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4
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01 Upcoming Full Scale Operation Spaceborne Dual-frequency Precipitation Radar (DPR)
—The contribution to next generation precipitation observation mission (GPM)—
Hiroshi HANADO/Katsuhiro NAKAGAWA

03 Lidar Measurements of the Atmosphere
—Laser remote sensing of the atmospheric constituents and wind—
Kohei MIZUTANI

05 The Future of DUV LEDs
—Development of light-extraction technology by nanophotonic structures for practical application of DUV-LEDs—
Shin-ichiro INOUE

07 Report on NICT Entrepreneurs' Challenge 2 Days 2013 "Kigyouka Koshien (1st day)/ Kigyouka Expo (2nd day)"

09 Report on Opening Ceremony and Symposium for the Resilient ICT Research Center

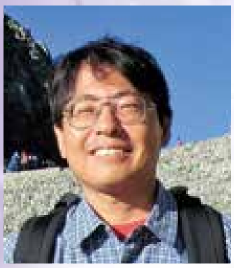
10 Report on "Completion Ceremony for Solar Wind Observation Satellite Data Receiving System" and "9th SPACE WEATHER USERS' FORUM"

11 Announcement of WIRELESS TECHNOLOGY PARK 2014 (WTP2014)

Cover image: Solar wind observation satellite data receiving antenna

Upcoming Full Scale Operation Spaceborne Dual-frequency Precipitation Radar (DPR)

—The contribution to next generation precipitation observation mission (GPM)—



Hiroshi HANADO

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After completing his master's degree, he joined the Communications Research Laboratory, Ministry of Posts and Telecommunications (currently NICT) in 1989. He was temporarily transferred to JAXA for DPR development from 2004 to 2007. He has been engaged in microwave remote sensing research.

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After completing his doctoral degree, he joined the Communications Research Laboratory, Ministry of Posts and Telecommunications (currently NICT) in 1988. For DPR development, he was at the National Aeronautics and Space Administration from 2006 to 2008. He has been engaged in microwave remote sensing research. Ph.D. (Engineering).

Introduction

As the Earth is often referred to as the "blue planet", when observed from outer space, over 70 percent of Earth's surface is covered with water. However, water resources that support our lives do not come not from the ocean but from freshwater falling on the land from the atmosphere such as rain or snow. In addition, it is said that about 60% of natural disasters are caused by heavy rains or floods, which are brought by excessive rainfalls or snowfalls (what they call precipitation). Precipitation has two aspects—one being the precious resources that support our lives, and the other being a "dangerous disaster factor". By using satellites, Global Precipitation Measurement (GPM) intends to observe the precipitation distribution on a global scale that has a large impact on our lives.

Precipitation radar and microwave radiometer

The GPM core satellite has precipitation radar that enables three-dimensional observation of the precipitation, and the microwave radiometer that observes the water vapor, cloud, precipitation, and sea surface temperature, etc., by measuring the feeble microwave band radio emitted from the earth surface and atmosphere. With the core satellite and subsatellite that has a microwave radiometer (Figure 1), the GPM creates a precipitation map at intervals of three hours using combinations of all the constellation observations which frequently measure global rain condition in high precision, and other meteorological data. Precipitation radar plays a role to achieve high precision by measuring the precipitation distribution in detail resolved in the height direction. On the other hand, while microwave radiometer provides the only two-dimensional measurement, it can observe more extensively and plays a role to frequently create a precipitation map.

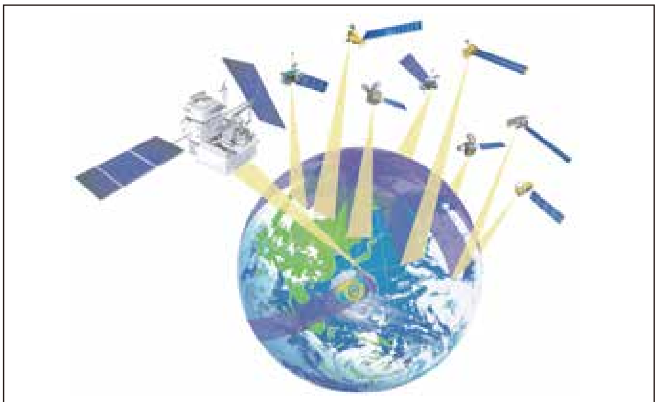
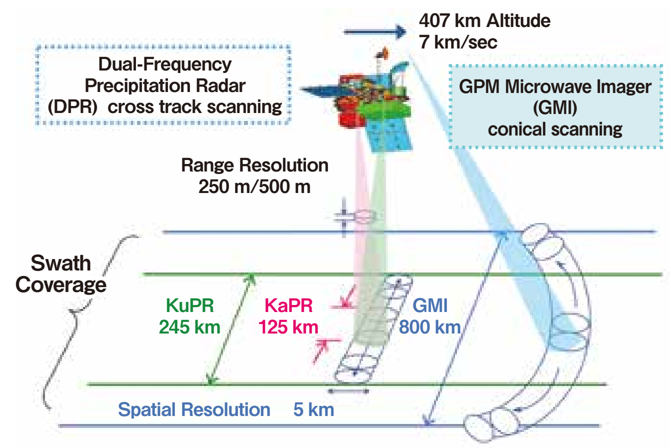


Figure 1 Conceptual diagram of Global Precipitation Measurement (GPM) (Courtesy of JAXA)
Core satellite and subsatellites

The GPM core satellite is a satellite jointly developed by Japan and the United States and launched with the H-IIA Launch Vehicle No. 23 on February 28, 2014. The satellite is equipped with Dual-frequency Precipitation Radar (DPR), which is jointly developed by NICT and Japan Aerospace Exploration Agency, and GPM Microwave Imager (GMI) developed by the National Aeronautics and Space Administration (NASA). The main role of the core satellite is to improve the observation accuracy by calibrating the observed precipitation data of microwave radiometers mounted on constellation of satellites, which is achieved by observing the precipitation condition simultaneously with two sensors, microwave radiometer and radar (Figure 2). For the orbit of the GPM core satellite, the angle of inclination is 65 degrees, and it observes from the tropics to middle and high latitudes. In addition, due to the non-sun-synchronous orbit, it can observe diurnal cycle of precipitation. The satellite circles the earth 15 to 16 times a day, in about 90 minutes per orbit, and observes the precipitation condition.



