August 1996/Vol. 28, No. 8

SCIENCE BULLETIN

National Science Council
106 Ho-Ping East Road, Sec. 2
Taipei, Taiwan, Republic of China

An Update on the ROCSAT-1 Project

The contract for the ROCSAT-1 satellite bus was signed on April 18th 1994 with the American firm TRW, and work formally began on the following June 17th. Following the completion of systems requirements, preliminary design review, and detailed design review stages, in April of this year (1996) integrated testing procedures for the satellite bus were approved. At present the manufacture, assembly, and testing of components is being carried out in accordance with fixed design specifications.

In addition, bids for the ROCSAT-1's three scientific payloads were successively awarded following the issue of the satellite bus contract. These payloads consist of an Ionospheric Plasma and Electrodynamics Instrument (IPEI) awarded to the University of Texas at Dallas, an Experimental Communication Payload (ECP) awarded to Micro Electronics Technology Inc., and an Ocean Color Imager (OCI) awarded to NEC Inc. The ground segment system and launch vehicle system contracts have been awarded to the American firms Allied Signal Technical Services Corp. and Lockheed Martin Inc. respectively. All subsystems of the ROCSAT-1 project are now underway in accordance with the original schedule.

All Space Program operations are subject to rigorous decision-making procedures, and resolving technical problems is the responsibility of experienced and highly educated experts. Problems are discussed during regular weekly meetings of the Project Management Commission, and means of improvement studied. In the case of major policy changes or design alterations, following a careful in-house assessment, suggested measures are submitted to the NSC. The measures are put into effect after they have been deliberated and approved by a five-man space technology steering committee. As required by law, all major projects must be approved by the Executive Yuan and the Ministry of Audit before being implemented. Agencies under the Executive Yuan regularly invite academics and specialists to review the project schedule and progress. As for the utilization of budgetary resources, after several years of strenuous efforts to improve management operations, during this year (1996) the effectiveness of project implementation reached a high of 92%.

In the near future the main focus of the Space Program Office's work will be on the integration and testing of systems including the satellite bus and payloads after they bave been shipped back to Taiwan beginning in May 1996. Individuals participating in integration and testing will include the technical personnel who have spent more than two years gaining practical experience at TRW and its subcontractors, as well as the domestic "B-team," who will work in conjunction with personnel who have received rigorous training from the manufacturers of testing equipment. Apart from these persons, various routes for the recruiting of well-experienced overseas engineers are currently being actively explored. All tasks which the Space Program Office is in charge of are carried out under an agency system so that ongoing work will not be hampered by changes in the duties of individual personnel.

As for the problem of the coupled loads of the launch vehicle and the ROCSAT-1, although Lockheed Martin has made repeated refinements of its analysis of launch vibrations, from a professional standpoint the results are difficult to accept. After performing a new analysis, this company recently announced that the vibration problem has been greatly reduced. However, the Space Program Office feels that this result lacks sufficient confirmation, and has requested Lockheed Martin to perform a more detailed analysis; the findings of this analysis are expected to be issued within two weeks.

The National Nano Device Laboratory Completes Fabrication of 0.18 Micron Element

The National Nano Device Laboratory of the National Science Council (NSC) has lately made further progress in its effort to develop sub-micron electronic elements and fabrication technologies. Following hard on the heels of its successful development of 0.25 micron elements in May of this year, it has recently completed the fabrication of an n-type 0.18 micron element. This element has displayed extremely good characteristics when operated at two volts, and features current leakage limited to a few pA/micron. The fabrication of this element gained momentum from the successful development of related technology modules including a 40 angstrom ultrathin isolation layer, a high-density plasma polysilicon etching technique, a low-energy (10 KeV) high-output interface implantation technique, and a rapid thermal processing system. The 0.18 micron element will serve as the core of a one-giga bit memory unit. The successful creation of this element signifies that the R.O.C.'s semiconductor element technology is poised to enter the 0.1 micron era. The Nano Device Laboratory has now begun work on the key technological modules needed for the fabrication of 0.13 and 0.1 micron elements.

The Nano Device Laboratory's technological development strategy is centered on the R&D of fabrication and integration techniques for advanced new elements, while simultaneously developing key technology modules. The Nano Device Laboratory has also scored a major success at developing a chemical metal polishing (CMP) technique that will play a key role in the fabrication of sub-micron elements. Besides enabling the planarization of silicon dioxide dielectric layers, this technique can also acheive optimal planarization of tungsten via holes during deep trench deposition involving selective tungsten vapor deposition. In this process the degree of planarization can be controlled to less than 50 nanometers. As for CMP techniques for metal membranes and other applications, the Laboratory is in the midst of developing the polishing agents and fabrication processes needed for the polishing of substances with low dielectric coefficients.

