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**Taiwan [Swiss] researchers score breakthrough in solar cell technology** (Central News Agency, 16 11 2011)

A research team composed of Taiwanese and Swiss chemists has developed new dye components that can highly enhance the solar conversion efficiency of dye-sensitized photovoltaic (PV) cells, the National Science Council (NSC) said. The success marks a significant step toward the creation of very cheap solar cells, which would greatly contribute to the development of the photovoltaic industry, according to council. The NSC-funded research team used porphyrin and cobalt to replace ruthenium and iodine as dye components, which increased the absorption of sunlight and resulted in a more efficient electron exchange and a solar conversion efficiency ratio of 13.1 percent, the council said. The previous cell design achieved a conversion efficiency of 10 to 11 percent, it said. The achievement has attracted attention in the global academic community and an article detailing the research results has appeared in the latest issue of the prestigious "Science" magazine. Other U.S. journals such as Chemical & Engineering News and Scientific American have also published articles on the major breakthrough in dye-sensitized solar cell technology, hailing it as yet another milestone in the global development of renewable energy. The research team, led by Yeh Chen-yu of National Chung Hsing University, Eric Diau of National Chiao Tung University, and Michael Gratzel, a professor at Ecole Polytechnique Federale de Lausanne (EPFL) in Switzerland, said the new invention can be easily commercialized at low cost. Yeh said at a news conference that the porphyrin-sensitized solar cells with cobalt-based redox electrolyte can be widely used in consumer electronics gadgets. Porphyrin is an artificial chlorophyll that plays the same role in dye-sensitized solar cells as chlorophyll in plant photosynthesis, Yeh said. The newly developed solar cells take the imitation even closer as the new chemical combination gives them a greenish tint, he added. "This new color increases the efficiency of the process that converts light energy into electricity," Yeh explained. Noting that solar cells with the new combination of chemicals can be used to create flexible, transparent solar panels, Yeh said they are a promising alternative for certain applications in which traditional rigid, silicon-based panels cannot be used. In addition, he added, this new efficiency benchmark brings them well within the efficiency range of more expensive silicon solar cells.

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**Contents**

1.	Taiwan opens integration and incubation center	2
2.	Taiwan's first biohydrogen fuel station unveiled	2
3.	Seahorse breeding breakthrough unveiled in Penghu	2
4.	Research team develops sensor system for cyclists	2
5.	Researchers urge solution to avoid destroying tissue	3
6.	University unveils Taiwan's first submerged tidal current generator	3
7.	Taiwanese scientists receive Thomson Reuters awards	3
8.	NCKU transfers grouper aquaculture technology	4
9.	Hualien develops new rice strain	4
10.	Taiwanese university unveils compound semiconductor lab	4
11.	Academia Sinica scholars honored by international science body	5
12.	Two professors jointly win Taiwan-France sci-tech award	5
13.	Taiwan researchers develop 'silicon brain' smart chip	6
14.	NCKU to establish international biodiversity research center	6
15.	Biotech innovation keeps Taiwan's aquarium fish sector bubbling	6



### 1. Taiwan opens integration and incubation center

(Taiwan Today, 02.11.2011)

The Supra Integration and Incubation Center (Si2C), the first government-sponsored agency in Taiwan dedicated to promoting the nation's biotechnology industry, was formally inaugurated Nov. 1, according to Si2C organizer the Science and Technology Advisory Group of the Executive Yuan. "The primary purpose of our center is to allocate resources to the nation's biotech industry and pharmaceutical companies, so that they can develop new and innovative biotech products," said Soo Whai-jen, managing director of the Si2C. In addition, Soo added, the Si2C will provide Taiwan's biotech companies with legal counsel, help them with patent applications, and offer them technical assistance. STAG Vice Convener and Minister without Portfolio Cyrus C. Y. Chu said that with the establishment of the Si2C, the government set up all "four pillars" needed to develop a complete value chain for the nation's biotech industry. The other three pillars, Chu said, are creating the Taiwan Food and Drug Administration, a task accomplished in 2009; setting up the NT\$60 billion (US\$2.03 billion) Biotech Venture Capital; and underwriting research investments in genetic translation and rapid prototyping production of medical devices. These efforts are part of the government's 2009 plan to double the biotech industry's output value in four years, according to the STAG. "Erecting these four pillars is only the first step," Chu said. "The government still needs to respond to the needs of industry and help firms overcome many difficulties." Soo, a former researcher and executive for Hoffmann-La Roche Ltd. and Shire PLC, both in the United States, assumed his present position after he was strenuously recruited by STAG. STAG said it is also working to have Shaw T. Chen, deputy director of U.S. Food and Drug Administration's Office of Drug Evaluation, join the Si2C team as soon as possible.