※cross track scanning: radar scanning perpendicular to the satellite's traveling direction
conical scanning: conically radar scanning

Figure 2 Concept of precipitation observation with GPM core satellite

Dual-frequency Precipitation Radar (DPR)

Dual-frequency Precipitation Radar (GPM/DPR) is a precipitation radar installed on the GPM core satellite, and a successor of the world's first TRMM Precipitation Radar, which is installed on Tropical Rainfall Measuring Mission (TRMM) launched in 1997. The TRMM/PR is still operational in orbit today. It realized the observation of precipitation distribution in the tropics with homogeneous

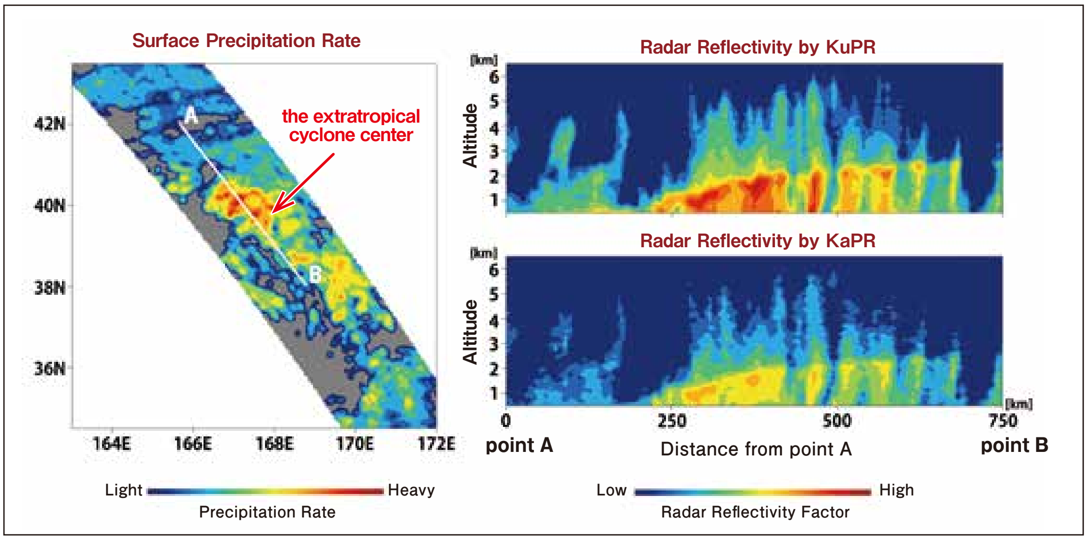


Figure 3 Observed images of GPM/DPR (Colored and edited version of the image by courtesy of JAXA/NASA)

offshore, and went to northeast direction in the south coast of Japan. In the evening of March 10, its central pressure became 976 hPa (equivalent to barometric pressure of a typhoon). The pressure distribution in Japan was high barometric pressure to the west and low pressure to the east, a typical atmospheric pressure pattern in winter, and resulted in a cold winter day even though it was March, and triggered heavy snow in Hokkaido.

Figure 3 shows the intensity of the rain, the left figure shows horizontal cross-section of rain intensity at the ground surface. The right side figures show the vertical cross-section of zonal heavy rain area, which stretches from the northwest to the southeast near the extratropical cyclone center, indicated from the point A to the point B on the left side figure. The top right figure is the observation result of KuPR. It shows the tendency that the height of strong echo (red) located in 250–700 km from the point A becomes lower toward the A point in the north. The observation result of KaPR in the bottom right shows the same tendency but the echo becomes weak (from yellow to green) at lower latitude near the ground surface. This difference is because the rain echo of Ka-band was more attenuated than that of Ku-band, shown as the height of rain becomes lower toward the north. In addition, this rain echo pattern indicates that it was snowing within the 200 km from the point A.

Table 1 The specification of GPM/DPR (Dual-frequency Precipitation Radar) and TRMM/PR (Precipitation Radar)

	GPM/DPR		TRMM/PR
	KaPR	KuPR	
Method	Active phased array (128 elements)		
Frequency	35.55 GHz	13.6 GHz	13.8 GHz
Peak transmit power	146.5 W	1012.0 W	616 W
Observation swath	125 km	245 km	215 km
Spatial resolution	5 km		4.3 km
Range resolution	500 m	250 m	250 m
Observation altitude	from the ground surface to 19 km		from the ground surface to 15 km
Minimum measured precipitation intensity	0.2 mm/h	0.5 mm/h	0.7 mm/h
Size (meter)	1.4×1.2×0.8	2.5×2.4×0.6	2.2×2.2×0.6
Weight	324.0 kg	429.9 kg	464.87 kg
Power consumption	314.8 W	423.1 W	217.1 W

precision regardless of land and sea, and also observed the three-dimensional precipitation distribution inside an early typhoon on the sea, which cannot be observed by ground based radars. TRMM/PR has brought such new knowledge that contributes to the understand ing of the global climate mechanism. One of the major roles of DPR is to expand the ability of TRMM/PR—from the tropics to middle and high latitude. To achieve this, the GPM/DPR consists of two radars using different frequencies; Ku-band radar and Ka-band radar. By using dual-frequency and the difference of the scattering and attenuation in frequencies by precipitation, the radar enables the improvement of the accuracy of precipitation intensity estimation, and identifies the types of precipitation (liquid type such as rain or solid type such as snow). Then the radar observes the precipitation of middle and high latitude capturing various details. Table1 shows the specification of GPM/DPR and TRMM/PR. KuPR is improved version of TRMM/PR, which enables the higher sensitivity with the increase of transmit power. KaPR has 2 observation modes. One is the high sensitivity mode using Ka-band, which uses short wavelength, and the other is the high accuracy mode that enables the high accuracy of precipitation intensity estimation by attenuation correction with dual frequency algorithm, which simultaneously starts the measurement of the same observation volume with KuPR.

Observed Images by GPM/DPR

Figure 3 is the example of observed images taken in the initial check-out period. At around 22:39 on March 10, 2014, the GPM core satellite observed a mature extra-tropical cyclone on the sea about 2,000 km east of Japan. It appeared above Okinawa

Future prospects

The initial check-out period is scheduled from March to April of 2014. After that, DPR will start the regular operation from May 2014. By carrying out the external calibration experiment of DPR, NICT will monitor the performance of the radar and secular change and conduct the ground validation of the data observed by DPR and of the algorithm of precipitation rate estimate. The direct validation of the observation data will be conducted with simultaneous observation by the C-band weather radar (nicknamed COBRA), which is installed in NICT Okinawa Electromagnetic Technology Center, and by Phased Array radar Network Data system (PANDA) for X band, a system completed in March 2014. Also, the validation of the algorithm will be carried out with balloon observation with the aim to observe the precipitation particle inside of the melting layer where snow or ice melts into raindrops in detail (Figure 4).

