# Yushan Fellow Program

## Performance Report

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| **University and Appointed Faculty:** National Yang Ming Chiao Tung University International College of Semiconductor Technology | **Academic Field:** Engineering |
| **Name of the Yushan (Young) Fellow:** Hiroshi Iwai | ■ **Yushan Fellow** □ **Yushan Young Fellow** |

Assessment of effectiveness of tangible work (The implementation results can be presented cumulatively, including the annual performance report of the second year, which can include the results of the first year and the second year)

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
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| 1. Chief content of the Yushan (Young) Fellows' research work and overview of full research process. | **Promotion of research and education of ICST (International College of Semiconductor Science and Technology), NYCU** | Prof. Iwai has taken excellent leadership for the management of research and education, resulting in the successful promotion of semiconductor research and education in NYCU.<br>In order to promote the research and education of semiconductor device technologies, securing big funding and human resource are necessary. This is realized by obtaining big semiconductor research project funded by government and industry.<br>He took excellent leadership for the planning and submission of a 5-year big academia-industry collaborative research project (ACE Project) to the government with yearly huge budget on advanced semiconductor devices including Si and GaN. The project was approved by the government and started on March 1, 2021 with the member of 30 professors and with the huge 1st year budget. He served as one a co-leader of the entire project as well as the manager of the sub-group of 5/6G telecommunication device development (high frequency GaN and Si devices) consisting of 12 professors and 2 companies. The execution of the project is excellent and the targets of the 1st year have already been achieved.<br><br>He contributed to the promotion of education activities of ICST (International College of Semiconductor Technology), NYCU through his worldwide network. For example, he negotiated with University of Sheffield, UK and successfully make the university to join the joint degree | Appendix No. |

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| | | program. Recently, the international exchange of students/researchers has been in difficult situation because of the COVID-19, but he continued the communication with the foreign universities through on-line meetings for the future exchange and workshop.<br><br>He conducted excellent distinguished lectures online as the IEEE EDS 'Eminent Lecturer' (https://eds.ieee.org/education/distinguished-lecturer-mini-colloquia-program/distinguished-lecturer-listing) to IEEE EDS chapters in the world to show the presence of ICST NYCU for the education of semiconductor technology to the world. Also, he was often invited to deliver keynote speeches at the international conferences.<br><br>He has been recognized by ECS (Electrochemical Society) that he is an electronics pioneer in solid-state science and technology and received Gordon E. Moore Medal in 2021 (https://www.electrochem.org/press/hiroshi-iwai/). This is the highest honor in ECS in semiconductor area, contributing the promotion of NYCU's academic status. Indeed, he was honorably introduced by the President Lin of NYCU on his annual report and greeting at the Chinese New Year 2022 "其中榮獲國際指標性獎項亦不在少數，如岩井洋教授獲 The Electrochemical Society, ECS 頒授 2021 Gordon E. Moore Medal 與 Awarded Life Membership 兩項榮譽" (https://www.nycu.edu.tw/news/3219/). | A3<br><br>A4<br><br>A5 |
| 2. The link between Yushan (Young) Fellows' future research topics and the university's development and the anticipated benefits (including Higher Education SPROUT Project):<br><br>(1)Fellows' research plan and goals<br>(2)The link | **2.(1) Fellows' research plan and goals**<br><br>**2.(2) The link between scholars' research content and the university's development**<br><br>**2.(3) Specific work performance or achievements,** | Planning and organizing project proposal for RF and power semiconductor device research including GaN and Si devices. Submission of the proposal to the government and obtain sufficiently high financial support. After the acceptance of the project, management of the execution of the project. Achievement of the satisfactory high performance of the devices.<br><br>The research of GaN and Si semiconductor devices for RF and power applications are exactly the one which are going on at NYCU and quite match to the university's requirements.<br><br>The purpose of initiating ICST at NCTU/NYCU is the promotion of the semiconductor R & D and its education through international exchange program. For the execution of the top-level research and education, a good research projects with appropriate purpose/target with sufficiently large | |

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| between scholars' research content and the university's development<br>(3)Specific work performance or achievements, please include the mid-term progress report of the particular research plan<br>(4)Anticipated goals (including qualitative or quantitative working performance or results)<br>※ If there is a quantitative work achievements, please fill out "Quantitative Assessment Form" | **please include the mid-term progress report of the particular research plan**<br><br>**2.(3).1 Planning, submission, management of big research project for RF and power semiconductor device** | budget and world top level members are required, especially for the semiconductor device research. We set the following 4 items for the promotion of ICST activities.<br><br>2.(3).1 Planning, submission, management of big research project for RF and power semiconductor device<br>2.(3).2. Some of the Semiconductor device research results such as GaN HEMT.<br>2.(3).3 Promotion of international exchange activities of ICST, NTCU<br>2.(3).4 Promotion of academic status of ICST, NYCU by paper publication, lecture delivery, service to academic societies and receipt of honors<br><br>The specific results of the 4 items are described in the following.<br>2.(3).1.1 **Project for ACE Technology for 2025 ~ 2035**<br>Prof. Iwai started to work the planning of the academia-industry collaborative project with Prof. Edward Yi Chang and Prof. Jack Sun from the beginning of 2020 and draw a grand design of the research project with the collaboration with ICT (Information & Communication Technology) industries in Taiwan, setting the target for the future semiconductor device development which will be produced in 2025 to 35. We selected 3 important device categories (Intelligent memories, RF devices for 6G, and Smart power devices) as shown in Fig. 1. The entire project consists of 30 professors including some from Japan, Europe and United States as shown in Fig. 2 (next page). | |

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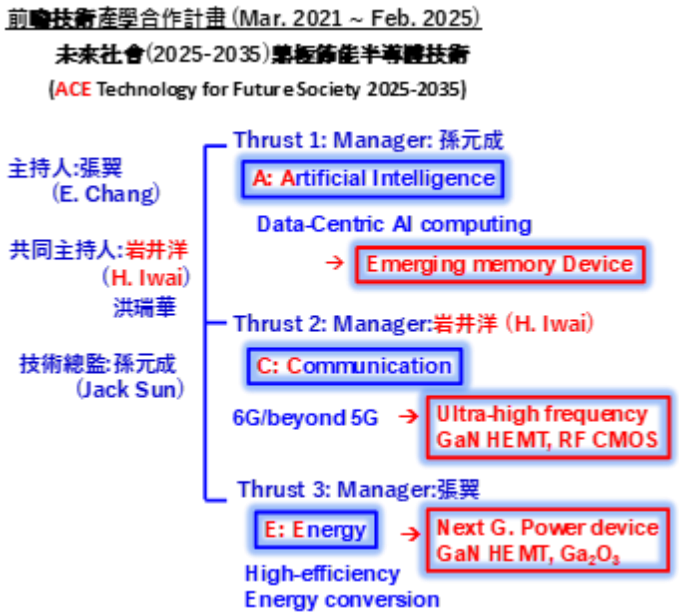
| | |  | |



**Fig. 1** ACE Project

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**Fig. 2** ACE PJ member list

Prof. Iwai especially contributed to the design and formation of the sub-groups of high-frequency communication semiconductor device for 5 ~ 6 G telecommunication (Thrust 2) and power semiconductor devises (Thrust 3), both of which include the development of GaN HEMT devices. The project proposal was submitted to MOST in August, 2020 and approved February 2021 as 5-year project with huge budget per year.