In conjunction with the NSC's plans to make it an open laboratory, the Nano Device Laboratory has been accumulating experience at long-term cooperation with the domestic semiconductor industry and has achieved excellent results from its sponsorship of industrial-academic joint research projects. The Laboratory is now preparing to conduct a tour of educational institutions during October of this year in order to introduce its technical services and opportunities for cooperative research. Moreover, it is planning to step up cooperation with the industrial sector in order to realize its role as a open laboratory and make the greatest possible contribution to the domestic development of submicron elements and technologies.

The Taiwan Area Internet Conference and WWW Exhibition

Over the last few years the surging growth of the Internet and the World Wide Web (WWW) has shaken the world's culture of science and technology and the environment in which it takes place. Now individuals anywhere in the world can use fast and convenient network equipment to instantly acquire the newest international information. The Internet can also be used to establish channels of communication between individuals—regardless of where they are—who may use it to exchange ideas, convey messages, conduct business, or even travel around the world. This great technological breakthrough now presents a great challenge for the knowledge and experience of humanity.

Apart from its great popularity overseas, in Taiwan too many industries and professions are racing to come up with new Internet applications. This has resulted in the flourishing growth of domestic Internet use. In order to collect and exchange the experience that Internet users in Taiwan have accumulated, on October 21st to 24th of this year the "Taiwan Area Internet Conference and WWW Exhibition" will be held at the Center for High Performance Computing.

This event will consist of an exhibition and a conference which will be held simultaneously. The conference is primarily intended to introduce Internet applications in various professions and types of businesses. Presentations and discussions will be held on topics linking the Internet with applications in government, science and technology, education, the media, business, law, and culture. Nearly thirty organizations have been invited to participate in the exhibition portion of this event, and include those in the information industry, the media, the financial sector, and government agencies. At the exhibition it will be explained how different enterprises are utilizing the Internet to engage in publicity or promote sales. The exhibition will be open to all visitors free of charge, and interested persons are invited to come and enjoy this feast of knowledge.

The National Science and Technology Information Center Network (STICNET)

In order to promote the use of the National Science and Technology Information Center Network (STICNET), expand the range of available network services, serve a larger segment of the population, and assist overseas scholars—particularly those studying Asian topics—to obtain information on domestic research, the Science and Technology Information Center (STIC) of the National Science Council (NSC) has made the STICNET a major Internet site for information on science and technology research in the R.O.C. From June 15th to 28th of this year (1996), STIC personnel were sent to the NSC's American offices to conduct seminars introducing the STICNET. These seminars were held at the Science Divisions of the Taipei Economic & Cultural Offices in Los Angeles, Chicago, Washington, and San Francisco. It is hoped that the personnel at these offices will promote the use of the STICNET throughout the length and breadth of the American academic community.

In addition, on October 19th STIC will hold an Internet seminar at the Sino-American Science and Technology Conference. This seminar will introduce the STICNET and its ongoing development.

The Synchrotron Radiation Research Center Designs and Constructs an Elliptically Polarized Undulator

Third-generation storage rings are gradually coming on-line at synchrotron radiation facilities around the world. The most significant feature of this advanced type of accelerator is that specially-designed insertion devices can be installed along its straight sections. The use of diverse types of insertion devices will greatly expand the range of uses of synchrotron radiation. For example, by raising the strength of magnet arrays of alternating polarity, it will be possible to push the spectrum of synchrotron radiation into a higher energy range, enabling the generation of soft X-rays or even hard X-rays. Such magnet arrays are commonly termed "wigglers." If the spacial period of the alternating magnetic field can be shrunk, forcing charged particles to perform smaller and smaller oscillations, then the radiation produced will display constructive interference within certain spectra, which will greatly increase the luminosity of useable radiation. Moreover, within the vacuum ultraviolet or soft X-ray range, the radiation can possess the coherence seen in visible-light lasers. This type of insertion device is known as an "undulator." If the alternating magnetic field is extended from one dimension to two dimensions, it is possible to create elliptically polarized undulators or wigglers. Different types of insertion devices can be designed in order to meet various special needs, insuring that the synchrotron radiation facility is able to provide to scientific users a diverse assortment of highly flexible observational tools.

