National Science Council

ISSN: 1607-3509

Science Bulletin

May 2003/Vol. 35, No. 5

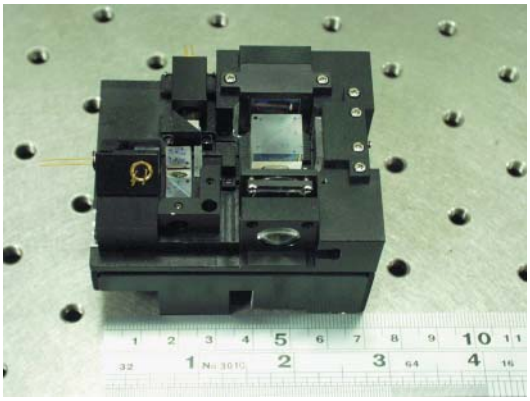
Diffractive Laser Encoder System Leads Way Towards Precision Positioning

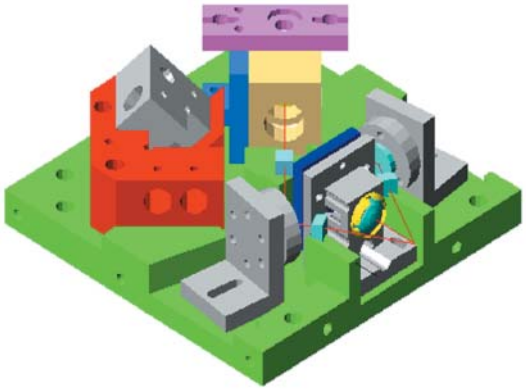
The industry-university cooperative research project, "Research and Development of a Diffractive Laser Encoder System," directed by Professor Lee Chih-kung at the Institute of Applied Mechanics, National Taiwan University, has recently completed the first prototype diffractive laser encoder system that possesses the world's highest head to scale alignment tolerance.

This industry-university cooperative project has just completed the second of its two three-year phase program. The total funding for the project is NT$40 million, which is jointly provided by the National Science Council (NSC) and its collaborating industrial partner, AHEAD Optoelectronics, Inc. The Project team consists of nine professors and nearly one hundred researchers. The Project team has integrated extensive knowledge and experience in varied fields such as optics, mechanical engineering, electronics, electric engineering, and programming. The Project has required the consolidation of its competence in design, manufacturing, metrology, and diffractive optical elements (DOE) to expand towards new applications, such as the creation of this newly developed diffractive laser encoder system.

The innovation of this new system can be seen from the 24 patents applied, of which four basic patents are on the diffractive laser encoder system itself, and the remaining 20 patents are related to metrology and systems development technology. To date, an impressive 17 patents out of the 24 applied, have been granted.

Prof. Lee describes the diffractive laser encoder system as a sensor for an ultra-precision positioning system that utilizes a miniaturized optical system, a sub-micron grating scale, and an innovative integrated circuit design. This unique system integrates optical-mechanical elements and signal processing circuits to achieve sub-nanometer positioning accuracy. This system can thus serve as a key subsystem for all future high-precision production equipment such as semiconductor steppers and flat panel display processors. The development of this type of system can enhance and elevate Taiwan's key system production capability and global competitiveness.





The current phase of the project has been built on the results of the first phase — "Pioneering Research Diffractive Optical Elements." Using the world's most advanced diffractive laser encoder as the research and development platform, its researchers have developed a highly competitive system that sets a world record in terms of overall system alignment tolerance. The industrial partner of the project, AHEAD Optoelectronics, has helped to collect market information and assist in the optical encoder system integration. As such, the research team has been able to stay abreast of worldwide diffractive laser encoder system R&D specifications, insuring the focus and innovation of the overall research efforts.

As the application areas of diffractive laser encoder development includes process monitoring, automatic precision angle and length positioning, etc., the successful development of this type system can be expected to yield several billion US dollars worth of positive impact for IC and other high-tech industries. With the successful development of this technology, Taiwan can now not only look forward to belonging to a privileged class of countries with worldwide leading R&D technologies in diffractive laser encoders, but now it also has the means to increase the percentage of domestically made process equipment used in many high-tech industries worldwide.

