NARLabs 國家實驗研究院

儀器科技研究中心

Instrument Technology Research Center

2016 Annual Report

儀科中心一〇五年報

Instrument Technology Research Center
Annual Report

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Words from the Director General

主任 楊燿州

Faced with the tremendous challenges on Taiwan's technology industries and the strong need of domestic technology advancement, Instrument Technology Research Center (ITRC) remains committed to its mission. In 2016, ITRC continued to heed requirements from all sectors and dedicated itself to providing technological solutions including strengthening our partnership with the industry and academia and expanding ITRC's technological capabilities to achieve innovation and creativity in engineering technologies. ITRC's efforts have bridged critical sectors such as the domestic semiconductor equipment and biomedical optics industries. Our achievements have successfully increased Taiwan's competitiveness in the R&D development of advanced instruments.

In the past year, in response to changes in industries, ITRC has been devoted to engaging with the industry, academia and research organizations. ITRC hosted a "Seminar on Advanced IC Packaging Process Stepper Demonstration" which attracted close to 20 semiconductor equipment and optoelectronic industry vendors from up, mid, and downstream of the supply chain. The very first "Advanced IC Packaging Process Stepper" designed and developed in Taiwan was demonstrated in the seminar. ITRC collaborated with Taiwan Semiconductor Manufacturing Company and successfully developed a 12" plasma-enhanced atomic layer deposition(ALD) system. The system will provide opportunities for local production of the semiconductor industry in Taiwan.

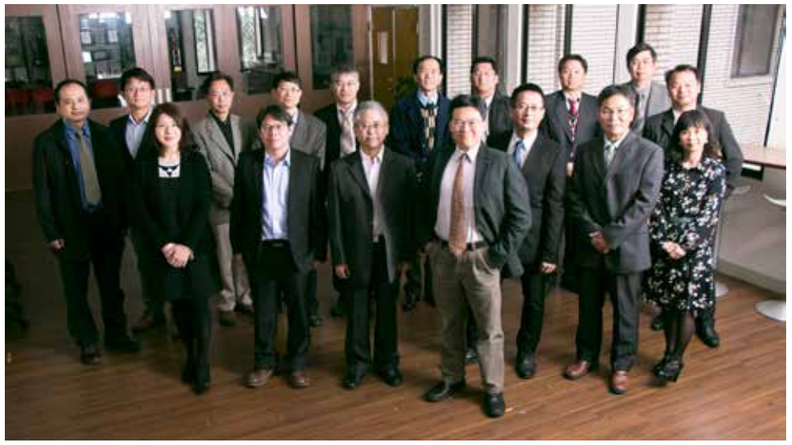
ITRC is actively engaged in the development of next-generation technologies and collaborated with the Department of Engineering and Technologies of MOST, National Chip Implementation Center and National Nano Device Laboratories along with Taiwanese industrial leaders including Hiwin Technology, MediaTek, Mobiletron, and Advantech-LNC Technology in the joint promotion of Internet of Things Sensor Service Platform. In 2016, ITRC hosted both the annual exhibition for presenting the year-end achievement and the midterm exchange seminar for the second year of the Internet of Things Sensor Service Platform Project in hopes of maximizing the independent research results of the sensor and promoting them in applications in the industry.

In addition, ITRC developed the"Subcutaneous Hemorrhage Imaging System"in concert with Lumos Tech. Co., Ltd. to promote the industrial development of high-end medical instrument industry in Taiwan. ITRC also organized the "Subcutaneous Hemorrhage Imaging System" presentation seminar in which Dr. Henry Chang-Yu Lee, the world's foremost forensic scientist bore witness. The Subcutaneous Hemorrhage Imaging System is an effective tool for forensic identification in Taiwan; it can also be used extensively in the domain of forensic identification. To promote the biomedical industry in Taiwan, ITRC held the Taiwan Biomedical Technology International Market Entry Launch Ceremony and NARLabs/Tongtai Group/China Steel/ThinTech Materials Technology 3D Printing Joint Laboratory Opening Ceremony, as well as the "3D Printing Medical Supply for the World Cup Press Conference". These events were organized to promote the biomedical industry on the international market.

ITRC launched the Optical Systems Integration R&D Consortium to boost domestic industrial development and the Consortium has facilitated 15 academia-research-industry joint R&D projects. In addition, ITRC expanded technological capabilities and followed national technological policies to construct the integrated biotechnology incubation service platform, select medical instrument projects with clinical requirements and market potential and provide them with incubation services in order to help R&D teams enter the high-end medical instrument market. ITRC assisted 18 R&D research teams and facilitated the establishment of 5 new companies in 2016. ITRC established an environment with one-stop service platform in the Hsinchu Biomedical Science Park that conforms to the ISO13485 standard for medical devices, and has since provided services to over 250 individuals.

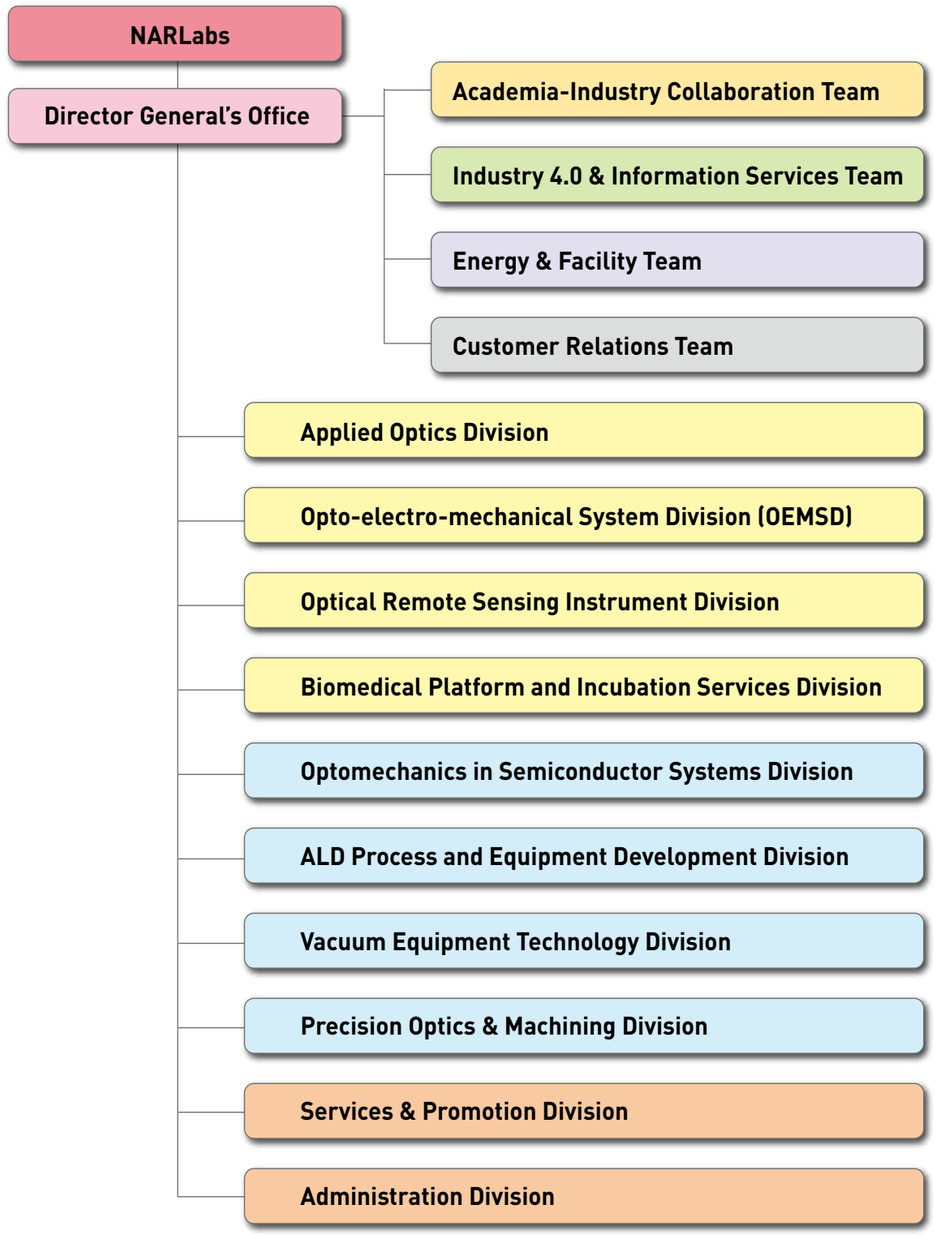
In terms of international development, after several years of active campaigns by ITRC, the I^2MTC 2016 International Conference was held by ITRC in Taiwan for the first time. The participants hailed from 41 countries, totaling over 300 people. This conference not only promoted information exchange between domestic academicians and the international community of instrumentation and technology, but also enhanced Taiwan's international recognition and influence in the instrumentation and technology domains.

Facing volatile market trends in global industries, ITRC will continue to be passionate and dedicated in forming partnerships with the industry, academia and research organizations. We shall integrate ITRC's advantages and experience in technological research and development and innovate R&D applications. We shall also continue to assist the advancement and transition of the industry in hopes of using our steady stream of innovative energy to promote the technological competitiveness of Taiwan's industries and help the research and development of the industry, academia and research organizations in Taiwan to reach new heights.