<http://www.taiwantoday.tw/ct.asp?xItem=179243&ctNode=445>

### 2. Taiwan's first biohydrogen fuel station unveiled

(Central News Agency, 03 11 2011)

Feng Chia University in Taichung unveiled the first hydrogen fuel station in Taiwan that supplies biologically produced hydrogen. Two mini hydrogen concept cars were also introduced at the launch ceremony and a change of the biohydrogen batteries in the vehicles was demonstrated. The technology was developed through collaboration among the university, the National Science Council and the Bureau of Energy under the Ministry of Economic Affairs (MOEA) since 1998. In their research, they succeeded in using microbiological technology to produce hydrogen fuel from agricultural waste. The cars, each fueled by six containers of hydrogen, produce no air pollutants, only water, said the university's vice president Lee Bing-jean. The concept cars will be test driven by students for a year, with the evaluations and results recorded for future hydrogen energy research, the university said.

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### 3. Seahorse breeding breakthrough unveiled in Penghu

(Taiwan Today, 07.11.2011)

The Penghu Marine Biology Research Center announced 7 Nov. that a process it developed has been used to successfully breed tens of thousands of seahorses in one batch. "The potential business opportunities deriving from this technology are huge," said Tsai Wann-sheng, director of the center, which is part of the Council of Agriculture's Fisheries Research Institute. "For medicinal uses, one kilogram of seahorses can fetch between NT\$70,000 and NT\$80,000, while a single seahorse is worth at least NT\$300 on the ornamental fish market," Tsai said. In traditional Chinese medicine, seahorses are used as an aid to circulation and to treat sexual impotence and urinary incontinence. Tsai noted that no other country has developed complete technology for breeding seahorses, and that the actual length of time it takes for seahorse eggs to spawn and produce a product ready for sale was previously unknown.

<http://taiwantoday.tw/ct.asp?xItem=179455&ctNode=445>

### 4. Research team develops sensor system for cyclists

(Central News Agency, 05 11 2011)

A Taiwanese university research team has developed a sensor system that significantly improves the safety and comfort of cyclists, but is compact enough to fit on a bicycle's handlebars. The system collects a wide range of data — on temperature, humidity, ultraviolet rays and air quality — and then processes it, issuing warnings or suggestions to the cyclist.

<http://www.taipeitimes.com/News/taiwan/archives/2011/11/05/2003517534>



## 5. Researchers urge solution to avoid destroying tissue

(Central News Agency, 07 11 2011)