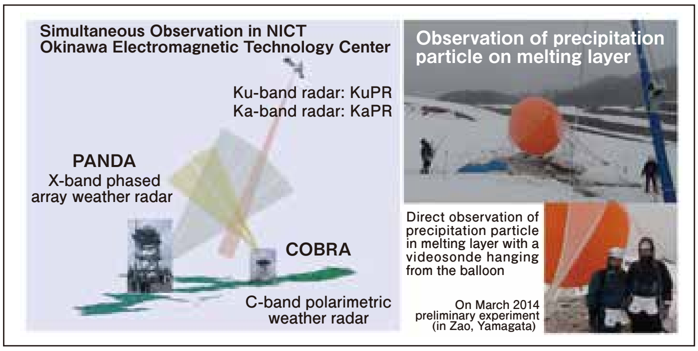
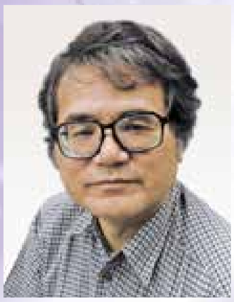


Figure 4 Ground validation of Dual-frequency Precipitation Radar (GPM/DPR)

Lidar Measurements of the Atmosphere

—Laser remote sensing of the atmospheric constituents and wind—



Kohei MIZUTANI

Chief Senior Researcher,
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After working as a Special Researcher, Communications Research Laboratory, the Ministry of Posts and Telecommunications (CRL, currently NICT) in 1991, he joined CRL in 1993.
He has been engaged in laser remote sensing. Ph.D. (Science).

Introduction

Atmospheric phenomena have become a popular topic: greenhouse gases such as carbon dioxide, air pollutants such as PM2.5, tornadoes, and heavy rains. LIDAR (LIght Detection And Ranging) is one of the devices that measures these atmospheric phenomena and atmospheric components. Lidar sends pulse laser light to the atmosphere and receives backscattering from atmospheric molecules, airborne particles (aerosol), and clouds (Figure 1). The distance to the scattering matter is calculated from the time difference between the transmission and detection of the pulse laser light. Lidar is also referred to as the laser radar, which means a kind of radar using laser light. Lidar can measure aerosols such as Asian dust, air pollution particles (such as PM2.5), pollen, sea salt particles, smoke; and it can also measure the clouds, wind, and carbon dioxide, etc.

Mie lidar

You can estimate the types of scattering particles and the altitude distribution of aerosol and cloud by the intensity distribution of received light, polarization, and wavelength dependence. Such lidar devices are called Mie lidar (lidar that measures the scattering of particles larger than or comparable to the wavelength of the laser light where Mie theory is applied), and are installed around the world including polar regions for atmospheric observations. NICT started monitoring observation of air pollutants such as PM2.5 by installing a Mie lidar in Fukuoka in Kyushu —a region susceptible to the air from Asia— for atmospheric environment measurement in the spring of 2014. This lider has a spectrometer on the receiver so it can measure the fluorescence from the organic matter. Obtained data is expected to be used for research about the nature and source of air pollutants, and the improvement of the accuracy of diffusion prediction.

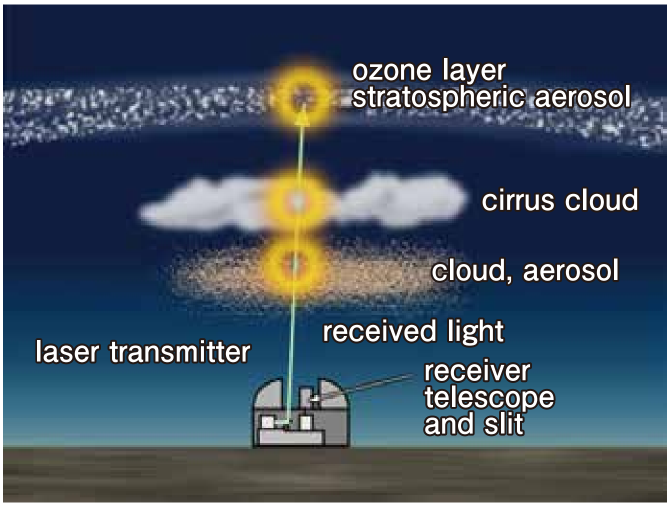

Figure 1 Conceptual diagram of lidar device

Coherent Doppler lidar

When the laser light is backscattered by the aerosol or cloud moving with the air, the frequency change occurs due to Doppler shift. NICT has been conducting R&D of coherent Doppler lidar that measures the wind velocity by measuring the frequency change. Figure 2 shows the overview of wind observation by coherent Doppler lidar developed by NICT and installed on NICT headquarters building roof. The coherent Doppler lidar is set in a container. The laser light is sent from the scanner installed on the top of container and is backscattered by aerosol, and the lidar receives it through the same scanner. The laser we developed emits light at eye-safe wavelength of 2 μm and you can transmit it in any directions by the scanner. Since the laser light never spreads unlike radio waves, it is not necessary to worry about the extra reflection from the earth's surface even in case of near-surface measurement. Figure 3 shows the example of the observed wind distribution by the device. It shows the horizontal wind distribution by the azimuthal scan in an elevation angle of 2 degree. The lidar device is at almost the center of the map and it observes wind components of each direction centered on the device. The directions with no data are the area where the device can not make measurement because of obstacles. In addition to the average flow of the south-southwest, there are also fine structures of wind shown with light and shade of around 1 km. With such observation, we would like to capture the status of gust wind and the precursor of heavy rains.

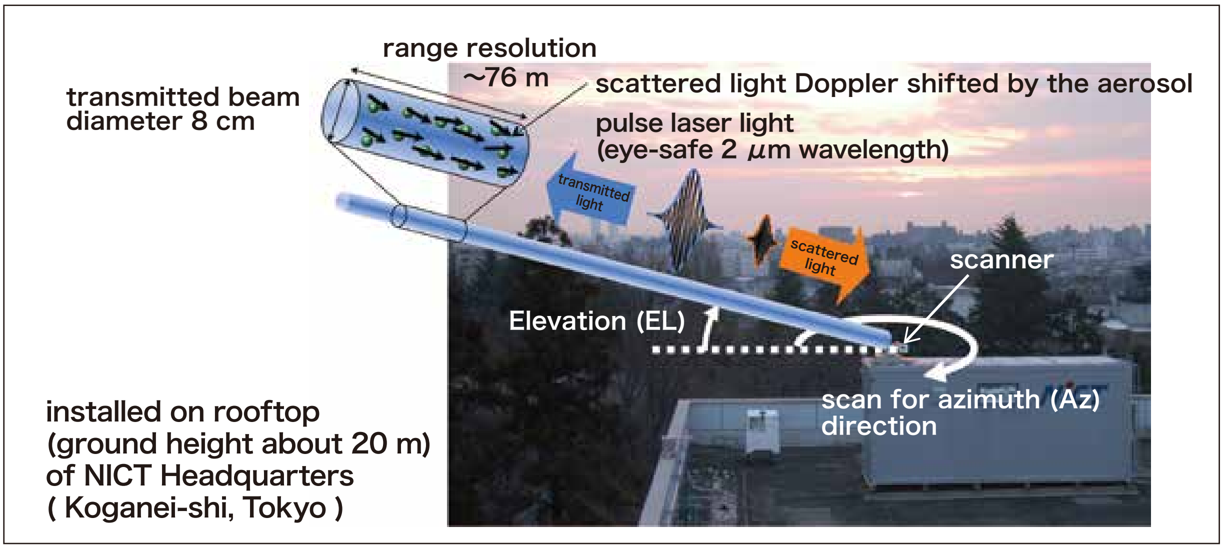

Figure 2　Wind observation by coherent Doppler lidar developed by NICT

In March 2014, we installed phased array weather radar-Doppler lidar sensor fusion system in bases of NICT in Okinawa (Figure 4) and Kobe. Doppler lidar works in conjunction with phased array weather radar and other meteorological devices, etc. and is a part of the space meteorological data acquisition experiment system. We believe that demonstration research by such experiment system will become the foundation of the future meteorological observation system.