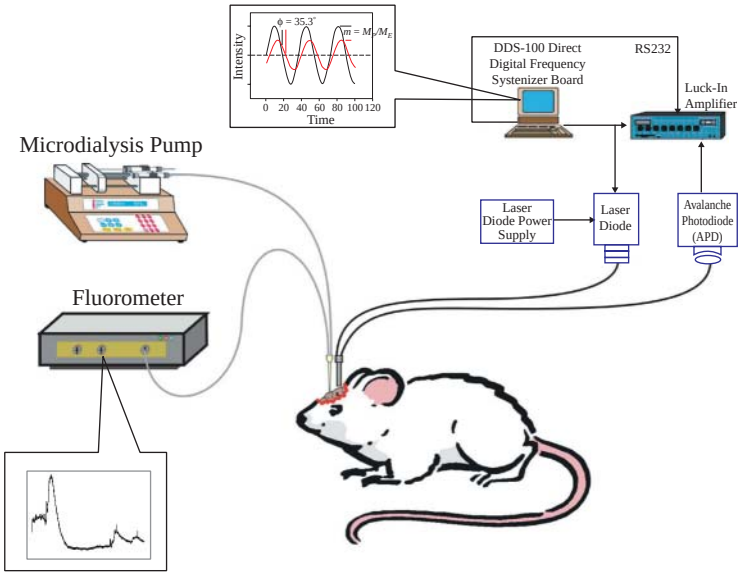
Noninvasive Ultrasound Drug Delivery Technology Developed in Taiwan

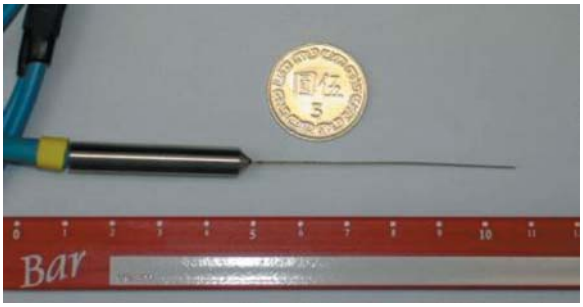
An NSC-funded research team led by Prof. Yang Chung-shi of the Department of Applied Chemistry at National Chi Nan University announced on April 24 that it had successfully performed research on live animal using a microdialysis system, a micro-lightguide integrated system, and fluorescent nanosphere. The team's most significant records included research on cutaneous absorption and sampling in animals and research on vascular permeability in cases of ischemia.

Prof. Yang explained that his team's project is a targeted effort to deliver therapeutic drugs to specific organs in the body. The tiny size of nanosphere allows them to easily enter the body, making them ideal drug delivery vehicles. It can be easily foreseen that nanosphere will one day have a vast range of biomedical applications involving live organisms. But to realize nanosphere's bright prospects, researchers must investigate the key question of how they are transported in the body, and their ultimate distribution, before they can be used in practical applications. Only after it has been found out where nanosphere go in the body can their effectiveness in medical applications be assessed.

The team has achieved preliminary success in delivering drugs noninvasively. Ultrasound vibrations were used to cause 20 nm fluorescent particles to penetrate the skin of living animals and enter the subcutaneous tissue via blood vessels. This was the first time anywhere in the world that ultrasound and nanosphere have been used as a noninvasive drug delivery and testing technology.

The team employed white rats as its animal model. It was found that 20 kHz ultrasound vibrations caused 20 nm fluorescent nanosphere injected into the blood to leave the blood vessels and enter the subcutaneous tissue.





This finding proves that ultrasound can be applied in the extraction of blood samples without the use of needles. The method is much less painful than the use of a needle, and thus offers considerable potential as a noninvasive blood sampling technique. In addition, the research team also discovered that the use of 20 kHz ultrasound vibrations was sufficient to cause 20 nm fluorescent particles to be absorbed by the skin and seep to the subcutaneous tissue. This conclusively shows that ultrasound vibrations can be used to promote skin absorption allowing drugs to be delivered without the pain of an injection. The team hopes to combine this technology with a biochips system it is currently developing to create an integrated system for blood sampling and analysis and drug delivery.