Facing the possibility that they might have to destroy stored human blood and tissue samples because of a law on human biomedical samples passed last year, researchers urged the government to help them find a different solution. Adopted on 3 Feb 2010, the Human Body Biological Database Management Act includes a one-year buffer period for researchers to obtain the required permits or consent to store human blood and tissue samples. After the deadline next year, all samples without proper paperwork have to be destroyed. The biomedical industry estimates that by 5 Feb, it might have to destroy more than 1 million samples stored by hospital laboratories, biotech companies, or genetic databases that were before the legislation was enacted. Epidemiologist Chen Chien-jen, who is a research fellow at Academia Sinica, said many important research projects, such as one on a lung cancer gene, have been suspended because the deadline is approaching. He said that researchers took years to establish human biological databases. If they want to keep the samples, researchers now have to go back to ask the providers whether they agree that the samples can be used for new research, to submit the renewed agreement papers to the ethics committee and then continue their research only after the renewed agreement passes a committee review, he said. Academia Sinica researcher Chen Ting-hsin, who specializes in hepatitis studies, said he had obtained human biological samples for research on Hepatitis B and gained consent from the providers to use the specimen in research. "Now researchers have found that they could use the same samples for research on Hepatitis C, but have to go back to the patients to get their consent for using their samples for Hepatitis C studies," he said. "It may seem easy in words, but it's hard to do." Chen Chien-jen said that because the new law puts restrictions on exporting human biological samples, it would become more difficult for Taiwan to be included in transnational clinical studies. Director of the Department of Health's (DOH) Bureau of Medical Affairs, Shih Chung-liang, said there were two possible ways to resolve the problem researchers face under the new law. If the sample provider did not specify which research projects their samples were authorized to be used on, researchers may use the sample for new studies as long as the ethics committee approves, Shih said. Shih said that researchers may also hide all information related to the sample provider so that it would be impossible to find out who that person was, or keep the sample temporarily until obtaining renewed consent before initiating new research. However, several human rights groups, including the Taiwan Association for Human Rights, the Human Sample Protection Association Taiwan, the Taiwan Tongzhi Hotline Association and Taiwan Women's Link, issued a joint statement calling on the DOH to execute the law as it is and destroy all unauthorized samples on 5 Feb. If the department violates the law, the statement said, they would report the case to the Control Yuan.

<http://www.taipeitimes.com/News/taiwan/archives/2011/11/07/2003517695>

## 6. University unveils Taiwan's first submerged tidal current generator

(Central News Agency, 14 11 2011)

A local college on Monday unveiled the first submerged tidal current generator in the country, which it said marked an important step forward in Taiwan's efforts to harness tidal energy resources. The tidal energy generator developed by National Taiwan Ocean University has completed frequency and efficiency tests inside the world's third largest cavitation tunnel at the school, the research team said. It also revealed its plan to conduct frequency tests next year between Heping Island in northern Taiwan and the outlying Keelung Islet, where the tidal flow is high and the tidal stream is steady. Professor Ke Yung-tse noted that ocean tides are a promising energy resource because they are more stable than wind power. Lee Kuo-Tien, president of the university, said that although the team successfully developed the tidal current generator within a period of two years, Taiwan still had a long way to go before it could rely on tidal energy for commercial uses. The new generator, however, represented an important step forward, he said. The research was funded by the National Science Council as part of the country's National Science Technology Program for energy.

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## 7. Taiwanese scientists receive Thomson Reuters awards

(Central News Agency, 15 11 2011)

Eleven Taiwanese scientists were recognized by Thomson Reuters for their groundbreaking research in areas such as biomedical science, psychiatry, engineering and agricultural science, in the news agency's third such award ceremony in Taiwan. The scientists were presented with the awards after their research was analyzed using Thomson Reuters Research Front Methodology, which examines the patterns of citations of academic research papers, to assess their level of influence on specific scientific fields. Wong Woei-fuh, managing director of Rest of Asia Pacific at Thomson Reuters, said his agency noticed a trend in Taiwan's research, which he said has broadened from technological and industrial-focused research to research on basic science and social sciences. "It's a sign that



the government has made sufficient investment, or given enough funding, to help research and development continue its growth not just in the high-tech industry, but in areas where you don't see the return of investment in the short term," he said. Taiwan ranked 18th on a Thomson Reuters list that ranks countries by the number of research papers they produced from 2001 to August 2011 and 22nd in terms of the number of citations worldwide, said the agency. Taiwan also ranks 20th worldwide in total citations in physics from January 2000 to June 2010 and 18th in chemistry from January 2000 to December 2010. The scientists were awarded for their contributions in areas such as cancer cell research and anti-cancer drug discovery, depression treatment, plant nutrition, unparticle physics, light-emitting diodes (LED) and nanotechnology. Thomson Reuters Taiwan Research Day and Research Front Awards have been given out once every five years in Taiwan since 2001. Similar events have also been held in Australia, China, South Korea, Japan, and India.