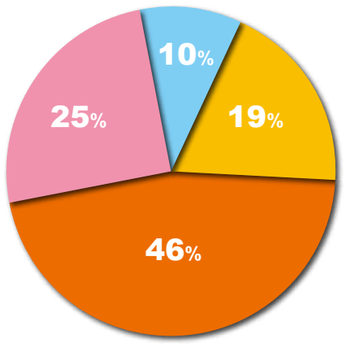


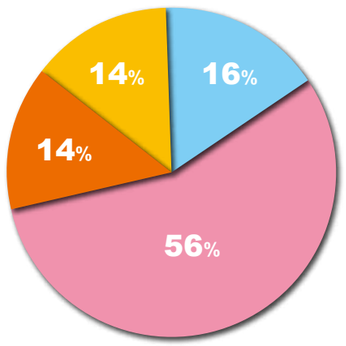
Overview of the Instrument Technology Research Center

Organization Chart

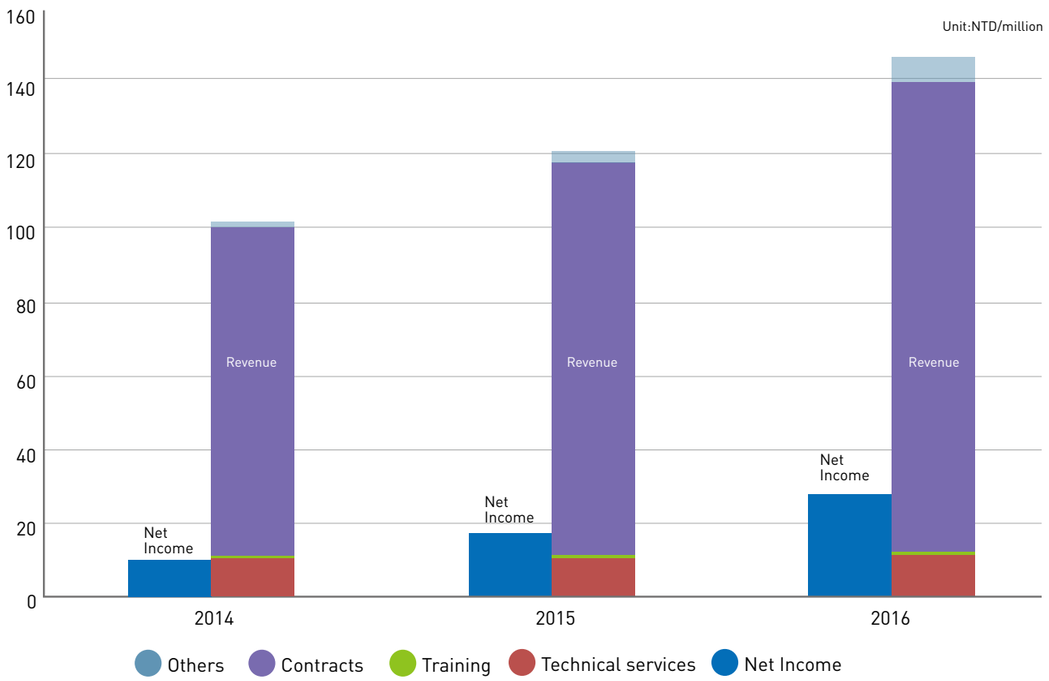


Deployment of Manpower





Financial Data



Core Facilities

Vacuum Technology & Thin-film Process

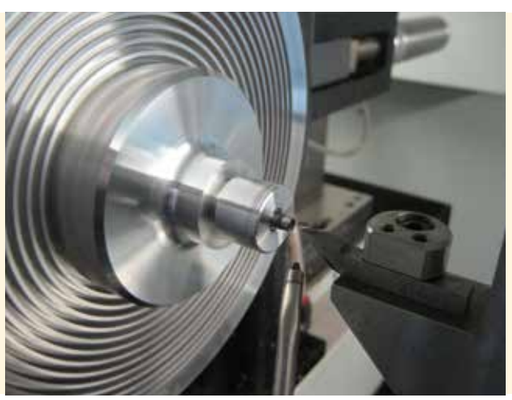
ITRC provides advanced vacuum system development, thin-film process development, and inspection/calibration service platforms; its chief core facilities include:

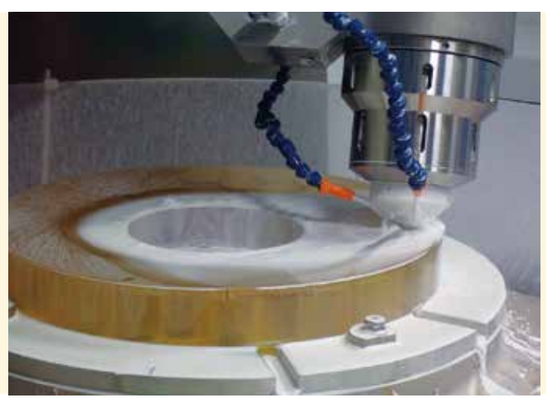
- Large-aperture lens coating system
- Transmission electron microscope
- Single-wafer plasma-enhanced atomic layer deposition (PEALD)

Precision Opto-mechanical Engineering

Having accumulated 40 years of experience in optical polishing technology, ITRC provides precision opto-mechanical element and system design and produce services; its core facilities include:

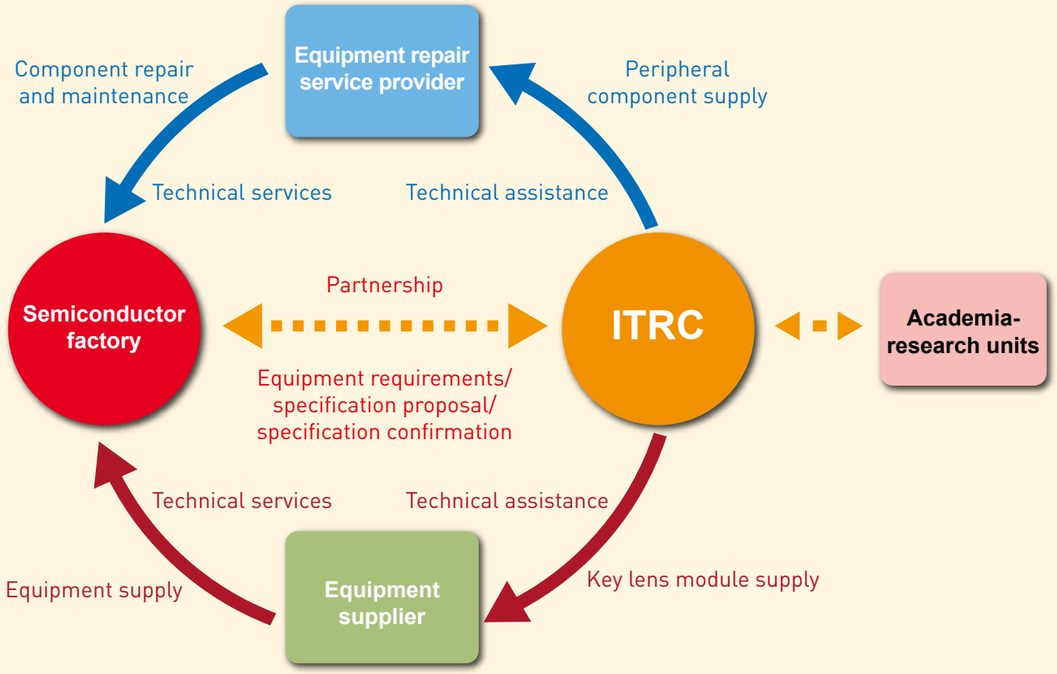
- Lens polishing and testing equipment
- Ultra-precise diamond turning and milling machine
- Segmented interferometer





Business Cooperation Model

ITRC actively introduces a new operating model of "servicing customers of customers", and bridges the gap between the product supply and demand of upstream and downstream firms as well as in the R&D of academic institutions to research, develop, and translate the demands at the consumer end into capacities at the supplier end. Tapping on the novel service concept of integrating innovation into engineering and incorporating engineering into our services, ITRC accelerates the transformation of R&D and innovative outcomes into industry applications, thereby adding value to the services of its industry chain. The diagram below illustrates the operating model of manufacturing lithography lens modules; the model comprises of three stages: Lens customization service, lens batch production, and technology transfer after trial mass production.



Operating model of manufacturing lithography lens modules

GABC Service

Executing crucial policy tasks (G)

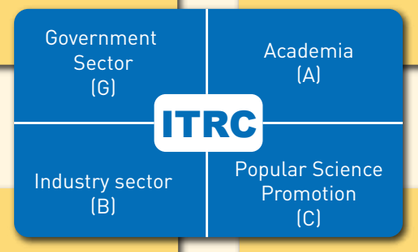
Supporting major academic projects (A)

Commercializing novel technologies (industry) (B)

Promoting popular science education (C)

- Serving as the eyes of the FORMOSAT-5 satellite
- Developing a monitoring device for disaster prevention at the Zhuoshui River Bridge
- Assisting with refining agricultural development
- Executing the "Taiwan Biotechnology Take-off Action Plan"

- Supporting national projects and industrial fundamental technology projects
- Supporting innovation, entrepreneurial projects, and prototype production
- Cultivating biomedical teams and verifying medical equipment
- Cooperating with academic institutions in the R&D of instrument technologies and systems specific for prospective studies



- Improving industry-specific instrument systems and key components
- Selling lithography lens to Taiwan Semiconductor Manufacturing Company
- Selling lithography E-pin to ASML
- Cooperating with Epistar in developing LED chip inspection systems
- Selling the developed chip inspection system and Taiwan-made machines to Samsung Group

- Holding *i*-ONE International Instrument Innovation Competition
- Fostering talents in instrument technology and promoting popular science education
- Updating knowledge and information via publishing Instruments Today and ITRC News.
- Hosting optoelectronics exposition, semiconductor expositions, and SPIE exhibition

Notable Achievements in 2016

TRC relies on its R&D expertise and applies ITRC's technological capabilities to assist industry and academia experts in leveraging their R&D as well as innovative capabilities, accelerate their process of product commercialization, and to create economic benefits for Taiwan's industries; thereby generating mutually beneficial outcomes for both industry and academic researchers. ITRC received the12th National Innovation Award for its ICG Fluorescence Onsite Visualization and Assessment System. The Subcutaneous Hemorrhage Imaging System was recognized by Dr. Henry Chang-Yu Lee. The annual exhibition for presenting the year-end achievement of the Internet of Things Sensor Service Platform Project, as well as the Advanced IC Packing Process Stepper Demonstration and Investment Expo were also held. Additionally, ITRC hosted the 3D Printed Medical Materials Advancing to the World Cup press conference, attracting a number of media reports and achieving outstanding results.