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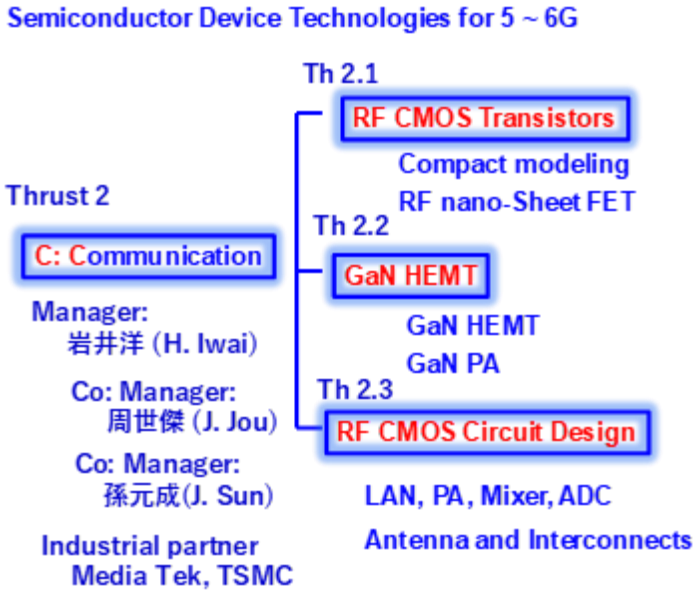
| | |  <br>**Fig. 3** Research Items for Thrust 2<br><br>The project started from March 1, 2021 as the 5-year project with the first-year budget of 125M TWD including overhead and in-kind. He worked as the manager of Thrust 2 (shown in Fig.3).<br>Prof. Iwai conducted the excellent management of the research execution of Th.2 with co-managers, Prof. Jerry Jou and Jack Sun by holding monthly meetings with the all members. The Th.2 consists of further sub-research groups. The first one Th. 2.1 includes the compact modeling and the verification of state-of-the-art RFCMOS devices available for the current mass production. Also, the RF characteristics of nano-sheet MOSFETs are modeled based on the experimental results. Th.2.2 includes the device fabrication of RF GaN HEMT and design and fabrication of GaN PA (Power Amplifier). Th.2.3 includes RF circuits block design and verification of the state-of-the-art RF CMOS. The blocks are LNA (Low Noise Amplifier), PA, Mixer, ADC (Analog to Digital Converter), and antenna.<br>The member of Th.2 for the 1st year (2021.3 ~ 2022.2) includes 11 professors, 4 researchers, 14 Ph.D. students, and 19 Master students. So, the project contributed not only to the promotion of the research but also the education of the students. The budget delivered to the Th.2 for the 1st year excluding overhead and in-kind was huge. The targets of the project for the 1st year were achieved | A6<br>A7<br>A8<br>A9<br>A10 |

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| | | already at the middle of February 2022. The detailed concreate results cannot be disclosed because of the confidentiality of the project. However, some of the results have been already published as papers (14 journal papers [J1 ~ J14] and 19 conference papers [C1 ~ C19] as shown below.<br>**Journal**<br>[J1] Hsin-Cheng Lin, Tao Chou, Chia-Che Chung, Chia-Jung Tsen, Bo-Wei Huang, and C. W. Liu, "RF Performance of Stacked Si Nanosheet nFETs," IEEE Transactions on Electron Devices, Vol. 68, No. 10, pp. 5277-5283, Oct. 2021.<br><br>[J2] Deepak Anandan, Hung Wei Yu, Ching Ting Lee, Chang Fu Dee, Azrul Azlan Hamzah, and Edward Yi Chang, "Effect of Flow Rate Scaling on SAE-InAs Crystal Phase and Integration of Self-Catalyzed InAs/InSb Heterostructure Nanowires on Si (111) Substrate by MOCVD", ECS Journal of Solid State Science and Technology, 2021 10 071011, 2021<br><br>[J3] Sung-Lin Tsai, Takuya Hoshii, Hitoshi Wakabayashi, Kazuo Tsutsui, Tien-Kan Chung, Edward Y. Chang and Kuniyuki Kakushima, "Room-Temperature Deposition of A Poling-Free Ferroelectric AlScN Film by Reactive Sputtering", Appl. Phys. Lett. 118, 082902, 2021.<br><br>[J4] P Huang, QH Luc, A Sibaja-Hernandez, CW Hsu, JY Wu, HL Ko, NA Tran, N Collaert and Edward Yi Chang, "Investigation of Device Transport Characteristics Enhancement of In0.53Ga0.47As MOSFET through in Situ NH3/N2 Remote-Plasma Treatment", AIP Advances 11, 015050, 2021.<br><br>[J5] Deepak Anandan, Hung-Wei Yu, Ching-Ting Lee, Chang-Fu Dee, Azrul Azlan Hamzah and Edward Yi Chang, "Effect of Flow Rate Scaling on SAE-InAs Crystal Phase and Integration of Self-Catalyzed InAs/InSb Heterostructure Nanowires on Si (111) Substrate by MOCVD", ECS Journal of Solid State Science and Technology.<br><br>[J6] Chun Wang, Yu-Chiao Chen, Heng-Tung Hsu, Yi-Fan Tsao, Yueh-Chin Lin, Chang-Fu Dee, and Edward-Yi Chang, "Adoption of the Wet Surface Treatment Technique for the Improvement of Device Performance of Enhancement-Mode AlGaN/GaN MOSHEMTs for Millimeter-Wave Applications" 14(21), 6558, Materials 2021.<br><br>[J7] Ping-Yu Tsai , Yu Chen, Chun-Hsiung Lin, and Edward Yi Chang "Control of Vth of the enhancement high-frequency AlGaN/GaN HEMT fabricated by oxygen-based digital etching" Applied Physics Express 14, 126501, 2021 | A11<br><br>A12<br><br>A13<br><br>A14<br><br>A15<br><br>A16<br><br>A17 |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | | [J8] Chiao-Yun Hsiao, Chung-Tse Michael Wu, and Chien-Nan Kuo, "A W-Band 1-dB Insertion Loss Wilkinson Power Divider Using Silicon-Based Integrated Passive Device," IEEE Microw. Wireless Compon. Lett., vol. 31, no. 6, pp. 654-657, June 2021.<br><br>[J9] Te-Yen Chiu and Chun-Hsing Li, "Low-Loss Low-Cost Substrate-Integrated Waveguide and Filter in GaAs IPD Technology for Terahertz Applications", IEEE Access, Vol. 9, pp. 86346-86357, 2021.<br><br>[J10] Te-Yen Chiu and Chun-Hsing Li, "340-GHz Heterogeneously-Integrated THz Imager with 4°-Beamwidth 16 × 16 IPD Antenna Array for Lensless Terahertz Imaging Applications," IEEE Access, vol. 9, pp. 102195-102206, Jul. 2021.<br><br>[J 11] N. Khiabani, C.-W. Chiang, N.-C. Liu, Y.-C. Kuan and C.-T. M. Wu, "An Ultrawide Ku- To W-Band Array Antenna Package Using Flip-Chipped Silicon Integrated Passive Device with Multilayer PCB Technology", in IEEE Microwave and Wireless Components Letters, Vol. 31, no. 7, pp. 861-864, Jul. 2021.<br><br>[[J12] C.-W. Chiang; R. Huang; C.-J. Liang; C.-T. M. Wu, and Y.-C. Kuan, "A 3-D Pillar-Based Electromagnetic Interference Shield for W-Band Antenna on Silicon Using Wire Bonding Technology", in IEEE Transactions on Components, Packaging and Manufacturing Technology, vol.11, no. 12, pp. 2238 – 2241, December, 2021.<br><br>[J13] H. W. Chan, W. C. Lee, K. L. Chiu, C. W Jen and S. J. Jou, "A Digital Two-Stage Phase Noise Compensation and rCFO/rSCO Tracking Module for mmW Single Carrier Systems", IEEE Transactions on Very Large Scale Integration Systems, Vol. 29, Issue： 5, pp. 904-915, May 2021.<br><br>[J14] Hung-Chih Liu, Zheng-Chun Huang, Ngoc-Giang Doan, Chih-Wei Jen, Shyh-Jye Jerry Jou, "Joint Digital Online Compensation of TX and RX Time-Varying I/Q Mismatch and DC-Offset in mmWave Transceiver System", IEEE Transactions on Circuits and Systems I: Regular Papers, pp.1-14, Oct. 2021.<br><br>**<u>Conference</u>** | A18<br><br>A19 |