Another aspect of the team's work has been research on changes in the permeability of cerebral blood vessels in cases of ischemia. This research has been carried out on white rats using a microdialysis probe together with a 0.4 μm micro-lightguide probe system developed by the team. After ligation of blood vessels to induce ischemia, the increased permeability of the blood brain barrier allowed fluorescent nanosphere injected into the blood to cross the barrier and enter brain tissue. The weakening of the blood brain barrier (and the concurrent increase in its permeability) is one of the most damaging effects of ischemia. The method developed in

this project can be used in clinical practice to assess damage to the blood brain barrier when a congestive stroke occurs. The research team is now in the midst of further R&D on the clinical and academic use of implanted micro-lightguide probes.

The next steps in this project will be to develop methods of observing nanosphere in living tissue using optical and nuclear imaging technology, and perform R&D on targeted drug delivery and clinical examination systems.

NSC Funds Recruiting of Research Scholars by Universities and Research Organizations

While in the past it was possible to recruit technical manpower and postdoctoral researchers only to take part in research projects and teaching, the National Science Council's (NSC's) recently-drafted "Guidelines Governing the Recruitment of Research Scholars" allows broadened funding for the recruitment of much more overseas personnel by public and private universities and research organizations. It is hoped that this measure will give Taiwan the academic manpower it needs to pursue many major mid- and long-term research projects.

While the NSC enacted regulations governing the recruitment of sci-tech talent and postdoctoral research manpower at an early date, Taiwan is currently in the midst of a transformational period, and adequate research manpower is needed to successfully implement national projects geared to raising Taiwan's level of technological achievement. For this reason the NSC recently decided to develop new channels for recruiting outstanding academic manpower from overseas, and especially facilitate the return of émigré talent for mid- and long-term research projects in Taiwan.

The NSC has indicated that the goal of the new "Guidelines Governing the Recruitment of Research Scholars" is to establish a research scholar system at universities and colleges. The guidelines will provide new sources of funding for the recruitment of domestic and foreign scholars and research teams to work on major mid- and long-term research projects in Taiwan, and will thereby enhance Taiwan's academic research standards. At the same time, the guidelines will also facilitate the orderly promotion of postdoctoral research fellows in conjunction with the research scholar system, sustaining research careers and insuring that researchers can dedicate themselves to their work with a sense of security.

Research scholars (not including those from China or from China via a third area) who can be recruited under the guidelines include NSC Lecturer, Research Scholar, Associate Research Scholar, Assistant Research Scholar, and Postdoctoral Research Scholar. Funding can be used for salaries, airfare, resignation funds, insurance, salary differential subsidies, and research project expenses.

Research scholars may receive funding for three-year research projects during their period of appointment, and those who achieve good results may continue to apply for funding several times. While application for NSC Lecturer is accepted at any time, Research Scholar, Associate Research Scholar, and Assistant Rresearch Scholar are selected once a year, and Postdoctoral Research Scholar is selected twice a year. In addition, to encourage domestic research personnel to dedicate their efforts to long-term research, Postdoctoral Research Scholar can earn promotion through successive grades to the level of Research Scholar. The guidelines were publicly announced in March, and applications are already being accepted.

NSC Council Meeting Passed the Plan for the Second Phase of NAPHM to Include Drought Mitigation

The main goal of the National Science and Technology Program for Hazards Mitigation (NAPHM) is to gain a deeper understanding of the natural and human factors causing or worsening typhoons, earthquakes, and other disasters, while developing or acquiring preventive or mitigation technology. Total funding for implementation of the program was NT$753.5 million over the period of 1998~2000. The program has been jointly planned and implemented by the NSC Council for Sustainable Development in conjunction with other relevant government agencies, and results have been realized in actual disaster relief work.

