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Building World-Class National Laboratories — Establishment of the NARL and NSRRC

One of the major events of June 2003 was the establishment of two nonprofit research institutions, the National Applied Research Laboratories (NARL) and the National Synchrotron Radiation Research Center (NSRRC). In order to better respond to rapidly-changing technological trends and meet the nation's basic and applied scientific research needs, the Executive Yuan began transforming the NSC's national laboratories into independent nonprofit institutions in 1998. In January of this year, the National Laboratory Institute Provisional Office and NSRRC Provisional Office were formally established and merged to establish the NARL and NSRRC on 2nd and 3rd of June, respectively.

The NARL's competent authority is the National Science Council (NSC), Executive Yuan, and NSC Minister Dr. Wei Che-ho is concurrently the chairman of the NARL. National Space Program Office (NSPO) Director Academician Lee Lou-chuang is concurrently NARL president and is responsible for management and promotional work. The NARL currently consists of the following six research laboratories: National Nano Device Laboratories, National Laboratory Animal Center, National Center for Research on Earthquake Engineering, NSPO, National Center for High-Performance Computing, and National Chip Implementation Center.

While the NARL will continue to receive research funding budget from NSC in the future, each laboratory will be able to perform commissioned research projects and raise its own funds. The NARL's employment, accounting, and finance will be functionally independent, giving each laboratory more flexibility and enabling it to offer competitive salaries when recruiting personnel and purchase new equipment whenever necessary such that it can promptly engage in the cutting-edge researches. For instance, the implementation of a Research Fellow Program, formally limited to the NSPO only, to all of the NARL's research laboratories will allow them to offer world-class scientists and technological specialists the equivalent salaries that they would expect to receive overseas.

The NARL's main mission includes the promotion of advanced technology development to meet national needs, the supply of R&D resources for academic research, the establishment of R&D platforms to strengthen research capacities, the extension of scientific research applications, and the advancement of international cooperation. In addition, the NARL will also promote the integration of existing laboratory resources in support of academic research, while facilitating the vertical integration of the nation's technology development system. NARL's ultimate goal is to build a system of world-class national laboratories.

Dr. Lee Yuan-tseh, President of the Academia Sinica, was appointed chairman of the NSRRC when it was established on June 3, while Dr. Chen Chien-te continues to serve as the facility's director. Located in the Hsinchu Science-based Industrial Park (HSIP), NSRRC is one of the largest scientific research facilities in Taiwan. NSRRC's mission is to operate a cutting-edge synchrotron radiation facility and promote pioneering scientific research. Designed and constructed in Taiwan, the NSRRC light source went into operation in October 1993, and its synchrotron radiation beamlines were opened to researchers in April 1994. Many new research instruments have been added to the light source in recent years, turning the center into a world-class facility with state-of-the-art research capabilities in the vacuum-ultraviolet and soft-X-ray spectral regions.

To provide researchers access to hard-X-rays, collaborative international project was initiated in 1998 to construct two hard-X-ray beamlines at the world's largest synchrotron radiation facility — the SPring-8 light source in Japan. Now completed, Taiwanese scientists are able to conduct sophisticated experiments using the full range of synchrotron radiation available from the two light sources.

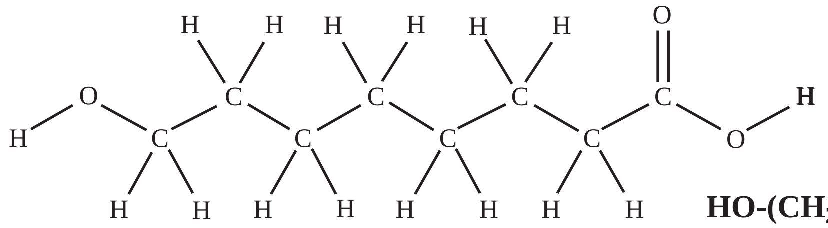
During the 20th century, synchrotron radiation has become an important scientific tool used in such diverse fields such as physics, chemistry, biology, materials science, chemical engineering, environmental engineering, energy resources, mechanical engineering, and electronics. After being set free from the civil service system, NSRRC will continue to provide a superior synchrotron radiation research and experiment environment to domestic and foreign researchers, host cutting-edge basic and applied research, expand participation by industry and academic institutions, promote international technology sharing and cooperation, and raise the nation's research standards and international scientific standing.

