The 38th Annual NANO Testing Symposium

KFC Hall
Kokusai Fashion Center
Sumida-ku, Tokyo, Japan

19, 20 November 2018

http://www-NANOTS.ist.osaka-u.ac.jp/
NANOTS@ist.osaka-u.ac.jp

Sponsored by The Institute of NANO Testing
In cooperation with
- The Institute of Electronics, Information and Communication Engineers
- The Japan Society of Applied Physics
- Reliability Engineering Association of Japan
- Union of Japanese Scientists and Engineers

Contents

1 Location

All Sessions:

KFC Hall and KFC Hall 2nd, Kokusai Fashion Center
1–6–1, Yokoami, Sumida-Ku, Tokyo, 130-0015 Japan
Phone: +81-3-5610-5801

Exhibition:

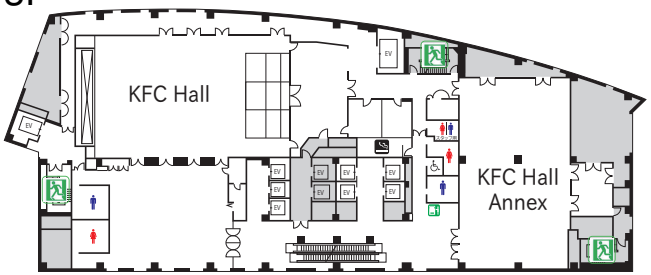
KFC Hall Annex, Kokusai Fashion Center

Evening Session:

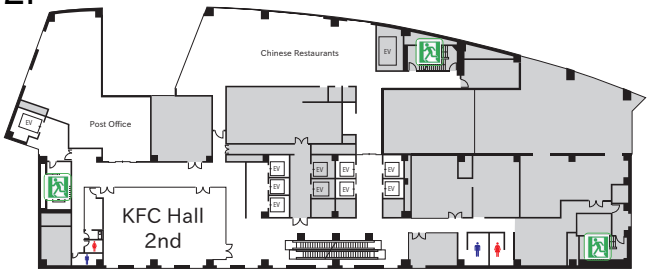
KFC Hall, Kokusai Fashion Center

2 Floor Map

3F



2F



3 Special Invited Talk

The following special invited talk will be given.

13:40–14:40, Monday, 19 November:

"Edge platform strategy to realize society 5.0"
by Dr. Shozo Saito, *Chairman, Device & System Platform Development Center Co., Ltd*

4 Invited Talk

The following invited talks will be given.

16:35–17:35, Monday, 19 November:

"What value adding is expected for power devise?"

by Dr. Katsuaki Saito, *Hitachi Power Semiconductor Device, Ltd.*

9:00–10:00, Tuesday, 20 November:

"A new international system device roadmap for cloud/IoT-edge solutions"

by Dr. Yoshihiro Hayashi, *Chairperson of SDRJ (Renesas Electronics Corporation)*

13:00–14:00, Tuesday, 20 November:

"Attosecond electron imaging"

by Dr. Yuya Morimoto, *Ludwig-Maximilians-Universität München*

5 Panel Discussion

A panel discussion on "Machine learning — Its possibilities and limitations" will be held on Tuesday, 20 November 10:45–12:10 in the conference hall (KFC Hall on 3F).

6 Poster Session

A poster session will be held on Monday, 19 November 17:35—-18:00 in the exhibition hall (KFC Hall Annecx on 3F). Short (1min) oral presentation of the poster session papers will be given on Monday, 19 November 12:22–12:30 in the conference hall (KFC Hall on 3F).

7 Authors Corner

Authors corner, a place for audience to meet with and discuss with authors, will be given just after the sessions (except for special and commercial sessions) in the exhibition hall.

8 Evening Session

Evening session of NANOTS is a special session for discussing on research trend around the world and the future perspective. The session will be held on the Monday night in KFC Hall.

9 Exhibition and Commercial Session

The Symposium will feature the latest in service providers, equipment manufacturers and suppliers. A large exhibit floor will give the opportunity to key-vendors to represent the core business area in these fields. Furthermore, a commercial session will give the opportunity to introduce new products with short presentation.