Among the tasks performed during the first phase of the NAPHM were the compilation of hazard mitigation databases, implementation of hazard potential surveys and analysis, hazard simulation and risk analysis, develop-

ment of early warning and forecasting technology, a hazard management decision-making support system, rapid safety diagnosis and reinforcement of earthquake-damaged buildings, design of earthquake-resistant buildings and assessment of seismic-resistance, development and application of an earthquake hazard assessment decision-making support system, development of a disaster notification and emergency response system, assessment and review of the disaster prevention and relief system, and formulation of disaster prevention and relief strategies. Preliminary results are considered to be very promising.

To facilitate the legislation of the Disaster Prevention and Response Act, support the emergency relief work performed by the Central Emergency Response Center, and draft policy recommendations concerning the functioning of the Executive Yuan Hazard Mitigation Specialist Consultation Committee, the NAPHM has implemented a disaster relief demonstration project and is assisting local governments to draft regional disaster mitigation and relief plans. This work is channeling the results of technology R&D into practical undertakings. NAPHM's results are thus making a substantial contribution to disaster mitigation and relief technology and practical work in Taiwan.

At the 160th NSC Council Meeting, held on April 7, participants approved the results of the first phase of the NAPHM, and passed a revised plan for the second phase of NAPHM. As befits an environment in which new hazards are constantly emerging, revisions include the addition of drought mitigation, relevant socioeconomic issues, and hazard mitigation awareness and education tasks.

The Council Meeting approved the conclusive NAPHM phase one results assessment report, and a consensus was reached that NAPHM had performed extremely well during the period from 1999 to 2001. Besides collecting an impressive amount of data, the program had also established good channels of communication with the various agencies in the nation's disaster mitigation and relief system. Because of this, the Council agreed to continue implementation into a second phase, which continues the program from 2002 to 2006. This phase will strengthen emphasis on drought mitigation, socioeconomic issues, and disaster mitigation education and awareness work.

NSC Approved NT$7.3 Billion in Funding for Biotech Pharmaceuticals Program

The April 7 meeting of the NSC Council Meeting approved NT$7.3 billion in funding for the National Science and Technology Program for Biotechnology and Pharmaceuticals, which will be implemented from this year (2003) to 2006. The program's overall objective is to perform R&D leading to the development patentable herbal medicines, new synthetic compounds, and biotech drugs.

After the conceptual plan for the National Sci-Tech Program for Biotechnology and Pharmaceuticals had passed review, an overall plan was issued and approved by the NSC Council Meeting on April 7. The program will be directed by Prof. Teng Cheming of the National Taiwan University (NTU) Graduate School of Pharmacology. Prof. Teng is also Associate Dean of the NTU College of Medicine Office of Research and Development, and is well-respected in the world of pharmacology.

The National Sci-Tech Program for Biotechnology and Pharmaceuticals is the extension of the National Science and Technology Program in Pharmaceuticals and Biotechnology. Hoping to build on the results of the early program, and avoid overlap with the National Research Program for Genomic Medicine, the NSC has renamed the program to place more emphasis on biotechnology, herbal medicines and small molecules.

The major government agencies participating in this program are the NSC, Ministry of Economic Affairs, and Department of Health, which are responsible for integration of research organizations for the purpose of new drug discovery, pre-clinical tests, and clinical tests respectively. Apart from the integration of the government's drug R&D resources, the NSC will recruit more domestic research personnel and encourage active participation, while promoting the realization of results in the industrial sector.

Editorial Office: Rm. 1701, 106 Sec. 2 Ho-ping East Road, Taipei, Taiwan 10622, Republic of China
Tel: +886 2 2737-7594, Fax: +886 2 2737-7248, Email: chenlee@nsc.gov.tw
http://nr.stic.gov.tw/ejournal/SciNews/scibulletin.htm
Subscription price for each copy: US$1.00
Payment must be made in US dollars by a check payable to National Science Council.

國　內：每份新台幣 25 元，訂閱請利用郵政劃撥儲金帳戶 0101222-5 號
戶　名：行政院國家科學委員會。

ISSN 1607-3509
GPN: 2005800003