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Growing by Leaps and Bounds

2004 Operating Report from the Southern Taiwan Science Park

The Southern Taiwan Science Park's operating performance grew by leaps and bounds in 2004, according to Dr. Tai Chein, Director-general of the Southern Taiwan Science Park Administration at a recent press conference. The Park's companies earned NT$259.4 billion during the year; this figure represented growth of 67% over 2003 and exceeded the Park's target of NT$250 billion. Additionally, the Park's total import and export value for 2004 (January through December) reached NT$501.2 billion, more than doubling the NT$237.1 billion value from 2003.

According to Dr. Tai, optoelectronics and integrated circuits remained the respective leaders of the six main Park industries in 2004. The optoelectronics industry's cumulative earnings of NT$168.6 billion throughout the year represented growth of 87.9% from earnings of NT$89.7 billion in 2003, and accounted for a full 65.0% of total earnings by Park companies during the year. Within this industry, flat panel displays were the biggest moneymaker, followed by optoelectronics materials/elements/systems. The integrated circuits industry's earnings of NT$83.2 billion in 2004 were up by 36.5% from earnings of NT$ 60.9 billion in 2003, and accounted for 32.1% of total earnings by Park companies. Within the integrated circuits industry, chip manufacturers performed best in 2004. The precision machinery industry ranked third place with earnings of NT$4.6 billion in 2004, and sales growth of 40.6% over earnings of NT$3.3 billion in 2003. Makers of precision instruments and equipment performed best within the precision machinery industry. The biotechnology industry, computer and peripheral industry, and telecommunications industry took fourth, fifth, and sixth place with earnings of NT$ 1.2 billion, NT$904 million, and NT$ 872 million respectively.

As far as imports and exports were concerned, Dr. Tai noted that the Park's total imports and exports reached NT$ 501.2 billion in 2004, of which exports totaled approximately NT$ 221.5 billion (up by 79.7% over 2003) and imports totaled approximately NT$279.7 billion (up by 139.7% over 2003). Among the Park's six major industries, the optoelectronics industry led in the export category with exports worth NT$101.6 billion (up by an outstanding 171.8% from the previous year). The integrated circuits industry followed with exports worth NT$31.6 billion and up by 100.3% over the previous year. The precision machinery industry accounted for exports worth NT$1.2 billion. As far as imports were concerned, the optoelectronics industry was the leader with imports worth NT$146.9 billion (up by 136.3%), and was followed by the integrated circuits industry with imports worth NT$124.9 billion. Driven by the expansion of 12" wafer fabs, the integrated circuits industries' imports grew by an astounding 901.9% on the strength of foreign equipment purchases.

The Park's leading destinations for exports in 2004 were Asia, Europe, and North America, ranked in order of export value. In terms of export growth rate, the Mideast led with export growth of 615.8% (due to increased exports to Turkey and then Saudi Arabia), followed by South America with export growth of 604.6% (due to low baseline value), and Europe with growth of 326.3%. The most imports came from Asia, North America, and Europe, in order of import value. As for import growth, the Mideast led with import growth of 545.7% (mainly due to the import of integrated circuits equipment from Israel and other equipment from trading companies in the Mideast), followed by other areas with growth of 480.0% and Africa with growth of 471.5% (both due to low baseline values).

Earnings of Six Major Science Park Industries in 2003 and 2004

Units: NT$100 million

Industry	Earnings		Growth rate
	2003	2004	
Optoelectronics	897.18	1,685.76	87.90%
Integrated circuits	609.00	831.54	36.54%
Precision machinery	32.71	46.00	40.64%
Biotechnology	5.29	11.55	118.26%
Telecommunications	6.63	8.72	31.76%
Computers and peripherals	1.08	9.04	737.16%
Other enterprises	1.24	1.72	38.80%
Total	1,553.13	2,594.33	67.04%

When import and export statistics are broken down by country, the three leading sources of imports were Japan, the US, and Hong Kong, while the three leading destinations for exports were Hong Kong, Korea, and Japan. Here it should be noted that the Park still depends heavily on Hong Kong for product transshipment. Exports to the Netherlands grew at the highest rate – 536.5%. Among the six major industries, the optoelectronics industry led in raw material imports with NT$33.9 billion, followed by the integrated circuits industry with raw material imports worth NT$5.3 billion. The integrated circuits industry imported the most machinery and equipment (NT$119.6 billion), followed by the optoelectronics industry (NT$ 112.8 billion).

