the lack of scientific approach to development, application and management. In order to make maximum use of China's available resources, it is important to develop both underground and underwater resources at the same time. For this reason, we should concentrate on developing and utilizing earth resource satellite systems.

China is currently in the process of developing different types of advanced meteorological and earth resource satellites. The meteorological satellites include those in sun-synchronous orbits and geosynchronous orbits. The earth resource satellite is being developed under a joint

venture between China and Brazil, and is expected to be completed during the "Eighth 5-Year Plan" period. Studies are also underway to provide better capability for monitoring the atmosphere, the landmass and the ocean by improving the resolution, expanding the spectrum for remote sensing, and extending the satellite mission life.

**Development of Space-Borne Micro-Gravity Resources.** By conducting research in materials and microbiology on a space vehicle under weightless conditions, it is possible to manufacture high-quality materials and substances that cannot be produced on earth; they include semiconductors, optical materials, special alloys and medicines. These accomplishments will have very high economic and scientific value. At present, most developed countries are actively engaged in the research and development of micro-gravity resources. However, to carry out this task requires the use of retrievable satellites, which are currently available only in the Soviet Union, the United States and China. China has accumulated more than 15 years of experience in retrievable satellites since it began development in the 1960's. In recent years, significant progress has been made in conducting micro-gravity experiments on domestic satellites; some of the accomplishments are considered to be state-of-the-art. Therefore, from the point of view of society's needs and technical feasibility, research and development of micro-gravity resources clearly will be the trend of future satellite applications.

In addition to the above-mentioned areas, priority should also be given to satellite systems that are urgently needed for national defense. It should be pointed out that many satellite applications are shared by both military services and civilian organizations. Therefore, integrated development and utilization of satellites is an inevitable trend of the future.

Over the past 20 years, China has accumulated a great deal of valuable experience in aerospace technology. Its accomplishments in the development, launch, operation, control and application of various types of satellites have demonstrated the ability of the Chinese people to solve complex technical problems. Therefore, as long as sufficient funding is provided by the State, China's scientists and engineers will provide their technical know-how to develop, launch, and utilize the satellite systems to contribute to China's socialistic modernization effort.

**JJ-7P Fighter-Trainer Makes Successful Flight**  
*91P60063 Guiyang GUIZHOU RIBAO in Chinese*  
*14 Nov 90 p 1*

[Summary] On 13 November 1990 the JJ-7P fighter-trainer made a successful 19-minute flight and landed without incident. The JJ-7P is a tandem two-seat fighter training aircraft developed by the Guizhou Aviation Industry Corporation and represents a major modification of the JJ-7 fighter-trainer. The JJ-7 made its first flight in 1985, and drew considerable interest from international aviation circles at that time. In early 1989,

the Ministry of Aeronautics and Astronautics put out the requirement for the JJ-7P and by March 1989 the modified plans for the aircraft were finalized. The Guizhou Aviation Industry Corporation spent 19 months on the project, completing the aircraft in October 1990. The JJ-7P is a light-weight, high-altitude, supersonic, high-performance combat fighter-trainer and a major item on the R&D agenda of the Ministry of Aeronautics and Astronautics Industry. The Chinese consider this aircraft to be near state-of-the-art and capable of competing with similar aircraft from advanced countries.

### **Aerospace Trade Pursuing Drive to Hit World Mark**

40100017 Beijing CHINA DAILY in English  
6 Dec 90 p 1

[Article by staff reporter Li Hong]

[Text] China's aerospace industry, coming to the close of a promising year, is set to continue its drive in catching up with the world's latest hi-tech developments, a leading official said yesterday in Beijing.

Four new types of aircraft are expected to come off the assembly line and be ready for service next year, while several others will be modified and improved.

But Aerospace Industry Minister Lin Zongtang told a press conference in Beijing yesterday that China may launch fewer satellites next year, and that he would soon go abroad to negotiate for possible launch contracts.

Lin and other space experts re-affirmed that China's self-developed launch vehicles Long March 3 and Long March 2-E met world advanced standards.

According to schedule, China will launch two communications satellites in the coming year for the Australian Satellite Company and for ArabSat.

The country is at present producing a large capacity "Dongfanghong 3" telecommunications satellite designed to meet domestic demand. And it also plans to

launch a weather satellite in 1993 to supplement the Feng Yun 1 solar satellite already in orbit in order to form a weather forecasting network covering the whole country, latest reports said.

Lin said that by November 26, his ministry, a government agency administering the research, design and production of aircraft, spacecraft, rockets and missiles, had realized all the main goals planned for 1990, including five successful space ventures and the take-off of two types of aircraft.

China launched a "Dongfanghong 2" communications satellite in February, the AsiaSat 1 in April, a test satellite atop its newly-developed Long March 2-E in July, its second meteorological satellite "Feng Yun 1" in September and its 12th retrievable remote-sensing satellite in October.

Lin spoke highly of the powerful four-booster reinforced Long March 2-E launch vehicle which has a lift-off ability of 600 tons and carrier ability of up to nine tons.

China had also made outstanding efforts in developing and improving new aircraft, the minister said.

The Guizhou Aircraft Manufacturing Corporation in southwest China developed the supersonic J-7P military trainer, and the Xi'an Aircraft Manufacturing Corporation in Shaanxi completed an improved model of the Y-200B passenger plane.

Lin stressed that wider cooperation between China and foreign countries could speed up the country's research and development of aircraft.

He revealed that China is seeking a foreign partner to develop long-range jets.

Lin said the total exports of aero and space-related products, conducted by the China National Aero-Technology Import and Export Corporation (Catic), the China Great Wall Industry Corporation (CGWIC) and the China Precision Machinery Import and Export Corporation (CPMIEC), would hit a record of 1.56 billion yuan (\$300 million) this year.

**Chinese University at Forefront in  
Millimeter-Wave R&D**

91P60060 Beijing KEJI RIBAO [SCIENCE AND  
TECHNOLOGY DAILY] in Chinese 29 Nov 90 p 2

[Article by Peng Dejian [1756 1795 1696]: "China  
University of Science and Technology at Forefront in  
Domestic Millimeter-Wave R&D"]

[Summary] In a 10-year effort, a team led by Prof. Li Dunfu [2621 2415 1788] of China University of Science and Technology has developed four types of equipment for millimeter-wave technology. Experts have certified that these four apparatuses, which have now passed CAS academy-level appraisal, approach or meet international standards of the late eighties. These newly developed devices will satisfy the domestic demand and some have already been exported to the U.S., Japan, and West Europe.

The FM (frequency modulation) linearity of the millimeter-wave linear FM continuous-wave radar front-end unit, the first of the four devices certified, has reached 3

ten thousandths, matching the state-of-the-art worldwide; the second apparatus, a millimeter-wave-radar multi-channel receiver front-end unit, incorporates advanced high-packing-density technology to achieve 70dB channel isolation and a relatively low noise figure; the third apparatus, a band-spread device for millimeter-wave instruments, solves problems involved with domestic testing of millimeter-wave devices and opens new paths for further development of higher-frequency test instruments; and the fourth device, an 8-millimeter miniaturized phase-locked source, can serve as a new small-size, high-reliability, highly stabilized signal source for a variety of testing systems and radar systems.

These four types of equipment were independently developed under a situation wherein exports to China of such technology have been restricted or embargoed by foreign governments. Some of the applications of this technology include communications, satellites, remote sensing, meteorology, radio astronomy, military (guidance systems for missiles and other weapons), and plasma diagnostics. The units will especially be of value in modernizing guidance units in China's weapons systems and remote-sensing satellites.

**Fermentor Sensors Developed**

91P60040B Shanghai WEN HUI BAO in Chinese  
13 Oct 90 p 1

[Article by Huang Xin [7806 6580]: "Basic Sensors for Bioengineering Applications Developed in Shanghai"]

[Summary] To promote industrialization of Chinese biotechnology, many basic sensors for bioengineering applications have been developed by Shanghai Metallurgy Institute of the Chinese Academy of Sciences. The newly developed multi-contact defoaming sensors have demonstrated the advantages of saving defoaming agents and preventing leakage after testing in the 60-ton fermentor of the Shanghai Yeast Plant and the 50 M<sup>3</sup> fermentor of the Shanghai Tianchu Monosodium Glutamate Plant. Another sensor, the liquid measurement sensor, will provide the nation's biotechnology industry with a complete automated liquid measurement system by continuously measuring the quantity of liquid in the reactor. The other two sensors, the discharge-type CO<sub>2</sub> analyzers, have also reached world standards. Chinese scientists have suggested the popularization of these sensors in order to better serve the nation's industrialization of bioengineering.

**Direct Detection of Human Immunodeficiency Virus (HIV) Gene by the Polymerase Chain Reaction**

40091003A Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese  
Vol 10 No 5, Oct 90 pp 273-276

[English abstract of article by Yang Lihong [2799 4539 1347], Xiang Bingyi [7309 4426 2034], and Su Chengzhi [5685 2052 5347] of the Department of Biochemistry, Fourth Military Medical University]

[Text] The polymerase chain reaction (PCR) and southern blot were used to detect the HIV gene directly. Primer HIV-env125-1, HIV-env125-2 and probe HIV-env101-1 were synthesized with automated DNA synthesizer. Using pCP10 (contains HBV gene), M56 (contains hantaan virus cDNA M fragment), pUC19, JBV and human genomic DNA as controls, the conserved region 2 of HIV-env gene was specifically amplified from target DNA pARV-2/7A. It is shown that the method is highly specific and sensitive and can detect a single molecule of HIV gene from the sample.

**Threonine-Producing Gene-Engineered Bacterium Produced**

91P60040C Shanghai WEN HUI BAO in Chinese  
4 Oct 90 p 4

[Article by Ni Dazheng [0242 1129 2973]: "Threonine-Producing Gene-Engineered Bacterium Passes Appraisal"]

[Summary] The first strain of highly active and stable threonine-producing gene-engineered bacterium has been produced by Wu Ruping and Yang Shengli 5 years after their developments of penicillin acylase gene-engineered bacterium. Threonine, one of the eight human essential amino acids for histone synthesis, is the amino acid that promotes phospholipid formation and oxidation of fatty acids in higher animals and is an important resource for synthesizing new wide-spectrum antibiotics that can correct bacterial resistance to penicillin and the toxic side effects caused by penicillin. China is now one of the three countries capable of producing this strain of bacterium. The State is planning to industrialize the production of this high-yield, high-recovery strain of bacterium in the near future.

**A Monoclonal Antibody Produced by Immunization With the Synthetic Peptide From HLA-B27 Recognizes an Allospecific Determinant of HLA-B27 Lymphoblastoid Cell Lines**

40091003C Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 5, Oct 90 pp 282-286

[English abstract of article by Shi Bingjun [2457 4426 6874], Deng Hongkui [6772 1347 7608], et al., of the Shanghai Institute of Immunology; project supported by the National Natural Science Foundation of China]

[Text] Based on the results of epitope analysis of HLA-B27 primary structure involved in recognition by T and B cells with computer program a good antigenic determinant candidate of amino acid sequence 63-84 from HLA-B27 was selected for chemical synthesis. After conjugation with carrier KLH, this synthesized peptide was used as an immunogen in the production of monoclonal antibodies with a modified immunization protocol. Nine clones of monoclonal antibodies which only reacted with synthetic peptide without crossreaction with carrier have been obtained by three times of fusion. Only one of them, F3H7, was identified to be specifically reactive with synthetic peptide as well as with HLA-B27<sup>+</sup> lymphoblastoid cell lines as tested by microcytotoxicity

and immunofluorescence test. The epitope recognized by F3H7 seems to be around in residues from 67 to 78 of HLA-B27 molecule according to ELISA screening of a series of synthetic peptides. The implication and application of the monoclonal antibody F3H7 in the study on the relationship between HLA-B27 and ankylosing spondylitis have been discussed.

**Shanghai Institute a Leader in Organic Chemistry**  
*91P60040A Shanghai WEN HUI BAO in Chinese*  
*21 Oct 90 p 1*

[Article by Ni Dazheng [0242 1129 2973], Yao Shihuang [1202 6108 3552]: "Chinese Organic Chemistry Research Now Among World's Advanced Nations"]

[Summary] The Shanghai Organic Chemistry Institute of the Chinese Academy of Sciences, the largest Chinese organic chemistry organization, has become a mainstay in the field of organic chemistry both domestically and overseas. The institute has determined the protein structure of trichosanthin, the chemical structure and artificial synthesis of qinghaosu (arteannuin or artemisinin) on the basis of artificial synthesis of yeast alanine-transferred nucleic acids. The trichosanthin has been applied clinically to induce abortion for 15,000 women in China, and the qinghaosu is being used as a new antimalarial drug for some 200 million malaria sufferers. Recently the Chinese Government is building a life organic chemistry open laboratory in the institute. In the area of metal organic chemistry, the institute started its metal organic chemistry research in 1987 and built an open laboratory in 1989; 26 projects, including metal superconducting films and induced synthesis of organic compounds with metal organic materials, were achieved. A new CAS computer chemistry open laboratory was established in 1989, and achievements in chemical data base and synthesis design of computer accessories were attained. The institute has become an internationally recognized organic fluorine chemistry research center due to its successful developments of fluorocarbon artificial blood that has been successfully used on the battlefield, its fluorine-plastic alloys, and its synthetic freon substitutes.