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| | | [C1] Jyh-Chyurn Guo, Jyun-Rong Ou, Adhi Cahyo Wijaya, and Jinq-Min Lin," The Impact of Parasitic RLC and Layout Optimization for Sub-60nm Multi-finger nMOSFETs with Super-350GHz fMAX for mm-Wave CMOS," in 2021 Solid State Devices and Materials (SSDM), Japan, pp.690-691, Sept. 7, 2021.<br><br>[C2] 翁祐晨 (張翼教授之博士學生)、黃延儀，"GaN 半導體材料"，2021 光電協進會(PIDA) 化合物半導體技術路線圖特刊發表會<br><br>[C3] 張翼，"Recent Development of GaN PowerElectronic Technologies and Applications" ，NExT Forum: Compound Semiconductor in E - Vehicle.<br><br>[C4] Edward Yi Chang, "Extremely High Performance InGaAs FinFETs for Next-Generation CMOS Logic Applications", 6th International Conference on Nanoscience and Nanotechnology (ICONN-2021), Invited Talk, India, Feb. 1-3, 2021.<br><br>[C5] Deepak Anandan, Edward Yi Chang, Hung Wei Yu, Hua Lun Ko, Venkatesan Nagarajan and Sankalp Kumar Singh, "Selective Area Epitaxy of Axial Wurtzite-InAs Nanowire on InGaAs NW by MOCVD", 2021 International Symposium on VLSI Technology, Systems and Applications (VLSI-TSA), Hsinchu, Taiwan, Apr.19-22, 2021.<br><br>[C6] Edward Yi Chang, "An Enhancement-Mode GaN FEG-HEMT (Hybrid Ferroelectric Charge Trap Gate Stack) Device for Power Switching Applications", Keynote Speaker, Vebleo Webinar-2021, virtual, Apr. 23-26, 2021.<br><br>[C7] C. Wang, Y. C. Chen, H. T. Hsu, C. C. Lee, T. J. Huang, and Edward Y. Chang, "Thin Barrier Enhancement-Mode AlGaN/GaN HEMTs with Oxidation Treatment and ALD Al2O3 Dielectric Layer for Power Amplifier Application", 2021 ICMN, Berlin, Germany, May 20-21, 2021.<br><br>[C8]Edward Yi Chang, "Use of HfZrO Ferroelectric Thin Flim as Gate Stack Material to Achieve High Vth E-Mode GaN HEMT for EV Application", Keynote Speaker, 2021 International Conference on Surface Engineering (8th ICSE 2021), Weihai, Shandong, China, Aug. 24-26, 2021.<br><br>[C9] Elangovan Surya, Edward Yi Chang, and Stone Cheng. "Reliability Assessment of the p-GaN High Electron Mobility Transistors for Power Switching System", Automation 2021, accepted | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
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| | | [C10] Yuan Wang, Yi-Fan Tsao, Chien-Ming Tsao, Hans-Joachim Würfl and Heng-Tung Hsu, “A Polarization Switchable Antenna Switch Module for Ka-band Application”, 2021 IEEE International Symposium on Radio-Frequency Integration Technology (RFIT), August 2021.<br><br>[C11] Yi-Fan Tsao, Chien-Ming Tsao and Heng-Tung Hsu, “A New Design Technique for Power Amplifiers Operating Close to Unit-Current-Gain Cutoff Frequency”, 2021 IEEE International Symposium on Radio-Frequency Integration Technology (RFIT), pp. 25-27, August. 2021.<br><br>[C12] Ping-Hsun Chiu, Yuan Wang, Yi-Fan Tsao and Heng-Tung Hsu, "Effect of the Device Geometry on the Linearity Performance of AlGaN/GaN HEMTs with Dual-Gate Configuration," 2021 International Electron Devices & Materials Symposium 2021 (IEDMS 2021), Tainan, Taiwan, Nov. 18-19. 2021.<br><br>[C13] Yi-Fan Tsao, Yuan Wang, Chien-Ming Tsao, Hans-Joachim Würfl and Heng-Tung Hsu, "An X- to Ka-band Single-Pole-Double-Throw Switch with Good Power Handling Capability," 2021 IEEE Asia Pacific Microwave Conference (APMC), Cali, Colombia, Nov. 28-December 1, 2021.<br><br>[C14] 許恒通，“GaN HEMT RF 元件於通訊領域的應用”，2021 光電協進會(PIDA) 化合物半導體技術路線圖特刊發表會<br><br>imaging applications,” in IEEE Int. Symp. Radio-Frequency Integration Technology (RFIT), Taiwan, Aug. 25-27, 2021.<br><br>[C16] Chun Wang and Chun-Hsing Li, “A G-band frequency doubler in 40-nm digital CMOS for THz applications,” in IEEE Int. Symp. Radio-Frequency Integration Technology (RFIT), Taiwan, Aug. 25-27, 2021.<br><br>[C17] Yu-Hsien Lin, Chi Liu, Chia-Lin Hu, Kang-Yu Chang, Jia-Yin Chen and Shyh-Jye Jou, “A Reconfigurable in-SRAM Computing Architecture for DCNN Applications”, 2021 International Symposium on VLSI Design, Automation and Test (VLSI-DAT), Hsinchu, Taiwan, Apr. 19-22, 2021.<br><br>[C18] Tong-Lin Pan, Shao-Tzu Li, Chi Liu, Tuo-Hung Hou, Shyh-Jye Jou and Tian-Sheuan Chang, “Robust Model Mapping Optimization for Non-Ideal Computing in-Memory”, 2021 International Symposium on VLSI Design, Automation and Test (VLSI-DAT), Hsinchu, Taiwan, | |

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| | **2.(3).2. Some of the Semiconductor device research results such as Power GaN HEMT.** | Apr. 19-22, 2021.<br><br>[C19] Chia-Chen Chang, Yu-Tung Chin, Hossameldin A. Ibrahim, Kang Yu Chang, and Shyh-Jye Jou, "A Low-Jitter ADPLL with Adaptive High-Order Loop Filter and Fine Grain Varactor Based DCO", 2021 IEEE International Symposium on Circuits and Systems (ISCAS), Daegu, South Korea, May 22-28, 2021.<br><br>**2.(3).1.2 GaN device development project with Nagoya University**<br><br>Another project for GaN device research for with foreign university has been planned. For this project, a world-top research group in GaN semiconductor in a foreign country is necessary as a partner. We chose Nagoya University, Japan as a foreign partner. Prof. Amano is a Nobel Laureate for GaN diode. Prof. Hiroshi Iwai knows Prof. Amano and Nagoya University very well and helped the meeting as shown in Fig. 4. The proposal was successfully submitted to the government with Prof. Amano group in January 2022.<br><br>  <br>**Figure 4.** Meeting with Nagoya University on December 18, 2021<br><br>In addition with RF GaN devices, Prof, Iwai have been assisting the ICST and CSDL (Compound Semiconductor Device Laboratory) of NYCU to develop new FE (Ferro-Electric) G E-mode GaN | |

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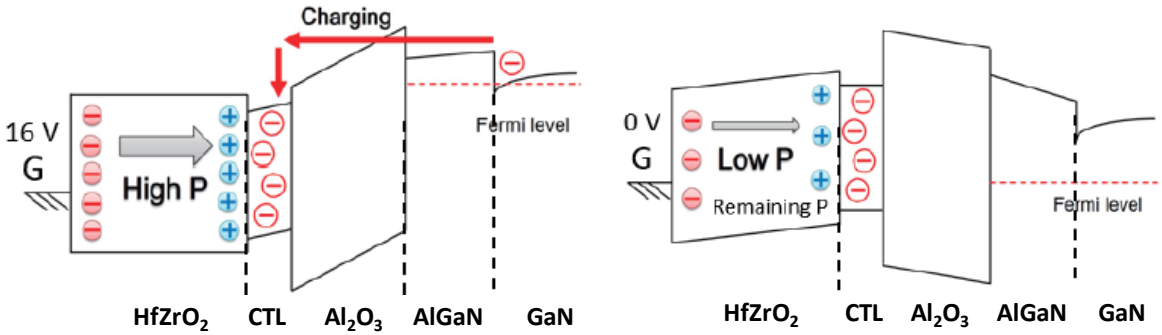
| | | HEMTs as a power device, working with students. The results have been published in several papers such as Symposium on VLSI Technology [C20] – which is one of the highest rank conferences in the semiconductor device field. It is of great help in the international visibility of NYCU reserch. GaN HEMT is a promising device for future high frequency and high efficiency power switching device applications as well as frontend milli wave communication devices for 5 and 6G. Especially for power applications, due to the fail-safe and fault turn-on issues of high-power switching devices, the normally-off GaN HEMTs with high $V_{th}$ are needed. Conventionally, there were several techniques for obtaining positive $V_{th}$ such as the gate recess method in which the surface of the channel is etched off. However, this resulted in the significant degradation in $I_{D,max}$ and also the $V_{th}$ of the E mode GaN HEMTs were not high enough to avoid fault turn-on. In this work, a new concept of FEG E-mode GaN HEMTs to solve the problem, by the combination of ferroelectric and charge trapped layers was demonstrated as shown in Fig. 4.<br>  <br><br>**Fig. 4.** FEG (Ferro-Electric) E-mode GaN HEMTs [C20]<br><br>In 2020, the research of FEG E-mode GaN HEMTs were continued and 600 V endurance voltage, $V_{th}$ > 3.5 V and $I_{dmax}$ > 700 mA/mm were confirmed.as shown in Fig. 5. GaN HEMT is also used as a power device. Benchmark (Fig. 6) shows superiority of our GaN HEMT as a power device. | |