The12th National Innovation Award for ICG Fluorescence Onsite Visualization and Assessment System

A multidisciplinary fluorescence imaging team from National Taiwan University Hospital (NTUH), ITCR, NTU Computer Science and Information Engineering Department, and Wanfang Hospital jointly developed a prototype of the ICG Fluorescence Onsite Visualization and Assessment System (iFOVAS) under the support of the Ministry of Science and Technology (MOST). This system is a breakthrough of existing visualization methods in which surgeons must rely on monitors to observe the location of the surgical site. This innovation involves using a projector to guide the surgeon to the fluorescing site, thus resolving the problem, which is that ICG fluorescence imaging technology must rely on monitors in order to indirectly examine fluorescence images. This development increases the intuitiveness and continuity of the surgery. The iFOVAS received the 12th National Innovation Award this year.

Group Photo of the ITRC Award-Winning Team

Subcutaneous Hemorrhage Imaging System: A New Tool for Forensic Identification

ITRC successfully developed the Subcutaneous Hemorrhage Imaging System, which performs comprehensive identification of subcutaneous bleeding that is invisible to the eye in the early stages of the injury. Existing blood oxygen concentration tests generate only single-point information. ITRC has overcome this technological bottleneck, leading the world in building an imaging system that measures a large area (8×8 cm) of the skin's blood oxygen concentration. This development is extremely sensitive and applicable for determining the time of injury. This system was realized by ITRC's cooperating vendor, Lumos Tech. Co., Ltd., and verified by Dr. Henry Chang-Yu Lee, the world's foremost forensic scientist; it is already in use by U.S. law enforcement agencies. Subcutaneous Hemorrhage Imaging System is an effective tool for forensic identification in Taiwan; it is expected to be extensively used in the domain of forensic identification.

The "Subcutaneous Hemorrhage Imaging System" jointly developed by ITRC and Lumos Tech. Co., Ltd.

Forensic scientist Dr. Henry Chang-Yu Lee at the exhibition

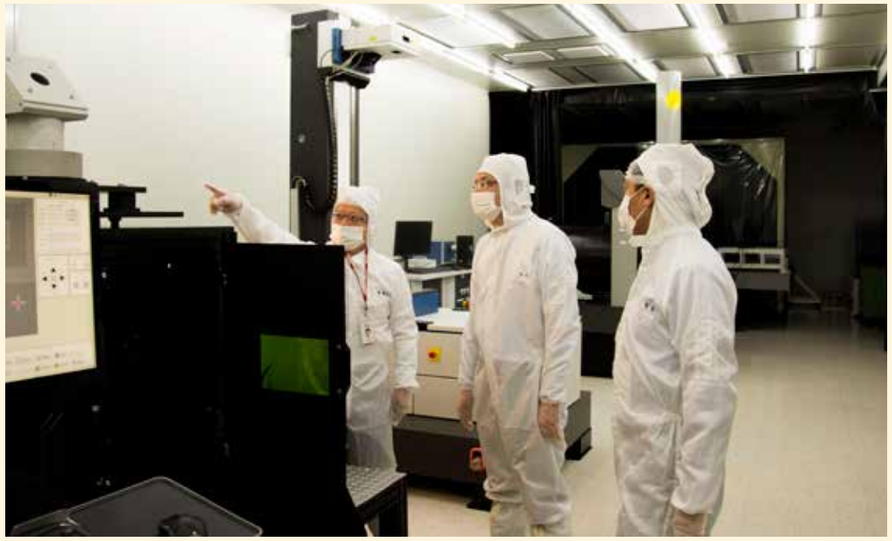
Annual Exhibition for Presenting the Year-End Achievement of the Internet of Things Sensor Service Platform Project

ITRC hosted the annual exhibition for presenting the year-end achievement of the Internet of Things Sensor Service Platform Project, which was participated by 17 teams of academic experts from eight domestic universities. These teams collectively presented their R&D outcome in sensor component to a number of leading vendors in Taiwan. In the exhibition, the sensors were divided into the following categories according to their applications: wearable devices and personal care, cyber-physical systems (CPS), internet of vehicles, and universal sensors. It is anticipated that this project will help academic experts to realize their forward-looking R&D outcomes, integrate sensor prototypes into domestic industrial applications, and promote autonomy for Taiwan's sensor component technologies.

Group photo of the Internet of Things Sensor Service Platform project team and industry experts

Advanced IC Packaging Process Stepper Demonstration Seminar: Taiwan Successfully Developed the Advanced IC Packaging Process Stepper

ITRC hosted the Advanced IC Packaging Process Stepper Demonstration Seminar, which exhibits Taiwan's first-ever set of localized, independently manufactured and designed the Advanced IC Packaging Process Stepper and its developmental process. Through this seminar, the technical capacity of ITRC and the semiconductor industry is fused, hoping to initiate the local development of the upstream and downstream key component technology. This Advanced IC Packaging Process Stepper will be introduced to the industry supply chain in the next few years to facilitate the autonomous manufacturing of semiconductor equipment and key optical elements and improve Taiwan's competitiveness in the semiconductor industry.



TSMC's Vice President Jing-Kung Lin (middle) inspecting the lithography machine

Taiwan's 3D Printed Artificial Joints Marching into the International Market for the First Time

ITRC held its 3D Printed Medical Materials Advancing to the World Cup press conference. Facilitated by the Instrument Technology Research Center, Taiwan's first biomedical-grade 3D printing metal powder manufacturer that has passed the preclinical animal test, ThinTech Materials Technology Co., Ltd., combined with Tongtai Group's self-developed metal 3D printing equipment, have successfully printed a medical material product for the United Orthopedic Corporation; the product has passed the stringent ISO-10993 biocompatibility certification and earned the right to be launched into the international market. The Executive Yuan, Legislative Yuan, Institute for Biotechnology and Medicine Industry, Ministry of Health and Welfare, Ministry of Science and Technology, Taiwan Medical and Biotech Industry Association, Association for Dental Sciences of the Republic of China, National Taiwan University Hospital, China Medical University Hospital, as well as major domestic and international manufacturers are all witnessing a crucial milestone in Taiwan's precision medical care technology!

Torch lighting ceremony celebrating the advancement of 3D printed medical materials to the "World Cup"

I²MTC 2016 International Conference in Taiwan for the First Time!

ITRC has actively vied for the right to host the IEEE International Instrumentation and Measurement Technology Conference (I²MTC). Following more than five years of effort, the I²MTC 2016 International Conference was held from May 23–26, 2016 in Taiwan for the first time. The participants hailed from 41 countries, totaling over 300 people. Four hundred research papers were presented. This conference not only promotes information exchange between domestic academicians and the international community of instrumentation and technology, but also substantially enhances Taiwan's international influence over the instrumentation and technology domain. It is worth mentioning that with well-organized and considerate arrangement, ITRC I²MTC 2016 working group got elected to join the competition of "Taiwan MICE Award", organized by the Bureau of Foreign Trade, Ministry of Economic Affairs. It was presented with Silver Award, the 2nd place out of 37 Conferences in Group B which comprises of conferences with total attendees below 500.

Prof. Ruth Dyer, President of IEEE I&M Society, welcomed attendees of I²MTC 2016 at Taipei International Convention Center.

International Recognition of R&D Outcomes Achieved in 2016

ITRC has generated an abundance of outstanding R&D achievements and received a wide variety of awards, including the 12th National Innovation Award for its ICG Fluorescence Onsite Visualization and Assessment System and the Taiwan Photonics Society's Optoelectronics Technology Contribution Award for its Subcutaneous Blood Stasis Inspection System. Awards received in 2016:

Awards received in 2016

Event	Participating work	Award
2016 Optoelectronics Technology Contribution Award	Subcutaneous blood stasis inspection system	Optoelectronics Technology Contribution Award
NARL Award for Outstanding Contributions in Science and Technology	Using Atomic Layer Deposition in the Preparation of Highly Reactive Copper Nitride Nanocrystalline Fuel Cell Catalyst	Academic Research Award of Merit
NARL Award for Outstanding Contributions in Science and Technology	Research and development of aero-optical element and optomechanical system	Outstanding Achievement Award in the technology development category
Chinese Metrology Society Outstanding Measurement Engineer Award	Portable wafer edge defect testing system	Outstanding Measurement Engineer Award
Chinese Institute of Engineers	Cloud remote non-contact crack measurement device	Paper Award

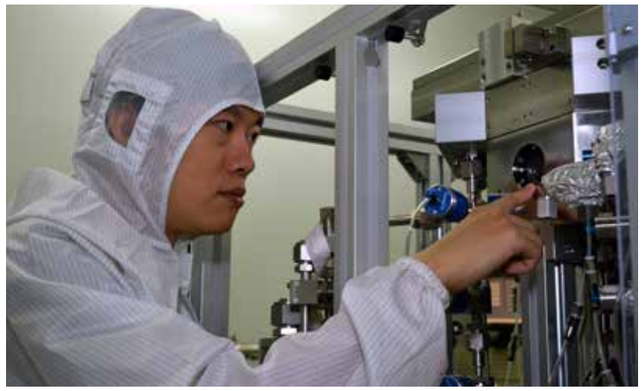
Comprehensive Improvement of ITRC's Information Operational Capability

Incorporating information management system facilitates improving ITRC's operational efficiency and duration. ITRC completed the Reimbursement Deposit Certificate Electronic Verification System to accelerate various reimbursement operations. Traditional certification of deposit for reimbursement applications is provided in hard copy, which must be signed and submitted. On average, each application requires approximately 5 days to be processed. After the electronic system is completed and launched, the duration of the entire procedure is shortened to 2 days. In addition, the Procurement Information and Supplier Contract Management System was completed, increasing the procurement efficiency by approximately 56%. ITRC also completed building the Property Electronic Inventory System and replaced all of its property labels to RFID tags, which enables inventory to be conducted by hand held devices. This system can effectively improve inventory efficiency.