**The Preparation of Monoclonal Anti-Idiotypic Antibodies Against Human Anti-HBs and Their Immunogenicity**

*40091003D Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 5, Oct 90 pp 301-303*

[English abstract of article by Wang Haitao [3769 3189 3447], Chen Wanrong [7115 8001 2837], and Jiang Yutu [5592 6276 0956] of the Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing]

[Text] The monoclonal anti-idiotypic antibodies against human anti-HBs were prepared by fusing the myeloma cells, SP2/0, with the spleen cells of BALB/c mice which had been immunized with human anti-HBs purified by affinity chromatography. Two hybrids, R<sub>1</sub> and R<sub>2</sub>, showed the ability to inhibit the binding of human anti-HBs and HBsAg. Each of four adult BALB/c mice was injected with 100 µg of R<sub>2</sub> three times intraperitoneally. Each of two rabbits was immunized with 1 mg of R<sub>2</sub> four times subcutaneously. All the mice and rabbits produced anti-HBs and the specificity was confirmed by neutralization test or competitive inhibition test (solid-phase radioimmunoassay, SPRIA). The anti-HBs titers of sera of mice and rabbits were from 2<sup>-8</sup> to 2<sup>-11</sup> and from 2<sup>-9</sup> and 2<sup>-10</sup> respectively.

**Chemical Synthesis of a Gene Coding for High Essential Amino Acids of Humans**

*40091003E Shanghai FUDAN XUEBAO [JOURNAL OF FUDAN UNIVERSITY—NATURAL SCIENCE] in Chinese Vol 29 No 2, Jun 90 pp 189-197*

[English abstract of article by Zhang Xiaodong [1728 2556 2639], Yang Di [2799 6611], et al., of the Institute of Genetics]

[Text] A gene coding for high essential amino acids of humans was synthesized by using the solid phosphoramidite method. The gene is 300 bp in length and encodes 94 amino acids except two restriction sites at the end. More than 92 percent of the amino acids are essential for humans. When the gene is fused to the plant gene promoter in either direction, the expressed gene product will be a protein of high essential amino acids. The plant-preferred codons were chosen for the gene. Codons encoding lysines were inserted into this gene at interval. In order to modify and separate the two large fragments to be assembled, the EcoR I, EcoR I and BamH I, Hind III restriction sites were designed at 5' end, 3' end and the 141 bp site of the gene, respectively. Two large fragments were assembled by the method of "Three Steps Separating Annealing Assembling" and inserted into M13mp18 RF DNA separately. The identity of the two fragments was checked by DNA sequencing. After two DNA fragments were isolated, purified, ligated, and inserted into M13mp18 RF DNA and transformed. The identity of the gene was checked by enzymatic digestion and DNA sequencing.

**The Study on Construction of Genomic Bank, Recombinant DNA Hybridization, DNA Sequencing Analysis and Polymerase Chain Reaction in Icterohaemorrhagiae Leptospira**

*40091003B Beijing ZHONGHUA WEISHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 5, Oct 90 pp 277-281*

[English abstract of article by Bao Lang [7637 2597] and Dai Baomin [0108 0202 3046] of the West China University of Medical Science, Chengdu]

[Text] The first genomic bank of *icterohaemorrhagiae leptospira* was set up in this lab, and a series of recombinant DNA clones were collected. From these DNA clones, a number of DNA radioactive labelled probes were used for DNA hybridization in Southern blotting technique. Then, the DNA sequences were analyzed. The restriction map and open reading frames of the amino acid coded by the DNA sequence were determined. Two pairs of oligonucleotide primers for PCR were synthesized and DNA of leptospire were detected by means of polymerase chain reaction (PCR).

The recombinant DNA clones were divided into various groups by the selection of replica hybridization and dot

blots further with genomic DNA probes, which can identify and recognize the different strains, serovars and serogroups by Southern blotting analysis. After the restriction map was determined, the recombinant DNA clone pLIps01 was sub-cloned and seven proper clones were selected. Clone S-LIHp-1 and S-LIHp-5 were sequenced. The restriction map and open reading frames (ORF) of amino acids coded by these DNA fragments have come out by the microcomputer analysis. The microquantity of DNA in various serogroups of leptospire were detected by means of PCR, the control groups showed negative reaction. Therefore, it could be developed into a powerful tool for early diagnosis of Leptospirosis.

## New Parallel Processing Systems Described

### 160MIPS-Peak 980 STAR Systolic Array

91P60047 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 43, 7 Nov 90 p 1

[Article by Han Guangjun [7281 0342 6511]: "China's First 100MIPS-Class Systolic Array Computer Debuts in Wuhan"]

[Summary] The 980 STAR systolic array computer, developed as a key state Seventh 5-Year Plan project by the Wuhan Digital Engineering Research Institute [formerly Institute 709 of the China State Shipbuilding Corporation; see earlier report in JPRS-CST-90-012, 18 Apr 90 p 16], recently passed national-level technical appraisal. This major advance in domestic parallel processing technology will provide a new path for supercomputer development in China.

The 980 STAR multi-level-parallel general-purpose two-dimensional systolic array computer, which meets international standards of the mid eighties, consists of four components: a host, an image subsystem, an interface processor, and a systolic computing array. The programmable, reconfigurable, and expandable array, in turn, consists of 16 [independently functioning] cells in a 4 x 4 matrix. Pipeline beat is 200 nanoseconds, and single-cell processing speed is 10 million instructions per second (MIPS), making for a peak array processing speed of 160MIPS. Maximum throughput is 80Mbytes per second.

The new systolic array computer comes with both a user operating environment and a user development environment. The former integrates statements in the PL/M-86 language of the Intel 310/286 host [Intel 310 augmented iRMX operating system] with the 980 STAR's library functions system. The development environment is geared toward high-level R&D applications and includes a library management system with expandable library functions; new library functions can be developed via the high-level language Syla, and microprogram development tools and a microprogram simulation and debugging environment are also included.

Applications of the new high-speed parallel processing system are seen in mathematics, electronics, aerospace, biological research, petroleum prospecting, and medicine. The institute is currently developing a new STAR model which will have a processing speed two levels of magnitude greater than that of the 980 STAR; the new model will be oriented toward both industry and defense.

### Hierarchical System Using Domestic RISC Chips, Inmos Transputers

91P0047B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 44, 14 Nov 90 p 1

[Article by Xu Youhui [6079 0147 6540]: "RISC-Based Hierarchical Parallel Processing System"; cf. JPRS-CST-90-019, 23 Jul 90 p 41, a description of a similar but less powerful system developed by the same institute]

[Summary] Using [domestically made] RISC [reduced instruction set computing] chips, East China Institute of Computing Technology has developed a hierarchical microcomputer parallel processing system, now officially accredited by an expert technical committee called by the Ministry of Machine-Building & Electronics Industry. The system consists of three layers: the topmost layer is the microcomputer host, an IBM PC AT or compatible; the middle layer consists of three "clusters" (described below); and the bottom layer consists of 12 processing elements (PEs), each PE being an Inmos T800 Transputer chip (10MIPS or 1.5MFLOPS processing speed, 2MByte built-in memory). A "cluster" consists of four PEs, one of which is employed as the cluster main control processor. Each cluster, with the associated interconnection network of RISC-based circuitry, is contained on one circuit board. Data communications between clusters is via the widely used MP (message passing) mode. Peak processing speed for the 12-PE system is 80MIPS or 10MFLOPS.

The new system can run under the XENIX and DOS operating systems, and is designed for the C, FORTRAN, and Occam parallel languages as well as the C, FORTRAN, and Pascal serial languages. The system is especially suitable for engineering calculations and graphics/image processing.

### Another Transputer-Based Processor with Parallel Potential

91P0047C Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 43, 7 Nov 90 p 39

[Article by Sun Ding [1327 1353]: "Jiangnan Institute Puts Out JN T800-8M-BCB Microcomputer Transputer Processor"]

[Summary] In order to greatly increase microcomputer processing speed for solving problems involving huge quantities of data, the Jiangnan [Computing] Institute has recently developed and marketed the JN T800-8M-BCB microcomputer Transputer processor. The new processor consists of one PC standard board insert with an Inmos T800 Transputer chip (10MIPS or 1.5MFLOPS processing speed) and an 8MB RAM, and is designed for an IBM PC XT/AT or compatible, as well as for all 386 systems with an AT bus. Several processors can be inserted into the microcomputer to form a multi-Transputer parallel system. The system will accept the C, FORTRAN, and Occam parallel languages. Software includes the TDS Transputer development system for the multi-board parallel system.

When one of the boards was tested with an 8MHz Donghai 286 under DOS 3.3 with parallel C language, 1 million U.S. national standard benchmarks were run, and the resultant rating was 5813 Dhrystones per second. This is 98 percent higher than the value for a 16MHz Compaq 386 without a Transputer processor for the same calculations, and 167 percent higher than the value for an IBM PC AT.

**Additional Details on First Domestic Reactor-Process Computer System**

91P60043A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 41, 24 Oct 90 pg 34

[Editorial Report] JISUANJI SHIJIE [CHINA COMPUTERWORLD], No 41, 24 October 1990, carries on page 34 a 500-word article on the State Education Commission's technical certification on 26 September 1990 of the "reactor-process computer system" developed by Qinghua University's Institute of Nuclear Energy Technology. Additional details not already provided in an earlier report on this topic [see JPRS-CST-90-028, 9 Nov 90 p 15] are given here.

The reactor-process computer system, whose technical appraisal committee included representatives of the State Nuclear Safety Administration, is an independently developed system based on imported technology. Specifically, the host consists of two PDP 11/73 computers, and the data acquisition equipment—imported from Britain's Solartron Company—consists of the recently marketed IMP intelligent separated acquisition stations forming a distributed data acquisition network. The investment in the domestic development of the [overall] system—compared to importation of the entire equipment, software, and other support—has saved over 75 percent of the cost.

**New Domestically Made PCs Described****Legend 286, 386, 486 Models**

91P60049a Beijing GUANGMING RIBAO in Chinese 31 Oct 90 p 2

[Article by Lu Sha [6424 3097]: "Chinese Developed Microcomputers at World State-of-the-Art"]

[Summary] Beijing, 29 Oct—The Legend [Lianxiang 5114 1927] series of microcomputers—whose development is part of the national Torch Plan—passed the acceptance check sponsored by an expert committee

from the Chinese Academy of Sciences (CAS) today. Operating speed and major performance indicators for these microcomputers meet or exceed international standards for similar PCs. The Beijing Legend Computer Group, which is under CAS, has now developed and marketed the 286, the 386, the 386SX, and the 486. Of these, the 286 is the most profitable; 8000 286 main computer boards are shipped monthly to the U.S. and Europe. The high-speed 386 and 386SX models, now in batch production, are also being sold abroad. The Legend 486, China's first domestically manufactured 486-class computer, is the highest performance microcomputer made in the world today, and its domestic manufacture indicates that China can compete in the highest ranks of the world PC market.

**First Laptop PC/XT**

91P60049b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 45, 21 Nov 90 p 1

[Article by Dong Zhiwen [5516 1807 2429] and Li Yanmin [2621 3601 3046]: "Changzhou Computer Plant Develops PC/XT Laptop Computer"]

[Summary] The first domestically made IBM PC/XT-compatible laptop microcomputer, the 4.77MHz PC 800, developed by the Changzhou Electronic Computer Plant in Jiangsu Province, has passed technical appraisal and is now being put into batch production. The new Chinese-English model has an uninterrupted power supply using an 80C88 chip, a 256KByte on-board RAM, comes with parallel and serial interfaces, and can be easily connected to standard peripherals such as a printer, plotter, or modem. The LCD can display 16 x 4 Chinese characters or 32 x 8 ASCII characters, and in the graphics mode can display a 256 x 64 dot matrix. Using a rechargeable battery, this light (2 kilograms) PC can run for 6 hours. The PC 880 uses the popular Memory Card memory; this technology has heretofore been restricted abroad, but the Changzhou plant independently designed and developed its own semiconductor memory card for use in the PC.

### Fiber-Optic Image Transmission Apparatus Developed

91P60057 Shanghai JIEFANG RIBAO in Chinese  
8 Nov 90 p 3

[Article by Zhang Xingduan [1728 5887 4551]: "Domestic Fiber-Optic Image Transmission Technology Enters World's Forefront"]

[Summary] Nanjing, 7 Nov (XINHUA)—The successful technical accreditation on 6 November in Nanjing of a domestically developed 500,000-fiber-bundle large-cross-section super-long-range fiber-optic image transmission apparatus demonstrates that the nation's fiber-optic image transmission technology has reached the world's forefront. The apparatus, which has various objective lenses at one end and an eyepiece with a fixed magnification factor at the other end, can be connected to television camera systems, and is specifically designed for long-range transmission of imagery—whether the end use be for observation, monitoring, or recording—from high-temperature, toxic or hazardous source areas. The technical experts agree that this apparatus, developed by Nanjing Research Institute 841, is a major achievement for China's fiber-optic research—with applications in industry, aerospace, and national defense, as well as in pure research—and that it will meet the domestic demand and moreover be competitive with foreign-made state-of-the-art products of like kind.