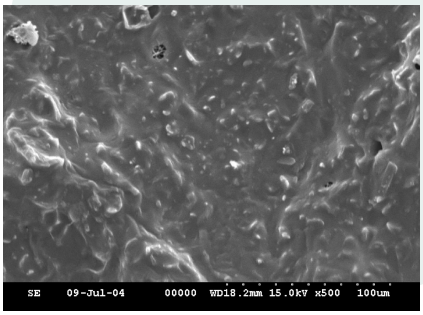
According to Dr. Tai, the Park had approved 157 new companies by the end of 2004, with 45 companies in optoelectronics, 38 in precision machinery, 28 in biotechnology, 22 in integrated circuits, 14 in telecommunications, 3 in computers and peripherals, and 7 in other categories. It is evident that the optoelectronics, integrated circuits, and biotechnology industry clusters are taking shape at the Park. After surpassing its operating earnings target of NT$250 billion for 2004, the Park looks forward to meeting a NT$300 billion target in 2005 and even passing the NT$1 trillion mark by 2009.

Reborn from Fire

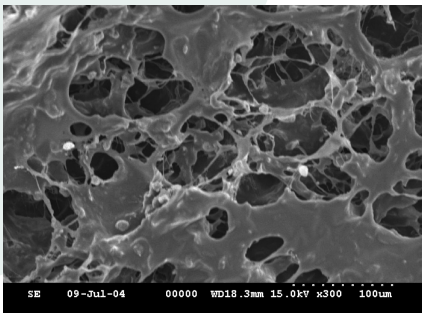
Breakthrough in Tissue Engineering Research Yields Better Artificial Skin

Skin burns are extremely dangerous, and victims of severe burns need to have their wounds covered quickly to survive. When burns cover more than 80% of the victim's body, however, the donor skin that remains will be insufficient to cover the wounds. What can be done to treat these burn cases? A multinational research team headed by Dr. Dai Niann-tzyy of the Division of Plastic and Reconstructive Surgery, Department of Surgery, Tri-service General Hospital, has successfully used *in vitro* tissue culture to develop a new type of artificial skin able to promote the healing of severe burns. The team's research results have been published in *Biochemical and Biophysical Research Communications*. When this type of artificial skin goes on the market, it will be a godsend for patients with severe burns and acute and chronic skin deficiencies.

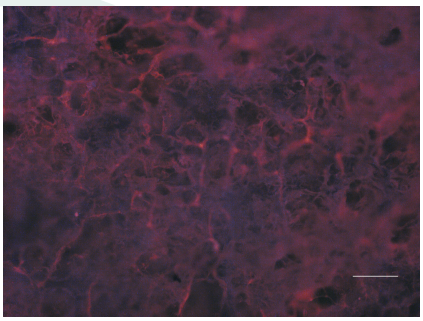
According to Dr. Dai, skin possesses a multi-layered structure consisting of the epidermis, dermis, and subcutaneous fat tissue. Research on the use of cultured human epidermal cells to treat burn patients goes as far back as 1979. While clinical trials have shown that cultured skin can be used effectively to cover extensive burns, the artificial skin tends to peel off early because the formation of basement membrane between the epidermis and dermis is lacking or slow, resulting in blisters and scarring. In addition, it usually takes from three to four weeks to culture enough of the patient's own epidermal cells to cover the whole body. In keeping with the prevailing belief in early debridement and early skin grafting, some researchers began covering burns with cadaver skin at the early stage of injury. When enough of the patient's own skin had been cultured to cover the burns, the epidermal layer was cut away and the wounds covered with cultured skin. This approach to treatment yielded even better clinical prognoses than treatment with cultured epidermal cells alone. On the other hand, the use of cadaver skin posed the threat of infec-



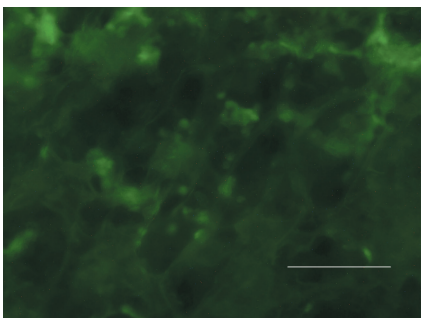
SWM revealed a confluent sheet of human keratinocytes growth on the upper surface of 1:20 collagen:PCL biocomposite in the co-culture system for 28 days.