In addition, we are promoting the development of on-board coherent Doppler lidar for aircraft. We expect that the observation of the wind distribution around the Japanese Islands with the lidar mounted on the aircraft will contribute to the improvement in such as route prediction of typhoon and weather forecast.

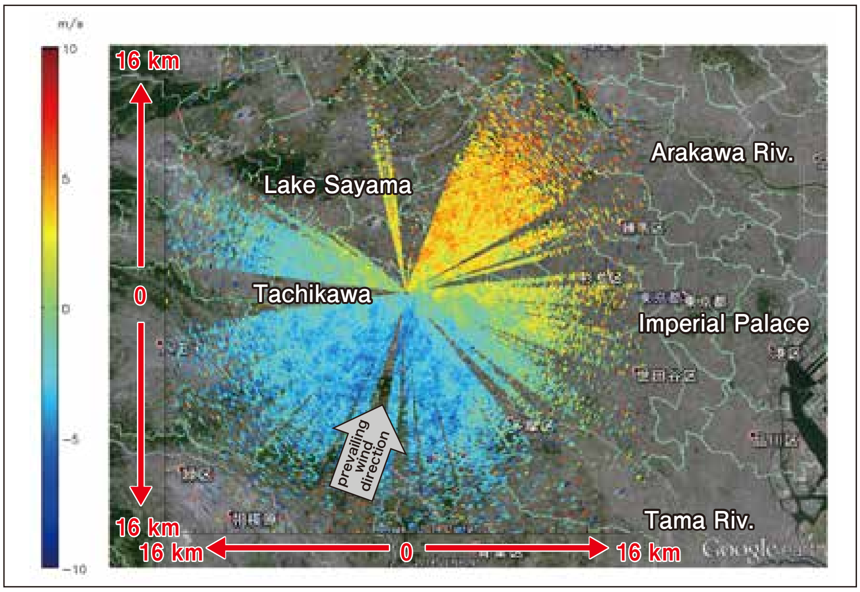

Figure 3　Wind distribution observed by azimuthal scan of coherent Doppler lidar in an elevation of 2 degree

Cold colors (negative wind speed) show the coming wind to the device, and warm colors (positive wind speed) show going wind from the device.

Future prospects

Since there are absorption lines of water vapor and carbon dioxide in the wavelength range used for NICT's coherent Doppler lidar, it can be used to measure water vapor and carbon dioxide. Currently, the lidar device that NICT developed can observe carbon dioxide concentration up to 5 km away with approximate 1% (4 ppm) accuracy. However, the observation accuracy that is currently required is about 0.3%, so we need more accuracy with less observation time.

In addition, we would like to contribute to the improvement of the world weather forecast by mounting coherent Doppler lidar on a satellite and having observation of the wind distribution all over the world.

Through R&D of observation devices that is more stable and more efficient, we will make it possible to observe wind and carbon dioxide from the earth's surface and the space further and more efficiently. This will contribute to the weather hazard prediction and global environmental protection.

Figure 4　Doppler lidar installed as phased array weather radar-Doppler lidar sensor fusion system in Okinawa

The Future of DUV LEDs

—Development of light-extraction technology by nanophotonic structures for practical application of DUV-LEDs—

Shin-ichiro INOUE

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After completing doctoral course and working as Special Postdoctoral Researcher of the Institute of Physical and Chemical Research, RIKEN, Assistant Professor of Institute for Materials Chemistry and Engineering, Kyushu University, he joined NICT in 2010. He has been engaged in research of nano-optoelectronics. He is also Associate Professor, Graduate School of Engineering Faculty and Engineering, Kobe University and Researcher of PRESTO, Japan Science and Technology Agency. Ph.D. (Engineering).

Background

The importance of deep-ultraviolet (DUV) light with 200–350 nm wavelength has been increasing in various fields from information, electronic devices to safety and sanitary environment, medical application, such as high-density optical data storage, disinfection of bacteria and viruses, purification of water and air, biosensing, biological and materials analysis, photolithography, prevention of nosocomial infection, and photodynamic therapy. It's becoming an important infrastructure that supports our society. For deep-ultraviolet light sources, gas light sources such as mercury lamps and excimer lasers has been conventionally used. However, the gas light source is short-lived, large in size and requires large power consumption. For such reasons, replacing it with semiconductor solid state light source, which is small in size and power consumption, has been much needed. In addition, as typified by the adoption of Minamata Convention on Mercury in last year, global efforts have been accelerated to reduce or eradicate harmful substances to the human body or environments such as mercury and fluorine. Therefore, the application of deep-ultraviolet light-emitting diodes (DUV-LEDs) with low environmental impacts, high efficiency and long life is strongly desired (Figure 1).

Under these circumstances, the R&D of DUV-LEDs has been very active all over the world. Although the recent performance has been greatly improved, the further improvement in efficiency is necessary for the practical use. The R&D of DUV-LEDs by NICT was adopted as A-STEP (Adaptable and Seamless Technology Transfer Program through Target-driven R&D), the stage for promotion of industry-academia collaborative R&D (feasibility study stage), Seeds Validation. NICT has been engaged in the full-fledged R&D with the aim to apply DUV-LEDs in cooperation with a company, which has been conducting joint research with NICT since December 2013. In this article, we will introduce our efforts towards the efficiency improvement of DUV-LEDs and its application such as the development of significant enhancement technologies in light-extraction efficiency by making use of nanophotonic structures.