10 Luncheon Seminar

Luncheon seminars will be given in lunch break time on Monday, 19 November. You must pre-register to attend the seminar. In some cases, your registration may not be accepted because of a business policy of the sponsor.

Hitachi High-Technologies Luncheon Seminar: Monday, 19 November

Theme: Semiconductor analysis solutions proposed by Hitachi High-Technologies Corporation

11 Official Languages

The official languages of the symposium are Japanese and English. Papers included in the proceeding will be written in Japanese or English. Papers in Japanese will have an abstract written in English. We will have no interpreter.

12 Registration Fee

Course	Fee	Including
Non-student	JPY 13000	All sessions, exhibition, and proceeding (download)
Student	JPY 5000	

Please pay the fee by 2 November 2018 in one of the following ways.

Wire Transfer: Please send Japanese YEN (JPY) to the following account by wire transfer:

Bank Name: Resona Bank, Ltd.

SWIFT (BIC) Code: DIWAJPJT

Branch Name: Senri-Kita Branch

Branch Code: 222

Address: 4-2-D2-201, Furuedai, Suita, Osaka, 565-0874, Japan

Phone: +81-6-6872-0651

Account Number: 6843152

Account Name: The Institute of NANO Testing Nakamae Koji

Note: All bank charges JPY 5,000 (= the sending bank charge + the receiving bank charge) must be paid by the participant.

Credit card: Please clik "Pay Now" button after you finish on-line registration.

13 Symposium Registration

We strongly encourage you to register on line by using our website: http://www-NANOTS.ist.osaka-u.ac.jp/ by 2 November 2018.

14 Cancellation Policy

Cancellations must be submitted in an e-mail. Cancellations received by 17:00, 9 November 2018 (in Japan Standard Time) are entitled to a refund minus an administrative fee (all bank charges plus a 10 % processing fee). No refunds will be given to registrants who cancel after 9 November 2018 or who fail to attend the event.

15 Accommodation Information

There is The Dai-ichi Hotel Ryogoku in the same building as the symposium venue. Please visit the following hotel's web site and book a room.

http://www.dh-ryogoku.com/english/

16 Latest Information

You can find latest information on all aspects of NANOTS at http://www-NANOTS.ist.osaka-u.ac.jp/ .

17 Steering & Program Committee

Chairman:

Koji NAKAMAE	(Osaka University)

Member:

Yasuo CHO	(Tohoku University)
Yasunori GOTO	(Toyota Motor Corp.)
Yasuhisa HIGUCHI	(Hitachi, Ltd.)
Susumu IIDA	(Toshiba Memory Corp.)
Toru KOYAMA	(Renesas Semiconductor Manufacturing Co., Ltd.)
Shinobu MOTEGI	(Thermo Fisher Scientific K.K.)
Kiyoshi NIKAWA	(Kanazawa Institute of Technology)
Yoichi OSE	(Hitachi High-Technologies Corp.)
Mitsuo SUGA	(JEOL, Ltd.)
Hirotoshi TERADA	(Hamamatsu Photonics)
Yuichiro YAMAZAKI	(NGR Inc.)

18 Secretariat

Katsuyoshi MIURA and Yoshihiro MIDOH
Secretariat of the Institute of NANO Testing
Nakamae Lab., Dept. Information Systems Engineering,
Grad. Sch. Information Science and Technology
Osaka University
1-5, Yamada-Oka, Suita, Osaka, 565-0871 JAPAN
Phone/Fax: +81-6-6879-7813 / +81-6-6879-7812
E-mail: NANOTS@ist.osaka-u.ac.jp
Web: http://www-NANOTS.ist.osaka-u.ac.jp/

19 Technical Program

Monday, Nov. 19, a.m. / KFC Hall

Power Device Analysis I — a.m., Mon 19

Chairman Yasuhisa Higuchi

(1) *9:30* Enhancement of thermal analysis capability of power semiconductor devices by searching high-emissivity films
N. Chinone, T. Matsumoto, and K. Koshikawa / System Div., Hamamatsu Photonics K. K.