### 8-mm Pulsed High-Power IMPATT Oscillators Fabricated

91FE0103C Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese  
Vol 11 No 8, Aug 90 pp 603-608 [MS received  
13 Oct 89]

[Article by Yang Yufen [2799 3768 5358], Zhang Huanghe [1728 7806 3109], Wang Baoqiang [3769 0202 1730], Hou Menghui [0186 1125 2585], Wu Xiaodong [0702 2556 2639], and Peng Bin [1756 2430]: "8 mm Pulsed High-Power IMPATT Oscillators"]

#### [Text] Abstract

This paper describes the design considerations and fabrication technology for an IMPATT [impact avalanche and transit time] diode, and the development of the microwave circuit structure and a pulse modulator. The chirp effect during pulse biasing has been explained. A method to reduce its bandwidth is introduced. The 8-mm IMPATT diode developed has an output power of over 20 W. Its maximum pulse output power at 35.5 GHz is 48 W. Its repetition frequency is tunable between

1-100 kHz and its pulse width is adjustable between 50 ns-1  $\mu$ s. Its frequency is stable and its reliability is high.

Key words: oscillator, millimeter-wave solid-state source, modulator.

#### I. Introduction

High-power IMPATT oscillators are widely used as millimeter-wave solid-state sources in military applications. For example, millimeter-wave tracking radars, missile target finders, short-range communications, tachometry and ranging need compact, lightweight, high-resolution millimeter-wave solid-state sources that are powerful enough to penetrate through clouds and fog, smoke and dust. The most active system is the 8-mm system with a central frequency of 35 GHz. The reasons are that atmospheric attenuation at this frequency is small and various 8-mm devices can easily be found to put together a complete system. A high-performance 8-mm pulsed solid-state source involves the development of the device, a pulse modulator and a microwave oscillator circuit. Only when all three components reach a certain standard is it possible to develop a satisfactory oscillator for practical use. A great deal of effort was spent on device fabrication and development of the pulse modulator and microwave oscillator circuit. A practical oscillator was developed. The pulse output power of the oscillator mostly ranges between 20-40 W. Its repetition frequency is selectable between 1-100 KHz and its pulse width is tunable between 50 ns and 1  $\mu$ s. In engineering applications, most systems are short-pulse systems. Therefore, our development work was focused on short-pulse IMPATT oscillators.

#### II. Pulsed IMPATT Devices

The major design consideration for a short-pulse 8-mm IMPATT diode is its impedance limit. Because a short-pulse IMPATT oscillator has a low duty ratio, its junction temperature would not rise appreciably. Consequently, its operating current density can be significantly increased, even up to one order of magnitude higher than that in continuous operation. Such a high transient current density drives up the transient space charge density in the active region. The space charge plays an important role in modulating the electric field distribution in the drift region. It puts the device in a large-signal operating mode. Therefore, carrier space charge effect and diffusion effect should be included in the design considerations. The interaction between the large-signal characteristics of the device and the circuit is more complicated. It is difficult to analyze accurately in the millimeter-wave band. Therefore, our analysis was primarily based on small signals. Then, the carrier space charge effect and diffusion effect were introduced under large-signal conditions to design various parameters of the device.

Based on small-signal theory, the impedance of the device is:<sup>1</sup>

$$Z = R_s + 1/\omega c_d \left[ \frac{1}{1 - (\omega/\omega_r)^2} \left( \frac{1 - \cos \theta}{\theta} \right) \right] \\ + j \frac{1}{\omega c_d} \left[ \frac{1}{1 - (\omega/\omega_r)^2} \left( \frac{\sin \theta}{\theta} - 1 \right) \right] \\ - \frac{W_A}{W_d} \left( \frac{1}{1 - (\omega/\omega_r)^2} \right)$$

When the operating frequency  $\omega$  is higher than the avalanche resonance frequency  $\omega_r$ , a negative impedance appears. The relation between the negative impedance  $R$  and transit angle  $\theta$  is:

$$-R\alpha(1 - \cos \theta)/\theta$$

From the above equation, we know that the largest negative impedance occurs when the transit angle is  $0.74\pi$ . It corresponds to a drift region that is  $0.37 V_s/f$  wide. Parameters calculated based on the small-signal theory tend to be low in doping concentration and electric field slope in the drift region, and high in its width. The actual width of the avalanche region is wider and the efficiency of the oscillator is lower. Therefore, the carrier space charge effect and diffusion effect must be included. A correction is made to the above equation (specific derivation is omitted). When the central frequency is 35 GHz, the final parameters of the device are:

$$W_A = 0.2-0.25 \mu\text{m}$$

$$W_d = 0.8 \mu\text{m}$$

$$V_B = 25-30 \text{ V}$$

$$N_d = (2-3) \times 10^{15} \text{ cm}^{-3}$$

$$\text{Diameter: } D = 200 \mu\text{m}$$

The process flow is as follows:

Material cleaning  $\rightarrow$  diffusion  $\rightarrow$  Cr, Au evaporation  $\rightarrow$  alloying  $\rightarrow$  Au electroplating  $\rightarrow$  mechanical thinning  $\rightarrow$  chemical thinning  $\rightarrow$  backside evaporation  $\rightarrow$  alloying  $\rightarrow$  photolithography  $\rightarrow$  Cr, Au etching  $\rightarrow$  mesa etching  $\rightarrow$  cutting  $\rightarrow$  dc testing  $\rightarrow$  press welding  $\rightarrow$  capping.

The key step is thinning. This is obvious from the relation between output power and series resistance of the device.

$$P = \frac{1}{2} [|G| - R_s B^2] [(V_r)_{\text{max}}]^2 \quad [2]$$

In order to obtain a higher output power, the impact of  $R_s$  must be minimized. In reality,  $R_s$  consists of three components, i.e., ohmic contact resistance  $R_c$ , resistance of the undepleted layer in the drift region  $R_d$ , and residual resistance of the thinned-down substrate  $R_{\text{sub}}$ . The ohmic contact resistance is dependent upon the fabrication process, materials and alloying temperature. With a good design, i.e., over-canalization during breakdown, the effect of the resistance of undepleted layer in the drift region  $R_d$  can be eliminated. The key is residual substrate resistance. Using a combination of mechanical and chemical thinning method developed, the substrate could be controlled at below  $20 \mu\text{m}$ .

The dc characteristics of the diode were tested on a semiconductor tester after mesa etching. The reverse saturation current is usually controlled at below  $10 \text{ nA}$  ( $10^{-9} \text{ A}$ ). Typically, it is  $5 \times 10^{-9} \text{ A}$ .

The typical dc characteristic curve is shown in Figure 1 [photo not reproduced].

Diodes with such characteristics were chosen. After cutting and welding, their microwave characteristics were measured.

### III. Development of Pulse Modulator

The pulse modulator is an important part of a high-stability, high-power pulse oscillator. It must be capable of providing a fast-rising current at approximately  $10 \text{ A}$  with very little fluctuation. It is also a constant-current source. In many applications, it is required that the leading edge be less than  $10 \text{ ns}$ . The pulse width and repetition frequency must be tunable within a wide range, such as between  $50 \text{ ns}$  to  $1 \mu\text{s}$  and  $1-50 \text{ KHz}$ . The modulator developed is a constant-current pulse source. The block diagram is shown below:

In the experiment, it was found that the length of the output cable had a large impact on the output waveform. The baseline of the detector wave profile was distorted with  $20 \text{ cm}$  of wire. Figure 3(a) [omitted] shows a typical wave envelope. In order to improve the output waveform and to minimize the effect of output cable, a knapsack approach was used. The oscillator cavity was mounted on the cap of the modulator, as shown in Figure 3(b) [omitted], to solve this problem.

### IV. Microwave Oscillator Circuit

In the development process, we designed three different circuits. In the first circuit, the high waveguide end is connected to a high-Q stable cavity. The high-Q cavity is used to raise the frequency stability and reduce oscillator noise. In order to raise the Q value of the stable high-frequency cavity, the  $H_{013}$  mode was used. Because the IMPATT is a low-impedance device, in order to achieve better impedance matching between the device and the circuit, we designed a resonant cap structure. The radius of the resonant cap is approximately  $\lambda/4$ . This resonant cap and the lower waveguide wall form a radial linear resonance cavity. The frequency of the oscillator can be

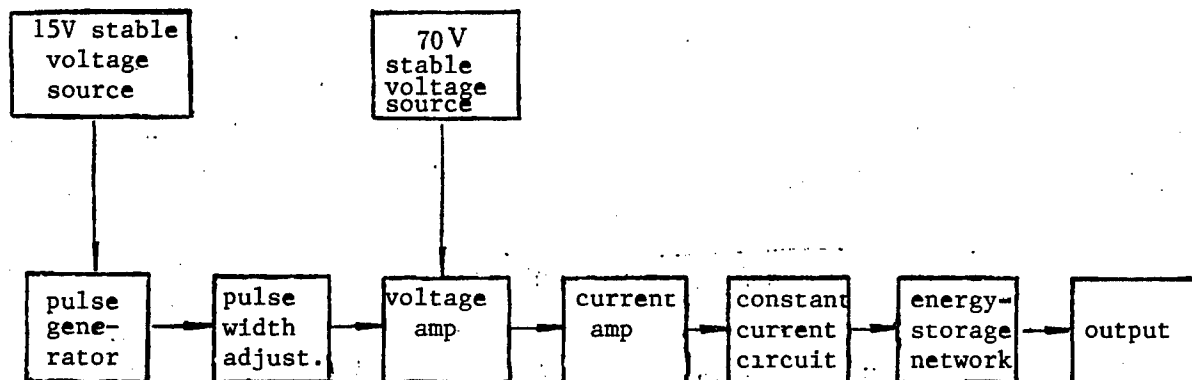


Figure 2. Block Diagram of the Large-Current Pulse Modulator

altered by changing the height of the resonant cap in the waveguide. On the other hand, it forms an impedance converter to solve the impedance-matching problem.

In order to reduce the volume and weight of the oscillator, we also designed two other oscillators. The cavity length for both is  $\lambda_g/2$ . A pulse bias was applied on the side. One has an adjustment rod on top to improve the output waveform. They are shown in Figures 4(a) and 4(b) [omitted].

V. Characteristics of the Oscillator

Figure 5 shows the block diagram of the microwave measurement system. This system uses a dual-beam oscilloscope to simultaneously monitor the output current pulse waveform of the modulator and the detector wave profile of the oscillator. Through the use of two directional couplers and an attenuator, the frequency spectra of the oscillators were observed by a frequency analyzer. Table 1 shows the typical results of several oscillators.

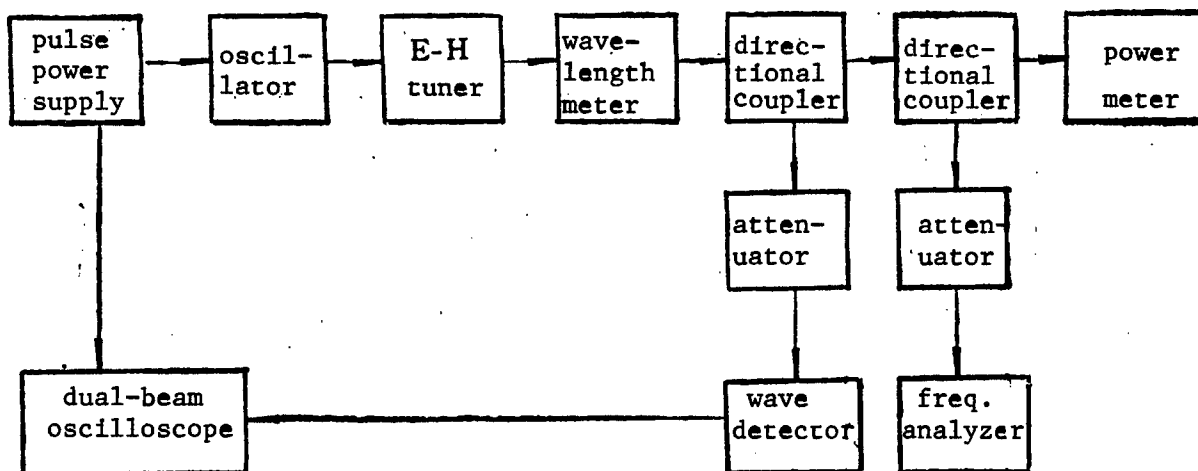


Figure 5. Block Diagram of the Microwave Testing System

Table 1. Typical Results of Pulse IMPATT Oscillators

Number	Operating voltage (V)	Operating current (A)	Oscillating frequency (GHz)	Output power (W)	Efficiency (%)
1	33	11.7	35.5	33	8.5
2	35	12.0	34.0	41.8	9.75
3	35	10.0	36.0	26	7.4
4	39	12.5	35.5	48	9.8

It was found experimentally that there was a time delay between the detector wave profile and the output bias pulse of the modulator. Such delay exists in all modulators. This is a common phenomenon. In general, such delay ranges from several tens to one hundred ns. Figure 6 [omitted] shows the typical result. This delay is caused by the time required to produce avalanche carriers at radio frequency and time needed to form the output pulse with the external circuit. In actual applications, specific measures must be taken based on different requirements.