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## **8. NCKU transfers grouper aquaculture technology**

(Central News Agency, 15 11 2011)

National Cheng Kung University (NCKU) announced that it has transferred novel immune-inhibition technology to promote grouper aquaculture to a third commercial operation. NCKU President Hwung Hwung-hweng and Chen Ho-hsiu, chairman of Grobest Feeds Corp. signed a contract on the technology transfer a day earlier. Chen noted that the technology allows for fast growth in grouper, increasing the meat and fat content without the use of growth hormones. In a 20-week field trial, Chen's research team used the immune-inhibition technology on one pond of groupers and a traditional method on another pond for comparison. The results show that groupers raised in the former pond grew to 490 grams, while the groupers raised in the latter pond reached only 375 grams. According to Chen, grouper farms normally need 14 months to produce marketable 600-gram fish. With the new technology, however, his team only needs 10 months to produce the same size of fish. According to the Council of Agriculture's Fisheries Research Institute, grouper raising is set to become a promising industry worldwide, with the Asia-Pacific region at its hub. At present, China is the No. 1 producing country, with Taiwan ranked in second place, although Taiwan's annual output value of US\$104 million is the world's highest -- twice that of China.

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## **9. Hualien develops new rice strain**

(Liberty Times, 21 11 2011)

After 10 years of research, a new strain of rice, the Hualien No. 21, is poised to be promoted to Hualien's rice farmers due to its high yields, outstanding quality and wonderful taste. Pan Chang-ru, an assistant researcher at the Hualien District Agricultural Research and Extension Station, which is responsible for the research, says that a decade's efforts by a farmer in Fuli Township via using organic methods have produced outstanding quality rice, both in taste and yields. He adds that the rice is also resistant to rice blast and brown planthoppers, minimizing the need for chemicals or other pest-resistant measures in growing it. Consequently, production costs are lower, so the station is promoting the strain throughout Hualien. The Hualien No. 21 rice is tasty and chewy when hot, and is also the perfect rice when chilled for use in making sushi. The rice excelled in an islandwide paddy rice survey, with a dry output of 6,900 kilograms per hectare in the first crop of the year, and a 5,200-kilogram yield for the year's second crop, making it an outstanding rice in both taste and yielding in Taiwan. Trial planting of the rice has shown that it exhibits a threshing pattern conducive to preventing large amount of rice from falling off the stalk and being lost, meaning the rice is suited to be harvested by machines. In addition, it only needs a limited amount of fertilizer, leading it to become the most representative strain of the Hualien area.

<http://www.taiwanheadlines.gov.tw/ct.asp?xItem=245123&CtNode=9>

## **10. Taiwanese university unveils compound semiconductor lab**

(Central News Agency, 21 11 2011)

National Tsing Hua University unveiled a new compound semiconductor laboratory that it hopes will contribute to the development of new chip components that will support alternative green energy sources. The lab represents the first project in Taiwan to fully integrate semiconductor component research, said Cheng Keh-yung, dean of NTHU's College of Electrical Engineering and Computer Science, at the inauguration ceremony. Cheng said the lab will cover passive and active component development from the epitaxy process (which creates crystals for many base semiconductor materials) to chip component manufacturing and testing. The lab, collaboration between the university's Center For Nanotechnology, Materials Science, and Microsystems and the Institute of Electronics



Engineering, is hoping to develop components that will generate green energy and reduce reliance on fossil fuels. Among the components targeted are high-brightness LEDs and high-power, high-voltage transistors, which Cheng described as the keys to developing next-generation lighting systems, electric cars and communications equipment. Cheng also hoped the lab would create an excellent research environment that brings out student's innovative potential.