The progress and challenges of DUV-LEDs

DUV-LEDs consist of AlGaN-based semiconductors of the direct transition type. Varying the mole fraction of AlN and GaN enables AlGaN-based DUV-LEDs to emit the light with almost full DUV range (210–365 nm). In semiconductor LEDs, if there are high-density defects in the crystal, the electron-hole pairs generated by injection current can easily be changed into the heat through defects without light emission. In AlGaN-based DUV-LEDs, since 10^8 cm^{-2} or more of high-density defects (dislocations) occur on the active layer (Figure 2 (a)) due to the large lattice mismatch in commonly used sapphire (Al_2O_3) substrates, there has been issues of the low internal quantum efficiency and the short lifetime. However, the recent progress of R&D of buffer layer technology and AlN substrates in several groups has brought the significant improvement on these issues. NICT has been conducting R&D of DUV-LED using AlN single crystal substrates in cooperation with Tokuyama Corporation. Since it is possible to reduce the defects (reduction of dislocations) such as less than 10^6 cm^{-2} with DUV-LEDs

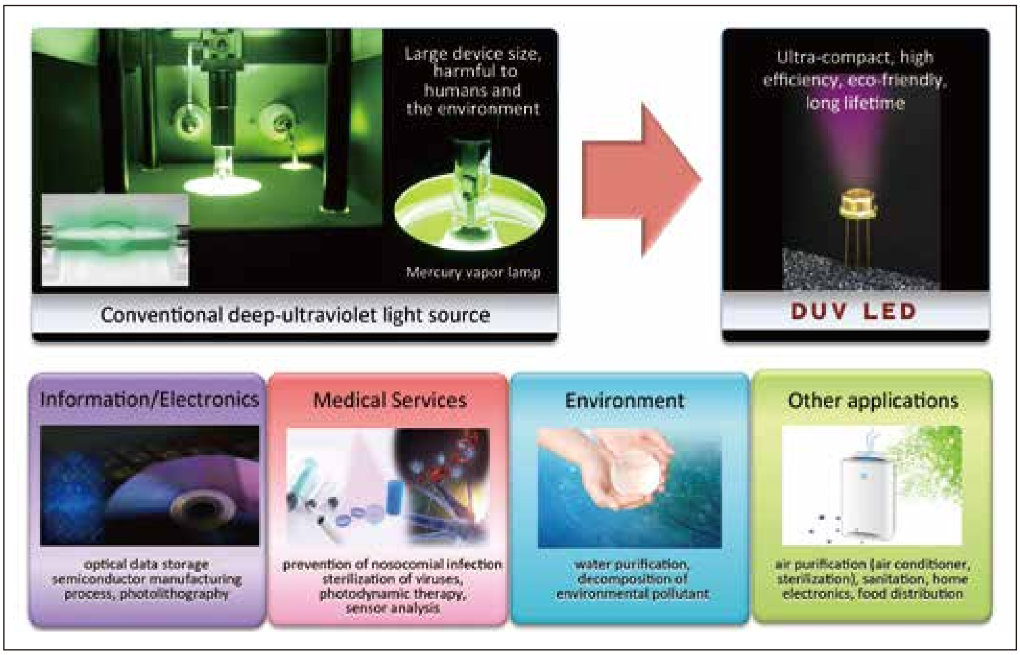


Figure 1　The impact and the applications of DUV-LEDs

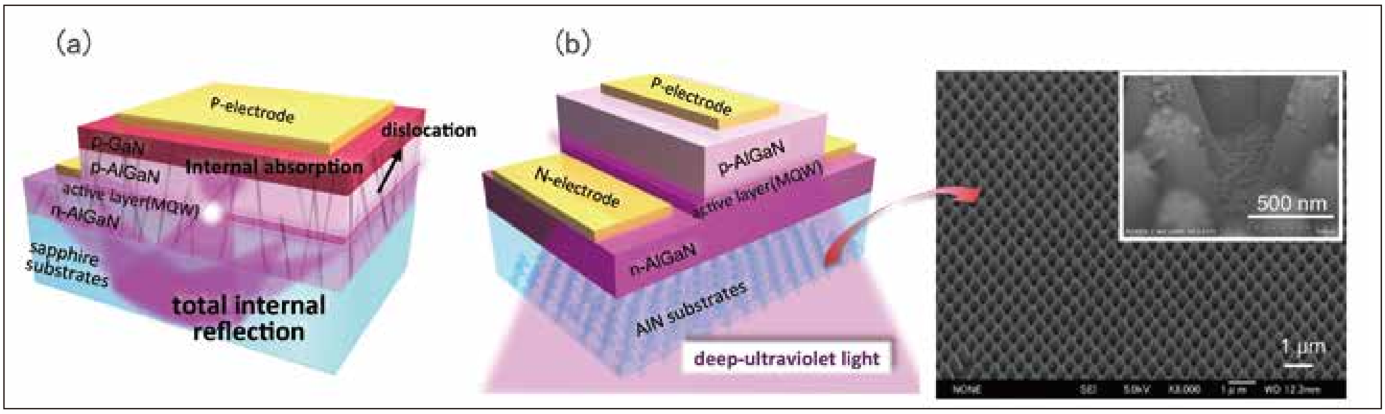


Figure 2 The device structure of AlGaN-based DUV-LEDs

(a) Schematic diagram showing problems of conventional DUV-LEDs (high-density dislocation defects, very low light-extraction efficiency)
(b) Schematic diagram of light-extraction structure with nanophotonic structure and its picture by Scanning Electron Microscope

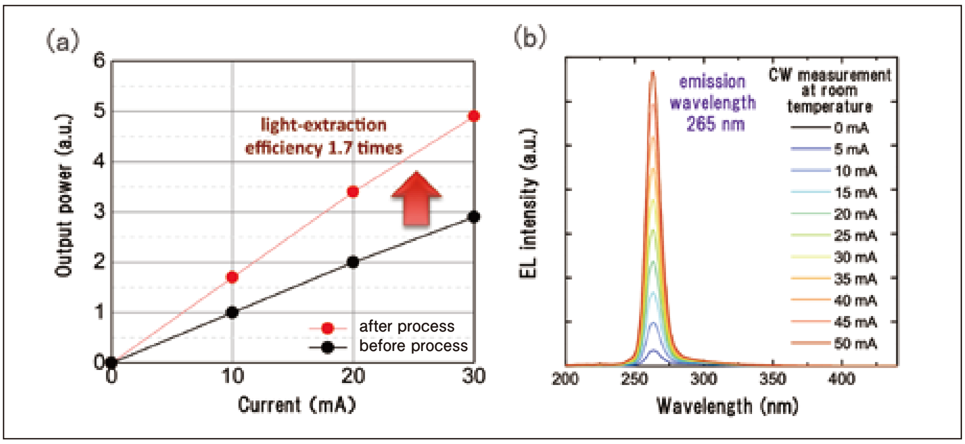


Figure 3 The emission characteristics and the performance improvement results of DUV-LEDs

(a) The improvement of the output power of DUV-LEDs with nanophotonic structure
(b) Emission spectra for each driving current

on AlN substrates, AlN substrates has high advantages in the lifetime and the reliability.

The current biggest factor that inhibits the efficiency improvement in DUV-LEDs is the problem of the very low light-extraction efficiency. This is a particular problem of DUV-LEDs. It is difficult to extract the light due to the internal absorption in the p-type GaN contact layer and the total reflection at the substrate interface. Therefore, most of the light emitted in the active layer change into thermal energy (Figure 2(a)). Especially, with AlN single crystal substrates, since the refractive-index is large (n = 2.29 @265 nm) compared to sapphire's, the critical angle get small (25.9 degrees). Thus, you can extract the only small amount of light. The results of theoretical calculation by 3D finite-difference time-domain (3D-FDTD) method, with absorption in p-type GaN layer considered, showed that the efficiency of light extraction from the flat surface (light extraction surface) of AlN substrates was just only about 4%. In other words, this problem is the main cause of very low external quantum efficiency in DUV-LEDs. With that being said, the improvement of DUV-LEDs depends on how to improve the light-extraction efficiency.