The formal establishment of the NARL and NSRRC signifies that the ROC's national laboratories have been set free of the civil service system and transformed into flexible nonprofit institutions. This event is certainly a very significant milestone in the development of scientific research and applications in Taiwan. The Executive Yuan is currently in the midst of a reorganization campaign of which the event is one part. Because the transformation of the NSC's national laboratories from part of the civil service system into independent corporate bodies is the first step in this process, it possesses landmark significance. Another action along these lines will be the future transformation of the Institute of Nuclear Energy Research under the Atomic Energy Council into a corporate juridical person, continuing the effort to change the national laboratories into nonprofit institutions.

A Small Victory Against SARS: NTU Team Isolates Anti-SARS Substance

SARS has had a serious economic and political impact on Taiwan over the last few months. Although SARS is currently under control, the current most important task at hand is to curb the future spread of the disease by setting into place, regulatory standard procedures that can prevent and contain future SARS cases from becoming an epidemic. During the SARS crisis, in addition to the government's quick responsive actions, universities and research institutions also quickly mobilized their resources to counter the SARS epidemic, which at its highest point resulted in 83 deaths, 697 people infected and over 24,000 home quarantined. Now, with the end of the SARS crisis, Taiwan is quickly recovering economically and continues to maintain its position as an Asian economic hub.

While the SARS epidemic was raging in Taiwan, the research team at National Taiwan University (NTU) Hospital, in a period of a little over one month, developed a fluorescence immunoassay reagent capable of quickly detecting the SARS virus, and also sequenced the 29,714 nucleic acids making up the viral genome. Building onto the results at the NTU Hospital,



$HO-(CH_2)_7-COOH$

Anti-SARS Hydroxyoctanoic Acid: an example of one of the series of compounds

National Taiwan University, working in conjunction with Tamkang University and the Industrial Technology Research Institute (ITRI) Materials Research Laboratories, formed a joint research team. With support from the National Science Council and the Ministry of Economic Affairs, the research team designed and synthesized a series of harmless organic compounds capable of killing the SARS virus, in a relatively unheard short time of 20 days. As a side benefit, these newly discovered compounds have also shown to have equal effectiveness against the enterovirus, which has a lipoprotein coat similar to that of the SARS virus.

In contrast to photocatalysts such as TiO_2 which need harmful ultraviolet light to achieve anti-bacterial effects, and in contrast to conventional antiviral agents which require a specific structure to bind to the viral coat to prevent infection, the organic compounds developed by the NTU-led team are harmless and possess the following features: (1) they are highly effective even under very high moist conditions which is precisely what is needed to compensate for the poor effectiveness of ordinary static filtration layers in moist environments, (2) as the SARS virus may carries a negative charge on its surface, the organic compounds designed in this project can be tuned to carry either a positive charge or a negative charge, which can adsorb and capture the SARS virus effectively. The molecular interaction between the compounds and the viral coat causes the crown-shaped external structure of the SARS virus to disintegrate, which disables the virus such that it loses its ability to bind to, invade and infect its host.

The harmless organic compounds developed in this project are water-soluble and can be used to make into an aqueous spray, cream or mist. The compounds, when mixed with water, can easily be sprayed to filtration materials such as facemasks, protective clothing, and air filters. Since the compounds are effective against a relatively broad spectrum of viruses and retain their strength under most conditions, they can be widely adopted for many applications. When techniques for the use of these compounds have been worked out more extensively, they will be significant contributions to the future prevention of SARS and other viral diseases, and will no doubt also boost the technological production and global competitiveness of relevant industries in Taiwan.