It was also found in the experiment that the top of the output wave was splitting up at high bias pulses, as shown in Figure 7 [omitted]. Once this phenomenon occurs, the output power no longer goes up with increasing modulator output voltage. Instead, it falls. Further increase in voltage might burn out the diode. The reason is that the modulator cannot supply any higher current. If the current capability of the modulator can be improved, the output power of the oscillator will rise further.

The frequency spectrum of an oscillator is also an important indicator for its performance. The pulsing mode is different from the continuous working mode. The frequency spectrum is usually wider and has side lobes. The main lobe is required to be approximately 10 dB higher than the side lobes. The frequency spectrum of the oscillator developed is shown in Figure 8 [photo not reproduced].

The noise of the pulse IMPATT oscillators developed is higher than that in continuous working mode. The reason is that there is a chirp effect during pulsing. Because of the junction temperature rise during pulse biasing, the impedance of the device varies. Finally, the oscillating frequency begins to change. The faster the junction temperature rises, the wider the frequency-shift bandwidth becomes. For a flat current pulse, modulating frequency effect lowers the oscillator frequency. With a rising current pulse, the oscillator frequency goes up with biasing current. If a suitable biasing current waveform is used, the frequency drop due to junction temperature rise can be canceled by the frequency increase caused by the slope of the current pulse, as shown in Figure 9. Of course, it is very difficult to come up with a biasing current pulse that just cancels the modulating frequency shift effect. The current pulse developed has a certain positive slope which improves the chirp effect to some extent.

## VI. Conclusions

Satisfactory results were obtained from the development of 8-mm IMPATT pulse diodes and oscillators. Their maximum output power has exceeded 48 W. They are already in field use and in production.

From the standpoint of technology, there is more potential for improvement of this modulator. The output power can still be raised, and the chirp effect can also be improved further.

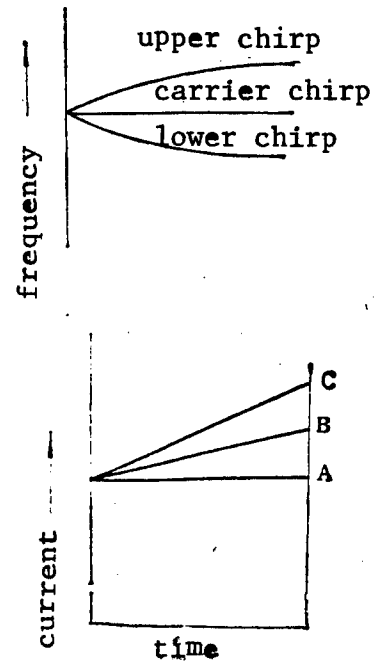


Figure 9. Frequency Chirp Effect

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## High-Speed 1.3-Micron InGaAsP/InP Mesa Structure Edge-Emitting LED Fabricated

91FE0103B Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 11 No 8, Aug 90 pp 590-593 [MS received 14 Aug 89]

[Article by Zhao Wei [6392 5588] (presently at Northeast Normal University, Changchun), Zhang Yushu [1728 3768 2579], Shi Jiawei [4258 1367 4885], Jin Enshun [6855 1869 7311], and Gao Dingsan [7559 7844 0005] of the Department of Electronics, Jilin University, Changchun: "High-Speed 1.3-Micron InGaAsP/InP Mesa Structure Edge-Emitting LED's"]

## [Text] Abstract

This paper introduces the development of a 1.3- $\mu\text{m}$  InGaAsP/InP mesa structure edge-emitting LED (ELED). The modulation frequency of the device is increased by heavy Zn doping in the active region and by introducing the mesa structure. A 500-MHz modulation bandwidth at -3 dB and 130  $\mu\text{W}$  power output at a current of 70 mA has been achieved.

Key words: modulation bandwidth, modulation depth, spectral half-width.

### I. Introduction

The high-speed edge-emitting 1.3- $\mu\text{m}$  InGaAsP/InP LED has a good potential in high-rate short-range optical fiber communications. In recent years, optical techniques are being introduced into data networks and user-based communication systems. For high-speed data networks, because of ease of fabrication, high reliability, low cost and good temperature behavior, the high-speed LED is very attractive and may replace lasers in this field. There are many papers reporting the development of high-speed LED's. A modulation speed of 2 Gbit/s has been realized. Furthermore, the 1.3- $\mu\text{m}$  ELED has been used in optical fiber transmission at 2 Gbit/s.<sup>1</sup>

The modulation bandwidth of an LED can be increased by doping the active region, reducing the thickness of the active region and raising the injection current density.<sup>2</sup> Heavy doping of the active region, in particular, can significantly increase the modulation bandwidth. This paper introduces the process to fabricate a 500 MHz-modulation-bandwidth 1.3- $\mu\text{m}$  InGaAsP/InP mesa structure edge-emitting LED by heavy Zn doping of the active region and by using a mesa structure. In addition, a new method to measure modulation bandwidth has been developed.

### II. Device Structure and Technique

Figure 1 shows the basic structure of the high-speed 1.3- $\mu\text{m}$  InGaAsP/InP mesa structure edge-emitting LED. Radiation recombination lifetime is reduced by heavy Zn doping of the active region in order to increase the modulation speed of the device. A mesa structure is used to completely block off transverse injection of carriers in order to eliminate the scattering of emitting light intensity. Therefore, the coupling efficiency between the light output and the optical fiber is dramatically improved. Furthermore, at a fixed injection current, because of the narrow mesa width, the injection current density is also significantly increased. Consequently, modulation frequency is also raised. Because of the mesa structure, parasitic capacitance which affects high-speed response is also reduced. Typically, the parasitic capacitance of our device is 20 pF. Based on  $f_{-3\text{dB}} = 1/(2\pi RC)$ , the modulation bandwidth at -3 dB can be as high as 2 GHz. In order to suppress laser oscillation, the LED has an oblique mirror.

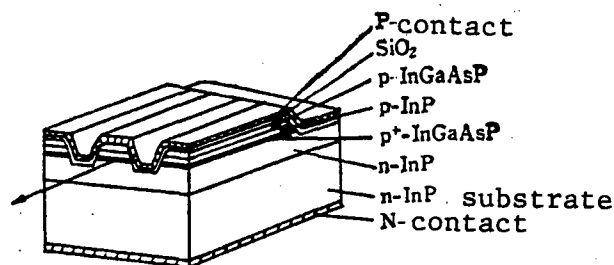


Figure 1. Basic Structure of the InGaAsP/InP Mesa Structure Edge-Emitting LED

The device is fabricated by growing the following layers sequentially on an n-InP substrate by liquid phase epitaxy: Te-doped n-InP buffer layer (5-7  $\mu\text{m}$ ), Zn-doped ( $5 \times 10^{18} \text{ cm}^{-3}$ ) P<sup>+</sup>-InGaAsP/InP active layer (0.2-0.3  $\mu\text{m}$ ), Zn-doped P-InP confining layer (-1  $\mu\text{m}$ ) and Zn-doped P-InGaAsP covering layer (-1  $\mu\text{m}$ ). By masking with SiO<sub>2</sub>, a mesa 8-9  $\mu\text{m}$  in width along <110> and a 50- $\mu\text{m}$  trough along <110> were chemically etched with Br<sub>2</sub>-CH<sub>3</sub>OH-H<sub>3</sub>PO<sub>4</sub>. A layer of SiO<sub>2</sub> was deposited at low temperature and a window was engraved on the mesa. Au/Zn-Au was evaporated onto P-side. After alloying, it was thinned down to 80-100  $\mu\text{m}$ . Then, Au-Ge-Ni was evaporated onto n-side. Finally, it was inverted and mounted on a heat sink as a sample.

When doping the active region of LED's with Zn, we noticed the following problems. First, because of its high diffusion coefficient<sup>3</sup> and its high concentration in the active region, Zn could easily diffuse toward the n-InP buffer layer to cause a junction shift. Therefore, the amount of time to form the active region should be as short as possible. This is good for the response time. However, when the active region is too thin, its homogeneity worsens and Auger recombination increases. Therefore, the time spent to grow the active region should not be too short. We spent 5-12 seconds to grow the active region and its thickness is 0.2-0.3  $\mu\text{m}$ . Second, because of its high vapor pressure, Zn could easily evaporate in the epitaxial process, resulting in system contamination. Therefore, we must minimize Zn contamination of the molten n-InP used to form the buffer layer. In this experiment, the source of the buffer layer and the source of the active layer were placed in graphite crucibles. Third, the doping concentration of the buffer layer must be carefully controlled. If it is too low, junction shift would occur which enlarges the light-emitting region and lowers the modulation bandwidth. However, if it is too high, the degeneracy goes up and can easily form a tunnel junction.

### III. Testing Method and Results

In order to achieve a high modulation rate, usually a dc bias is applied. However, sometimes a device cannot take a 100-mA dc current. Long measurement time would drive the junction temperature up. Narrow-band non-radiational Auger recombination increases significantly with rising temperature. Thus, it has a great impact on the characteristics of the device. In order to measure the high frequency modulation bandwidth of these LED's, we developed a high-frequency-modulation method based on pulsed pre-bias. An MFD-1A nanosecond pulse generator was used to send out a 300 Hz pre-bias pulse signal. An XFC-1 standard signal generator was used as a high-frequency modulation signal source. The output sinusoidal signal varies between 160 MHz and 1,000 MHz. The modulation bandwidth of the high-speed LED was measured using the circuit shown in Figure 2. The pre-bias current is 260 mA and the modulation depth is 15-20 percent. The modulation bandwidth was found to be 500 MHz. A stable modulation output is shown in Figure 3 [photo not reproduced].

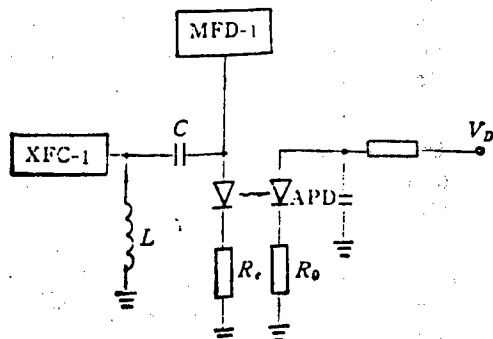


Figure 2. Block Diagram of Modulation Bandwidth Measurement Circuit

Figure 4 shows the P-I characteristics of the device. The light power output has a linear relation with respect to the injection current. When injection current is 70 mA, the light power output is 130  $\mu$ W.

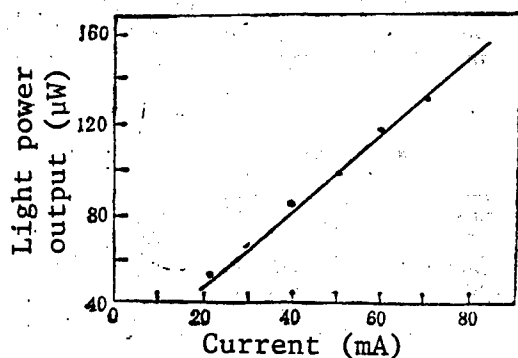


Figure 4. P-I Curve

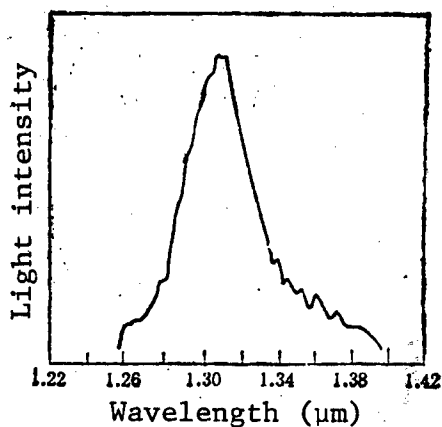


Figure 5. Emission Spectrum

The emission spectrum of the device is shown in Figure 5. The wavelength of the LED is approximately 1.3  $\mu$ m and the half width of the spectrum is approximately 400 Angstroms.

#### IV. Conclusions

A 1.3- $\mu$ m InGaAsP/InP mesa structure edge-emitting LED with a modulation bandwidth of 500 MHz was fabricated by heavy doping of Zn in the active region and by introducing a mesa structure. A good modulation output waveform was obtained. It has a good potential for use in short-range high-speed optical transmission systems.

The authors wish to thank Associate Professor Zhang Qingyou [1728 1987 2589], Engineer Ren Linfu [0117 5259 4395], and Mr. Shi Jinglong [4258 2529 7893] for their assistance in this work.

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#### Breakthrough in Semiconductor Laser Diode Development

91P60061 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 3 Dec 90 p 1

[Article by Fan Jian [5400 1696] and Hu Mucheng [5170 2606 2052]: "Major Breakthrough in Semiconductor Laser Development"]

[Summary] Two new kinds of semiconductor laser diodes—the "heart" of fiber-optic communications systems—have been developed by researchers at the CAS Institute of Semiconductors. An expert appraisal committee, headed by CAS Academic Committee member Prof. Ye Peida [0673 1014 1129], noted on 30 November that these new laser diodes are at a worldwide state-of-the-art level and constitute a major breakthrough for domestic optoelectronics R&D.

