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Southern Taiwan SIP and Hsinchu SIP Enjoy Exceptional Performance in 2002

The Hsinchu Science-based Industrial Park Administration (HSIP Administration) and the Southern Taiwan Science-based Industrial Park Administration (STSIP Administration) have publicly announced that the HSIP enjoyed turnover of NT$705.5 billion for year 2002 (Jan. ~ Dec.), representing growth of 6.5% over 2001, which beat the predictions of international market survey organizations such as SIA, WSTS, and Dataquest, who predict worldwide semiconductor market growth of only 1.3% ~ 1.8% for 2002 because of the torpid global semiconductor market and the confrontation between the US and Iraq; and the STSIP enjoyed turnover of NT$103.1 billion for the same period, representing growth of 106% over 2001. The fact that the STSIP was able to break through the NT$100 billion turnover mark for the first time after six years in operation shows that it offers a competitive advantage even in this period of economic slowdown.

The following is an analysis of the 2002 performance of individual industries in the two science-based industrial parks: The STSIP's optoelectronics sales grew by 162% over 2001, accounting for roughly 51% of STSIP turnover. In contrast, the HSIP's optoelectronics sales decreased by 3.5% and accounted for 8.5% of total turnover. IC firms in the HSIP had sales growth of 21.4% over 2001 and accounted for 64.8% of total HSIP turnover. IC firms in the STSIP had sales growth of 68% over 2001 and accounted for 47% of total turnover. As for other industries, precision machinery firms in the HSIP had sales growth of 12.4% over 2001, while their counterparts in the STSIP enjoyed growth of 105%. Biotech firms in the HSIP had sales growth of 6.1% over 2001, while those in the STSIP enjoyed growth of 67%. Telecommunications firms in the HSIP had sales growth of 0.8% over 2001, while those in the STSIP shrank. These statistics tell us that the optoelectronics and IC industries still play extremely important roles in Taiwan's high-tech industry, and that IC and optoelectronics industry clusters are coalescing at the HSIP and STSIP respectively.

Import/export trade: The HSIP's total import/export trade of NT$ 528.7 billion in 2002 represented growth of 2.4% over 2001. While exports of NT$279.2 billion had fallen by 2.9% over 2001, imports of NT$ 249.5 billion rose by 9%. Exports exceeded imports by NT$29.7 billion. The main recipients of exports from the HSIP were Hong Kong, Japan, the US, China, and Singapore in that order. Exports to China grew fastest (116%), followed by exports to Hong Kong (16%). The main sources of imports to the HSIP were Japan, the US, Singapore, Hong Kong, and the Philippines. Imports from the Philippines grew fastest (77%), followed by those from Japan (10%). The STSIP accounted for total import/export value of NT$158 billion in 2002. Exports of roughly NT$79.07 billion had grown by 192% over 2001, exceeded the equivalent figure of 2001 by NT$51.9 billion. Imports of NT$78.93 billion fell behind exports. Major export recipients were Asia, North America, and Europe in that order. Exports to North America grew fastest (413%), followed by Europe (250%) and Asia (149%). Major sources of imports were Asia, North America, and Europe in that order. Imports from Asia grew fastest (47%), followed by those from North America (36%) and Europe (14%).

The HSIP Administration has stated that there were 335 high-tech firms employing 98,685 persons in the park as of the end of 2002, and these figures represented increases of 7.4% and 2.4% respectively over 2001. Thanks to the gradual economic recovery, the number of HSIP employees has already increased by 6.4% over August 2001. Because the administration is vigorously recruiting entrepreneurs overseas, and because of the economic downturn at California's Silicon Valley, returning émigrés are continuing to launch startups in the HSIP. The 53 new HSIP firms founded in 2002 set a new record. Trends in the HSIP's turnover, import/export trade, and number of employees show that its high-tech industries are gradually escaping the effects of the economic slump, and are even on their way to a revival. It is estimated that firms in the HSIP will achieve turnover on the order of NT$750 ~ 850 billion this year (2003).

Another center of high-tech industry is taking shape at the STSIP in Tainan. Now in its seventh year of operation, the STSIP acquired 93 more high-tech firms, passed the NT$100 billion turnover mark, and added 15,000 jobs in 2002. These striking figures underscore the STSIP's success at growth in the midst of poor economic conditions. In particular, the optoelectronics industry cluster that is emerging at the STSIP (and specializing in TFT-LCD displays) has demonstrated a high level of competitiveness. There are now 26 optoelectronics plants in the park, including such key display manufacturers as Chi Mei Optoelectronics and HannStar Display. In light of ongoing trends, if the world economy remains stable throughout the year, firms in the STSIP can achieve turnover of NT$130 ~ 150 billion, and add 35 to their number, in 2003.