(2) *9:55* Application to a package failure analysis of ultrasonic beam induced resistance change (SOBIRCH)
T. Matsumoto[a], S. Eura[a], Y. Ito[a], T. Matsui[b], and N. Hozumi[b] / [a]Systems Div., Hamamatsu Photonics K. K., [b]Dept. Electrical & Electronic Information Engineering, Toyohashi Univ. Technology

(3) *10:20* High resolution mapping of subsurface defects at SiO_2/SiC interfaces by local deep level transient spectroscopy
Y. Yamagishi and Y. Cho / Research Institute of Electrical Communication, Tohoku Univ.

····· 10:45～11:05 Authors corner & break ·····

Commercial Session — a.m., Mon 19

Chairman Toru Koyama

(C1) *11:05* Teseda DFT analysis system
K. Sawada, H. Maekawa, and T. Anayama / Infinite Solutions Inc.

(C2) *11:12* Navigation system AZSA
K. Konishi / Product Planning & Development Group, Astron, Inc.

(C3) *11:19* Link functions in LAVIS-plus
M. Nikaido, T. Takahashi, Y. Sawamura, and K. Hirai / EDA Product Div., TOOL Corp.

(C4) *11:26* Introduction of a new thermal emission microscope Thermal F1.
H. Shirai, A. Kataoka, and K. Nishizawa / Systems Div. Business Promotion Dept., Hamamatsu Photonics K. K.

(C5) *11:33* Introduction of precision polishing for cross-layer analysis of brittle material
H. Matsubayahi / Nanotechnology Solution Div. Precision Instrument Group, BN TECHNOLOGY Corp.

(C6) *11:40* Proposal of analysis solution
T. Ueno[a] and N. Nanbu[b] / [a]Industrial Systems Team Sales Dept. 1 Systems Sales & Marketing Div. 2, Marubun Corp., [b]Sales Dept. 2 Device Sales & Marketing Div. 2, Marubun Corp.

(C7) *11:47* Intruduction of the latest automation application of SEM/FIB dual beam system
T. Muneta / Materials & Structural Analysis, Thermo Fisher Scientific

(C8) *11:54* Introduce circuit edit FIB Taipan G2 for 7nm process node
S. Motegi / Materials & Structural Analysis, Thermo Fisher Scientific FEI Company Japan Ltd.

(C9) *12:01* Introduction of new FIB-SEM system
N. Suzuki and T. Aiso / NanoImaging & Analysis, TOYO Corp.

(C10) *12:08* The introduction of high performance FIB-SEM system ETHOS NX5000
T. Sato[a], A. Morikawa[a], S. Sato[a], C. Kamiya[a], Y. Yamamoto[b], and H. Suzuki[b] / [a]Science System Prduct Div., Hitachi High-Technologies Corp., [b]Beam Technology Systems Design Dept., Hitachi High-Tech Science Corp.

(C11) *12:15* Introduction of STEM-NBD and strain analysis software Epsilon
N. Nakanishi, H. Sekiguchi, and M. Munekane / NanoPort Japan, Thermo Fisher Scientific

Poster Short Presentation — p.m., Mon 19

Chairman Toru Koyama

12:22 – 12:30 Poster Short Presentation
One minute abstract presentation by poster session presentors. Please see “Poster Session” for list of presentations.

····· 12:30～12:40 Group Photo ·····

Hitachi High-Technologies Luncheon Seminar — p.m., Mon 19

(L1) *12:40* Semiconductor analysis solutions proposed by Hitachi High-Technologies Corporation
*pre-registration required

Monday, Nov. 19, p.m. / KFC Hall

Special Invited Talk — p.m., Mon 19

Chairman Shinobu Motegi

(S1) *13:40* Special invited talk: Edge platform strategy to realize society 5.0
S. Saito / Device & System Platform Development Center Co., Ltd.