<http://focustaiwan.tw/SearchNews/doDetail.aspx?id=201111210031&q=semiconductor>

## 11. Academia Sinica scholars honored by international science body

(Taiwan Today, 23.11.2011)

Four Academia Sinica academicians were named new members of the Academy of Sciences for the Developing World (TWAS) 21 Nov, while another scholar at the institute received a TWAS Prize and a researcher was elected a TWAS Young Affiliate. Chang Wen-chang, elected a TWAS member in Biological Systems and Organisms, has for nearly four decades made significant contributions to the understanding of the functions of prostanoids and unsaturated fatty acid oxidation metabolites. Meanwhile, Chen Pei-er, whose research accomplishments include new insights into hepatitis D virus RNA replication and hepatitis B virus carcinogenesis, as well as mechanisms and treatment of viral hepatitis and related liver cancer, was elected in Medical and Health Sciences. Academician Lee Yuan-ern, elected a member in Chemical Sciences, has contributed greatly to research in spectroscopy, kinetics and dynamics of free radicals. Elected to the area of Physics was Chang Shih-lin, whose major contributions include developing X-ray multiple diffraction methods to solve X-ray phase problems in crystallography and condensed matter physics, as well as demonstrating the resonance interference of the X-ray Fabry-Perot resonator using dynamical diffraction from crystalline solids. Cheng Shun-jen of Academia Sinica's Institute of Mathematics and National Chiao Tung University Vice President Lin Yi-bing were named winners of the TWAS Prize. At the same time, Lin Keng-hui, an assistant research fellow at the Institute of Physics, was elected a 2011 Young Affiliate, an honor conferred annually on outstanding scientists under the age of 40. Founded in 1983, TWAS is a nongovernmental organization dedicated to promoting the development of scientific research in less advanced countries. It currently supports nearly 100 research projects in developing nations around the world.

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## 12. Two professors jointly win Taiwan-France sci-tech award

(Central News Agency, 24 11 2011)

Two university professors have won the 2011 Taiwan-France Science and Technology Award for their cross-border, cross-discipline research on how to structure mathematical computing on traditional Chinese acupuncture practice. Professor Tony W.H. Sheu of National Taiwan University and Marc Thiriet, a professor with the University of Paris at Marie Curie, won the prestigious award for their leadership in research on biofluid modeling and simulation. The research focused particularly on structural development of mathematical modeling of acupuncture and an acoustics-thermal-fluid coupling model for the prediction of temperature in liver tumors. Sheu and Thiriet have worked together for more than a decade on the research of biofluid modeling and simulation. In recent years, they have focused on research into the mathematical modeling on the clinical results of radio frequency ablation (RFA) in liver tumors, as well as in high-intensity focused ultrasound therapy (HIFU). They have led their teams to better understand blood flow in aneurysms and have developed computer simulation techniques to study the effects of acoustic waves on blood flow in capillaries and the biomechanics of an acupuncture needle in the collagen fibers under the skin. In addition, the two have devoted a lot of time to student exchanges between National Taiwan University and University of Paris at Marie Curie, offering summer courses and organizing Taiwan-French workshops, according to the award sponsors. Upon receiving the award, Sheu, a professor with NTU's Scientific Computing and Cardiovascular Simulation Lab and the Taida Institute of Mathematical Sciences (TIMS), said he will continue to work with Thiriet in the next three years. Professor Thiriet took the initiative to launch the acupuncture computing study after he was inspired by his wife's Qi Gong practice, according to Sheu. Traditionally NTU students have gone to France for study and research, Sheu said, noting that from 2011, a doctoral candidate from France will come to Taiwan for study and research each year. The Taiwan-France Science and Technology Award, now in its 13th year, was created jointly by Taiwan's National Science Council and France's Academie des Sciences. Michel Lu, Taiwan's representative to France, said France is now Taiwan's most important scientific research partner, apart from the United States.