SEM revealed good attachment and spreading of 3T3 fibroblasts in the porous structure of the lower surface of 1:20 collagen: PCL biocomposite in the co-culture system for 14 days.



Immunohistochemistry assay of the epidermal layer of the co-cultured skin model (100x; scale bar: 100 μm).



Immunohistochemistry assay of the dermal layer of the co-cultured skin model (200x; scale bar; 100 μm).

tion by AIDS or hepatitis, etc., and the source of the skin was subject to many restrictions. Nevertheless, clinical experience has shown that skin substitutes produced via tissue engineering methods could simultaneously promote the growth of dermal fibrous tissue and serve as an epidermal layer covering the wound.

Entitled "A Co-cultured Skin Model Based on Biocomposite Cell Support Membranes," this research project received support from the National Science Council, the Medical Affairs Bureau of the Ministry of National Defense, and the Childhood Burn Foundation of the Republic of China. The tissue-engineered skin developed in the project involves the use of co-culturing technology developed by Dr. Dai to culture layers of fibroblasts and keratinocytes on the two sides of a biocomposite film. The new artificial skin successfully developed in the project will be tested in animal experiments in the near future. In addition, the team hopes to eventually use gene transfer technology to reduce the rejection that may occur after tissue transplants, and thereby enhance the usefulness of the artificial skin. It is hoped that this groundbreaking work in burn medicine and tissue engineering will save many lives in the near future, and bring brighter prospects for patients with severe burns and acute and chronic skin deficiencies.

An Enlightening Breakthrough

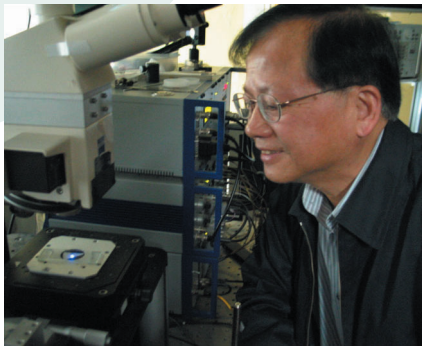
Taiwan's First Blue Light VCSEL is Developed at National Chiao Tung University

A research team led by Prof. Wang Shing-chung of the Department of Photonics, National Chiao Tung University successfully developed a gallium nitride (GaN) blue vertical cavity surface emitting laser (blue VCSEL) on February 24, 2005. The first blue VCSEL developed in Taiwan, this pioneering breakthrough is comparable to or even surpasses the work of leading research laboratories in the US and Japan, and raises Taiwan's blue VCSEL research to a world-class level.

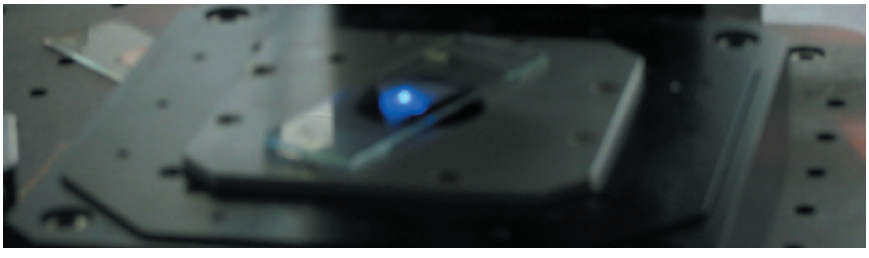
According to Prof. Wang, the blue VCSEL developed by his team consists of a vertical cavity and a multiple quantum well light emitting structure. Due to the lack of GaN substrate material, the epitaxial growth of GaN material and device structures is technically a very difficult process. Ordinary GaN light emitting devices can only achieve incoherent light emitting diode (LED) stage, and it is a great challenge just to fabricate conventional blue edge emitting lasers. Further, the realization of GaN blue VCSELs requires a pair of very high reflectivity multiple-layer structure to form the vertical cavity in order to achieve laser operation. Therefore, the technical difficulties involved here are much greater than that of edge emitting lasers.