··· 14:40～15:00 Break & Discuss with invited speaker ···

Power Device Analysis II — p.m., Mon 19

Chairman Yasunori Goto

(4) *15:00* Nanoscale evaluation of power semiconductor devices by scanning capacitance force microscope
N. Satoh[a] and H. Yamamoto[b] / [a]Faculty of Eng., Dept. of Innovative Mech. and Electro. Engineering, Chiba Institute of Technology, [b]Faculty of Eng., Dept. of Electrical and Electronic Engineering, Chiba Institute of Technology

(5) *15:25* Study on depletion layer visualization using voltage applied electron beam induced current
T. Tomizawa, T. Okazaki, A. Sugiyama, N. Murata, T. Katayama, Y. Kunimune, T. Koyama, and T. Ide / Analysis & Evaluation Technology Dept.. Technology Div., Renesas Semiconductor Manufacturing

(6) *15:50* Evaluation of dislocations in GaN single crystal by using etch pit method
Y. Yao[a], Y. Ishikawa[a], Y. Sugawara[b], D. Yokoe[b], N. Okada[c], and K. Tadatomo[c] / [a]Maters R&D Lab, Japan Fine Ceramics Center, [b]Nanostructures Research Lab, Japan Fine Ceramics Center, [c]Grad. Sch. Sciences and Technology for Innovation, Yamaguchi Univ.

····· 16:15～16:35 Authors corner & break ·····

Invited Talk — p.m., Mon 19

Chairman Yasuhisa Higuchi

(I1) *16:35* Invited talk: What value adding is expected for power devise?
K. Saito / Hitachi Power Semiconductor Device, Ltd.

····· 17:35～18:30 Discuss with invited speaker ·····

Poster Session — p.m., Mon 19

····· 17:35～18:30 in KFC Hall Annex ·····

(7) Automatic cell nucleus extraction from transmitted light images of pluripotent stem cells using deep learning
K. Arita, Y. Midoh, and K. Nakamae / Grad. Sch. Information Science and Technology, Osaka Univ.

(8) Phase unwrapping of quantitative phase microscope images for cell culture monitoring
S. Tanigawa, Y. Midoh, and K. Nakamae / Grad. Sch. Information Science and Technology, Osaka Univ.

(9) Image quality enhancement of an SEM image using conditional generative adversarial networks
Y. Midoh and K. Nakamae / Grad. Sch. Information Science and Technology, Osaka Univ.

(10) Comparison of countermeasures against NBTI/PBTI degradation for arbiter PUF
K. Suzuki, K. Miura, and K. Nakamae / Grad. Sch. Information Science and Technology, Osaka Univ.

(11) Effect of variance stabilization on denoising of low SNR fringe patterns using wavelet hidden markov models
Y. Midoh and K. Nakamae / Grad. Sch. Information Science and Technology, Osaka Univ.

(12) Measurement of semiconductor devices using dC/dz of scanning nonlinear dielectric microscopy methods
K. Ohta[a] and H. Tsuneyuki[b] / [a]LSI Solutions Div., Toshiba Information Systems (Japan) Corp., [b]Japan Semiconductor Corp.

(13) Numerical simulation for semiconductor characterization using ∂C/∂z-SNDM
Y. Hiranaga and Y. Cho / Research Institute of Electrical Communication, Tohoku Univ.

(14) (Canceled)
Contrast enhancement of amorphous layers in semiconductor using DCFI
N. Nakanishi, H. Sekiguchi, and S. Sadayama / NanoPort Japan, Thermo Fisher Scientific

Evening Session — p.m., Mon 19

18:30 – 20:30 Evening session of NANOTS is a special session for discussing on research trend around the world and the future perspective.

Location:
KFC Hall

Program:
International Conference Report
- IMC 2018 (Y. Midoh, Osaka University)
- MNE 2018 (S. Iida, Toshiba Memory)
- ESREF 2018 (K. Miura, Osaka University)

Tuesday, Nov. 20, a.m. / KFC Hall

Invited Talk — a.m., Tue 20

Chairman Toru Koyama

(I2) *9:00* Invited talk: A new international system device roadmap for cloud/IoT-edge solutions
Y. Hayashi / Chairperson of SDRJ (Renesas Electronics Corp.)

··· 10:00～10:20 Break & Discuss with invited speaker ···

Electron Optics & Application — a.m., Tue 20

Chairman Mitsuo Suga

(15) *10:20* Mitochondria segmentation in scanning electron microscope images using a machine learning approach (2)
K. Adachi, Y. Midoh, and K. Nakamae / Grad. Sch. Information Science and Technology, Osaka Univ.