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### 13. Taiwan researchers develop 'silicon brain' smart chip

(Central News Agency, 24 11 2011)

Taiwan researchers have developed a smart chip for computer recognition purposes that mimics certain functions of the human brain. The smart recognition chip is the first in the world to incorporate neuroscience into chip technology, said the project director, Chen Liang-gee of National Taiwan University's (NTU's) College of Electronic Engineering. Its functions include facial recognition and learning ability, he said. Chen said the Taiwan researchers on the neocortical computing project ambitiously tried to replicate some of the functions of the neocortex, the largest and most evolved section of the human brain that governs sensory perception, motor commands, spatial reasoning, conscious thought and language. Computers have strong calculating abilities, but are fairly weak when it comes to recognition, Chen noted. The objective was therefore to design a "silicon brain" to address this shortcoming and thus give computers important recording functions similar to the brain, Chen explained. It took five years to develop the chip, drawing on the expertise of researchers in the fields of psychology, ophthalmology, and neuroscience, he said. In another five to 10 years, it could be embedded onto eyeglasses, watches and other devices to help people identify each other by name and occupation, he envisioned. It would be almost like having a personal secretary with someone, Chen said. The Taiwan research team beat competitors from the United States and Europe in unveiling the technology, Chen said. The research paper on the project will be among nine Taiwan papers selected for presentation at the renowned IEEE International Solid-State Circuits Conference in San Francisco next February.

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### 14. NCKU to establish international biodiversity research center

(Central News Agency, 24 11 2011)

National Cheng Kung University (NCKU) is to set up an international biodiversity research center in 2012 to help preserve Taiwan's native animals and plants. NCKU decided to set up the center following a biodiversity forum that took place in mid-November, said Chiang Tzen-yuh, chairman of NCKU's Department of Life Sciences. Taiwan has rich biodiversity and a unique ecosystem, but the impact of global warming has affected the survival of native organisms, said Ho Chih-chen, NCKU vice president. Government and research institutes should take action to protect native species and prevent loss of biodiversity from the effects of extreme weather and natural disasters by setting up a Taiwan biodiversity organization to ensure sustainable growth of biodiversity, Ho recommended. For instance, the government should evaluate the economic value of biodiversity and cooperate with international organizations to establish a national seed bank to preserve the genes of native species of plants, animals and fungi, Ho added. The NCKU biodiversity research center will cooperate with domestic and international research centers such as the University of Washington and the Missouri Botanical Gardens, as well as with Taiwan's Council of Agriculture, the Endemic Species Research Institute, and National Tainan University, said Chiang.

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### 15. Biotech innovation keeps Taiwan's aquarium fish sector bubbling

(Taiwan Today, 27.11.2011)

While seldom in the spotlight except when the annual Taiwan International Ornamental Fish Exposition is held in the capital city of Taipei, Taiwan's aquarium fish sector is in fact a perfect example of the country's agricultural leadership and biotechnological innovation, and accordingly was targeted for strategic development by the ROC government in 2009. "Given its relatively modest input cost, lower resource consumption and high output value, the sector is an ideal candidate for high-end agriculture, one of Taiwan's six designated emerging industries," said Chu Tah-wei, chairman of the Department and Graduate Institute of Aquaculture at National Kaohsiung Marine University, during an interview with Taiwan Today 7 Nov. According to Council of Agriculture statistics, Chu said, Taiwan's aquarium fish sector has been growing at an annual rate of 10 percent since 2001, with output amounting to NT\$316 million (US\$10.5 million) in 2010. Exports of fish stock reached NT\$113 million in the same year, or roughly 1 percent of the global share estimated at US\$317 million. There are over 220 aquaculture farms in the nation dedicated to breeding such fish, with most of them located in southern Taiwan's Tainan City and Pingtung County. African cichlids are the leading breed, accounting for 33 percent of total production, followed by blood parrot cichlids at 25 percent and other South American cichlids at 20 percent. "Despite its limited global share, Taiwan is recognized as a top-notch supplier of premium fish in the world," Chu pointed out. While most stocks raised in Taiwan are foreign species, the country is able to cultivate more than 400 different kinds of fish on a regular basis, thanks to the advanced breeding skills of local farmers. Taiwan's agreeable climate is also a natural advantage, the expert said. "Fish raised in Taiwan easily stand out among their peers from Southeast Asian nations or even their homelands." Orders for aquarium fish often come with a diverse mix in low volume, and as a result, the ability to supply an assortment of species and make prompt delivery is a crucial requirement in the business, Chu said. "In this regard, Taiwan is widely considered one of