Prof. Wang's team has conducted research on GaN blue VCSEL for nearly five years under the support of the NSC, the National Science and Technology Program for Nanoscience and Nanotechnology, the Ministry of Education's Program for Promoting Academic Excellence of Universities, and National Chiao Tung University. The team has been developing the epitaxial growth process and multiple-layer vertical cavity fabrication technique, and has established device-processing steps. This breakthrough was finally achieved after countless iterations and constant improvements over many years. One of the key advantages of this blue VCSEL design is the ease with which the fabrication process can be transferred to mass production.

Blue VCSELs are expected to have a wide range of applications in high-density optical storage (HD-DVDs), large area laser displays, and lighting devices. Furthermore, the micro-cavity structure of GaN VCSEL gives them unique electronic and optical characteristics that can be used to control photon generation. Future applications may include quantum information and nanotechnology. Prof. Wang's research team is now working closely with the Quantum Information Laboratory headed by Prof. Yoshihisa Yamamoto of Stanford University. The team is also conducting research collaboration with the US Air Force Research Laboratory (AFRL).



Prof. Wang observing GaN blue laser operation.



GaN blue VCSEL in operation.

Taiwan's Brilliance

Breakthrough in Coding by ISU Doctoral Students Receives International Attention

Yet another NSC-funded research project has yielded groundbreaking results as two doctoral students at I-Shou University (ISU) achieved major discoveries in coding theory. The discoveries were made by ISU Information Engineering Graduate Institute doctoral student Lee Chong-dao and Electrical Engineering Department doctoral student Chen Yan-haw, under the supervision of dean and chair professor Truong Trieu-kien of the College of Electrical Engineering & Information Science and professor Chang Yaotsu of the Applied Mathematics Department. This project has attracted considerable international interest and two papers on the students' work have been accepted by *IEEE Transactions on Information Theory* and *IEEE Transactions on Communications* for publication in the near future. Recognition by these prominent international journals shows that world-class academic research on coding and decoding is being conducted at ISU.

According to Mr. Chen, author of the paper entitled "Algebraic Decoding of (103, 52, 19) and (113, 57, 15) Quadratic Residue Codes," the 21st century is the digital age, and all audio and video signals will be processed in digital form to ensure that signals transferred will not be interrupted by any error. And to achieve the elimination of errors, digital signals must be processed in a way known as "coding." The goal of Chen's research has led to perfect digital images and digital communications and ensured that information can be transmitted faster and more efficiently. If the technology developed under this project can be applied to products, it will make digital television images more realistic and improve the sound quality of mobile phones.

Lee Chong-dao (right) and Chen Yan-haw (left).

According to Mr. Lee, author of the paper entitled "Weight Distributions of Some Binary Quadratic Residue Codes," many researchers have been studying coding methods to improve transmission quality, and "Quadratic Residue (QR) codes" have long remained a problematic issue in the research of decoding. To tackle this difficult challenge, Lee focused on QR codes and used various types of computer equipment to perform a series of experiments. After examining the results of computer calculations, Lee discovered that the amount of calculations needed to determine whether the weight distributions of QR codes are regular can be reduced by a factor of eight. Lee's inference method represents a breakthrough in coding technology.

The Coding Center at ISU has been in existence for ten years. Under the supervision of Prof. Truong and Prof. Chang, students at the coding center have made continuous progress in research on coding and decoding technology, and most of their research achievements have been published in internationally respected journals. These successes have brought worldwide recognition to the Coding Center at ISU, and earned Prof. Truong the title IEEE Fellow for his outstanding contributions to research in coding theory. It is quite evident that ISU's coding research has caught the world's attention and is winning international admiration.

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