Prof. Chen Lianghui [7115 5328 1920], assistant director of the State High-Tech Optoelectronics Special-Topic Expert Group as well as assistant director of the CAS Institute of Semiconductors, commented that—following upon its late-seventies-to-early-eighties development of long-life AlGaAs laser diodes and 1.3-micron-wavelength InGaAsP laser diodes—the institute spent 4 years in a State 863 Plan fiber-optic-communications-oriented project that has now resulted in the successful development of new 1.3-micron-wavelength and 1.55-micron-wavelength InGaAsP uncooled single-mode laser diodes which operate normally up to 60°C. At a single-mode fiber-optic pigtail output power of 1 milliwatt, operating life is 120,000 hours; maximum operating life is 480,000 hours. These products, already in use at several domestic research institutions, are intended for export as well. The 1.55-micron distributed-feedback laser diode is a key component in long-range, high-capacity fiber-optic communications systems. In fabricating this type of diode,

researchers had to overcome numerous problems such as grating preparation and multi-step liquid-phase epitaxy to realize a diode which operates in dynamic single mode in a 370Hz to 1000Hz range. The low-threshold 1.3-micron bistable laser diode, which exhibits two optically stable states [i.e., on or transmitting, and off or non-transmitting], has a transmitting-state output power of over 8 milliwatts. This new optoelectronic device will play an important role in digital optical information processing, optical computing, and optical communications.

**Optical Constants of Superthin Films in the Soft X-Ray Region (60-900 eV)**

40090004A Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 8, Aug 90 pp 706-713

[English abstract of article by Cao Jianlin and Chen Xingdan of the Changchun Institute of Optics and Fine Mechanics, Academia Sinica, Mihiro Yanagihara, Masaki Yamamoto, and Takeshi Namioka of the Research Institute for Scientific Measurements, Tohoku University, Sendai, Japan; received 12 January 1990; revised 2 April 1990]

[Text] The optical constants of superthin films have been obtained from the reflectance vs. angle of incidence measurements using synchrotron radiation in the 60-900 eV soft X-ray region. Nonlinear least square curve fitting method is used for analyzing the measured data. Results are given for samples of C, Au, and Pt prepared by ion-beam sputtering (IBS), and the film thickness, the rms roughness of both films and substrates are also determined.

Key words: soft X-ray; superthin films; reflectance.

**Nonresonant Magneto-Tunneling in Asymmetric GaAs/AlGaAs Double-Barrier Resonant-Tunneling Structures**

91FE0103A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 11 No 8, Aug 90 pp 565-569 [MS received 13 Oct 89]

[Article by Yang Fuhua [2799 1381 5478], Zheng Houzhi [6774 0624 2784], and Chen Zonggui [7115 1350 0964] of National Laboratory for Superlattices and Related Microstructures, Institute of Semiconductors, Chinese Academy of Sciences: "Nonresonant Magneto-Tunneling in Asymmetric GaAs/AlGaAs Double-Barrier Structures"; project supported by National Natural Science Foundation]

[Text] Abstract

The characteristic differences in nonresonant magneto-tunneling processes in asymmetric GaAs/AlAs double-barrier resonant-tunneling structures with forward and reverse bias have been systematically studied in this

work. Furthermore, the different dwell times of traversing electrons in the well as they tunnel along opposite directions were used to satisfactorily explain the experimental results.

Key words: resonant-tunneling, nonresonant magneto-tunneling, magneto-tunneling spectra, phonon scattering, dwell time.

In recent years, dynamic processes associated with double-barrier resonant-tunneling structures (DBRTS) have attracted a great deal of interest.<sup>1-3</sup> Magneto-tunneling is an effective experimental tool. Leadbeater et al.<sup>3</sup> were the first to apply a strong magnetic field perpendicular to the potential barrier to study various scattering processes in DBRTS in the current valley of the I-V [current-voltage] curve. Furthermore, magneto-tunneling spectra were used to assess the contribution of nonresonant tunneling from elastic and non-elastic scattering to the valley current. However, magneto-tunneling spectra obtained experimentally are often very complicated. Specifically, LO [local oscillation] phonon-assisted tunneling might be stronger than that induced by elastic scattering in DBRTS. It might be the other way around

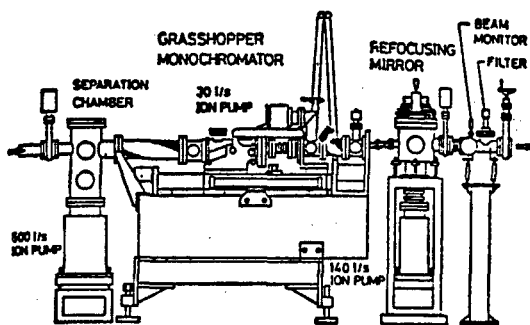


Figure 1. Synchrotron Radiation Beam Line BL-11A, KEK, PF

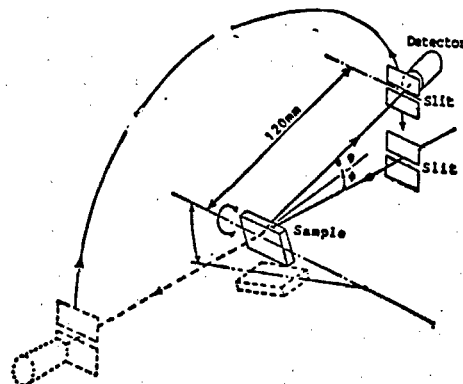


Figure 2. Schematic Diagram of Reflectometer

as well. The physical mechanism is still not clear. Since LO phonon-assisted transition is a non-elastic scattering event for electron to tunnel through a DBRTS, the intensity of the LO peak is not only related to the intensity of electron-phonon coupling but also to the time of interaction between electron and phonon during tunneling. In the past, tunneling time has been defined differently in the literature.<sup>4-7</sup> No rigorous experimental work has been done to determine which type of time domain actually affects the phonon-associated tunneling process. The experimental results obtained in this work provide some evidence to answer this question. To this end, the characteristics of the magneto-tunneling spectra of several asymmetric GaAs/AlAs DBRTS in the current valley region of the I-V curve were systematically studied. It was discovered that in DBRTS the difference in magneto-tunneling spectra with forward and reverse bias is related to the electron lifetime inside the well.

The DBRTS used in this work was grown on a  $n^+$ GaAs (100) substrate doped at  $2 \times 10^{18} \text{ cm}^{-3}$  by MBE (molecular beam epitaxy). It consists of a 75 Angstroms intrinsic GaAs well and two intrinsic AlAs wells 25 Angstroms and 17 Angstroms thick. The ohmic contacts on either side of the double barrier have a common layer structure.<sup>3</sup> The device was fabricated by using  $150 \times 150 \mu\text{m}^2$  and  $200 \times 200 \mu\text{m}^2$  AuGeNi metallic ohmic contacts as masks to etch out a mesa photolithographically. The I-V characteristics of DBRTS were measured at 4.2 K using a quasi four-prong technique. In order to suppress possible oscillation in the bias circuit in the negative resistance region, a 1.5 nF capacitor is closely connected to the sample in parallel.<sup>8</sup> In Figure 1 we can see from the I-V curve of DBRTS that the current peak-to-valley ratio under forward bias (top electrode positive relative to bottom electrode) is 22. Under reverse bias, it is 4.6 (bias scanned from negative to positive). There are apparent bistable regions in both directions. The insert in Figure 1 shows the energy band of the DBRTS sample away from the main resonant tunneling peak in the presence of a forward bias. The differential electrical conductance  $dI/dV$  of the device was measured by a conventional ac technique. The modulating amplitude of the constant voltage ac power supply is 1 mV.

The bottom curve in Figure 2 is the  $dI/dV$  versus bias voltage curve obtained at  $T = 4.2 \text{ K}$  and zero magnetic field.

Our discussion is focused on the current valley region. For the purpose of clear identification, two vertical dotted lines were drawn to mark the bistability region. In zero magnetic field, there is a small peak immediately after the main resonance peak. This peak was first observed by Goldman et al.<sup>9</sup> and was attributed to the contribution of LO phonon-assisted tunneling. As the magnetic field increased from zero, the flat peak gradually evolved into a series of magnetic oscillations. They include contributions from elastic-scattering-induced transition as well as LO phonon-assisted transition. Just as Leadbeater pointed out, except for the main reso-

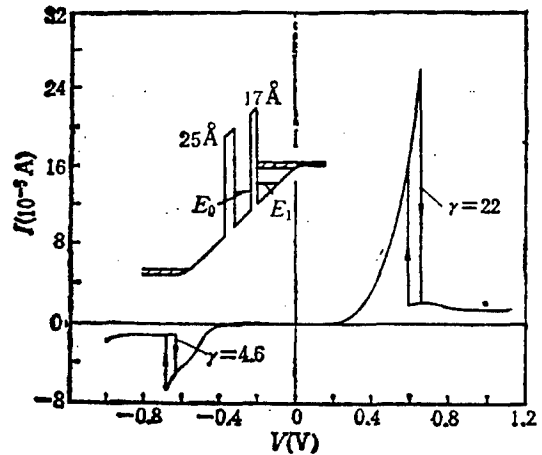


Figure 1. I-V Curve of Sample 4 at  $T = 4.2 \text{ K}$ .  $\nu = I_p/I_v$  is the current peak-to-valley ratio. Insert represents the energy-band structure under forward bias.

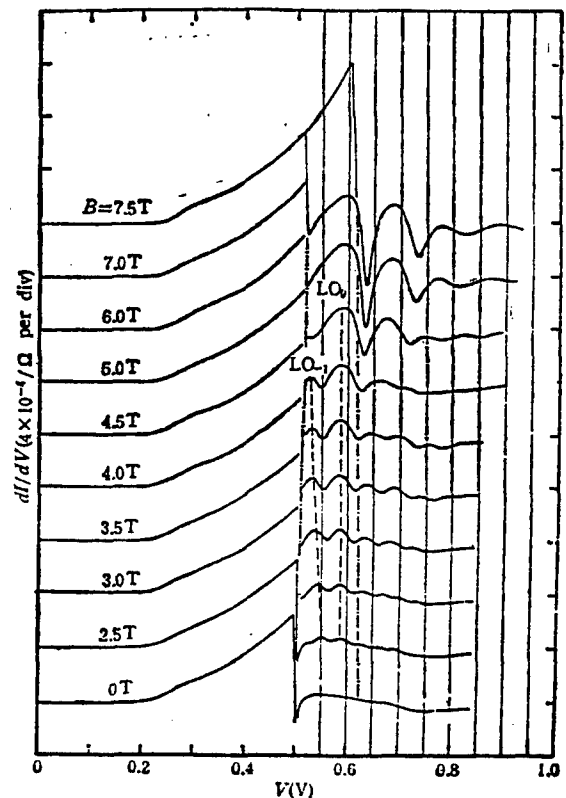


Figure 2. Differential Electrical Conductivity  $dI/dV$  vs. Forward Bias for Sample 4 at  $T = 4.2 \text{ K}$  in Different Magnetic Fields.  $W_c$  is the collector barrier thickness ( $W_c = 25 \text{ Angstroms}$ ).

nance peak, momentum is no longer conserved for traversing electrons perpendicular to the tunneling current in other magnetic tunneling processes. Therefore, only energy conservation must be obeyed:

$$E_i = E_0 + \frac{p\hbar c B}{m^*} + i\hbar\omega_{LO} \quad (1)$$

In the above equation,  $E_1$  is the lower energy of the two-dimensional energy band in the emitting region. Because a wider GaAs isolation layer was used in our DBRTS, three-dimensional electrons in the emitting region are quantized by the potential well at the interface and then condensed at  $E_1$ .  $E_0$  is the lowest two-dimensional bound state band energy in the well.  $\hbar\omega_{LO}$  is the energy of LO phonon.  $p$  indicates the Landau energy index change before and after tunneling. When  $i = 0$ , magneto-tunneling is only dependent upon elastic-scattering-induced transition processes.  $i = 1$  represents a transition process with a single LO phonon involved. Based on equation (1), it is very easy to assign the oscillation peak that is independent of the magnetic field as the pure LO phonon-assisted tunneling peak with  $p = 0$  and  $i = 1$ . Under a high magnetic field, various satellite oscillation peaks resulting from  $LO_0$  are denoted as  $LO_p$  ( $p = 1, 1, 2, 3$ ). The sector diagram shown in Figure 3(a) summarizes all identifiable oscillation series described above. Just as the figure shows, all  $LO_p$  peaks extrapolate back to the position of  $LO_0$ , i.e.,  $V = 0.585$  V, when the magnetic field approaches zero. The arrow points at the position of the main resonance peak. Up to now, the major characteristics of our GaAs/AlAs DBRTS are similar to those of GaAs/(Al,Ga)As DBRTS reported by Leadbeater. However, we are the first to report  $LO_{-1}$ . The newly observed  $LO_{-1}$  peak originates from the tunneling of electrons in the  $(n+1)$ th Landau level in the cumulative layer to the  $n$ th Landau level in the well. This process also releases an LO phonon along the way. Different from other  $LO_p$  peaks, instead of moving away from the main resonance peak with increasing magnetic field, the  $LO_{-1}$  peak gradually merges into the main peak.