Development of Instrument Technology

12" Plasma-Enhanced Atomic Layer Deposition System

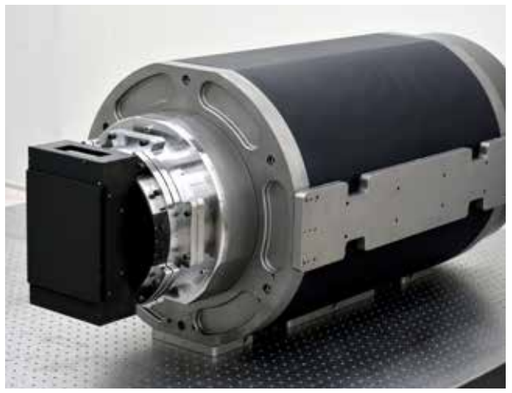
ITRC collaborated with Taiwan Semiconductor Manufacturing Company and successfully developed a 12" plasma-enhanced atomic layer deposition (PEALD) system. The system can quickly and uniformly transport chemical precursors to the surface of 12" silicon wafers to enhance uniform chemical precursor delivery, prevent dust formation, as well as improve thin film uniformity. This design can improve the efficiency of plasma reactions, reduce thin film damage, and achieve uniform PEALD reactions. Additionally, components can be swapped out to switch thin film deposition methods and correspond with the reactive properties of various chemical precursors; improved thin film quality can be obtained on 12" silicon wafers.



The 12" RF Capacitive PEALD System

Advanced IC Packaging Process Stepper for Semiconductor Industry

In response to the developmental trend of 3D-IC packaging industry in the global semiconductor industry, ITRC relies on its R&D experience of large-aperture optical systems from more than a decade and applied the knowledge



Projection lens for the Advanced IC Packaging Process Stepper

Advanced IC Packaging Process Stepper

to develop the "Advanced IC Packing Process Stepper. Equal magnification and large exposure area in this equipment was used to expose 12'' wafers using a step-by-step approach, and its resolution of exposure line and space (L/S) patterns achieved up to 2 μm. The developed technologies can be widely employed to various types of advanced lithography equipments, such as PCBs, LEDs and LCDs. The localized development of the "Advanced IC Packing Process Stepper " can expedite its application in the back-end packaging process for domestic semiconductor manufacturers, and also significantly improve the technical capacities of Taiwanese equipment manufacturers. This task can accelerate the service localization of the semiconductor equipment industry and prepare Taiwanese equipment manufacturers for entering the international semiconductor manufacturing market.

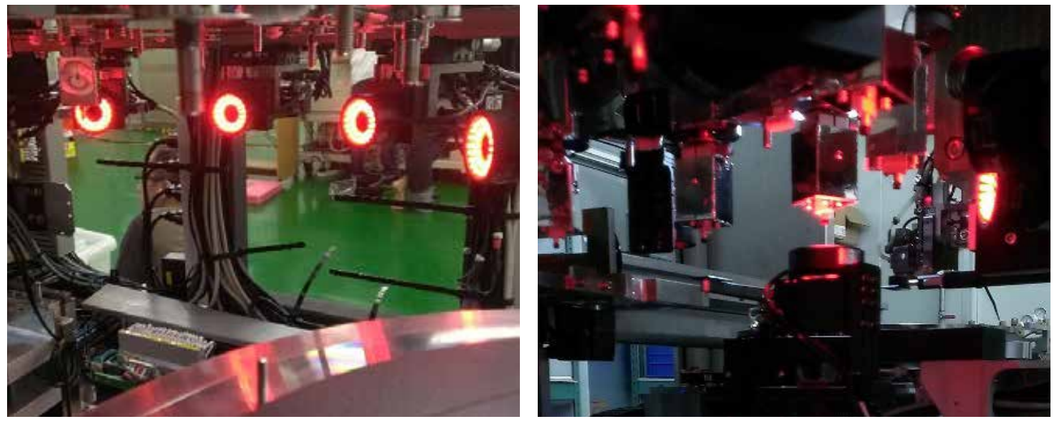
193-nm Deep UV (DUV) Anti-Reflection Films Development

As the demand for miniature semiconductor elements and circuit intensity increase rapidly, strict requirements have been imposed on the key processes of lithography. Currently, micro-imaging technologies primarily adopt a 193-nm DUV light source, which is not absorbed by thin-film materials. The development of a 193-nm anti-reflection coating (ARC) technology reduces the amount of stray light from the lithography system and improves the stability and yield rate of the manufacturing process, increasing the competitiveness of the industry.

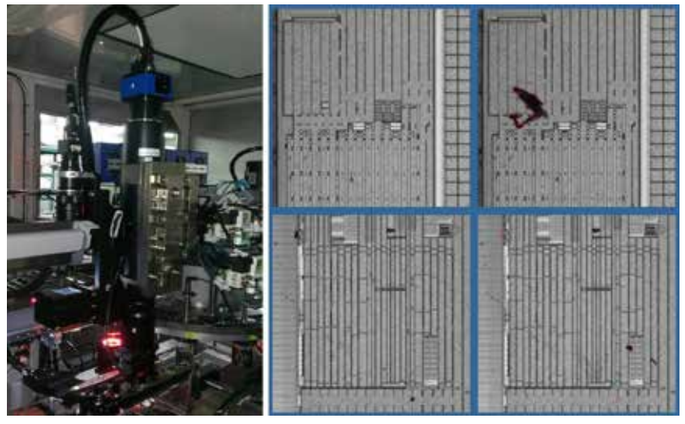
New sputtering materials for DUV (193 nm) coating

Optical Inspecting System for Defects on Six Sides of Chips

The defect inspecting system for six-sides of chip developed by ITRC can be integrated into chip sorters and applied to determine the chip quality for semiconductor-related industries. System has features of capable of inspecting defects on six sides of a chip with larger size, acquiring images with high resolution and defects inspection with high precision. Integrated into the high-speed chip sorter with multi-head for pick and place, the inspecting system can acquire the images of chips and detect their defects in real-time during the sorting process. Therefore the chips quality can be tracked and then feedbacked to the production line efficiently. This system also can be customized to meet the system requirements of semiconductor equipment for cooperative manufacturers. Dedicated optical inspecting system, including opto-mechanical imaging devices and detecting software, can be developed to raise the value and competitiveness of their equipment.



The optomechanical module of the six sides of chips defect testing system integrating a chip sorter



Positive imaging optomechanical module of the six sides chip defect testing system integrating a chip sorter

Precision Turning Centering System with Hydrostatic Bearing

ITRC uses a turning and centering process and poker-chip assembly, in which the lens and lens cone are assembled before conducting turning and centering on the metal lens cone. Thus, the inclination error caused by the assembly process can be greatly reduced during the turning process. Then, poker-chip assembly is adopted to control the coaxality of the lens cone assembly, which reduces the translation error, forming an optical lens module that features low eccentricity. This optical turning and centering system is characterized by X, Z, Z1, and C axes. The C axis was integrated with the hydrostatic bearing rotating platform provided by Department of Power Mechanical Engineering, National Tsing Hua University. The testing module is composed of ITRC's exclusive precision angle testing module and non-contact displacement testing module, which feature a testing precision of 5 arcsec and 2 μm, respectively. This centering system is used to conduct turning and centering on the secondary lens module of the lithography system lens module. The optimal eccentricity of the secondary lens module measured 5.6 arcsec (0.0016°), which verifies the world-class technological standard of this equipment.

Precision Turning Centering System with Hydrostatic Bearing

Development of Sputtering Equipment and Processes for DUV and High-Hardness Coating

In this research, the plasma technique will be implemented to set up a closed field magnetron sputtering with high-power impulse source. The closed field magnetron sputtering can generate multiple plasma areas that fully cover the sputtered target and substrate holder. Therefore, this system provides a room temperature deposition process with high ion current density, low bias voltage and high reaction. It benefits producing films over a large surface area at high deposition rate with excellent and reproducible optical properties.

In the high-power impulse magnetron sputtering system, the original DC sputter system is equipped with high-power impulse controller. It provides the pulse of power applied to the target with a low duty cycle and frequency. This leads to pulse power densities of several $kWcm^{-2}$ on the target. In addition, the plasma density of ITRC's system is 100 to 10,000 times greater than that of the traditional DC sputtering system.

By integrating these two technologies, ITRC developed a high-power closed field magnetron sputtering system, which improves the optical absorption problem and film density and adhesion of thin films. These capabilities gave rise to a novel sputtering approach that features high mechanical and optical quality.

The new sputtering technology developed by ITRC can be applied to sputter high-hardness thin films and DUV fluoride thin films.

ICG Fluorescence Onsite Visualization and Assessment System

The ICG Fluorescence Onsite Visualization and Assessment System (iFOVAS) prototype is primarily used to observe and track the flow movement of fluorescent dyes in real-time during surgical operations; it projects visible lights at positions where invisible fluorescent lights illuminate such as blood vessels or tissues, enabling surgeons to directly observe fluorescence images of the surgical site. This development resolves the problem, which is that ICG fluorescence imaging technology must rely on monitors in order to indirectly examine fluorescence images. The innovative design of this system eliminates the need for surgeons to rely on monitors and instead make direct observations. It is no longer necessary to verify repeatedly that

the location of the surgical site corresponds to the position of the label on the monitor. This increases the intuitiveness and accuracy of the surgery, thereby reducing surgery time and potential risks.