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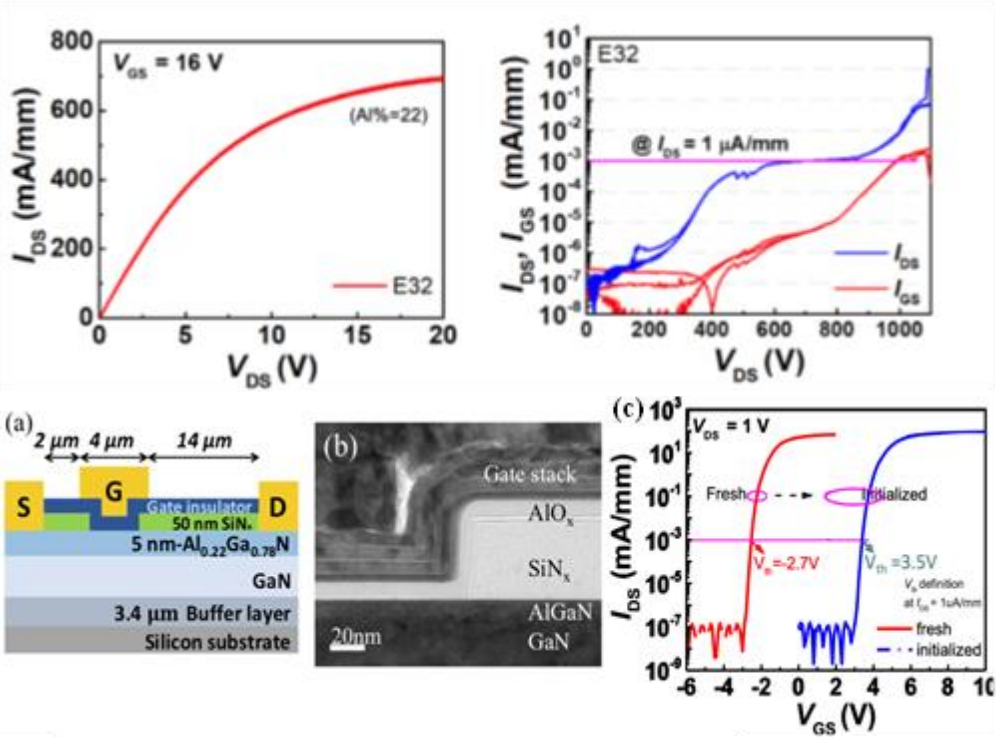
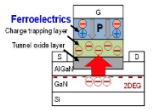



**Fig.5** FEG E-mode GaN HEMT characteristics obtained in 2020

| |  |  |  |  |  |
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| | **EPC** | **Transphorm** | **Panasonic** | **GaN systems** | **NYCU (Our results)** |
| Max rating(Vg max) | 6V | 18V | 4.5V | 7V | 23V |
| Threshold | 1.5V | 1.8V | 1.2V | 1.3V | 3.5V |
| Full enhancement | 4.5-5.5V | 8V | 4V | 6V | 6V |
| Safe margin($V_g$) | < 0.5V | 10V | 0.5V | 1V | 12V |

**Fig. 6** Benchmark of GaN power devices

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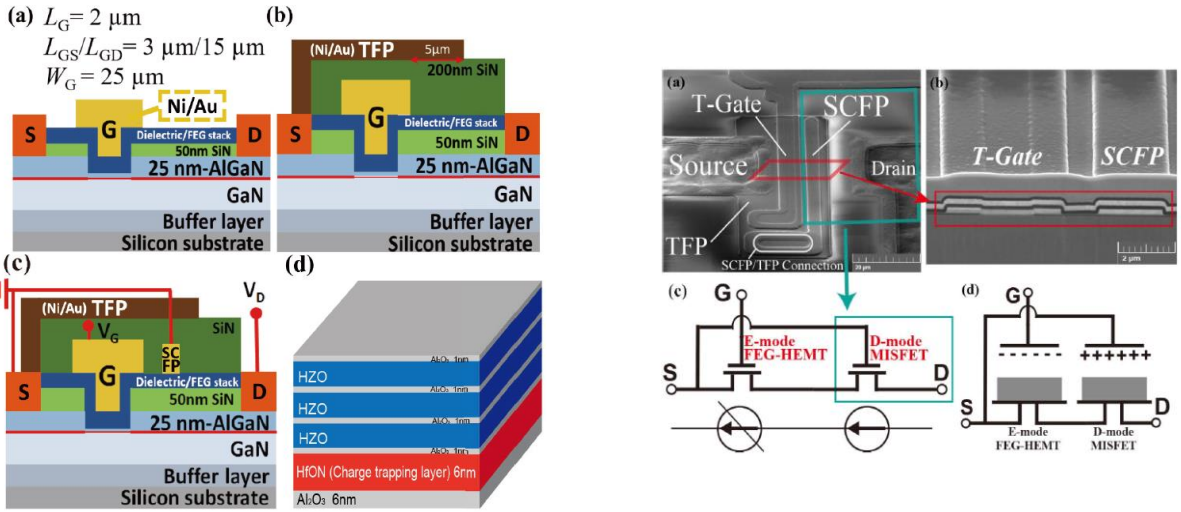
| | | In 2021, Prof. Iwai worked with students and we obtained further progress on the FE G E-mode GaN HEMTs as shown in Fig. 7 [J16]. A high-performance E-mode hybrid ferroelectric charge storage gate (FEG) GaN HEMT with an innovative source-connected field plate (SCFP) structure was investigated. The optimized E-mode FEG-HEMT implements a novel SCFP structure, which creates a cascode-like configuration with a D-mode GaN MISHEMT. This E-mode SCFP GaN FEG-HEMT has a positive $V_{th}$ of 2.81 V, a high $I_{D,max}$ of 757mA/mm, and a BV of 866 V. Dynamic $R_{ON}$ reduced 25% when operated at $V_{DSQ}$ = 400 V. ON-state stress tests also show improved current collapse phenomena. Additionally, to address the charge storage abilities of FEG-HEMTs, a multi-cycle OFF-state ($V_{DS}$ = 300 V, $V_{GS}$ = 0 V) retention test was conducted. The SCFP FEGHEMT showed 58.46% less $V_{th}$ shift percentage than the FEG-HEMT without field plates. | A20 |
| | |  | A21 |

**Fig. 7** FEG E mode GaN HEMS with SCFP [J16]

**Journal**

[J15] K. N. Huang, Y-C Lin, J-C Lin, C. C. Hsu, J. H. Lee, C-H Wu, J. N. Yao, H-T Hsu, V. Nagarajan, K. Kakushima, K. Tsutsui, H. Iwai, C. H. Chien, E. Y. Chang, "Study of E-Mode AlGaN/GaN MIS-HEMT with La-silicate Gate Insulator for Power Applications", Journal of Electronic Materials, vol. 49, no. 2, pp. 1348-1353, February, 2020

[J16] Jui-Sheng Wu, Chih-Chieh Lee, Chia-Hsun Wu,Min-Lu Kao, You-Chen Weng, Chih-Yi