In the following, the characteristic differences of nonresonant magnetic tunneling of asymmetric DBRTS under forward and reverse bias are discussed. Figure 3(b) shows the typical sector diagram measured with Sample 3 under a reverse bias. Sample 3 and Sample 4 are two DBRTS diodes on the same chip.  $V_{3D}$  represents the following bias condition. The bottom energy band in the well is lowered just below the three-dimensional state in the emitting region. Therefore, resonant tunneling of three-dimensional electrons to the quasi-two-dimensional state  $E_0$  is forbidden. When the bias is  $V_{2D}$ ,  $E_0$  in the well is no longer on the same level as  $E_1$ . Resonant tunneling from two-dimensional state  $E_1$  to  $E_0$  in the well cannot take place. Similar classification of  $V_{3D}$  and  $V_{2D}$  was discussed by Goldman et al.<sup>8</sup> Nevertheless, their results are very controversial.

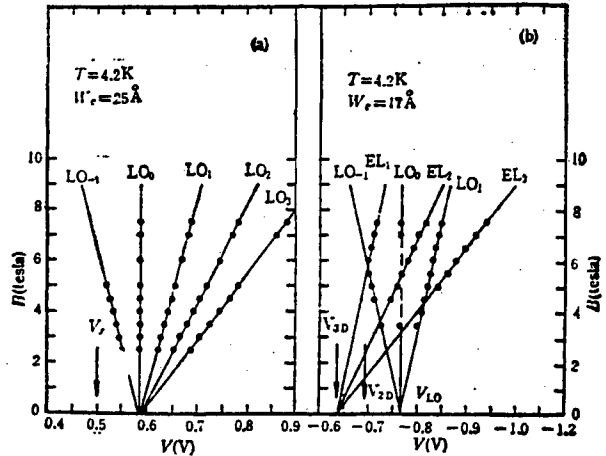


Figure 3. Voltages of Oscillation Peaks in the Valley of  $dI/dV$ - $V$  Curves Under Various Magnetic Fields. (a) sector diagram of Sample 4 under forward bias; (b) sector diagram of Sample 3 under reverse bias.

Comparing the sector diagram under forward bias to that under reverse bias, we found the following major characteristics.

First, under reverse bias, there is a new oscillation series, which is denoted as the  $EL_p$  series. Although the  $EL_p$  series is very similar to the  $E_p$  series reported in reference 3, they are not identical. When the magnetic field  $B$  drops to zero, the  $EL_p$  series gradually converges to  $V_{3D}$ , rather than  $V_{2D}$ . If the  $EL_p$  series is identical to the  $E_p$  series reported in reference 3, then the  $EL_p$  series should converge to  $V_{2D}$  when the magnetic field is decreased. As a matter of fact, when the  $(n+p)$  discrete Landau level is pulled below the  $n$ th Landau band of three-dimensional electrons in the emitting region, nonresonant tunneling between them, which is induced by elastic scattering, is completely suppressed.  $EL_p$  peak can be seen on the differential conductance curve  $dI/dV$ .

Second, under a reverse bias, this elastic-scattering-induced tunneling process ( $EL_p$  series) seems to be more apparent than LO phonon-assisted tunneling process ( $LO_p$  series). Under forward bias, there were five obvious  $LO_p$  oscillation peaks ( $p = -1, 0, 1, 2, 3$ ) in the current valley region. No  $EL_p$  oscillation peaks were found. On the contrary, there were only two  $LO_p$  peaks, i.e.,  $LO_{-1}$  and  $LO_1$ , that remained distinguishable. In addition, before the magnetic field reached 7 T [Tesla] the  $LO_0$  main peak was almost unrecognizable.

Third, between  $V_{2D}$  and  $V_{3D}$  ( $V_{LO}$  denotes the bias position of the  $LO_0$  peak), there is an interesting phenomenon that  $LO_{-1}$  and  $EL_1$  coexist in different magnetic fields.

In order to correctly understand the distinct difference of asymmetric DBRTS under forward and reverse bias, its

physical mechanism is further investigated. Under the assumption that electron-phonon interaction is limited in the well, Wingreen et al.<sup>10</sup> calculated the probability of LO phonon-assisted tunneling in DBRTS by using the S scattering matrix method. The LO phonon "replication" peak observed in the valley region was also verified. Based on similar considerations, we also assumed that electron-phonon interaction also mainly occurs in the well. Thus, it is not difficult to understand such a dynamic process as LO phonon-assisted tunneling. Dwell time of traversing electrons (or electron lifetime in the well) ought to be an important factor. In the tunneling model, dwell time is given in the following equation:<sup>8,11</sup>

$$\tau = \frac{2W}{T_c} \left( \frac{m^*}{2E_0} \right)^{1/2} \quad (2)$$

where  $W$  is the width of the well,  $E_0$  is the quasi-bound state energy in the well, and  $T_c$  is the probability of penetration of the collection potential. Obviously, the larger  $T_c$  is (i.e., the thinner collection potential is), the shorter electron lifetime  $\tau$  in the well becomes. As for forward tunneling, our DBRTS has a relatively thick collection potential (25 Angstroms). Therefore, electrons have a longer dwell time in the well so that there is a higher probability of interaction with LO phonons. Hence, the  $LO_p$  series becomes very strong. It is the opposite under reverse bias. Thinner collection potential (17 Angstroms) and shorter dwell time weakened the LO phonon-assisted tunneling process (i.e., LO oscillation peaks). Therefore, we can see that electron lifetime inside the well is a major factor controlling LO phonon-assisted tunneling. In addition, it explains the difference in behavior under forward and reverse bias.

In conclusion, this work systematically studies nonresonant magneto-tunneling associated with elastic scattering and inelastic scattering in asymmetric double-barrier resonant-tunneling structures. There is no doubt that its behavior is quite different under forward and reverse bias. This difference is caused by the different dwell time of traversing electrons tunneling through DBRTS in opposite directions.

The authors wish to thank the National Laboratory of Surface Physics for providing the MBE DBRTS wafers and to Li Chengfang [2621 2110 5364] for the fabrication work.

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## An Effective Method for Measuring High Reflectivity (or Transmissivity) of Optical Components

916A0002B Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 7, Jul 90 p 667

[Chen Yi, (Jilin Institute of Lasers, Changchun); Shao Zhongxing, (Changchun Institute of Optics and Fine Mechanics, Academia Sinica), (Received 8 November 1989)]

[Abstract] An effective method for measuring high reflectivity (HR) of laser mirrors and high transmissivity of optical components with antireflective (AR) coats is described in this paper. The features of the method are that  $\eta$ -components with HR or AR coats are measured at same time, and the measuring error is  $1/\eta$  of the normal way. Measurements of a group of laser mirrors with HR coats and a group of thin disks with AR coats show the acceptability of the method.

Key words: measuring; high reflectivity (transmissivity).

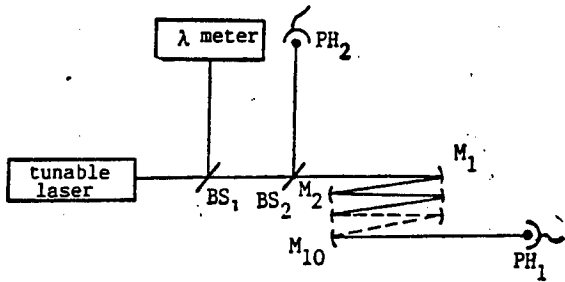


Fig. 1 The setup for measuring laser mirrors with HR coats by using the method of multiple reflection

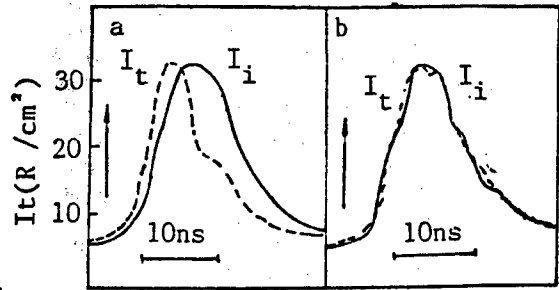


Fig. 2 Time dependence of incident  $I_i$  (solid) and transmitted  $I_t$  (broken) pulse ( $\lambda_i = 4360 \text{ \AA}$ )  
(a) The high density incident light  
(b) The low density incident light

**Excitonic Optical Bistability in ZnSe/ZnS Multiple Quantum Wells**

916A0002A Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 7, Jul 90 p 646

[Article by Shen Dezhen, Fan Xiwu, Fan Guanghan and Chen Lianchun, (Changchun Institute of Physics, Academia Sinica); Li Chunfei and Liu Yudong, (Received 8 November 1989; revised 15 February 1990)]

[Abstract] Optical bistability in the ZnSe/ZnS multiple quantum wells (MQWs) grown by MOCVD has been observed at 77 K for the first time with ns switching time. On the bases of the shape of hysteresis loop and photoluminescence and absorption spectrum measured, the optical bistability in the ZnSe/ZnS MQWs can be...

attributed to enhanced absorption effect, which originated from the collision broadening of excitonic resonance.

Key words: multiple quantum wells; optical bistability.

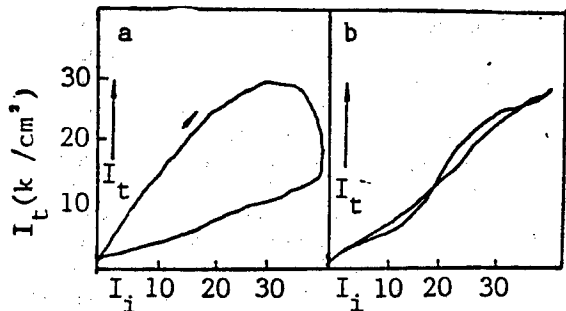


Fig. 3 The relationships between  $I_i$  and  $I_t$ , calculated from Fig. 2

(a) The hysteresis loop shows the increased absorption optical bistability (OB) at high incident density; (b) No OB at low incident density

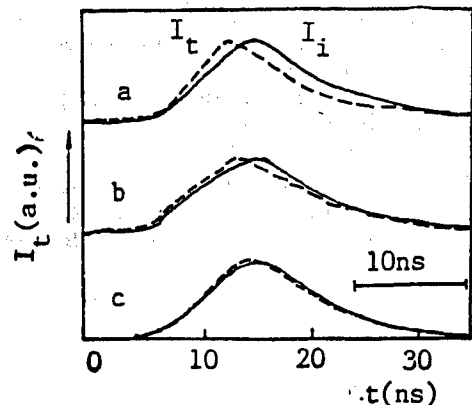


Fig. 4 Time dependence of incident and transmitted pulse on different incident light wavelength at 77K  
(a)  $\lambda_i = 4370 \text{ \AA}$ ; (b)  $\lambda_i = 4380 \text{ \AA}$ ; (c)  $\lambda_i = 4390 \text{ \AA}$

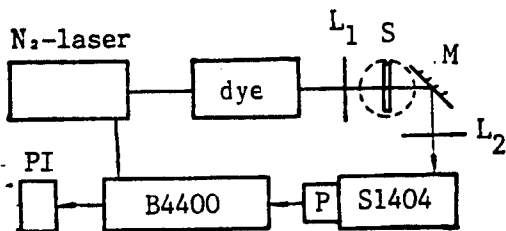


Fig. 1 Experimental apparatus for measuring the optical bistability

S: sample, B4400: 4400 Boxcar, SI404: monochromator, P: photomultiplier, PI: printer

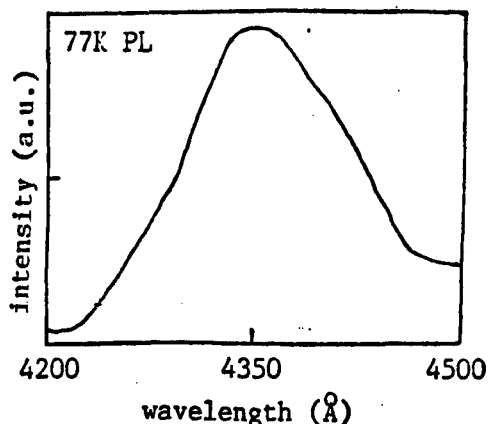


Fig. 5 The PL spectrum in ZnSe/ZnS MQWs at 77K

#### Studying and Measuring Distribution of Refractive Index for Thermo-Optic Effect in Glass Substrate

40090004B Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 8, Aug 90 pp 721-727

[English abstract of article by Chen Baoxue and Yuan Yifang of the Department of Instrumentation, Shanghai Institute of Mechanical Engineering; received 10 September 1988; revised 8 March 1990]

[Text] Almost all optical materials have the properties of thermal refractive index varying. Under the action of the local thermal source, distribution of refractive index is gradient, and the direction of propagation of the passing light beam will deflect. According to this physical property, it is possible to make various thermo-optic devices. It is proposed to fabricate strip Ti-film thermal source and to measure the deflecting angles of emergence beam in the paper. Using analytic method, the distribution of refractive index on the profile of substrate is obtained. And then according to energy conservation, temperature coefficient of refractive index of the material is obtained. Compared with the announced values, it is verified that

our experiment method is correct. The method described is available for studying and analyzing thermo-optic materials and devices.