ICG Fluorescence Onsite Visualization and Assessment System, iFOVAS

Subcutaneous Hemorrhage Imaging System

ITRC successfully developed the Subcutaneous Hemorrhage Imaging System, which performs comprehensive identification of subcutaneous bleeding that is invisible to the eye in the early stage of the injury. The system performs complete and comprehensive identification by measuring the subcutaneous oxygen content and hypoxia condition in the blood. Existing blood oxygen concentration tests generate only single-point information. ITRC has overcome this technological bottleneck, leading the world in building an imaging system that measures a large area (8×8 cm) of skin blood oxygen concentration. This development is extremely sensitive and applicable for determining the time of injury. This system was realized by ITRC's cooperating vendor, Lumos Tech. Co., Ltd., recognized by Dr. Henry Chang-Yu Lee, the world's foremost forensic scientist, and has been applied by the U.S. law enforcements. The Subcutaneous Hemorrhage Imaging System is an effective tool for forensic identification in Taiwan, and it is expected to be extensively applied to the domain of forensic identification.

Subcutaneous Hemorrhage Imaging System

The " Subcutaneous Hemorrhage Imaging System " jointly developed by ITRC and Lumos Tech. Co., Ltd.

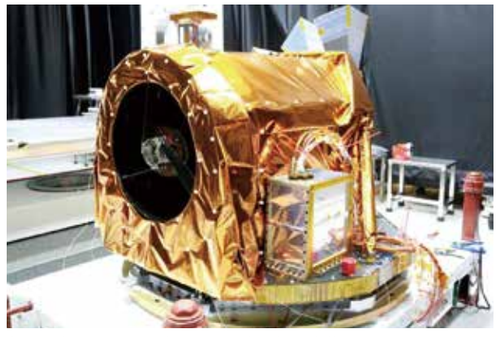
Mission-oriented R&D

Development of Remote Sensing Optoelectronic Instruments

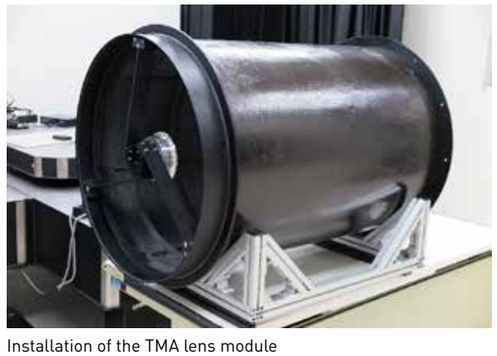
Relying on its many-years of optoelectronic instrument development and optomechanical system integration experience, ITRC participates in the FORMOSAT-5 remote sensing payload integration project. The Center has cooperated with NSPO in completing the development of a remote-sensing imager for the satellite's remote-sensing payload, and assisted with the integrated testing of the payload in preparation of the satellite launch. Considering the increasing needs of the Taiwanese people for satellite images featuring enhanced resolution, ITRC proposes to conduct a preliminary research on second-generation payload system (three-mirror anastigmat, TMA). The purpose of this research is to meet the needs of the Taiwanese people and to sustain technological development.

TMA is a three-lens telescopic optical system that employs off-axis aspheric lens. After its completion, ground surface resolution will be more than double that of the FORMOSAT-5. Due to limited funds and time, aluminum alloy is used to produce the lens for this project. During assembly, mechanical auxiliary equipment is adopted to assist with measuring the relative position of the primary and secondary lens. In 2016, the secondary lens was adjusted to correspond to the primary lens, resulting in a precision translation amount of 10 μm. ITRC will continue to install the third lens.

Integration of remote sensing payload and the satellite body



State of remote sensing payload before delivery



Installation of the TMA lens module

Biomedical Technology R&D and Verification Services

ITRC is employing its core capabilities and R&D expertise to integrate academic research resources and implement biomedical technology R&D and verification projects. ITRC expects that the establishment of clinical, academic, and industrial integration platforms will accelerate the translation and add value to the research results, as well as support the vigorous growth of Taiwan's biomedical industry.

Major accomplishments during this year:

◎ITRC completed the construction and operation of its universal core laboratories, including the biomedical optoelectronic imaging and information laboratory, the biomedical chip process laboratory, the in vitro diagnosis laboratory, and the system and mechanism production laboratory; this environment meets the medical device usability standard (IEC62366) and can provide documents required for the development of medical devices, including assessments and observation records.

◎ITRC has completed the TAF certification application for ISO17025 quality system (19 items were tested for TAF certification, including: power, humidity preparation, label identification, label wear and tear resistance, low voltage, voltage and current limit, operating voltage measurement, insulation withstand voltage test, ball pressure, equipment stability and transportability, handle load, temperature, power outage, error operation and single failure testing, exterior shell mechanical strength, drop test, mold stress relief, battery reverse polarity test and overcharging test, and current leakage test). Onsite TAF assessment was also completed. ITRC and a domestic third-party certification unit jointly constructed a laboratory for biocompatibility testing, which is currently in operation. The Biomedical Technological Service Platform has passed the ISO13485 international medical device quality system certification. A domestic entrepreneurial firm was also guided in obtaining an official license from foreign competent authorities; becoming the first vendor to obtain double certification in its "Advanced Packaging Process, Micro-channel Design, and Manufacturing Capabilities (ISO 13485 & ISO 9001). This is ITRC's first success in guiding a vendor to obtain certification.

◎ITRC held the Taiwan Biomedical Technology International Market Entry Launch Ceremony and NARLabs/Tongtai Group/China Steel/ThinTech Materials Technology 3D Printing Joint Laboratory Opening Ceremony, which enables the completion of a metal prototype sampling system. With a 3D biomedical composite material sampling system and the precision processing capacity of ITRC's precision optomechanical plant, a one-stop service platform for rapid production of medical device prototypes is provided to conduct the forming of metal, non-metal, and medical-use metal materials and to produce samples of physical models with highly complex geometry (e.g., polymer composite materials); these models will assist R&D teams in quickly translating initial product concepts into actual prototypes.

◎ITRC promoted the development of the 3D printing medical device industry by supporting MOST's "Development of Integrated Service Platform for Additive Manufacturing Technology" project, assisting Taiwanese manufacturers to develop medical-grade cobalt-chromium alloy powder, and passing the biocompatibility test (ISO10993) to facilitate the production of medical-grade bone lamellar. ITRC held its 3D Printed Medical Materials Advancing to the World Cup press conference on September 20, guiding traditional manufacturers to enter the medical device market. ITRC and domestic equipment manufacturers jointly developed a laboratory for 3D printing equipment verification to assist with relevant quality system certification.

◎An advanced medical device training program was offered, focusing on ISO10993 biosafety regulations, ISO11607 package validation testing, IEC6236 usability analysis and training drills, and IEC62304 medical software/firmware management validation. In total, the biomedical technological service platform has serviced 250 industry, academia, and research practitioners; 40 cases were received on the R&D service platform; and 255 people were cultivated.

Taiwan Biomedical Technology International Market Entry Launch Ceremony

R&D Outcome of the Composite Water Level Measurement System

This ITRC research project is an integrated project implemented by the National Center for Earthquake Engineering to facilitate bridge scour monitoring and planning. The project involved performing continuous maintenance, operation, and renewal of the integrated interface of telecommunication management systems for the Mingzhu Bridge, Zhongsha Bridge, Ziqiang Bridge, and Xibing Bridge. The system facilitated troubleshooting during Typhoon Nepartak, Typhoon Meranti, and Typhoon Megi in 2016, preparing Taiwan for the next typhoon season. In addition, data on scouring, water level, and water surface velocity were collected to provide academic units with research verification results for Zhuoshui River Bridge's scouring model. By using historical data documenting relevant research results for the watershed bridge disaster prevention warning system, the National Center for Earthquake Engineering teamed up with ITRC, National Chip Implementation Center, National Center for High-Performance Computing, and National Nano Device Laboratories to obtain the Technological Award of Excellence for Disaster Prevention Technology Application in 2016 from the Taiwan Association of Disaster Prevention Industry.

To facilitate the monitoring of bridge scouring, ITRC joined forces with industry, government, and academic experts to develop a novel composite water level and scouring measurement system. In addition, to meet the calibration requirements of the radar velocity sensor, a radar flow meter data acquisition interface design system was designed and tested. The data acquisition interface design system can modify firmware parameters according to user requirements, and to adjust the parameters of the radar current meter so that it conforms to onsite conditions.

This system was successfully applied and tested in the Current Meter Testing and Calibration Laboratory of the Water Resources Planning Institute, Water Resources Agency, and Ministry of Economic Affairs. In the future, the radar flow meter can be provided to various water resource units or academic and research institutes, and it can be integrated with ITRC's data acquisition interface design system to conduct calibrated testing of water surface's flow velocity.

Projects for Enhancing Industry's Fundamental Technologies

◎ In conjunction with the development of national policies, ITRC actively seeks to promote the country's capabilities in basic industrial technologies via technological innovation, integration, and value added development models. During 2016, ITRC was involved with the following projects for enhancing industry's fundamental technologies:

Project Name	Cooperating Unit	Implementation Period	Technological Outputs
MOCVD key components technology development and talent training	National Central University	2013/01/01 2017/03/31	MOCVD gas transport and power control subsystem
Basic technology R&D for a multi-axis grinding and forming system and mounting of hydrostatic bearing foundation	National Tsing Hua University	2015/01/01 2016/03/31	Multi-axis optical lens centering processing system, multi-axis (X,Y,Z,A,C) grinding and forming system and hydrostatic bearing foundation mounting, forming of spherical glass lens with an outer diameter of 200 mm, and forming of reference glass lens with a length of 490 mm.
Application of advanced physical sputtering material and metal glass sputtering material	National Taiwan University of Science and Technology	2015/10/01 2019/09/30	Sputtering metal glass thin film and introducing it to the biomedical market for the development of surgical skin-grafting blades, injection needles, and endodontic files.

Technical Services

TAF Certification Laboratory

ITRC offers standard testing and calibration services, including 9 calibration services and 2 testing services, all of which conform to ISO/IEC 17025 international standards. All 11 items have been certified by the Taiwan Accreditation Foundation (TAF). ITRC can provide combined ILAC-MRA-Mark calibration reports recognized internationally (80 economies and 90 accredited institutions). Each year, ITRC issues more than 200 test and calibration reports. Certification items and brief introductions of the laboratories are described below.