Performance improvement of DUV-LEDs by nanophotonic structure

The biggest issue preventing performance improvement and practical application of DUV-LEDs is their limited light-extraction efficiency. Currently, we have achieved the highest light-extraction enhancement of DUV-LEDs on AlN substrates in the world. We achieved the high light-extraction efficiency with the reduction of total internal reflection on AlN substrates by proposing and developing new light-extraction structure. The remarkable enhancement of light-extraction is caused by the multiplier light enhancement effects of periodic convex structures at the wavelength scale and smaller fine round convex structures (Figure 2(b)). Not only improvement of the light-extraction efficiency but light output uniformity between devices, manufacture cost, and yield rate are also considered in this unique structure. We achieved the fabrication of light-extraction nanophotonic structures with high precision and high uniformity for DUV-LEDs on AlN substrates. When compared to the devices without the nanophotonic structures, the relative emission intensities of DUV-LEDs recorded with the structures were as high as 1.7 or more (Figure 3). Also, the standard deviations of enhancement between devices were less than 0.03, and we highly achieved the reduction of the dispersion of output power between devices, which is essential for practical use. In fact, we fabricated a prototype of 265 nm DUV-LEDs in collaboration with Tokuyama Corporation and achieved the output power of more than 30 mW. And furthermore, for the reliability measurements, the lifetime for the 50% power reduction at 150 mA was estimated to be over 6,000 hours in 265 nm DUV-LEDs.

Future prospects

These results are expected to bring significant progress toward the improvement of efficiency and reliability, and the practical use of DUV-LEDs. In the future, using nanophotonic structure, we will further improve the light-extraction efficiency and develop the mass production and low cost technology such as nano-imprint technology. By these technologies, we will develop DUV-LEDs that has a high competitive advantage in both performance and cost.

The industrial uses of DUV-LEDs in various fields are expected, and there is a chance that the LED grows into a huge market. Ultimately, by the realization of mercury-free, ultra-compact, highly efficient, and long lifetime DUV solid light sources opening the possibility of new DUV applications, we would like to contribute to build lively, safe and secure and environmentally-friendly society.

Report on NICT Entrepreneurs' Challenge 2 Days 2013 "Kigyouka Koshien (1st day)/ Kigyouka Expo (2nd day)"

Entrepreneur Support Office,
ICT Industry Promotion Department

1st day Kigyouka Koshien

March 5, 2014

Twelve teams selected from all over Japan gave presentation on products and services related to ICT. In addition to Highest Award and Jury's Special Award, twelve companies sponsored the event and provided various elaborative special awards including "Luncheon with CEO". About one hundred and fifty students and faculty members joined the event, and actively exchanged information, questions and answers.

Highest Award — Cellars —unforgettable wines in your hand—

Team: Cellars　Representative: Mr.Takafumi YANO, Kyoto University

After uploading a picture of the label on wine bottle taken with a smartphone, the application instantly shows the detailed information of the wine including its brand name, etc. Cellars holds Japan's largest wine database of 180,000 bottles. With the originally developed recognition engine, the database is further enhanced by the data uploaded by users. Monetize: based on (1) commission from affiliated EC retailers generated when user buys the bottle of wine on the application (2) advertising revenue on the application (3) organizing events related to wine (4) discovery and import of wines whose value will increase in the future.

Jury's Special Award — Smart-Unipath

Team: CrowdDesigN　Representative: Mr. JUNG Sae Hyung, Kyoto Institute of Technology

Smart-Unipath is an online lecture distribution service that provides courses for international students preparing for examinations necessary to study in Japan such as Examination for Japanese University Admission for International Students. Once the course is registered, the lecture videos will be available on PCs and smartphones and can be played as many times as they wish. The quizzes and mock examinations allow learners to track their progress. Users receive consolations and helps from the service with various paper works necessary for entering school in Japan.

Snapshot of the awarding ceremony of Highest Award

Snapshot of the awarding ceremony of Jury's Special Award

Commemorative photo with the presenters

Kigyouka Koushien FY2013, Contestants team name/plan name ※numbers based on presentation order

① Tokyo Kawaii Guide/Tokyo Kawaii Guide　Representative: Masatoshi ASADA, Digital Hollywood University
② sO-Zo/sO-Zo　Representative: WANG Ran, Waseda University
③ PassionJelly/Happy World Map　Representative: Kisaki NISHIHARA, Okinawa National College of Technology
④ CAR-D2/Web Service for Foreigners Importing Used Car　Representative: Ryotaro KUBOTA, Doshisha University
⑤ Team 7lab/"emi-system" The aid-for-childcare communication system which connects parent and child by ICT
Representative: Tatsuya ISHINO, Kochi National College of Technology
⑥ Dreampharos/Frientor Service (Providing the dream-supporting platform for children with new type self-management mobile application)
Representative: DONG Wooseok, Japan Advanced Institute of Science and Technology
⑦ Cellars/Cellars —unforgettable wines in your hand—　Representative: Takafumi YANO, Kyoto University
⑧ "IITOMO" wo miru kai/Busp　Representative: Hiroki TOI, Oyama National College of Technology
⑨ Goroo/-melo-　Representative: Hiroya HANAFUSA, Yokohama National University
⑩ Sequence Robot/Innovation of line　Representative: Yuki TAKAHASHI, Chuo University
⑪ CrowdDesigN/Smart-Unipath　Representative: JUNG Sae Hyung, Kyoto Institute of Technology
⑫ MARK/MARK　Representative: Takaaki ITAGAKI, Keio University

In NICT, for the purpose of business promotion in the area of information communications technology, we carry out human resource development for the next generation, as well as students in technical colleges, universities, and graduate schools across the country with aspiration to utilize ICT, and support the business expansion of local startups.

As part of this effort, we held Entrepreneurs' Challenge, a two-day event on March 5 and 6, 2014 at KOKUYO HALL (Minato-ku, Tokyo). The event consists of "Kigyouka Koshien" where students and young entrepreneurs selected from across the country compete their business plans, and "Kigyouka Expo" where NICT promotes business matching by facilitating promising startup companies from various regions to find new funders and partners in business expansion after introducing their business plans.

Details: http://www.venture.nict.go.jp/ (Japanese version only)

2nd day Kigyouka Expo (※) — March 6, 2014

Twelve organizations selected from all over Japan gave passionate presentation seeking business cooperation, fundraising, and human resources related to new businesses of products and services using ICT. Local support organizations of respective regions also introduced how the support startup business in the presentation.