Opportunities at the Junction of Nanotechnology and Biotechnology: Use of Nanoparticles in Biological Testing

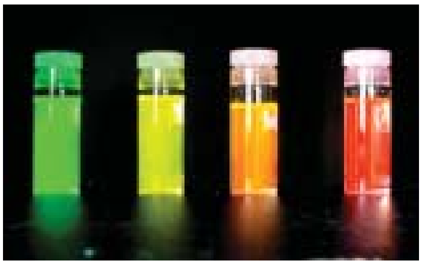
Although the NSC-supported nano-biotechnology project "Applications of Functionalized Nanoparticles in Biological Diagnostics and Assays" began only last year (2002), it has already yielded major findings. Led by Professor Chen Chia-chun of the chemistry department of National Taiwan Normal University, the research team has recently developed "carbohydrate encapsulated gold nanoparticles" that can be used to mark bacteria, and has also employed "semiconductor nanoparticles" to detect cancer cells.

Made by binding nanometer-scale gold particles with carbohydrates, "carbohydrate encapsulated gold nanoparticles" can be used in *in vitro* identification systems with excellent precision and specificity. For instance, they can be induced to bind with specific bacteria and thereby provide a simple, high-speed disease testing method. The research team has successfully used the nanoparticles to detect *E. Coli* bacteria causing urethritis. This innovative technology has already been put to use in commonly-used medical products. For example, the red mark indicating a positive result in pregnancy testers available in ordinary pharmacies is actually created by gold nanoparticles.

Professor Chen is currently applying for a US patent for his "carbohydrate encapsulated gold nanoparticles," which are non-toxic and extremely stable. The research team is using the nanoparticles to produce new antibodies in mice, and expects its results to have a major impact on future immunological analysis technology.

In addition, semiconductor nanoparticles can also be used in biotechnology. The nano-biotechnology research team led by Professor Chen has developed functionalized semiconductor nanoparticles with different color. Because these nanoparticles can bind with antibodies or DNA, they can be used to mark certain organelles or identify specific DNA sequences.

The special optical characteristics of the semiconductor nanoparticles, including their exceptionally strong fluorescence, high stability, easy detection, extended observation time, simple excitation, variety of fluorescence colors, and water solubility, will enable them to replace existing florescent markers and provide a multi-



color, high-speed, precise biological testing tool.

Taiwan's semiconductor industry is under pressure to specialize as it faces growing international competition. The industry will be able to stay a world leader only if it continues to innovate and make technical breakthroughs. While intersection of nanotechnology and biotechnology is a particularly promising area, Taiwan must work hard to keep up with such competitors as the US and Japan. A number of nano-biotechnology companies specializing in biological sensors and biochips, etc., have recently sprung up in the US. But since the medical testing market is even larger than the semiconductor market, this novel technology is sure to have a dazzling future.

Micro-Flow Calibration Breakthrough Boosts Nanometer Process Technology

Dedicated to vacuum technology research and development for more than 20 years, the NSC's Precision Instrument Development Center (PIDC) has developed a variety of vacuum measurement instruments. In addition, PIDC has established Taiwan's first standard vacuum calibration laboratory meeting international product quality certification needs. This laboratory, which has been accredited by "Chinese National Laboratory Accreditation" ("CNLA"), has long provided vacuum calibration services.

The nanoscale processes of etching, ion implantation, and chemical vapor deposition all require meticulous control of trace gas flow. Since control of gas flow rate will have a crucial effect on the quality of next-generation (below 90 nm) semiconductor devices, it is a key process technology. While the best calibration capability of gas flow rate meters in Taiwan currently have an accuracy of greater than 1 sccm, an accuracy of less than 0.1 sccm will be needed in future processes. PIDC has been implementing a three-year project to develop a micro-flow rate calibration system capable of measuring gas flow as little as 10^{-4} sccm since 2000. The completion of this system will enable trace gas flow measurement accuracy to be improved, raising the yield of Taiwan's semiconductor device processes.

The micro-flow rate calibration system developed at PIDC includes the two subsystems of a dual reservoir flow generator and a main chamber divided into the upper and lower chambers by an orifice plate. The design, manufacture, assembly, and use of this system all comply with ISO (International Organization for Standardization) quality management and technical requirements. In addition, the assessment of measurement uncertainty complies with the ISO's "Guide to the Expression of Uncertainty in Measurement" ("GUM"). After prolonged testing, PIDC has shown that the system is fit for primary calibration of gas micro-flows. The system can be used to accurately calibrate various vacuum instruments, including leak standards, vacuum gauges, micro-flow rate controllers, and residual gas analyzers. When Mr. John Wolfe, the president of the well-known American semiconductor process gas supply facility system manufacturer Wolfe Engineering, visited PIDC in September 2002, he realized that this system can successfully calibrate the micro-flow control instruments needed in next-generation processes, and he expressed great interest in cooperating with PIDC.