Key words: thermo-optic effect; thermal refractive index varying.

#### Laboratory for Quantum Optics (LQO) of SIOFM

916A0002C Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 7, Jul 90 p 592

[Text] The Laboratory for Quantum Optics (LQO) in Shanghai Institute of Optics and Fine Mechanics (SIOFM), Academia Sinica was formally set up and opened in May 1988. The lab director is professor Wang Yuzhu and the vice director is professor Wang Zugeng. The honorary chairman of the scientific council is professor Wang Daheng, the chairman is professor Wang Zhijiang, and the vice chairmen are professors Wang Yiqu and Wang Yuzhu. The major research subjects in LQO include the mechanical effects of light, the nature of nonclassical radiation field, physics and spectroscopy of metal cluster, and laser spectroscopy of atoms and molecules.

LQO is built on the base of laser spectroscopy and quantum optics lab which were originally existing in SIOFM. In 1980, the experiment of atomic beam deflection by laser was carried out in this lab. The results (the deflection angle, the spacial resolution and the ratio of signal to noise) were better than that acquired by other groups in the world at that time. Based on this efficient scheme used in atomic beam deflection LQO completed an experimental test of sub-poisson photon statistics of resonance fluorescence in 1984. Soon after the opening of LQO in 1988, for the first time the velocity bunching effect of atoms in a standing laser field and the channeling effect out of the standing field were observed and therefore a new method—channel collimated atomic beam spectroscopy was developed. Moreover, results of theoretical studies about new quantum effects of light field, dip in resonance fluorescence line, and the squeezed properties of chaotic field were acquired in LQO in this period.

At present there are four properly equipped laboratories in LQO. They are: Laboratory of Mechanical Effects of

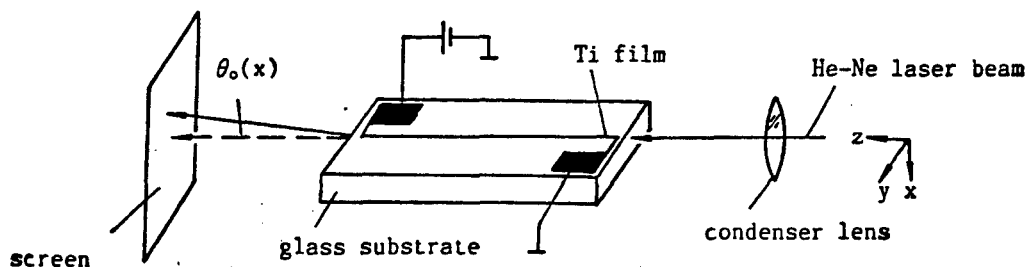


Figure 1. Schematic Diagram of Measuring System

Light, Laboratory of Nonclassical Effect of Quantum Light Field, Laboratory of Metal Cluster and laboratory of Laser Spectroscopy. LQO is doing its best in participating in the international competition in the the research field of quantum optics. The goal of LQO is to promote a rapid development in this field by both domestic and international science exchange and acquire

a lot of valuable research results, and at the same time to train a number of excellent young scientists.

LQO wholeheartedly welcomes all the scientists and scholars from home and abroad who wish to work in this Lab and accepts research project applications at all times.

### Foundation Laid for Nation's First VLSI Production Line

91P60050 Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 23 Nov 90 p 1

[Article by Jin Xiaotao [6855 1420 2711], Chen Shuxin [7115 3412 2450], and Li Kunkun [2621 2492 2492]: "Wuxi Microelectronics Construction Begins"]

[Summary] The foundation for China's first VLSI production line was officially laid on 16 November in Wuxi by representatives of the Huajing Electronics Group, part of the Wuxi Microelectronics Complex in Jiangsu Province. This project, the largest in investment and highest in technological level since the founding of the nation, involves the construction of an imported-equipment production line for 70-100 million VLSI chips per year, the latest in a series of expansions begun in 1983 with the importation of a color TV production line costing 270 million yuan and resulting in an annual output of 26,480,000 ICs. The major project begun on 26 January 1988 is to be completed in 1991. The project just begun now is to be completed in 1993 and involves an investment of over 900 million yuan. Representatives of Germany's Siemens Co. [the equipment provider] and Japan's Toshiba Corp. were also present at the foundation laying, as were officials of the Chinese government.

### New Gate-Array ASIC Technology Developed

91P60059 Shanghai WEN HUI BAO in Chinese 29 Nov 90 p 1

[Article by Wang Lin [3769 3829]: "New Integrated Circuit Technology Debuts"]

[Text] A new technology consisting of a series of 3-micron application-specific integrated circuit (ASIC) double-layer-metal-wiring processes, whose development was a key State Seventh 5-Year Plan project, passed the relevant expert appraisal yesterday. Gate array technology is a crucial part of the fabrication of custom ASICs and this particular 3-micron technology is one critically needed in China for further development and applications of these ICs. The principal research unit responsible for this achievement is the CAS Shanghai Institute of Metallurgy, with Research Fellow Zhang Min [1728 2404] at the head of the development team.

### Microwave Devices & Components Fabrication Facility in Production

01P60053 Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 18 Nov 90 p 1

[Article by Fan Mingyi [5400 2494 5030] and Song Yuping [1345 3768 1627]: "Key State Project—Microwave Devices Fabrication Facility—Passes Acceptance Check"]

[Summary] A facility for fabrication of high-frequency, high-power, high-reliability microwave devices and components at the Ministry of Machine-Building & Electronics Industry's (MMEI) Nanjing Institute 55 has been put into production and has passed national-level acceptance check. State Councillor and Minister of the State Planning Commission (SPC) Zou Jiahua, Vice Minister of the Commission of Science, Technology & Industry for National Defense (CSTIND) Ye Zhengda, and MMEI Vice Minister Zhang Xuedong participated in the ribbon-cutting ceremony.

This key state project, sponsored by SPC, CSTIND, and MMEI, will save the state a great amount of foreign exchange for imports of these products. The facility, 5 years in construction, consists of a microwave components production line, a silicon devices fabrication line, and a gallium arsenide (GaAs) fabrication line. Its products, which meet early eighties international standards, will be widely used in aerospace, satellite-borne radar, broadcast TV, and other areas.

After production gears up completely, the facility will be able to annually manufacture over 2000 microwave components of various types and almost 40,000 microwave devices, which will basically satisfy domestic demand and replace imports. The three ministers expressed hopes that the facility would take the lead nationally in the development of millimeter-wave technology, GaAs monolithic integrated circuit [MMIC] technology, and flat-screen display technology, and that it would make a major contribution to the nation's defense and economy.

### Interview with Vacuum Microelectronic Devices Specialists

91P60045 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 27 Oct 90 p 1

[Article by Wang Zhihua [3769 4160 5478]: "The Quietly Growing Field of Vacuum Microelectronics"]

[Summary] Recently, there has been growing interest worldwide (including annual international conferences since 1988) in the new field of vacuum microelectronics—the use of electrodes to create an electric field that controls electron movement and thus amplifies electronic signals. The new field revolves around devices called semiconductor vacuum microelectronic devices (diodes and triodes) or field emitter arrays, which are nothing like the old vacuum tubes of the 50s. In an effort to better understand the new technology, this reporter visited the Beijing Research Institute for Vacuum Microelectronic Technology and interviewed Professor Chen Qilue [7115 0366 3970] and Senior Engineer Peng Zian [1756 5261 1344].

Basically, the two specialists pointed out that the new field combines vacuum microelectronics technology with LSI (large-scale integrated circuit) technology. The vacuum microelectronic devices use micron-size field emission anodes with an emitted current density as high

as 10 million amperes per square centimeter. At present, one can fabricate 250,000 field emitter anodes on one 1-square-millimeter silicon chip.

The new devices have advantages such as high operating speed (switching speed can reach 1 picosecond); low operating voltage; high emitted current density; good resistance to high temperature, to strong nuclear radiation, and to strong electromagnetic pulse (EMP) radiation (thereby much preferable to transistors for military anti-jamming technology); high degree of device integration (with sub-micron technology, over 1 million vacuum microelectronic devices can be etched onto one 1-square-millimeter silicon chip), an attribute especially suited to the fabrication of high-capacity memory

devices for super-high-speed supercomputers; high operating frequency (60GHz devices are now being developed for use in high-performance cellular telephone systems); and high resolution, full color, and high luminance (attributes suitable for superior new types of display monitors such as those for the next-generation wall-mounted large-screen televisions).

These devices have especially strong applications in the military, such as in high-temperature sensors and controllers used in jet engines, guided missiles, and nuclear reactors; as electronic devices capable of functioning in nuclear radiation or strong EMP environments; and as miniature microwave, millimeter-wave and sub-millimeter-wave devices for radar, communications, navigation, and electronic countermeasures systems.

**Another World Record Claimed for Current Density**

91P60046 Beijing GUANGMING RIBAO in Chinese  
3 Nov 90 p 1

[Article by Wu Yali [0702 7161 7787]: "China Develops Superconductor with Highest Current Density"]

[Text] Beijing 2 November—It was learned today from the National Superconductivity Center that China has had yet another major advance in superconductivity research: in mid-October, specialists at the Northwest Nonferrous Metals Research Institute achieved a world-record-high current density for a YBCO [yttrium-barium-copper-oxide] superconductor, prepared via a new technique.

This new method, called the "powder melting (or fusion) processing technique," is stabler and provides better control of material characteristics than common powder techniques, and is therefore superior for continuous fabrication of yttrium-based superconducting wire (or tape) with high superconducting current density. The technique has been declared to the State Patent Bureau. The tested superconductor has a cross section of 0.23 square millimeter; tested at a temperature of 77K and in the presence of a magnetic field with a strength of 1 tesla, this superconductor exhibited a current density of

70,800 amperes per square centimeter without losing its superconductivity. This datum is the highest value reported to date domestically or internationally.

**First National SQUID Conference held**

91P60064 Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 2 Dec 90 p 3

[Article by Luo Jingwei [5012 4842 4885]: "Conference on Superconducting Quantum Interference Devices Convened"]

[Summary] Experts in the field of superconducting electronics have just assembled in Kunming for the nation's first academic conference on superconducting quantum interference devices (SQUIDs). Forty representatives from the 20 Chinese institutes engaged in SQUID research and development are attending the conference. Topics include high-T<sub>c</sub> [critical temperature] DC SQUIDs, high-T<sub>c</sub> RF [radio frequency] SQUIDs, and applications of SQUIDs in industry. Certain applications covered at the conference—such as use of high-T<sub>c</sub> SQUIDs in measuring weak currents, for geodetic electromagnetic information surveying, and for magnetic susceptibility measurement—have heretofore not been reported on abroad.

### Updating Telecommunications To Be Given 'Top Priority'

40100012A Beijing CHINA DAILY in English  
13 Nov 90 p 1

[Article by staff reporter Gao Jin'an]

[Text] Modern technology and equipment will be the major elements in the nation's telecommunication plan over the coming decade, Premier Li Peng said yesterday.

Addressing the opening session of the Asia-Pacific Telecommunity conference in Beijing, Li said that updated transmission technologies, such as microwave, optical fibre and satellite, should be widely used in China.

The Premier told the more than 100 foreign and Chinese participants that more programmed digital telephone exchanges will be installed in the next decade.

As a necessary part of the nation's economic infrastructure and a requirement for success of the opening policy, China has attached great importance to the development of telecommunications in the past 10 years.

In drafting the national development plans for the coming decade, Li revealed, telecommunications will be given top priority.

He assured participants at the conference that China will firmly carry on the reform and open policies initiated by Deng Xiaoping.

With the expected State investment, Li believed that Chinese telecommunications industry will witness a faster development in the coming 10 years.

At present, the national telephone exchange capacity stands at 20 million lines with 13 million telephone sets installed across the country, said Yang Taifang, Minister of Posts and Telecommunications.

Currently, there is about one telephone for every 100 Chinese people on average, and the ratio in some large and coastal cities is greater than 10 for every 100.

Yang said at the meeting that over 600 Chinese cities have joined the national automatic telephone network and from over 200 cities it is possible to dial any number in 182 countries and regions. That service as well as inter-city service, is already available for government agencies, foreign embassies, large businesses and similar users.

According to the ministry's long-term plan, the number of telephones will reach 33.6 million sets by the year 2000, marking a tremendous step forward for the nation's telecommunications.

The figure means that there will be 2.8 telephone sets for every 100 people across the country on the average.

Yang said that inter-city transmission will mainly depend on digital optical fibre, satellite and microwave communications, as Premier Li had suggested.

By the end of this century, the national telecommunications network will be automatized, Yang said.

While stressing a self-reliance policy, China will enhance its cooperation with all Asian-Pacific Telecommunity member countries and world telecom leaders to aid the modernization drive in telecommunications, the minister said.