The recent announcement of the discovery of anti-SARS compounds is a world's first. These compounds are specifically designed to adhere to the SARS virus and destroy its functionality and its infectiousness. Patent applications for these compounds have been submitted, and trial efforts to produce a suitable filter cloth are currently underway. Technology transfer, as well as development for mass production of the compound are currently in progress.

Made-in-Taiwan Superior Activated Carbon Fiber Cloth for Medical Use

After having studied carbon fiber processing since 1987 with major support from the NSC, Prof. Ko Tse-hao of the Dept. of Materials Science, Feng Chia University, has developed a method of using polyacrylnitrile (PAN) fibers as a raw material in the production of activated carbon fiber (ACF) cloth. Prof. Ko received a ROC patient in 1995 and an American patent in 2000 for this process. Prof. Ko recently developed a type of ACF material with germicidal ability, and has applied for patents in Taiwan, Japan, the US, and the EU.

Prof. Ko explained that the motivation for his research was a letter from an American company that he received several years ago. This letter invited him to go to the US to develop ACF cloth for military purposes. Prof. Ko's keen patriotism inspired him to stay in Taiwan and dedicate his efforts to the research and development of this new material.

Here we should note that only Japan, Russia, China, Britain, and Taiwan possess the technology needed to manufacture ACF materials. These countries also use different raw materials in the manufacturing process: Cellulosic fibers are used in Russia, Britain, China, Japan, and Taiwan; phenolic fibers are used in Japan; pitch fibers are used in Russia, China,

and Japan; and PAN fibers are used in Japan and Taiwan. After considering these four types of materials, Prof. Ko decided that the mechanical properties and high ductility of PAN fibers make them the best material for producing ACF. His research on PAN as a raw material is currently continuing.

ACF was first developed for use in military NBC (nuclear/biological/chemical) protective gear and gas masks. Taiwan is the only place in the world today where ACF cloth suitable for making NBC protective clothing can be manufactured. Prof. Ko has gradually developed ACF manufacturing techniques that can be applied to mass production for commercial purposes, such as for the processing and purification of wastewater, waste gas, and waste organic solvents. In addition, medical testing has shown that ACF cloth designed for use in NBC protective gear can also be used to make improved facemasks to protect medical personnel and the public from SARS and other diseases.

The NSC transferred ACF cloth manufacturing technology to the Taiwan Carbon Technology Co., Ltd. in 1996. The ACF cloth developed by this company has passed tests demonstrating its ability to protect against organophosphates, Sarin (GB), and mustard gas (HD); its quality far exceeds that of competing products overseas, and its price is only one-fourth that of competitors. The company received an NT$80 million order from the Ministry of Defense in 1996, and received an NT$70 million order in April of this year. Responding to the threat of SARS, the Ministry of Defense is using domestically-made ACF cloth to make face masks.

Thanks to the superior ductility and elasticity of ACF cloth made by Taiwan Carbon Technology compared with competing products made overseas, Germany's Alfred Karcher GmbH & Co., the world's second-largest NBC protective clothing manufacturer, considers ACF cloth the best available today — and far more effective than the nanometer-grade activated carbon material used by the US military. Karcher is now using Taiwan's ACF cloth to make NBC protective clothing for other free world countries. The armed forces in Germany, France, and Canada all use protective clothing made by Karcher. Karcher guarantees that its products can be used at least 20 times on NBC battlefields when given appropriate care and treatment.

The NSC also transferred ACF cloth manufacturing technology to the Challenge Carbon Technology Co., Ltd. in 2003. This company intends to manufacture ACF cloth primarily for use in industrial and civilian waste disposal applications. Target markets will include domestic and foreign semiconductor, electronics, and chemical engineering industries. The ACF cloth will offer these industries a way of treating waste that could not be adequately treated in the past.

Prof. Ko has said that he wanted to develop the best ACF cloth in the world. Ko's cloth is uniform, flexible, highly air permeable, and available in large pieces; it can be used to make military NBC suits that will not give wearers heatstroke. As soon as this cloth has passed medical quality testing, it can also be used to make protective clothing for medical personnel. The price is also likely to fall from NT$20,000 for military use to roughly NT$8,000 ~ NT$7,000.

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