**2.(3).3 Promotion**

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| | **of international exchange activities of ICST, NTCU** | Yang, Quang Ho Luc, Ching-Ti, E, Daisuke Ueda, and Edward Yi Chang "E-Mode GaN MIS-HEMT Using Ferroelectric Charge Trap Gate Stack With Low Dynamic On-Resistance and High Vth Stability by Field Plate Engineering," IEEE Electron Device Letters, vol. 42, no. 9, pp. 1268 – 1271, September, 2021.<br><br>**Conference**<br>[C20] C. H. Wu, S. C. Liu, C. K. Huang, Y. C. Chiu, P. C. Han, P. C. Chang, F. Lumbantoruan, C. A. Lin, Y. K. Lin, C. Y. Chang, Chenming Hu, Hiroshi Iwai, and Edward Yi Chang, "High $V_{th}$ Enhancement Mode GaN Power Devices with High ID,max Using Hybrid Ferroelectric Charge Trap Gate Stack," Symposium on VLSI Technology, pp. 60 ~ 61, June 2017<br><br>Prof. Iwai is a co-founder of ICST (International College of Semiconductor Technology) NCTU (at that time NYCU did not exist) with Prof. Edward Yi Chang, when Prof. Iwai was still a full professor of Tokyo Institute of Technology. Since then, he contributed to the promotion of ICST as a Vice Dean. He made Tokyo Institute of Technology, IIT (Indian Institute of Technology) Bombay, IIE Delhi, Univ. of Bologna (Italy), and Univ. of Granada (Spain) – all of them are top level university in the research of Semiconductor devices – join ICST as members of joint degree program. He has personal world-wide network with the presidents and directors of those universities, as shown in Fig. 8. For example, Prof. Iwai knows Director R. Rao and S. Chaudhuri very well since he was D. J. Gandhi Distinguished Chair Professor at IIT Bombay in early 2,000's. IIT Delhi promised to send more than 50 students to ICST in near future. | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
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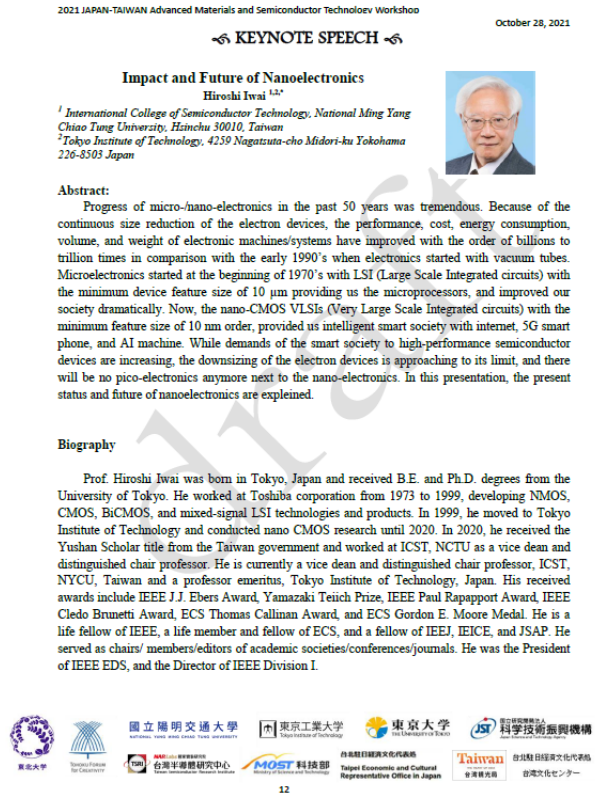
| | |  <br>**Fig. 8** Example of world leading universities which joined joint degree program with ICST, NYCU<br><br>In 2020, Prof. Iwai made University of Sheffield to join the joint degree program through his network for power device researchers as shown in Fig. 9. Prof. Shankar N. Madathil is a world leading researcher in the power semiconductor device and this will enhance the power electronics research at ICST.<br><br>  <br>**Fig. 9** Prof. Shankar E. Madathil and Univ. of Sheffield as a member of joint degree program with ICST<br><br>In October 2021, Japan-Taiwan Advanced Material and Semiconductor Workshop (https://www.tfc.tohoku.ac.jp/other-activity/7094.html)was held under the support of Taipei | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | **2.(3).4 Promotion of academic status of ICST, NYCU by paper publication, lecture delivery, service to academic societies and receipt of honors** | Economic and Culture Presentative Office in Japan. ICST was one of the co-organizers of the workshop. He worked with Prof. Edward Chang as a committee member and gave a key note speech there as shown in Fig. 10. His keynote speech was recorded and uploaded for YouTube by Tohoku Forum for Creativity (https://www.youtube.com/watch?v=60_eRR6-9mg&t=611s). | |



2021 JAPAN-TAIWAN Advanced Materials and Semiconductor Technoloev Workshoo

October 28, 2021

KEYNOTE SPEECH

**Impact and Future of Nanoelectronics**

Hiroshi Iwai [1,2,*]

[1] International College of Semiconductor Technology, National Ming Yang Chiao Tung University, Hzinchu 30010, Taiwan
[2] Tokyo Institute of Technology, 4259 Nagatzuta-cho Midori-ku Yokohama 226-8503 Japan

**Abstract:**

Progress of micro-/nano-electronics in the past 50 years was tremendous. Because of the continuous size reduction of the electron devices, the performance, cost, energy consumption, volume, and weight of electronic machines/systems have improved with the order of billions to trillion times in comparison with the early 1990's when electronics started with vacuum tubes. Microelectronics started at the beginning of 1970's with LSI (Large Scale Integrated circuits) with the minimum device feature size of 10 μm providing us the microprocessors, and improved our society dramatically. Now, the nano-CMOS VLSIs (Very Large Scale Integrated circuits) with the minimum feature size of 10 nm order, provided us intelligent smart society with internet, 5G smart phone, and AI machine. While demands of the smart society to high-performance semiconductor devices are increasing, the downsizing of the electron devices is approaching to its limit, and there will be no pico-electronics anymore next to the nano-electronics. In this presentation, the present status and future of nanoelectronics are expleined.

**Biography**

Prof. Hiroshi Iwai was born in Tokyo, Japan and received B.E. and Ph.D. degrees from the University of Tokyo. He worked at Toshiba corporation from 1973 to 1999, developing NMOS, CMOS, BiCMOS, and mixed-signal LSI technologies and products. In 1999, he moved to Tokyo Institute of Technology and conducted nano CMOS research until 2020. In 2020, he received the Yushan Scholar title from the Taiwan government and worked at ICST, NCTU as a vice dean and distinguished chair professor. He is currently a vice dean and distinguished chair professor, ICST, NYCU, Taiwan and a professor emeritus, Tokyo Institute of Technology, Japan. His received awards include IEEE J.J. Ebers Award, Yamazaki Teiich Prize, IEEE Paul Rapapport Award, IEEE Cledo Brunetti Award, ECS Thomas Callinan Award, and ECS Gordon E. Moore Medal. He is a life fellow of IEEE, a life member and fellow of ECS, and a fellow of IEEJ, IEICE, and JSAP. He served as chairs/ members/editors of academic societies/conferences/journals. He was the President of IEEE EDS, and the Director of IEEE Division I.

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**Fig. 10** Japan-Taiwan Advanced Material and Semiconductor Workshop

He also attended online meetings with IIT-Bombay and IIT Delhi both held in the morning and afternoon, respectively, on October 22 to promote the joint degree program after the COVID-19 becomes safe. We agreed to encourage the faculty to develop joint research proposals and seek research funding and to organize workshops for the purpose.

A22
A23
A4
A24
A25

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | | **2.(3).4 Promotion of academic status of ICST, NYCU by paper publication, lecture delivery, service to academic societies and receipt of honors**<br><br>Prof. Iwai contributed to the promotion of the academic status of ISCT by paper publication, delivering distinguished lectures as the eminent lecturer of IEEE Electron Devices Society, service to academic societies as a committee member, and receipt of the highest-level honor of academic society.<br><br>**2.(3).4.1 Receipt of honor**<br><br>He received the following honors in 2020 and 2021 from Electrochemical Society, which has a history of more than 100 years and which is one of the most prestigious academic society in the semiconductor field. He also received NYCU certificates for Glory to the university.<br><br>[R1] ECS (Electrochemical Society) Fellow, June 2020<br>[R2] ECS Awarded Life Membership, November 2020<br>[R3] ECS Gordon E. Moore Medal, June 2021 (https://www.electrochem.org/press/hiroshi-iwai/) (Fig. 11)<br>[R4] NYCU Certificate for Glory to the university for the ECS awarded life membership, November 2021 (Fig. 12)<br>[R5] NYCU Certificate for Glory to the university for the ECS Gordon E. Moore Medal, November 2021 (Fig. 12) | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|

The Electrochemical Society
Advancing solid state & electrochemical science & technology

## Electronics Pioneer Hiroshi Iwai Receives ECS Gordon E. Moore Medal for Outstanding Achievement in Solid State Science & Technology

### Iwai Delivers Moore Medal Address on June 3

Pennington, NJ – The Electrochemical Society (ECS) honored Hiroshi Iwai, Vice Dean and Distinguished Chair Professor at the International College of Semiconductor Technology, Taiwan, and Professor Emeritus of the Tokyo Institute of Technology, Japan, with the 2021 ECS Gordon E. Moore Medal for Outstanding Achievement in Solid State Science & Technology. He delivers his Award Address, "Impact of Micro-/Nano-Electronics, Miniaturization Limit, and Technology Development for the Next 10 Years and After," at the *239th ECS Meeting with IMCS18.* The address can be seen live online at 2100h EDT, Thursday, June 3, after which it will be available through June 26, 2021. There is no cost to participate, however pre-registration is required.