TAF Accredited Laboratories	Certification Items	
ITRC Vacuum Standards Lab (Lab No.: 0081)	KA2014 (calibration)	SEM pitch standard
	KA2014 (calibration)	SPM pitch standard
	KD2002 (calibration)	Ion vacuum gauges
	KD2003 (calibration)	Capacitive vacuum gauges
	KD2006 (calibration)	Other vacuum gauges
ITRC Optoelectronic Calibration Lab (Lab No.: 1529)	KG3005 (calibration)	Film reflectance
	KG3006 (calibration)	Film transmittance
	KG3012 (calibration)	Luminance meter/brightness colorimeter
	KG3027 (calibration)	Glossy boards
ITRC Optoelectronic Calibration Lab (Lab No.: 2340)	O999 (testing)	Radius of curvature
	O999 (Testing)	Index of refraction

1. **Vacuum Standard Lab (TAF number: 0081)** ITRC's Vacuum Standard Laboratory is the first facility of its kind to receive CNLA calibration certification. The lab's calibration items include ion vacuum gauges (KD2002), capacitive vacuum gauges (KD2003), and other vacuum gauges (KD2006); this lab serves various industries, government units, academic institutions, and research centers; it provides over 100 calibration certification services each year. Furthermore, this is the only lab in Taiwan to perform optical testing related to film reflectance and film transmittance (O001, testing); it provides comprehensive spectrum measurement services to academic and industrial users. ITRC employs scanning probe microscopes (SPM) and scanning electron microscopes (SEM) to provide pitch standard calibration services in the ranges of 100 to 10,000 nm and 100 to 2,000 nm (KA2014). respectively Calibration results are based on the weights and measures of international institutions such as Physikalisch-Technische Bundesanstalt (PTB) from Germany and National Physical Laboratory (NPL) from the UK. This provides domestic quality assurance departments and measurement laboratories with the ability to enhance their instrument accuracy and reliability, which enable them to save substantial calibration costs and wait time (3 to 6 months) of sending samples overseas.
   In response to customers' instrument calibration needs, ITRC also provides customized, high-precision pitch standard standard deviation (∂ < 0.3%) services to resolve customers' special instrument calibration needs. ITRC is committed to the long-term development of instrument calibration technology, which contributed to ITRC receiving the 6th, 8th, and 10th R&D Creativity Award for Measurement Science and Technology as well as the 9th, 11th, 13th, and 16th Outstanding Measurement Engineer Award from the Chinese Metrology Society.
2. **Optoelectronic Calibration Lab (TAF number: 1529 and 2340).** This is the first laboratory to submit an application for TAF certification after ITRC became a member of NARLabs. This facility subsequently received two laboratory numbers because it offers certification items on calibration as well as testing. The four certification items consist of luminance meter/brightness colorimeter (KG3012, calibration), gloss boards (KG3027, calibration), radius of curvature (O999, testing), and index of refraction (O999, testing); it is the first laboratory in Taiwan to offer certified testing reports for items as radius of curvature and index of refraction certifications.
   This laboratory upholds the spirit of precision, innovation, showing respect, and teamwork; it also embraces the goal of providing the best quality and credible services. In addition to ITRC's internationally recognized measurement services offered to domestic and foreign industry, academic, and research institutions, its calibration ability has also established a solid foundation for the development of instrument technologies, which is expected to promote domestic exchanges regarding relevant instrument technologies and further perfect Taiwan's technological standards and product quality.

Commissioned Production and Repairing Services

In line with its goal of supporting academic research and serving industry professionals, ITRC provides commissioned production, repairing, and calibration/testing services for vacuum, optical, and electronic instruments and components. In 2016, ITRC provided testing and process equipment services a total of 1,930 times to 159 companies, academic institutions, and research centers.

The following are some of the more notable technical service cases performed by the Instrument technology platform on behalf of academic and industrial users in 2016:

Entrusted by	Project name
Semiconductor manufacturer	Commissioned to develop a high-speed linear scanning chip-back defect inspection system
	Development of the atomic layer deposition technology and process
Biochemical technology R&D industry	Ultrasonic contrast agent medical material development project
Optoelectronics manufacturer	Freeform surface reflective lens development
Precision machining manufacturing industry	Progressive multi-foci freeform surface mold development
Medical device research and development industry	Non-pedicle screw fixation minimally invasive lumbar fusion in vitro surgical simulation
Precision Machinery Research & Development Center	UR5 electric-controlled arm and mechanical visual module integrated system
Metal Industries Research & Development Centre	Study of customized porous teeth and jaw of craniofacial prostheses
National Health Research Institutes	Portable smart skin testing system
Academia Sinica's Applied Science Research Center	Solar collection and spectral power system design and production
Institute of Physics, Academia Sinica	Image acquisition equipment - Excitation light microscope lens
National Taiwan University	Development of photovoltaic array sensor and sphygmomanometer system integration
National Tsing Hua University	Research and development of two-generation forced flow atomic layer deposition system and three-dimensional nano-solar elements
National Chiao Tung University	Implanted chip packaging process
National Central University	MOCVD key components technology development and talent training
Taipei Medical University	Integrative research on the development of 3D Connex Bio-factory composite bioprinter system for craniofacial and maxillofacial reconstruction surgery for oral cancer patients
National Chiao Tung University	Consigned manufacturing of a silicon μm-wire array enhanced boiling heat transfer structure
National Chung-Shan Institute of Science and Technology	Preparation of Zn (O,S) buffer layer by using large-area atomic layer deposition and the full-vacuum element production process

Instrument Technology Training Programs

ITRC hosts multiple workshops and seminars to nurture outstanding, talented professionals, and to foster research professionals needed by Taiwan's high-tech industries and academic institutions; it aims to enhance the quality and quantity of the country's research talent.

ITRC held the following workshops and seminars in 2016

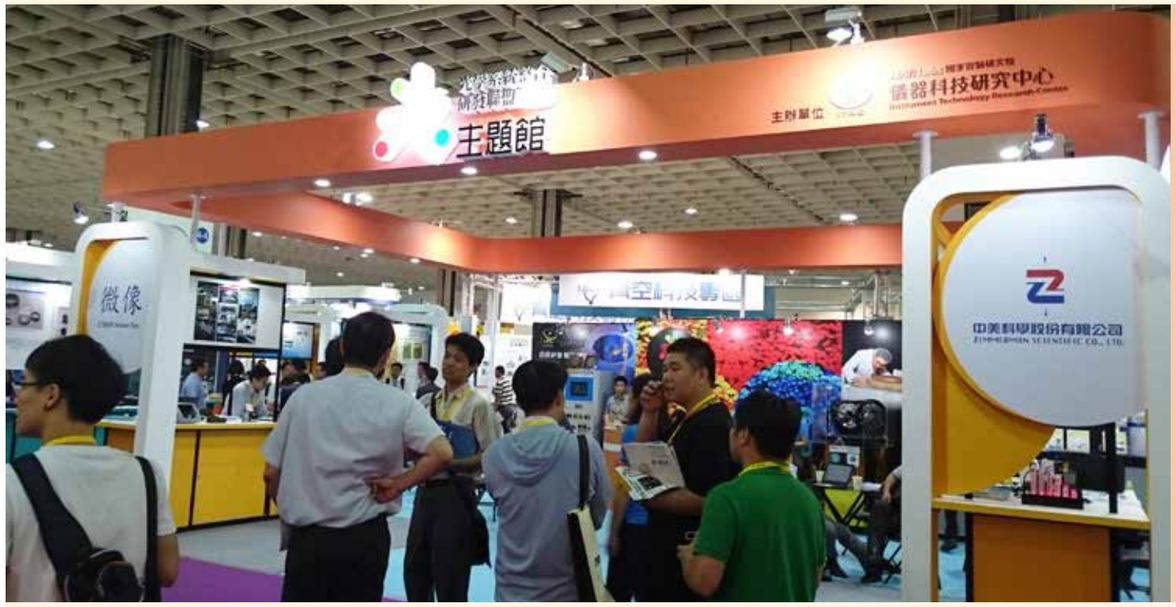
Name of workshop/seminar	Date
Workshop on practices of IoT LinkIt ONE application development	1/7-1/8
Workshop on practices of IoT LinkIt ONE application development	1/14-1/15
Workshop on graphene preparation and practical applications technology	1/21-1/23
Si2C/STB Entrepreneurial Workshop	2/3
Fundamental training on optical measurement technology	2/19
Workshop on practices of IoT SMART application 7688	2/25
Workshop on practices of IoT SMART application 7688	3/3
Advanced workshop and training on optical measurement technology	3/4
Mechanical design of precision pick-and-place platform and integrated opto-electro-mechanical technologies	3/11
Theory Study: Workshop on film optics and coating technology	3/23-3/24
Workshop on practices of optical instrumentation system	3/24

Laboratory: Workshop on film optics and coating technology	3/25
Precision opto-mechanical training and workshop: National Chiayi University's Electrical Engineering Department	3/30
Workshop on R&D, design, and manufacturing of precision optical systems: Department of Physics, National Cheng Kung University	3/31
Workshop on the development direction of forensic identification instruments	4/12
Precision opto-mechanical training and workshop: Department of Mechanical Engineering, Chien Hsin University of Science and Technology	4/26
Si2C /STB Innovative Application Conference	4/27
Precision opto-mechanical training: The 5S principle and ISO 10110 illustrations	5/11
Precision opto-mechanical training: Testing skills and instrument use	5/12
Stray light analysis workshop	5/12
Workshop on the applied development of semiconductor equipment and supply chain management	5/20
Biomedical instrument workshop	5/31
Precision opto-mechanical R&D workshop: Department of Mechanical Engineering, National Central University	6/1
Workshop on the use of spatial information technology in the analysis of changes in ground vegetation coverage	6/13
Workshop on chemical safety and management	6/21
Si2C /STB Innovative Application Conference	6/28
Precision opto-mechanical training and workshop: Department of Mechanical and Computer-Aided Engineering, St. John's University	7/25
Workshop on organic solvent management	8/9
Conference on medical device industrial regulations and quality management system conforming to regulatory requirements	8/25
ISO quality management training course	9/19
Si2C /STB Innovative Application Conference	9/29
Instrumentation Technology Innovation Seminar	10/1
Manufacturing and implementation system training course	10/5-10/6
Manufacturing and implementation system training course (practical discussions)	10/7
Aerospace science project: MIT Workshop	11/24
Workshop on R&D, design, and manufacturing of precision optical systems: Department of Materials Engineering, Ming Chi University of Technology	11/30

Industry-academic-research Collaboration

Optical Systems Integration R&D Consortium Accomplishments

With the collective efforts of industries, academia, and research institutes, ITRC established the Optical Systems Integration R&D Consortium in 2013, which has implemented 15 industry–academia cooperation projects as of today. The 2016 Taipei International Optoelectronics Expo was the first time where ITRC gathered members of the Optical Systems Integration R&D Consortium in a joint exhibition to produce industrial synergy. Capitalizing on the capacity of the Consortium, ITRC has assisted domestic firms in autonomously developing instruments, thereby enhancing Taiwan's global competitiveness.