The primary vacuum absolute standard calibration systems currently in use in Taiwan employ mercury pressure gauges to rough-vacuum level. But because the micro-flow calibration system developed by PIDC uses the constant volume orifice flow method to perform primary vacuum absolute standard calibration, it can be used to calibrate both medium-vacuum and high-vacuum instruments (10^{-3} to 10^{-6} torr). After testing uncertainty and long-term stability, it was found that the system had an uncertainty of less than 5.6% even when working at its limit of a 10^{-6} torr vacuum. The ROC's National Measurement Laboratory now plans to develop a high to ultra-high vacuum constant pressure vacuum calibration system capable of measuring 10^{-4} to 10^{-8} torr. When completed, these systems will give the ROC a formidable primary absolute standard calibration tool for vacuum instruments. PIDC and the National Measurement Laboratory now in the midst of sharing their calibration technology and pushing forward their campaign to improve domestic vacuum measuring capability.

NSC Issued "White Paper of 3C Integration Technology and Industries"

The NSC officially issued the fourth edition of the "*White Paper of 3C Integration Technology and Industries*" on February 17. The White Paper provides the newest information on 3C integration, including forefront technology and potential products, and can serve as a specialized reference for all interested users. The White Paper's content consists of promising current and future products and technologies selected by specialists from industry, academia, and the research community, and it also contains sections on market analysis and trends, core technologies, technological trends, competition analysis, and standards and organizations.

Implementing the "3C Integration Technology Program" under the NSC's sponsorship, the National Information Infrastructure (NII) Enterprise Promotion Association has also published the three previous white papers. The 2002 White Paper issued on February 17 was the fourth. Its main content consists of up-to-date information from the previous year, and it explores the current and future state of technology and markets in Taiwan and abroad. The NSC hopes that White Paper will inspire industry, government, academia, and the research community to work together to further develop this area, and make Taiwan a global center of integrated product R&D and manufacturing in the near future.

The "*White Paper of 3C Integration Technology and Industries*" contains the most up-to-date professional information on 3C integration technology, including forefront technologies and promising products, as a reference for users. The White Paper explores existing and future products and technologies chosen for their potential by specialists from industry, academia, and the research community, and it provides detailed analysis of markets and trends, core technologies, technical trends, competition, and standards and organizations.

The White Paper emphasizes information appliance (IA) technology. Incorporation of digital technology in consumer electronics products has yielded many exciting new mobile communications products over the past few years. Examples include intelligent mobile phone handsets offering mobile communications and personal digital assistant functions, digital cameras, and light, compact MP3 and DVD players. In addition, families are increasing adopting digital lifestyles. From a broad point of view, the convergence of the IA industry with the Internet service market is an inevitable trend. When the time comes, consumers will be able to go online using many devices, and obtain individualized information from a wide variety of websites. Mobile online services will bring about the full-scale digitization of transactions, spurring a wealth of new business opportunities for the 3C industry.

The White Paper points out that, apart from digitization and integration, the main trends occurring in the world 3C industry is the use of SOC (System-On-a-Chip) technology to putting a central processor, memory, and interface on a single chip. Besides enabling even lighter, thinner, and more compact products, SOC technology can enhance effectiveness, facilitate IP compatibility, and provide the robustness needed for repeated use. Yet another major trend is the customization of 3C products.

As expressed by Stan Shih, chairman and CEO of the Acer Group and project co-convener, Taiwan's 3C industry has laid a solid foundation and acquired formidable experience. All businesses' service items must embrace 3C integration in the future if they are to go on creating higher added value. And it is clear that service industries will emphasize integration ability. In summary, not only will 3C integration become a mainstream trend in Taiwan over the next decade, but it will also be the key to international competitiveness. All industries must therefore strive to realize the benefits of 3C integration.

Development of "Nanostructured High Entropy Alloys" at Tsing Hua University

A research team led by Prof. Yeh Jien-wei of the Department of Materials Science and Engineering, National Tsing Hua University, has spent seven years performing a NSC-funded research project on metal alloys. The team has recently developed a groundbreaking "nanostructured high-entropy alloy." This alloy, which is a "multi-principal-element alloy," promises to have a wide range of industrial applications.

"Nanostructured high-entropy alloys" are distinguished from conventional alloys by their "high entropy." The development of conventional alloys has virtually come to a standstill, and researchers are finding it difficult to develop new alloy systems or create new functional alloys from old alloy systems. The only way to break through this impasse is to cast aside conventional alloy concepts. Apart from proposing the pioneering "multi-principal-element alloy" concept, the Tsing Hua University team has also shown that these alloys can be readily synthesized, processed, analyzed, and used in practical applications. In fact they appear to have numerous academic and industrial applications. High-entropy alloys present many opportunities to resolve practical problems arising from lack of conventional alloys with appropriate functionality.

The unique and diverse mechanical, chemical, and magneto-opto-electronic properties of high-entropy alloys give them impressive application potential in many different industries. We can look forward to high-entropy alloys playing a significant role in the upgrading of the alloy industry and development of high-tech sectors.

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