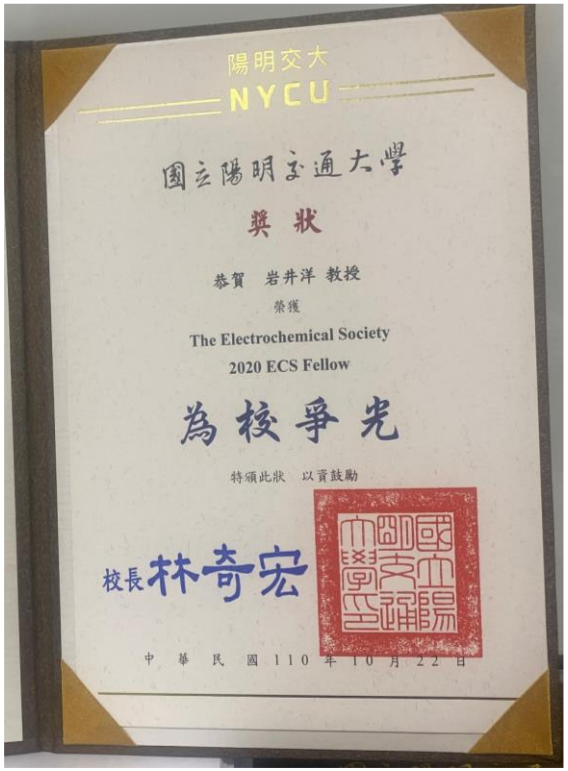
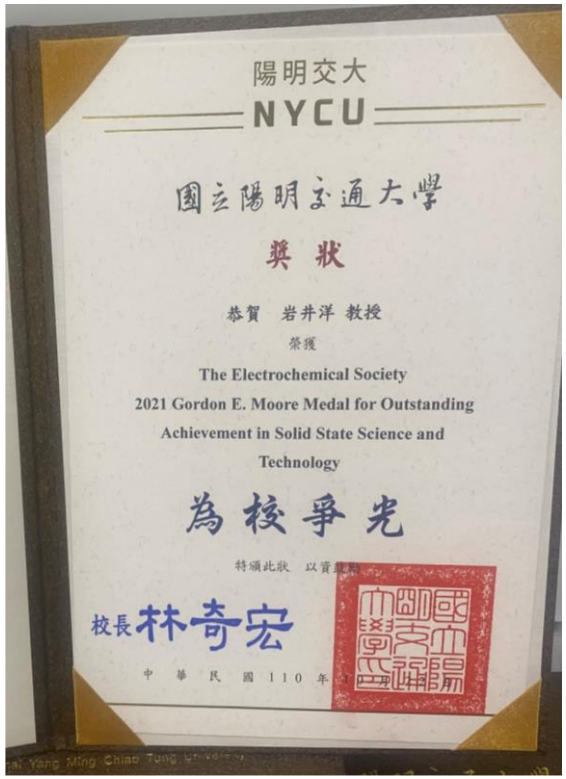
Hiroshi Iwai

**Hiroshi Iwai's presentation** is a unique opportunity to learn about the impact of micro-/nano electronics, miniaturization, and the future development of the technology, from a pioneer in the field. He introduced many new process technologies which were the first, or one of the first, in the world: BPSG planarization, source/drain ion-implantation, reactive ion etching for poly Si gate, rapid thermal annealing for shallow doping, rapid thermal oxidation for ultra-thin gate oxides, rapid thermal nitridation for oxynitride gate oxides, and NiSi silicide. Best known for the miniaturization of MOSFETs from 8 μm to recent sub-50 nm generations, Iwai contributed to the continuation of Moore's law for 50 years. An RF CMOS project he initiated in 1995 resulted in the success of Bluetooth. From the early period of large scale integrated circuits, he was involved in developing product technologies: the first NMOS LSI technology at Toshiba in 1975, several generations of memories—1k SRAM, 64 k DRAM, and 1M SRAM—and bipolar and BiCMOS technologies for analog and RF.

https://www.electrochem.org/press/hiroshi-iwai /

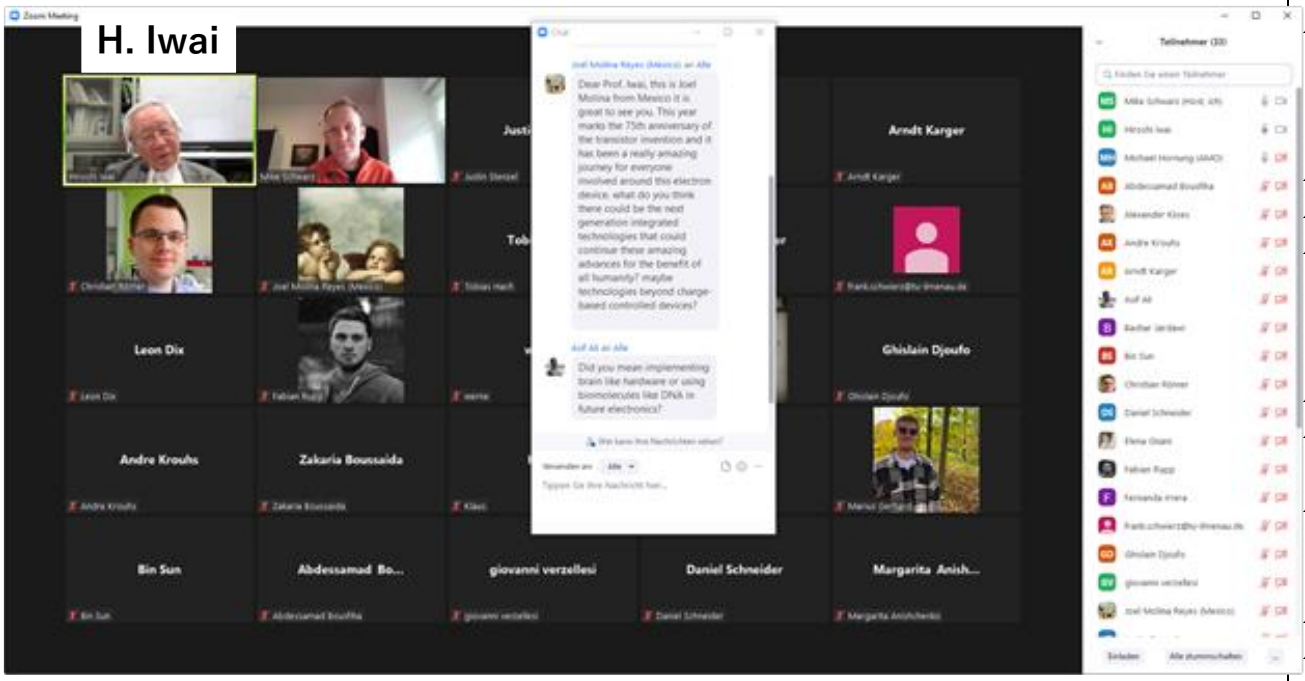
**Fig. 11** G. Moore Medal

He has been recognized by ECS (Electrochemical Society) as an electronics pioneer in solid-state science and technology and received Gordon E. Moore Medal in June 2021 as shown in Fig. 11 (https://www.electrochem.org/press/hiroshi-iwai/). This is the highest honor in ECS in semiconductor area, contributing the promotion of NYCU's academic status. Indeed, he was honorably introduced by the President Lin of NYCU on his annual report and greeting at the Chinese New Year 2022 "其中榮獲國際指標性獎項亦不在少數，如岩井洋教授獲 The Electrochemical Society, ECS 頒授 2021 Gordon E. Moore Medal 與 Awarded Life Membership 兩項榮譽" (https://www.nycu.edu.tw/news/3219/) as shown in Fig. 12.