The Optical Systems Integration R&D Consortium Theme Hall

Industry Contract Projects

In order to diffuse its R&D capabilities, ITRC encourages its R&D teams to meet the needs of the industry via industry-academic collaboration, in order to enhance the R&D capacity of Taiwan's industries, increase the added value of our products, and promote the technological upgrade within the nation's industries.

The following are just some of the notable ITRC industry contract cases in 2016.

Contract Name	Collaborating Industry
Development of high-precision torque modulation electric tool technology	Electronic material production
Ultrasonic contrast agent medical material development project	Biotechnology
Progressive multi-foci freeform surface mold development	Production of electronic equipment
Assembly and characterization of a multi-channel laser excitation spectral sensor	Precision instrument production
Polishing of the top pin in wafer transport mechanism	Machine production
Panorama system design and production	Electromechanical engineering
Five-sided chip defect optical testing system	Semiconductor manufacturer
High-speed optical examination and chip sorting development project	Semiconductor packaging equipment manufacturer
Optical film material development and component production	Semiconductor manufacturer
Project on the development of implanted electrical stimuli medical equipment	Medical service industry
Commissioned to develop a high-speed linear scanning chip back defect testing system	Semiconductor packaging equipment manufacturer
Commissioned development of a high-speed linear scanning chip back defect testing system	Semiconductor manufacturer

Academia Partner Contract Cases

ITRC is the ideal partner and promoter for academic researchers thanks to its support for academic research, promotion of science and technology development, and its involvement in long-term cooperation with Taiwan's universities. The following are some of the most notable academic partner contract cases during 2016.

Contract Name	Cooperating Partner
Consigned manufacturing of silicon μm-wire array enhanced boiling heat transfer structure	National Chiao Tung University
Integrative research on the development of 3D Connex Bio-factory composite bioprinter system for craniofacial and maxillofacial reconstruction surgery on oral cancer patients	Taipei Medical University
MOCVD key components technology development and talent training	National Central University
Research and development of a second-generation forced flow atomic layer deposition system and three-dimensional nano-solar components	National Tsing Hua University
Commissioned project involving biomedical chips	Chang Gung University
Implanted chip packaging process	National Chiao Tung University
Micro-grain LED wafer array optoelectrical testing system	National Tsing Hua University
Basic technology R&D for a multi-axis grinding and forming system and mounting of hydrostatic bearing foundation	National Tsing Hua University
Application of reverse thermo-responsive hydrogels in 3D deposition ceramic materials and integrated mechanical development	Kaohsiung Medical University
Development and testing of implanted artificial retinal projection system	National Chiao Tung University
Consigned manufacturing of a sputter gun	National Central University
Development of photovoltaic array sensor and sphygmomanometer system integration	National Taiwan University
Safety validation of leukocyte reduction filters and guided operational strategy project	Chung Yuan Christian University
LabVIEW program framework - research and development of portable whistle sensing gas detector	National Taiwan Normal University

Plans for Industry-academic-research Collaboration Projects

To promote industrial development, mitigate the gap between learning and practical applications, and to create concrete, beneficial outcomes for industrial, academia, and research organizations, ITRC established the Optical Systems Integration R&D Consortium, which attracted several industry-academic-research collaboration projects. Since its establishment in 2013, the Consortium has implemented 15 industry-academic-research collaboration projects as listed below.

Project Name	Industry Partner	Academia Partner
Monitor and analysis of the generation of submicron particles through valve actuation in high-vacuum systems	Machinery and appliances wholesalers	National Central University, National Formosa University
Guidance on mirror sputtering and testing technology in anti-laser destruction DUV 248-nm etching exposure system	Semiconductor-related industry	National Tsing Hua University
Development of wafer array probe measurement platform for the development and production of gas sensors	Semiconductor manufacturer	National Tsing Hua University
Monitor and analysis of the generation of submicron particles through valve actuation in high-vacuum systems	Machinery and appliances wholesalers	National Central University, National Formosa University
Development of high-temperature pulse DC sputtering systems and film production technologies	Vacuum technology	Chang Gung University
Development of absorption-based attenuator key component and guided sputtering technology for wide-angle DUV light lithography equipment	Semiconductor equipment manufacturer	National Taiwan University of Science and Technology
Development of key light adjusters for second-generation UV light micro-imaging equipment and guide to coating techniques	Semiconductor equipment manufacturer	National Taiwan University of Science and Technology
Functions of key components of DUV 248 nm etching exposure system and integrated alignment coating	Semiconductor-related industry	National Taiwan Ocean University
Development of PEALD applied to UV LED	Semiconductor manufacturer	National Central University
Guidance on sputtering and testing technology for the development of a large-aperture i-Line reflective mirror module	Semiconductor-related industry	
Development of ZrB_2 buffer layer thin-film process technology for GaN film deposition on Si substrates	Vacuum technology	Ming Chi University of Technology
Development of high-rigidity XY θ tri-axial laser direct-writing image feeding system featuring a mask aligner	Semiconductor-related industry	National Taiwan Normal University
R&D of polarization system for UV light of a new-generation of lithography equipment and coating technology	Semiconductor-related industry	National Taiwan University, National Yunlin University of Science and Technology
Guided endoscopic image sensor and 5.6-mm smart micro transnasal endoscopy	Medical equipment industry Optical R&D industry	Kaohsiung Medical University Chung-Ho Memorial Hospital
Development of the I-line narrow band pass filter applied to lithography equipment for MEMS process	Semiconductor-related industry	National Yunlin University of Science and Technology

International Cooperation

Signing of Cooperative MOUs

ITRC has currently signed cooperation MOUs with the following units: (1) Institute of Physical and Chemical Research (RIKEN), Japan, (2) Center for Information Storage Device, Yonsei University, South Korea, (3) Advanced Photonics Research Center, Osaka University, Japan, and (4) University of Technology of Troyes, France.

Participation in the Operations of International Instrument Technology Organizations

ITRC actively participates in international instrument technology organizations, and also hopes to enhance its own international visibility and status. ITRC currently participates in the following international organizations:

ASME (American Society of Mechanical Engineers)

NAMIS (an international research network on Nano and Micro Systems)

IEEE IMS Taipei Chapter

IEEE I^2MTC

AVS Taiwan

Cooperative International Research Projects

ITRC is conducting preliminary-stage commissioned projects and joint research with international academic and research units, and hopes to establish a foundation for formal cooperation in the future. The following is a progress summary of cooperative projects and their respective results:

Taiwan–South Africa Cross National Ultra-precise Processing R&D Team Participating at the US SPIE International Conference

Cooperating unit	Subject of cooperation	Year	Progress
Institute of Physical and Chemical Research (RIKEN)	(1)IR proximity broadband adjustable metamaterials (2)Development of 100 THz broadband with multi-layer, three-dimensional metamaterials	2014-2017	Both parties have commenced a research project, conducted several short-term visits and are performing bilateral research. This year, a thesis paper titled Interplay of Mutual Electric and Magnetic Couplings Between Three-Dimensional Split-Ring Resonators was submitted to Optics Express.
Academy of Physical Sciences, Czech Republic	Application of ALD High-Coverage Protective Layer to Enhancing the Biocompatibility of NiTi Alloy Stent	2014-2016	Research personnel were dispatched on a short-term visit for the purpose of project discussion, conducting experiments, and publishing papers. ITRC has also dispatched designated personnel to Czech Republic to gain an insight into how labs of academic institutes operate; conduct studies on how ALD protection layers can improve the Ni-ion release problem associated with NiTi coronary stents, provide lectures on specific topics, and discuss future cooperation plans to develop ALD equipment.
Nelson Mandela Metropolitan University, Republic of South Africa	Contact lens ultra precise processing technology for Africans and Asians	2016-2018	A South African representative, Prof. Khaled Abouelhossein visited this year to perform bilateral division of labor and discussion on the research topic.
Teams from the AWQC and University of South Australia, and Department of Environmental Engineering, National Cheng Kung University (bilateral international cooperative research project)	Enhancing water quality management by using advanced observation technologies and data modeling	2014-2016	In collaboration with National Cheng Kung University, ITRC held a press release to present its international collaborative achievements on May 31, 2016, and this press release was reported by various domestic media on June 1.
NantBiosciences	Active transgenic research projects	2015-2016	ITRC's R&D results were tested in a physical model by American authorities who provided feedback and suggested revisions. Currently, ITRC is making minor adjustments.

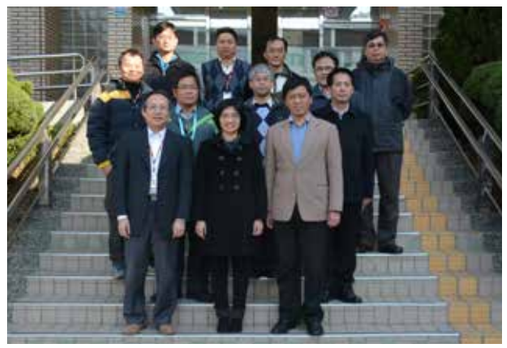
Milestones in 2016

2016/01

01/05 ITRC's ICG Fluorescence Onsite Visualization and Assessment System won the 12th National Innovation Award in the Clinical Innovation Category by the Institute for Biotechnology and Medicine Industry (IBMI).