After the presentations, SHIKUMI DESIGN Inc. won the Audience Award by the vote of audience. Subsequently, a talk session was held by the mentors from ICT Mentor Platform (Mr. Hisashi KATSUYA and Mr.Jun NAKAJIMA), the representative from local support organization (Mr. Koichi KOSHIDA, Ishikawa Sunrise Industries Creation Organization), and the Audience Award recipient SHIKUMI DESIGN Inc. (Mr. Shunsuke NAKAMURA). They discussed frankly about NICT's effort in hosting two-day event from their perspectives: as a mentor, local support organization, and startup company. The event welcomed a total of 200 participants, including members from major corporations, ICT related companies in Tokyo, investment companies and local incubation supporting organization. They all enjoyed lively exchange of ideas and information.

Talk session


Snapshot of the presentation

Commemorative photo with the presenters

Audience Award

"Playing Instrument by Moving Your Body with New Generation Instrument 'KAGURA'"

SHIKUMI DESIGN Inc. (Representative Director, Mr. Shunsuke NAKAMURA)

New generation instrument "KAGURA" uses the camera installed in PC, and makes a sound according to the movement of the user. Its intuitive user interface can potentially create a new genre—a hybrid of instrumental performance and dance—. We would like a wide range of users to enjoy "KAGURA"; from musicians, performers to children.

(※) "Kigyouka Expo" is a new name for what was formerly referred to as "ICT Business Plan Contest", a series of events that was held for fifteen times in the past. The new name "Kigyouka Expo" was dubbed with a wish to put forth all kinds of people involved in entrepreneurship just like World Expo to support ICT startups: groups, individuals, and communities fostered across the nation.

Kigyouka Expo FY2013, Presentators (companies)
※numbers based on presentation order

① Toru DOMON (President), **Clear Inc.** (Hokkaido district: Sapporo) 【support organization】Sapporo Biz Café
② Shinya OKAMOTO (Director), **IT COWORK INC.** (Tohoku district: Aomori) 【support organization】Aomori Pref. (Miyagi Pref., Miyagi Mobile Society)
③ Hiroyuki MIURA (Representative Director), **PLUSVoice** (Tohoku district: Miyagi) 【support organization】Miyagi Pref., Miyagi Mobile Society
④ Masayuki HISADA (President of CEO), **Aizu Laboratory, Inc.** (Tohoku district: Fukushima) 【support organization】Aizuwakamatsu City
⑤ Kosuke MORI, (Sole proprietor, Representative) (Kanto district: Kanagawa) 【support organization】Shonan Industrial Promotion Foundation
⑥ Kazuya NITTA (Owner), **ablecomputer Inc.** (Hokuriku district: Ishikawa) 【support organization】Ishikawa Sunrise Industries Creation Organization (ISICO)
⑦ Jean-Marc PELLETIER (Fellow), **dango Inc.** (Tokai district: Gifu) 【support organization】Softopia Japan
⑧ Keisuke ARAKAWA (Representative Director), **Entrepreneur Inc.** (Tokai district: Aichi) 【support organization】Artificial Intelligence Research Promotion Foundation (Aichi Venture House. co., ltd.)
⑨ Shinji FUKUMOTO (CEO), **Future Electronic Technology, Inc.** (Kinki district: Osaka) 【support organization】Osaka Chamber of Commerce and Industry
⑩ Hideoki TADA (Director), **VECTOR Co., Ltd.** (Chugoku district: Okayama) 【support organization】Business Incubator Okayama (BIO)
⑪ Hisashi MUROZAKI (President of Executive Officer), **MEDIAS** (Chugoku district: Hiroshima) 【support organization】Hiroshima Internet Business Society (HiBiS)
⑫ Shunsuke NAKAMURA (Representative Director), **SHIKUMI DESIGN Inc.** (Kyushu district: Fukuoka) 【support organization】Fukuoka Ruby and Software Industry Promotion Committee

Report on Opening Ceremony and Symposium for the Resilient ICT Research Center

Resilient ICT Research Center

NICT established a world-leading research center named "Resilient ICT Research Center" in Katahira Campus of Tohoku University. The center is the result of NICT's effort in collaborating with industry, academia and government to create research facilities that promote R&D for strengthening the resilience of information communications network against disasters after the Great East Japan Earthquake on March 11, 2011, when information communications were extensively damaged. We held the opening ceremony of Resilient ICT Research Center on March 3, 2014, followed by the opening symposium at Sakura Hall in Katahira Campus of Tohoku University.

The ceremony started with welcoming remarks by Masao SAKAUCHI, President of NICT, and guests' addresses by Prof. Susumu SATOMI, President of Tohoku University, Mr. Toshiyuki TAKEI, Director-General for Policy Coordination, Minister's Secretariat, Ministry of Internal Affairs and Communications, Acting Governor of Miyagi Prefecture, Acting Mayor of Sendai City, and Vice President of Tohoku Economic Federation. They expressed their expectations for the center to promote R&D for resilient technologies to meet the growing needs of the society through its research facility, and to promptly expand its achievements with an aim to be a world-leading research center. The ceremony ended with the closing speech by Yoshiaki NEMOTO, Director General of Resilient ICT Research Center, who expressed the Resilient ICT Research Center's policies and its mission. There were a total of 60 participants in the ceremony, including the people from Tohoku University, government agencies, local governments, the private sectors, and NICT.

At the opening symposium for Resilient ICT Research Center (hosted by the Ministry of Internal Affairs and NICT) held in the afternoon of the same day, after two keynote lectures, the lecture themed on "the direction of the research center and the promotion of industry-academia-government collaboration" from industry, academia, and government was given. Results presentations on resilient ICT (ten subjects) which were directly commissioned by the Ministry of Internal Affairs ended in FY2012 were also performed and activities for further practical application of the research results were introduced. Through the symposium, we shared the same recognition—the circumstances of resilient ICT research, base formation, and the importance of collaboration system between industry, academia and government. Exhibition of the research results was also performed on the first floor of the same Sakura Hall. There were 187 participants in total for both the symposium and the exhibition.