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | |   <br>**Fig. 12** NYCU Certificate for Glory to the university<br><br>**2.(3).4.2 keynote and Invited paper and presentation**<br><br>Prof. Iwai was invited to give keynote and invited papers/presentations for several times as shown below.<br>**Journal Paper**<br>[J17] H. Iwai, Gordon E. Moore Medal Invited Paper "History of Micro-/Nano-Electronics Development; Breakthroughs and Innovations" ECS Trans. vol. 102, no. 2. pp. 63 -112, June, 2021 (paper for [C22].)<br><br>[J18] H. Iwai, Key note invited paper "Impact of Micro-/Nano-Electronics, Technology, | A26<br>A27<br>A28<br>A29<br>A30<br>A31<br>A32<br>A33<br>A34<br>A35<br>A36, A37<br>A38<br>A39 |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | | Development for the Next 10 Years and after," ECS Trans. vol. 102, no. 4, pp. 81 -95, June, 2021 (paper for [C21].) | A40<br>A41 |
| | | **Conference paper**<br>[C21] H. Iwai, Keynote presentation "Impact of Micro-/Nano-Electronics, Technology, Development for the Next 10 Years and after," 16th Symposium on 'High Purity and High Mobility Semiconductors', at the 239th ECS Spring Meeting 2021 (May. 30 – Jun 3 in Chicago) (related with [J18]). | A42<br>A43<br>A44 |
| | | [C22] H. Iwai, Gordon E. Moore Medal Speech "History of Micro-/Nano-Electronics Development; Breakthroughs and Innovations," 11th Symposium on 'Silicon Compatible Emerging Materials, Processes, and Technologies for Advanced CMOS and Post-CMOS Applications', at the 239th ECS Spring Meeting 2021 (May 30-June 3, 2021 in Chicago, IL) (related with [J17]). | A45<br>A46, A47<br>A48 |
| | | [C23] H. Iwai, Invited keynote Speaker "Impact of Micro-/Nano-Electronics, Miniaturization Limit, and Technology Development for the Next 10 Years and after," 3rd International Conference on Communication, Devices and Computing (ICCDC 2021), August, 2021. | |
| | | [C24] H. Iwai, keynote Invited Talk and IEEE EDS Distinguished Lecture, "Past and future of micro-/nano-electronics," Proc. 2021 IEEE 32nd International Conference on Microelectronics (MIEL 2021), pp. 3 – 8, September, 2021. | |
| | | [C25] H. Iwai, Keynote Speech, "Impact and Future of Nanoelectronics," 2021 JP-TW Advanced Materials and Semiconductor Technology Workshop, October, 2021. | |
| | | [C26] H. Iwai, Invited Talk, "NMOS LSI Development from 1970's to the beginning of 1980's," International Conference on ASIC (ASICON 2021), October, 2021 | |
| | | [C27] H. Iwai, Short Course Lecture, "Past and future of micro-/nano-electronics ," The 29th Korean Conference on Semiconductors, January, 2022<br>http://kcs.cosar.or.kr/2022/short_course.jsp | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | | **2.(3).4.3 IEEE Electron Devices Society Distinguished lecture as the eminent lecturer**<br>https://eds.ieee.org/education/distinguished-lecturer-mini-colloquia-program/distinguished-lecturer-listing<br><br>Distinguished Lecturer Listing<br><br>EDS EMINENT LECTURER<br><br>This is the highest honor that is bestowed upon an EDS Distinguished Lecturer in direct recognition of excellence and superior contributions to the field of Electron Devices<br><br>  <br><br>HIROSHI IWAI<br><br>**Fig. 13** IEEE EDS Eminent Lecturer<br>Prof. Iwai has been contributing to the education of semiconductor technology as an IEEE EDS Distinguished Lecturer since 1994. He received the title of 'Eminent Lecturer' by EDS in 2020 which is the highest honor of the distinguished lecturer as shown in Fig. 13, and there has been only he who received this title till now. Since 2020, he has given 5 lectures to the students and researchers of the world (Asia, Europe and United States). | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | |  <br>**Fig. 14** Distinguished lecture for IEEE EDS Germany Chapter | A49<br>A50<br>A51<br>A52<br>A53<br>A54, A55<br>A56<br>A39, A57<br>A58, A59<br>A60, A61 |
| | | [D1] H. Iwai, “End of CMOS miniaturization and technology development after that”, IEEE EDS MQ "Emerging Nano Devices and Circuits – The Roadmap Ahead", October 5, 2020, Jointly Organized by Department of Electronic Science, University of Delhi South Campus and IEEE Delhi EDS Chapter – India | A62<br>A63 |
| | | [D2] H. Iwai “End of CMOS miniaturization and technology development after that”, December 3, 2020, IEEE EDS MQ organized by IEEE Penang Joint Chapter ED/MTT/SSC, IEEE Malaysia Section in collaboration with IEEE Sensors and Nanotechnology Joint Councils Chapter, Malaysia Section | A64 |
| | | [D3] H. Iwai “End of CMOS miniaturization and technology development after that”, March 26, | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | | 2021, IEEE Mid Hudson Valley EDS and the Schenectady EDS Chapters, USA<br><br>[D4] H. Iwai, "Past and future of micro-/nano-electronics," Mini-Colloquium "Nanoelectronics and Nanodevices", IEEE EDS Serbia and Montenegro ED/SSE Chapter, September 12, 2021<br><br>[D5] H. Iwai, "History, Impact and Future of Nanoelectronics," IEEE Germany EDS Chapter, February 18, 2022<br><br>**2.(3).4.4 Lecture at NYCU**<br><br>[L1] H. Iwai, Lecture to ICST, NYCU student, 13:30 ~ 16:30 September 30, 2020.<br><br>[L2] H. Iwai, Lecture to ICST, NYCU student, 13:20 ~ 14:10 September 28, 2021.<br><br>**2.(3).4.5 Contribution to academic society as committee member**<br><br>Contribution to the academic societies as a volunteer is also important factor for the status of the university. He has served the following 15 roles since 2020.<br><br>[A1] Member of IEEE EDS (Electron Devices Society) Humanitarian Committee, 2020 - present<br>https://eds.ieee.org/about-eds/governance/standing-committees/humanitarian-committee<br><br>[A2] Member of IEEE EDS Education Award Committee 2020 ~ 2021<br><br>[A3] Chair of IEEE EDS Education Award Committee 2022 ~ present<br>https://eds.ieee.org/about-eds/governance/standing-committees/awards-committee<br><br>[A4] Member of IEEE EDS Award Committee 2022~ present<br>https://eds.ieee.org/about-eds/governance/standing-committees/awards-committee<br><br>[A5] IEEE TAB (Technical Activity Board) Conflict Resolution Committee 2021 ~ present<br>https://rosters.ieee.org/displayRoster/cmtab519.html | A65<br><br>A66<br><br>A67<br><br>A68<br><br>A69<br><br>A70<br><br>A71<br><br>A72<br><br>A73 |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | | [A6] Member of Executive Committee, Electrochemical Society (ECS) Electronics and Photonics Division (EPD) 2020 ~ present<br>https://www.electrochem.org/epd-officers | A74 |
| | | [A7] Member of Technical Program Committee, European Solid State Research Conference (ESSDERC) 2020 ~ present<br>https://www.esscirc-essderc2022.org/all-tpc-members | A75 |
| | | [A8] Member of 22th Technical Program Committee, Insulator Films on Semiconductors INFOS) 2021 (June 28 – July 2, 2021, Rende, Italy) (Fig.15)<br>http://events.dimes.unical.it/infos2021/ | A76 |
| | | [A9] Member of International Advisory Committee: International Electron Devices Technology and Manufacturing (EDTM) Conference 2020 ~ 2021<br>https://ewh.ieee.org/conf/edtm/2021/committee.html | A77 |
| | | [A10] Member of Advisory Committee, International Junction Technology Workshop (IWJT), 2020 ~ present<br>http://www.iwailab.ep.titech.ac.jp/IWJT/index.html | A78 |
| | | [A11] Member Steering Committee China Semiconductor International Conference (CSTIC), 2020 ~ present<br>http://www.semiconchina.org/en/7 | |
| | | [A12] Member Steering Committee International Conference on Microelectronics (MIEL), 2020 ~ present<br>http://miel.elfak.ni.ac.rs/Committees | |
| | | [A13] Co-chair of Advisory Committee, IEEE International Conference on ASIC (ASICON), 2020 ~ present<br>http://www.asicon.org/Data/List/COMMITTEE | |
| | | [A14] Co-chair of Technical Program Committee, International Conference on Solid-State and Integrated Circuit Technology (ICSICT), 2020 ~ present | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | **2.(4) Anticipated goals (including qualitative or quantitative working performance or results)** | http://icsict.com/Data/List/Committees<br><br>[A15] Liaison Asia, Symposium on Microelectronics Technology (SBMicro), 2020 ~ present<br>https://sbmicro.org.br/chip-in-the-fields-2021/SBMicro2021<br><br>[A16] Liaison Asia, IEEE Latin America Electron Devices Conference (LAEDC), 2020 ~ present<br>https://attend.ieee.org/laedc-2022/organizing-committee/ (Fig.16)<br><br>**INFOS 2021 Organizing Committee**<br>**Felice Crupi, General Chair**<br>  <br>**H. Iwai**<br><br>**Fig. 15** INFOS organizing committee members | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | |  H. Iwai<br>**Fig.16** IEEE Latin America Electron Devices Conference (LAEDC) Organizing committee<br>As described in the previous section, all of the 4 items are going well. Quantitative working performance shown in “Quantitative Assessment Form” is excellent. There is almost no doubt that the goals are achieved. | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| | | | |
| 3. Support provided by the university and the project's original goals (please specify the type of support or funds provided by the university to assist in research, such as research equipment and funds, research assistant personnel expenses, accommodation, relocation, | Sufficiently-high budget and human resource for promoting the research and education | Through the ACE research project, the university gave huge budget to his managing sub-project (ACE project Thrust 2) for the first year as already mentioned. Human recourse of 11 professors, 4 researchers, 14 Ph.D. students, and 19 Master students are provided. All the equipment belongs to ICST and CSDL are available for the research.<br>One secretary is provided for Prof. Iwai by ICST. | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| children's education assistance, etc.) | | | |
| 4. Yushan Fellows ' team cooperation (please list team members and cooperation methods) (Yushan Young Fellows don't need to fill in this) | **List of the members** | **Host:** 張翼 (Edward Yi Chang)<br>**Secretary:** 孫小珞<br><br>**<u>Members working for his project ACE Thrust 2</u>**<br>**Professors:** 周世傑, 孫元成, 張翼, 郭治群, 劉致為(NTU), 許恒通, 郭建男, 尹大根, 李俊興, 管延城<br><br>**Researchers:** 林靖民, 林岳欽, 曹逸凡, 任治偉<br><br>**Ph.D. students:** 張濬朋, 林鑫成(NTU), 李明文, 翁祐晨、鄭夏汐、許哲瑋, 王垣, Sam Suresh Jayabalan, Surajit Kumar Nath, 邱德彥, 王淳, 劉泓志、邱康綸、杜仲倫<br><br>**Master students:** 周書緯、林明佑、梁宸維, 邱冠穎, 邱炳勳, 吳啟仲, Abinash Patnaik, 邱品鈞、林奕宏、林志學, 安亞席, 林澤緣、薛乃誠、吳宗翰、曾振源、張峻銘、張暐晟、廖豐儒、李家榮 | |