Group photo of award-winning team of the ICG Fluorescence Onsite Visualization and Assessment System

01/25 Director General Wan-Jiun Liao of the Ministry of Science and Technology visited ITRC.



Director General Wan-Jiun Liao of the Ministry of Science and Technology visiting ITRC

2016/02

02/03 Si2C/STB Entrepreneur Gathering was hosted.

02/04 Distinguished guests, including Deputy Director Shui-Long Hsieh of the Department of International Cooperation and Science Education visited ITRC.

Deputy Director Shui-Long Hsieh of the Ministry of Science and Technology visiting ITRC

02/13 ITRC participated in the SPIE Photonics West 2016 exhibition in the United States.

Vice Chancellor Dr. Jen-inn Chyi of the University System of Taiwan visiting ITRC's exhibition booth

2016/03

03/06 ITRC assisted the American Society of Mechanical Engineers (ASME) in hosting the Student Professional Development Conference (SPDC) competition, which changed its name to "NARLabs Smart Machinery Competition".

Group photo of participants of the "NARLabs Smart Machinery Competition"

03/10 Official opening of the Joint Laboratory for Medical Device Biocompatibility Testing

03/26 ITRC hosted the Optical Systems Integration R&D Consortium 2016 spring seminar.

Group photo of participants of the Optical Systems Integration R&D Consortium 2016 spring seminar

2016/04

04/02 ITRC hosted a press conference for announcing Subcutaneous Hemorrhage Imaging System results.

Dr. Henry Chang-Yu Lee attending the Subcutaneous Hemorrhage Imaging System results press conference

2016/05

05/23 ITRC held the 2016 I²MTC conference, and it received the Silver Award in Conference Group B of the Taiwan MICE Awards 2016.

Dr. Chi-Hung Hwang, General Chair of I²MTC 2016, receiving the Taiwan MICE Silver Awards in Conference Group B

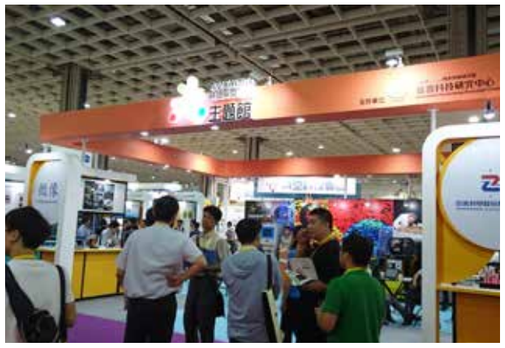
05/26 ITRC held the annual exhibition for presenting the year-end outcome of the Internet of Things Sensor Service Platform Project.

2016/06

06/07 ITRC participated in the 13th Optatec exhibition in Frankfurt, Germany.

Distributors came all the way from Taiwan to visit ITRC's exhibit

06/15 ITRC organized a theme center with the Optical Systems Integration R&D Consortium partners, participating in the 2016 Taipei International Optoelectronics Expo.



The Optical Systems Integration R&D Consortium Theme Center

06/15 ITRC hosted the National Applied Research Laboratories Productivity 4.0 Progress and Results Exhibition and Forum.

Group photo of participants of the National Applied Research Laboratories Productivity 4.0 Progress and Results Exhibition and Forum

2016/07

07/14 ITRC held the Taiwan Biomedical Technology International Market Entry Launch Ceremony and NARLabs/Tongtai Group/China Steel/ThinTech Materials Technology 3D Printing Joint Laboratory Opening Ceremony.

NARLabs/Tongtai Group/China Steel/ThinTech Materials Technology 3D Printing Joint Laboratory Opening Ceremony

2016/08

08/05 Director General of ITRC, J. Andrew Yeh, took over as the Deputy Executive Secretary, Office of Science & Technology.

2016/09

09/07 ITRC participated in the 2016 SEMICON Taiwan International Semiconductor Exhibition

ITRC participating in the 2016 SEMICON Taiwan International Semiconductor Exhibition

09/20 ITRC held the torch lighting ceremony for the 3D Printed Medical Materials Advancing to the World Cup press conference and the NARLabs/Tongtai Group/China Steel/ThinTech Materials Technology 3D Printing Joint Laboratory outcome exhibition.

Torch lighting ceremony for Taiwan's medical device industry

2016/10

10/01 ITRC held the 8th *i*-ONE International Instrument Innovation Competition.

The 8th *i*-ONE International Instrument Innovation Competition

10/17 President of NARLabs Yeong-Her Wang visited the Biomedical Group of ITRC.

Director of ITRC Biomedical Platform and Incubation Services Division, Chih-Sheng Yu, introducing the applications of medical materials in 3D printing technology to President Wang

10/26 Minister Hung-duen Yang of the Ministry of Science and Technology visited ITRC.

President of NARLabs Yeong-Her Wang (second from the left) explaining ITRC's biomedical capacity to Minister Hung-duen Yang of the Ministry of Science and Technology (first from the left)

2016/11

11/04 ITRC held the Internet of Things Sensor Service Platform Project Phase-2 Mid-Term Exchange Conference.

The Internet of Things Sensor Service Platform Project Phase-2 Mid-Term Exchange Conference

11/12 ITRC hosted the Optical Systems Integration R&D Consortium 2016 autumn exchange seminar.

The Optical Systems Integration R&D Consortium 2016 autumn exchange seminar

2016/12

12/01 TVBS production team for the TV show "The World is Turning" visited ITRC's 3D printing-related laboratory.

The host of the "World is Turning" Tsai-Yen Gu and ITRC's biomedical team

12/16 ITRC hosted the Advanced IC Packaging Process Stepper Demonstration Seminar.

Introducing distinguished guests to ITRC's core technologies

NARLabs 國家實驗研究院
儀器科技研究中心
Instrument Technology Research Center
ITRC

2016 Annual Report

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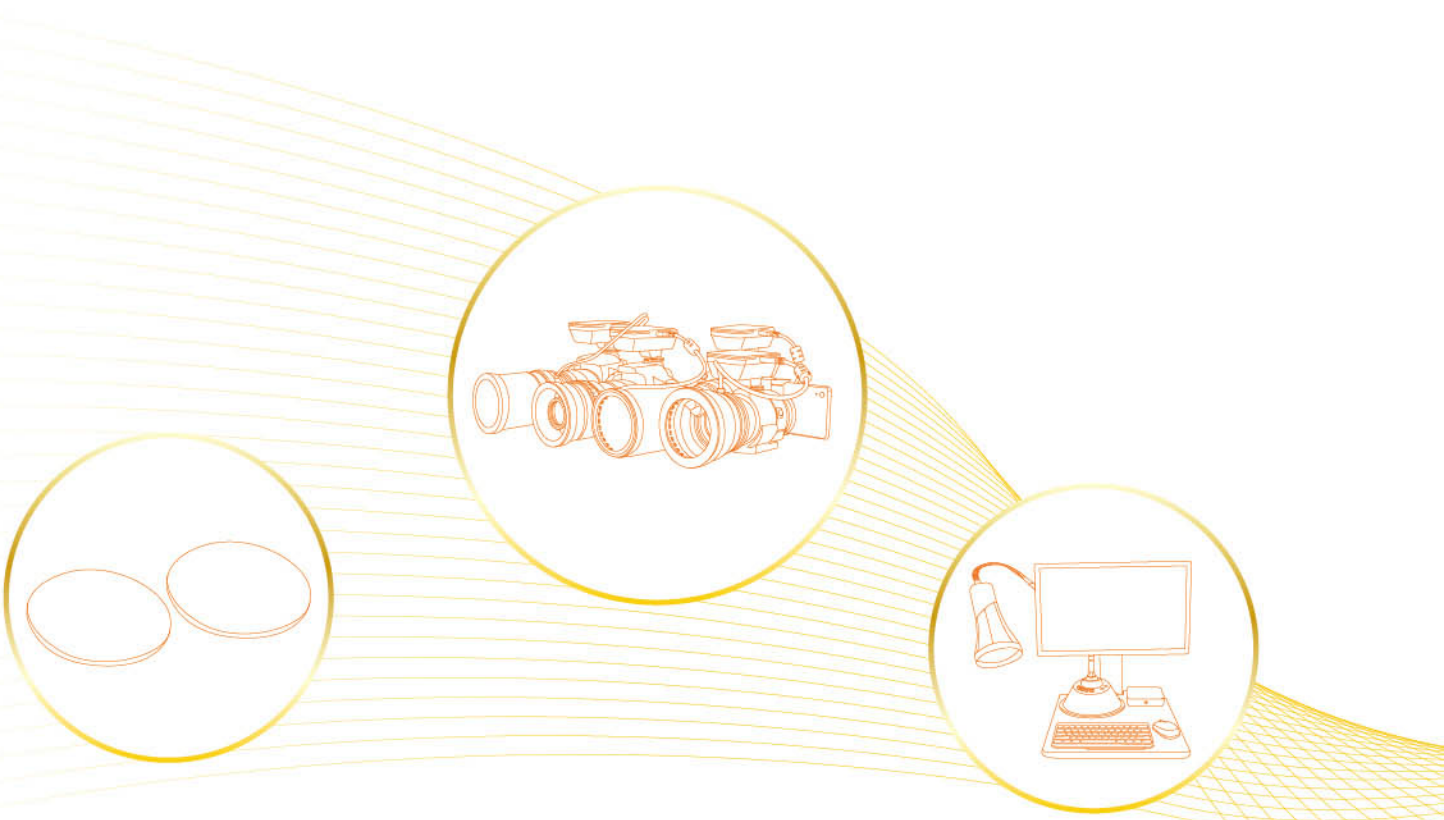

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