Symposium Program

Keynote Lecture

"Current Status and Issues of Tohoku University Reconstruction Action"
Prof. Nobuyoshi HARA, Executive Vice President (for Earthquake Disaster Reconstruction), Tohoku University

Keynote Lecture

"Innovation Challenge —for Safe and Secure Social Infrastructure—"
Mr. Hiromichi SHINOHARA, Executive Vice President, Nippon Telegraph and Telephone Corporation

Lecture

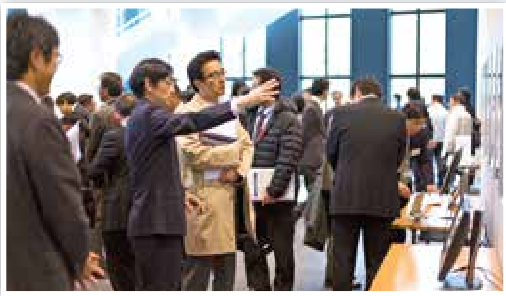
"Direction of Activities of the Research Center and Promotion of Industry-Academia-Government Collaboration"
Hiroshi KUMAGAI, Associate Director General, Resilient ICT Research Center
Prof. Masataka NAKAZAWA, the Executive Director of Research Organization of Electrical Communication, Tohoku University
Mr. Motoo NISHIHARA, General Manager at Cloud System Research Laboratories, NEC Corporation

"R&D for Strengthening Disaster Resilience in Information and Communication Networks"
Report on R&D results (10 subjects)

Opening Address by Masao SAKAUCHI, President of NICT

Resilient ICT Research Center, located in the Katahira Campus of Tohoku University

Opening Symposium of the Resilient ICT Research Center



Exhibition

Report on "Completion Ceremony for Solar Wind Observation Satellite Data Receiving System" and "9th SPACE WEATHER USERS' FORUM"

Space Weather and Environment Informatics Laboratory,
Applied Electromagnetic Research Institute

NICT held "Completion Ceremony for Solar Wind Observation Satellite Data Receiving System" and "9th SPACE WEATHER USERS' FORUM" at NICT headquarters (Koganei, Tokyo) on March 20, 2014. In the ceremony, after Dr. Masao SAKAUCHI, President of NICT gave a greeting speech as a host, Mr. Toshiyuki TAKEI, Director-General for Policy Coordination, Minister's Secretariat, Ministry of Internal Affairs and Communications spoke as an invited guest. Then, Dr. Toshio IGUCHI, Director General, Applied Electromagnetic Research Institute explained space weather and the recently built solar wind observation satellite data receiving system, the congratulatory address by the National Oceanic and Atmospheric Administration in U.S. was introduced, and the ribbon cutting ceremony was conducted. More than 80 people attended the ceremony including researchers from universities and research institutes, and people related to aviation, satellite operation, and ham radio. After the ceremony, we held a tour of the antenna of the newly built system and the meeting room for the space weather forecast.

Newly-developed antenna receiving satellite data for solar wind observation

Greeting speech from Mr. Toshiyuki TAKEI, Director-General for Policy Coordination, Minister's Secretariat, Ministry of Internal Affairs and Communications

Subsequently to the ceremony, SPACE WEATHER USERS' FORUM was held where Dr. Fumihiko TOMITA, Vice President, gave the opening remarks, and a greeting speech from Mr. Tatsuhiro HISATSUNE, Director of Space Communications Policy Division, Ministry of Internal Affairs and Communications followed. After that, four lectures were given. After the forum ended, we conducted individual consultations about space weather, mini-lessons of how to read space weather data, and held a tour of NICT's exhibition room. In total, more than one hundred people participated.

The lecture presentation materials of the day are available on the following URL. http://seg-www.nict.go.jp/SpaceWeather/home/forum.html (Japanese version only)

Ribbon cutting ceremony with Mr. Toshiyuki TAKEI, Director-General for Policy Coordination, Minister's Secretariat,Ministry of Internal Affairs and Communications (right), Dr. Masao SAKAUCHI, President of NICT (center), Dr. Fumihiko TOMITA, Vice President of NICT (left)

USERS' FORUM Lectures	
Lecture 1	"The Recent Trend of Space Weather" Dr. Mamoru ISHII, Director of Space Weather and Environment Informatics Laboratory
Lecture 2	"The Use of Space Weather in an Airplane" Mr. Retsu AKUTSU, Chairman of HUPER Committee, Air Line Pilots' Association of Japan, Captain of B787, All Nippon Airways Co., Ltd.
Lecture 3	"Evaluation of Atmospheric Drugs that Have Effects on Spacecraft: Aiming for More Precise Spacecraft Operation" Prof. Hitoshi FUJIWARA, Faculty of Science and Technology, Seikei University
Lecture 4	"Management of Radiation Exposure for Astronauts and Space Weather Prediction" Mr. Masaru SATO, Associate Senior Engineer, Astronaut Medical Operations Group, Flight Crew Operations and Technology Department, Human Space Systems and Utilization Mission Directorate, JAXA

Mini Lectures of How to Read Space Weather Data		
【The Sun】	【The Magnetosphere】	【The Ionosphere】

Group photo of attendees

The forum lecture

Individual consultation about space weather

Announcement of
WIRELESS TECHNOLOGY PARK 2014 (WTP2014)

Date: May 28–30, 2014

Venue: West Hall 3 & 4, Tokyo Big Sight
(held simultaneously with WIRELESS JAPAN 2014, and TRANSPORTATION SYSTEM EXPO 2014)

Organized by: NICT, YRP R&D Promotion Committee and YRP Academia Collaboration Network

Overview

Wireless Technology Park (WTP) is an exclusive event focused on the research and development of wireless technology, and has been held every year in cooperation with industry, academia, and government. WTP consists of three areas: the "Exhibition" where you can find the latest wireless technologies and researches, the "Seminar" that introduces the recent technical trends in wireless communications, and the "Academia Session" where university laboratories present their R&D results. In WTP2014, NICT will lecture and showcase the latest results from the R&D with a focus on wireless technology that supports a smart society.

This year, WTP is planning exciting projects such as exhibitions and seminars under the special theme of "Wireless Technology that Supports Smart Society", an exhibition of results from academia-industry collaborative researches, and an exhibition on the history of wireless technology. We look forward to your visit.

Exhibitions and Seminars by NICT

<Exhibitions>

- Research and demonstration platform of "Wi-SUN" to support social ICT
- Radio device and profile extension technology of the international standard "Wi-SUN"
- Mobile communication system utilizing TV White Spaces
- Wireless relay using small Unmanned Aircraft Systems (Resilient wireless mesh network)
- Infrastructure-independent peer aware communication (PAC) system
- Sheet medium communication and application technology
- Indoor navigation system co-operated with UWB positioning and smart devices
- Phased array weather radar that captures three-dimensional structures of torrential rain, etc.

<Seminars>

- Overview of the initiatives by NICT towards wireless communication technology
- R&D of wireless communication technology to support social infrastructure
- Initiatives towards dependable wireless communication technology
- Recent R&D activities on space/satellite communication
- Phased array weather radar that captures three-dimensional structures of torrential rain
- UWB indoor positioning system and the applications

Last year's exhibition

Detail

For more information, please visit WTP website (http://www.wt-park.com/eng/index.phtml).
※You can enter the exhibition free of charge by making a reservation at the WTP2014 website.

Contact Information

<Inquiry about the event>
WTP2014 show management office (in EJK Japan, Ltd).
TEL: +81-3-6459-0444 FAX: +81-3-6459-0445
E-mail: expo2014@ejkjapan.co.jp

<Inquiry about NICT's exhibitions and seminars>
Planning Office of Wireless Network Research Institute, NICT
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