| Main points of assessment | The anticipated goals | Concrete work achievements or results | Supporting documents |
|---|---|---|---|
| 5. Yushan (Young) Fellow should aim to cooperate and exchange foreign academic resources, which should be linked to university development. It's suggested to make good use of these global academic network resources to assist the internationalization of the host university and promote international exchanges and cooperation, including teachers and students exchange activity between universities, international research collaborations, dual degree programs and so on. | **Promotion of exchange with foreign universities** | Prof. Iwai has been influential to IEEE and ECS (Electrochemical Society) as an office and active member for the management of the society for more than 25 years since the middle of 1990's. For example, he served as the member of IEEE Board and the president of IEEE Electron Devices Society. He has been chair/visiting professor/researcher of many foreign universities such as IIT Bombay, EPFL (Switzerland), Stanford Universities. He was in charge of international exchange program of COE (Center of Excellence) for 10 years at Tokyo Institute of Technology.<br>Thus, he has very large world network with the representatives and researches of world-top level universities.<br>He initiated ICST with Edward Yi Chang as a vice dean in 2015, when he was still a full professor of Tokyo Institute of Technology for the purpose of promoting international exchange program in the field of semiconductor related technologies in Taiwan. Since then, he has aggressively promoted the exchange with foreign universities by adding many foreign universities to joint degree program through his network.<br>As written in 2.(3).3, he has still been active for the international exchange program. For example, he added Univ. of Sheffield as a member of joint degree program of ICST in 2020. He attended online meeting with IIT Bombay and Delhi for the near future plan after the COVID-19 becomes safe. He serves as a committee and keynote speaker at the Japan-Taiwan Advanced Material and Semiconductor Workshop organized under the collaboration scheme of NYCU and Tohoku University. | |

**Appendix 1**

# Quantitative Assessment Form

| Item | | Results and concrete work performance | Explanation |
|---|---|---|---|
| 1. Manpower training | | Doctoral courses:_____0_<br>Graduate courses:_____ 2_<br>Undergraduate courses:_____0_<br>Doctoral students:_____14 persons<br>Master's students:_____19_ persons<br>Undergraduate students:_____0 persons<br>Others:_____0_ persons | |
| 2. Papers and research works | Domestic | Journal papers:_____0_<br>Academic books and papers in books:___0__<br>Conference papers: ____0__<br>Technical reports:_____0___<br>Others:____0___ | |
| | Overseas | Journal papers:_____18__<br>Academic books and papers in books:___0__<br>Conference papers: ____26___<br>Technical reports:_____0___<br>Others:_____0___ | |
| 3. Keynote speaker | | ____4__panels /sessions | |
| 4. Patents （including patents pending） | Domestic | Quantity: ____0_____ | |
| | Overseas | Quantity: ____0_____ | |
| | ☐ N/A | | |
| 5. Industry-Academia Cooperation | | Number of partnered enterprises :___2____ | |
| | | Number of industry-academia research projects: _____1_____ | |
| 6. Technology licensing | | Technology licensing cases: ____0____ | |
| | | Total technology licensing royalties （amount）NT$_____0_____ | |
| | | ■ N/A | |
| 7. Others | | | |

**Appendix 2**

# Post-Implementation Opinion Survey of Yushan Fellow Program

Dear Yushan (Young) Fellow,

We appreciate your time to respond to the following questions regarding your Yushan Fellowship. Your feedback will help us evaluate and improve the quality of the management of the Program. Please note that all information you provide to us will be kept confidential. Kindly reply the form directly to the project office at yushan@heeact.edu.tw

We would appreciate any suggestions you may have regarding the program at any time.

The form is also available on Yushan website.

Thank you for your opinions and assistance!

The host organization: Ministry of Education

The co-organizer: Higher Education Evaluation and Accreditation Council of Taiwan

## 1. Opinion Survey Form

| Questions | Level |
|---|---|
| The administrative system is complete and sound | 1.☐Strongly disagree 2.☐Disagree 3.☐Neutral 4.☐Agree 5. ■Strongly agree |
| All information is presented in Chinese and English | 1.☐Strongly disagree 2.☐Disagree 3. ☐Neutral 4. ■Agree 5.☐Strongly agree |
| The living supports are sufficient | 1.☐Strongly disagree 2.☐Disagree 3. ■Neutral 4. ☐Agree 5.☐Strongly agree |
| The expense application and reimbursement is complete and sound | 1.☐Strongly disagree 2.☐Disagree 3.☐Neutral 4. ■Agree 5.☐Strongly agree |
| Adequate administrative staff /research assistant | 1.☐Strongly disagree 2.☐Disagree 3.☐Neutral 4.☐Agree 5. ■Strongly agree |
| Smooth communication | 1.☐Strongly disagree 2.☐Disagree 3.☐Neutral 4. ■Agree 5.☐Strongly agree |

## 2. Difficulties during the project implementation and suggestions for improving Yushan Fellow Project?

Due to the great support of NYCU people, the Yushan Fellow Project has been going well, in spite of COVID-19, and there were no big difficulties.

Last year, the report had to be translated into Chinese, but this year, English report is accepted. This is a step of the improvement.

One thing to be improved is the starting time of the Yushan Fellow Project budget. Academic year start on February 1 in Taiwan. But, the execution of Yushan budget becomes possible around June or July every year. There are some problems in the period of between February and June/July in terms of execution of the budget.

Name: 岩井洋 Hiroshi Iwai (signature/seal imprint)

Date: 025/02/20 (day/month/year)