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the best one-stop-shopping locations," he noted, adding that local exporters' advanced packaging technologies also ensure that the damage rate is kept under 5 percent during transportation. Given its long history in aquaculture, Taiwan has developed a well-established supply chain second to none in the world. "The efficient intra-sector division of labor and the ability to quickly adapt to market developments have combined to make Taiwan a respected contender in this increasingly popular industry," he said. There have been several major breakthroughs in the sector's development over the years, the scholar said. The year 1986 represents a milestone with the successful breeding of blood parrot cichlids, a cross-species hybrid of *Amphilophus citrinellus* and *Cichlasoma synspilum*. "This creature not only established Taiwan as a leader in breeding technology, it also inspired fish growers in other nations to engage in similar efforts," Chu explained. Another achievement came in 2001 when New Taipei City-based Taikong Group successfully produced the world's first genetically modified fluorescent fish. The glowing animal was selected by Time magazine as one of the 40 coolest inventions of 2003, further strengthening Taiwan's leadership when it comes to breeding innovative ornamental fish. The sector has also been greatly boosted by Taiwan breeders' outstanding performance in international fish competitions, according to Chang Shan-ya, who won this year's Taiwan International Ornamental Fish Competition with his champion discus. "Taiwan was the overall winner of the first International Discus Championship held in 1996 in Duisburg, Germany, the most important event of its kind in the world, and continued to dominate the biennial competition in 2004, 2006 and 2008," he said. Chang himself was a winner of the 2008 event. "These titles not only represent personal achievements, they also help reinforce the impression that Taiwan is a production center of ornamental fish of the highest quality in the world," the champion breeder said. "Fish grown in Taiwan usually sell for twice the global average prices given their overall superior quality," said Wang Sen-chuan, secretary-general of the Taiwan Ornamental Fish Association. "Anyone with a little experience can appreciate the brighter colors and much more beautiful body shapes of Taiwan's aquarium fish," he said. "It is fair to compare the local breed to designer clothing in the fashion industry." According to Wang, Taiwan is also a top producer of various peripherals such as aquarium tanks, aquatic plants, fish feed, health supplements and life support systems. "The country's output of these items is even higher than that of fish stock, and local suppliers are often the spotlight at international fish shows," he said. "The problem is that most local firms operate as contract manufacturers for foreign brands and can only secure a small share of the profit margins," Wang pointed out. "It is not easy to create a brand name, but this is definitely the path local firms should choose for long-term development." Despite these obvious advantages, a number of hurdles are hampering the sector's expansion, according to the three experts. "The lack of additional freight capacity to transport fish stock is one of the major culprits," Wang pointed out. While Taiwan is ideally located closer than its Southeast Asian rivals to major markets such as Japan, mainland China and the U.S., fish exporters often find it difficult to secure enough freight services during the holiday seasons. The problem is even more serious for shipments to Europe, Wang added. Unlike the situation in Singapore, the exporting hub for shipments from Southeast Asian nations, only a few airline companies offer direct flight services between major European cities and Taiwan, and this constraint has put Taiwan at a great disadvantage in efforts to promote business in Europe. Farming ornamental fish requires a lot more know-how than growing other agricultural products, and the higher technological barriers are keeping newcomers from joining the race, according to Chu. "Many aquarium operators have been unable to expand their business because there is simply no additional land available to build more farms," he added. Higher production costs are also undermining Taiwan's competitiveness in the lower-end market, Chang said. Other than organizing major trade shows and helping promote overseas markets, the government can do more to assist the local sector, Chu said. "For example, the COA should help fish farms and exporters conform to international standards and pass the required quality assurance standards." Chu also sees further regulatory easing on introducing new species to the country as an important part of the sector's development strategy. "This will allow farmers to create more species that can really showcase Taiwan's pedigree in breeding ornamental fish," he said. "This will help differentiate Taiwan from its rivals and help ensure the country's leadership in the long run."

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