The Synchrotron Radiation Research Center recently completed the conceptual design of an advanced elliptically polarized undulator (EPU5.6) at the end of July. This insertion device will be capable of energies ranging from 80 eV to 1,400 eV. It is expected that circularly and linearly polarized vacuum ultraviolet and soft X-rays will be generated within one and a half years. This type of insertion device is also currently being constructed at synchrotron facilities overseas, such as America's Advanced Light Source, Japan's SPring-8, and Germany's Bessy II.

After the construction of the EPU5.6 elliptically polarized undulator has been completed, the synchrotron radiation it produces will open new territory for research on magnetism and magnetic materials. It will also provide a powerful research tool for the development of such high-tech products as magnetic detectors used in medicine and magnetic storage devices used in computers. The design and construction of this insertion device is a very challenging task; the fact that Taiwan is one of the few nations capable of pulling off this feat shows its position as a leader in the international academic world.

A Report on Diode Pumped Solid-State Laser and Laser Microprocessing System Research

The three goals of Precision Instrument Development Center (PIDC) are to improve the research environment, support academic research, and advance industrial technology. Apart from the completion of a diode pumped solid-state laser system at the Center's laser laboratory, the Precision Measurement and Control Laboratory has also demonstrated its technical proficiency by successively developing a laser measuring machine, an automatic gauge block interferometer, one- and two-axis submicron positioning systems, and a high accuracy 3D lens measuring machine. In the wake of these successes, this laboratory has also come out with a laser microprocessing system meeting international standards and with many potential applications for both academic research and high-tech industries; the Center is currently cooperating with defense agencies, academic institutions, and semiconductor firms to develop applications.

Diode Pumped Solid-State Laser System

The Center has become a domestic leader in the design and development of laser systems; it can design systems according to the specifications provided, and calculate the quality of the light source required (size of focal point and beam divergence angle), laser crystal specifications (material, thickness), lends curvature, and length of laser cavity, etc. The Center can also perform numerical simulations to calculate a system's output power and excitation efficiency. The prototype diode pumped solid-state laser system developed at the Center emits light at 1.06 and 0.53 micron wavelengths. This laser is fully up to international standards and will be used for such industrial applications as laser machining, laser evaporation coating, and fabrication of semiconductor memory elements, resistors, and masks. Medical uses will include acupuncture, retina surgery, treatment of skin conditions, and the stopping of bleeding.

The Center has also set up a laser quality measurement system that will be used to provide such services as measuring laser power, intensity distribution, and wavelength. In response to the needs of academic research and high-tech R&D, future work will include the development of pulsed solid state lasers and solid-state lasers emitting light at various wavelengths.

Laser Microprocessing System

Combining laser processing and precision positioning technologies, the laser microprocessing system has a processing focal area of 20-30 microns and possesses an automatic dynamic focussing capability. This system's precision processing stage utilizes a friction drive in conjunction with a pneumatic bearing and a laser interferometer. The stage can position objects with 0.02 micron precision, and can accurately obey commands given it. The system as a whole can directly inscribe minute designs using its laser, and has a range of applications including laser marking, fabrication of IC microelectronic circuits, and the precision etching of resistance, capacitance, and frequency elements.

At present this system has already been successfully used for the etching of pure gold thin film resistors and the processing of the microtexture of hard disk surface structure. The precision etching of pure gold thin film resistance can be used in the ignition system of weaponry to control the time of firing. The processing of the microtexture of hard disk surface structure is a key technology for the next generation of hard disks and also represents the solution of a current problem of great concern for the world's hard disk manufacturers. These research findings demonstrate the Center's mastery of precision laser processing technology. In the future the Center will work on the development of laser micro-electro-mechanical systems (MEMS). MEMS constructed with extremely short wavelength lasers are a major goal of development efforts throughout the world; the use of this revolutionary, next-generation technology will enable the construction of extremely small motors, sensors, micro-accelerometers, and other system elements finding uses in such fields as automotive engineering, biomedicine, and information storage.

發行人：蔡　清　彥
發行所：行政院國家科學委員會
台北市和平東路二段一〇六號
印刷廠：百杰電腦排版印刷有限公司
台北市復興南路二段二九三－三號十一樓之二

行政院新聞局出版事業登記證局版北市誌字第一〇四三號
中華郵政北台字第一一六五號執照登記為新聞紙類（雜誌）交寄