The Asian-Pacific Telecommunity, founded in 1979, has 22 member countries, two associate member countries and 17 non-voting members. China, enjoying good cooperation ties with the organization, is one of its founders. This was its first conference held in China.

### Developments in Fiber-Optic Communications Reported

#### Loose-Structure Oil-Filled Optical Cable Accredited

91P60051a Beijing DIANXIN JISHU  
[TELECOMMUNICATIONS TECHNOLOGY]  
in Chinese No 11, Nov 90 p 47

[Text] The GYTA and GYTA53 types of loose-structure oil-filled single-mode fiber-optic cable, developed for the first time in China by Institute No 5 of the Ministry of Posts & Telecommunications, recently passed ministry-level technical appraisal. Key technical indicators for these types of fiber-optic cable, whose development was a Key State Seventh 5-Year Plan S&T project, approach international standards for the mid eighties. The nation's first domestically made 140Mbit/s [DS4, 1920 voice circuits] fiber-optic-cable communications project (the Hefei-Wuhu project [see JPRS-CST-89-005, 23 Feb 89, p 84]) utilized these kinds of optical cable.

#### Another Hong Kong-Shenzhen Line

91P60051b Beijing DIANXIN JISHU  
[TELECOMMUNICATIONS TECHNOLOGY]  
in Chinese No 11, Nov 90 p 47

[Text] Hong Kong International Telecommunications Ltd. concluded an agreement a few days ago with the Guangdong Province Posts & Telecommunications Management Bureau on the construction of another advanced mainland fiber-optic cable between Hong Kong and Shenzhen. First-phase capacity will be 15,360 telephone lines, and after the entire project is completed total capacity will be 46,080 lines. The new optical cable, when added to the old coaxial cable, will provide a total of 92,160 circuits, and thus will become one of the world's largest communications channels.

### New Optical Transmission Line Launched in Tianjin

40100013b Beijing CHINA DAILY in English  
23 Nov 90 p 2

[Article by staff reporter Huang Xiang]

[Text] Tianjin yesterday inaugurated China's first optical transmission systems production line in response to the government's continuing efforts to expand communication capacity.

Production also marks the first foray into China for Standard Elektrik Lorenz AG (Alcatel SEL), a German communications giant which organised the technology transfer.

The new production line will enable Tianjin Optical and Electrical Communications Corporation (TOEC) to offer the whole range of optical transmission products for line equipment up to 140Mbit/s—"a highly sophisticated and state of the art technology in the field," according to Peter Poepper, the corporation's chief representative in Beijing.

His statement was echoed up by the managing director of the corporation's international relations department, Hans-Joachim von Ludwig, who called the 12 million Deutsch mark (\$8.16 million) production line a solid basis for the long-term continuation of bilateral business relations.

Alcatel SEL has been involved in comprehensive technology transfer for this project since 1988, when it was approved by both the German and Chinese governments.

According to von Ludwig, who is a board member of Stuttgart-based Alcatel SEL, the corporation is preparing an optical joint venture with TOEC—previously a supplier of military communications equipment.

He said all the paper work would be finished by the end of the year. But he said "it will take another two or three months to get it through."

Total investment will be around DM20 million (\$13.6 million) with a planned 50-year cooperation term.

### Absolute Frequency Standard of 1.5- $\mu$ m Semiconductor Laser

916A0004B Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 11 No 5, Sep 90 pp 39-40, 46 [MS received 7 May 89]

[Article by Xie Yi [6200 3015] of Optical Fiber Communications Laboratory, Beijing University of Posts and Telecommunications, and Wu Yizun [0702 1744 1415], since deceased]

[Abstract] Due to the energy transfer mechanism of the vibration-rotation transition of  $\text{NH}_3$  molecules in the

near-infrared waveband, the frequency of a 1.5- $\mu$ m GRIN-ROD [graded-index-rod] external cavity InGaAsP BH [buried heterostructure] laser is locked to one of the  $\text{NH}_3$  absorption spectral lines; its wavelength is 15,196 Angstroms. In addition, there are the following data: the threshold current of the laser device is 55 mA at 21°C; the changes in laser frequency with respect to changes in temperature and current are -14.4 GHz/°C and -750 MHz/mA; the laser free drift when environmental temperature is controlled to 0.01°C is less than 140 MHz for prolonged period in the open-loop-system status; and the variation in laser frequency with PZT [piezoelectric transducer] voltage change is 74 MHz/V. As an absolute frequency standard, the system frequency drift and fluctuation never exceed 1 MHz for a prolonged period.

Three figures show a frequency-locked system of a 1,500 nm InGaAsP BH external-cavity semiconductor laser, a one-dimensional differential curve for  $\text{NH}_3$  molecules at the 15,196 Angstroms absorption peak, and frequency-varying values before and after the system closed-loop status is plotted with an X-T recorder.

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### Jitter Performance of Timing Recovery Unit of Optical Communications Systems

916A0004C Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 11 No 5, Sep 90 pp 51-54, 61 [MS received 26 Nov 88]

[Article by Huang Shouhua [7806 1343 5478] of Beijing College of Posts and Telecommunications, and Zhao Zisen [6392 2737 2773] of Wuhan Institute of Posts and Telecommunications]

[Abstract] In digital communication systems, the quality of the signal regenerating circuit directly affects the transmission quality and range of the overall system. One of the major indexes for the circuit quality is the timing jitter performance. Hence, it is necessary to analyze and compare features of various clock recovery circuits in order to find the optimal circuit arrangement and to optimize the system transmission quality. From general expressions for the timing jitter power spectrum in an optical communications system, the two following expressions of the jitter properties of nonlinear circuits (NLC) are analyzed and compared with typical parameter values: square-law (SL) and linear rectifier (LR).

Three figures show a receiver for an optical communications system, the jitter power spectrum of SL-NLC and the total jitter power spectrum of LR-NLC.

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### Optical Wave-Front Division Multiplex Communications

916A0004A Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 11 No 5, Sep 90 pp 1-6 [MS received 20 Mar 89]

[Article by Dong Xiaoyi [5516 1321 5030] and Zhang Jianzhong [1728 1696 1813] of Modern Optics Institute,

Nankai University, Tianjin; and Sheng Qiuqin [4141 4428 3830] of Physics Department, Nankai University, Tianjin]

[Abstract] The article reports, for the first time, that the degree of spatial coherence of an optical wave can be modulated with a multidimensional Raman-Nath acousto-optical modulator and can be demodulated with multichannel optical gratings. Thus, multichannel signals can be transported in a single light beam. Optical wave-front space division multiplexing can be achieved in optical communications.

Eight figures show a multidimensional 35 MHz-center-frequency, 10 MHz-bandwidth acousto-optical modulator, a coordinate relationship in a multidimensional situation, an optical grating-type demodulator, reference figures for exchange of integration variable, results of calculation using the light grating value  $N$  as parameter, curves showing the related signal  $R$  versus Raman-Nath parameter  $U_1$ , a curve for  $R$  versus  $U_x$ , and actual demodulated signals.

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### Statistical Design Approach for the Repeater Spacing of Single-Mode Optical Fiber Systems

916A0004D Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 11 No 5, Sep 90 pp 91-93 [MS received 4 Aug 89]

[Article by Xiang Zhongjian [7309 1350 0256], Wei Leping [7279 2867 1627], and Bai Qizhang [4104 0366 4545] of the Telecommunications Transmission Research Institute, Ministry of Posts and Telecommunications]

[Abstract] Repeater spacing is a primary goal in designing optical-fiber communications systems. The larger the repeater spacing, the lower is the cost and the higher are the technical and economic benefits realized

for an optical-fiber communications system. Therefore, this problem has been consistently emphasized by system designers.

Based on factory and field optical-power parameter distributions, a statistical design for the repeater spacing of 140 Mbit/s single-mode optical-fiber systems is presented. The results show that the maximum achievable repeater spacing is 17 km greater than that calculated using a conventional worst-case design approach; this constitutes a premature failure rate of 0.1 percent. Furthermore, a simplified statistical design approach is also presented. Adopting this simplified approach may not only obviate calculation complexity related to a full statistical design approach, but also can retain its main advantages.

A figure shows a cumulative estimate curve for repeater spacing.

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#### Design and Implementation of an Interface for Voice Input and Output

916A0004E Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 11 No 5, Sep 90 pp 94-96 [MS received 3 Nov 87]

[Article by Ni Yongren [0242 3057 0088] of South China University of Science and Engineering, Guangzhou]

[Abstract] The computer-on-a-chip Transputer is a new device emerging after many years' development by the INMOS Corporation in Great Britain. The paper introduces the design and experimental results of an interface for voice input and output implemented with the Transputer and the control program written in the parallel programming language Occam. The paper describes a schematic diagram for voice input and output interface components, design of a voice-interface circuit and its control program, as well as the frequency properties of voice-interface components satisfying requirements for telephonic communications. The Transputer and Occam can also be used in voice and data transmission over networks.

Five figures show the logic schematic drawing for the interface between a telephone and a Transputer; the data transmission circuit between voice coding and encoding on the one hand, and the Transputer on the other; the read/write time sequence signal controller using a TP3056 CMOS codec [complementary metal-oxide semiconductor coder/decoder] chip; a schematic diagram for the telephonic communications environment and control program; as well as a test method and the characteristic curve for the frequency properties of interface components.

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#### Nation's First DMW Trunkline Project Operational

91P60052 Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 11, Nov 90 p 47

[Text] The nation's first digital microwave (DMW) communications trunkline project is about to be turned over for use. This project's circuit runs from Beijing in the north through Tianjin, Hebei, Shandong, Jiangsu, and Anhui Provinces, and finally to Shanghai, a total length

of over 1700 kilometers. This project not only constitutes China's first DMW communications trunkline, it also is Asia's first long-distance, high-capacity DMW circuit.

**Portable Satellite TV Earth Station on International Market**

*91P60055 Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 18 Nov 90 p1*

[Article by Huang Jiwei [7806 4949 0251]: "Portable Satellite TV Earth Station Enters International Market for First Time"]

[Summary] On 7 October, two flat-bed trucks carrying a portable satellite television earth station set out from the Ministry of Machine-Building & Electronics Industry's Shijiazhuang Institute 54, which developed the system, on a trip to Myanmar [Burma]. This is the first time that

a Chinese-made portable satellite TV earth station has been sold on the international market. This portable station, which can send one TV program or receive two, will form an integral part of Myanmar's satellite TV system.

An expert technical appraisal of the new portable earth station was given by the AsiaSat Company's Senior Engineer Xu Jinqiang, who supervised the entire debugging and testing process. Mr. Xu officially certified that the portable station complies with all relevant requirements—including Intelsat's strict requirement for antenna sidelobe characteristics—for entering the AsiaSat network built around AsiaSat I. The portable earth station utilizes a high-gain, low-sidelobe ring-focus antenna, a domestically made 400-watt traveling-wave-tube high-power amplifier, and a 55K [i.e., noise temperature of 55°K] low-noise amplifier.

**Experiments of Joined In-Beam  $\gamma$  Equipment**

916A0001A Beijing GAONENG WULI YU HE WULI  
[HIGH ENERGY PHYSICS AND NUCLEAR  
PHYSICS] in Chinese Vol 14 No 7, Jul 90 p 641

[Article by Guo Yingxiang, Sun Xiangfu, Luo Yixiao, Lei Xiangguo, Sun Xijun, Xu Xiaoji, Zhao Zhizheng, Wang Jicheng and Yu Jianfang, (Institute of Modern Physics, Academia Sinica, Lanzhou); Wen Shuxian Li Shenggang, Weng Peikun, Hua Pengfei, Li Guangsheng, Yuan Guanjun, Zhu Lihua, Zhang Lankuan, Yu Pan-shui, and Yang Chunxiang, (Institute of Atomic Energy, Beijing)]

[Abstract] 4 symmetric and 6 asymmetric BGO Compton shielded HpGe detectors which constitute the Joined In-Beam Gamma Equipment have been completed and measured at the Institute of Atomic Energy (Beijing) and Institute of Modern Physics (Lanzhou) respectively. The first set of experiments has been carried out by using the equipment. This paper describes the experimental set up and the general case of the

measurements. A discussion about the Compton suppression is given. The observed  $25/2^+$  of the  $\Delta J = 1$  band built on the  $9/2^+$  (lg 9/2 proton hole) state of  $^{121}\text{Cs}$  is the highest level among the similar bands of other Cs isotopes.

**Statistical Description of the Incident Energy  
Dependence of Mass Yield Distribution of  
Fragments in  $^{12}\text{C}(15-45\text{MeV/A})+^{63}\text{Cu}$  Reactions**

916A0001B Beijing GAONENG WULI YU HE WULI  
[HIGH ENERGY PHYSICS AND NUCLEAR  
PHYSICS]  
in Chinese Vol 14 No 7, Jul 90 p 672

[Article by Qi Dahai and Sa Benhao, (Institute of Atomic Energy, Beijing)]

[Abstract] In this paper a statistical model is successfully used to describe the disassembly of hot nucleus created in intermediate energy heavy ion collisions ( $15-45\text{MeV/A } ^{12}\text{C}+^{63}\text{Cu}$ ). The results of the dependence of mass yield distribution of the fragments on the incident energy are consistent with experimental data quite well.

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