Panel Discussion a.m., Tue 20

10:45 – 12:10 Theme: Machine learning — Its possibilities and limitations

Moderator: Susumu Iida / Toshiba Memory Corp.

Panelists:
T. Matsunawa / Toshiba Memory Corp.
T. Ohmori / Hitachi, Ltd.
S. Ishii / Kyoto Univ.
Y. Kanazawa / Fujitsu Laboratories Ltd.
T. Kubo / Toshiba Memory Corp.

(P1) Machine learning in computational lithography
T. Matsunawa / Toshiba Memory Corp.

(P2) Etching profile optimization utilizing plasma engineering and machine learning
T. Ohmori, H. Nakada, I. Masayoshi, K. Naoyuki, U. Tatehito, and K. Masaru / Research & Development Group, Hitachi, Ltd.

(P3) Three-dimensional image processing methods based on machine learning
S. Ishii / Grad. Sch. Informatics, Kyoto Univ.

(P4) Application of artificial intelligence technology in design and manufacturing
Y. Kanazawa / Artificial Intelligence Lab., Fujitsu Laboratories Ltd.

(P5) Utilization big data for innovation in semiconductor memory manufacturing —comprehensive big-data-based monitoring system for yield analysis in semiconductor manufacturing—
T. Kubo / Digital Process Innovation Center, Toshiba Memory Corp.

····· 12:10～13:00 Lunch Break ·····

Tuesday, Nov. 20, p.m. / KFC Hall

Invited Talk p.m., Tue 20

Chairman Susumu Iida

(I3) *13:00* Invited talk: Attosecond electron imaging
Y. Morimoto / Ludwig-Maximilians-Universitt Mnchen

··· 14:00～14:20 Break & Discuss with invited speaker ···

Fault Localization p.m., Tue 20

Chairman Hirotoshi Terada

(16) *14:20* Open defect localization in 1x5 μm 3-D TSV structures by light-induced capacitance alteration (LICA)
K.J.P. Jacobs[a], J.D. Vos[a], M. Stucchi[a], I.D. Wolf[a], and E. Beyne[a] / [a]Dept. 3D and Silicon Photonics Technologies, IMEC, [b]Dept. Materials Engineering, KU Leuven

(17) *14:45* Realization of "skeleton wafer" testing for failure analysis
A. Jingu[a], H. Yanagita[b], S. Okanishi[b], S. Tanaka[c], and T. Koyama[a] / [a]Analysis & Evaluation Technology Dept., Renesas Semiconductor Manufacturing Co., Ltd., [b]Advanced Device Technology Dept., Renesas Electronics Corp., [c]Evaluation Analysis Dept., Renesas Engineering Service Co., Ltd.

(18) *15:10* Detection of open failure using the optical probed thermoreflectance method with light heating at micro-meter area
K. Endo[a], T. Izumiya[a], T. Nakamura[b], N. Chinone[b], K. Koshikawa[b], T. Matsumoto[b], and K. Nakamae[c] / [a]Discrete Semiconductor Quality & Reliability Engineering Dep., Toshiba Electronic Devices & Storage Corp., [b]Systems Div., Hamamatsu Photonics K. K., [c]Grad. Sch. Information Science and Technology, Osaka Univ.

····· 15:35～15:55 Authors corner & break ·····

Fault Localization/Physical Analysis p.m., Tue 20

Chairman Kiyoshi Nikawa

(19) *15:55* Characterization of thermal defects using pulsed emission with DBX camera
M. Morag and N. Leslie / Analytical Instrument Group, Material & Structural Div., Electrical Fault Analysis, Thermo Fisher Scientific

(20) *16:20* Studies of electro optical frequency mapping by power supply modulation
M. Saeki, Y. Matsumoto, Y. Oka, and H. Tsukui / Evaluation Analysis Dept., Renesas Engineering Services Co., Ltd.

(21) *16:45* Optimized evaluation of short failure analysis by voltage applied EBAC
J. Fuse[a], T. Sunaoshi[a], T. Kanemura[a], Y. Nara[b], A. Kageyama[c], and T. Mizuno[d] / [a]Application development Dept, Hitachi High-Technologies, [b]Electron microscope systems design 1st Dept, Hitachi High-Technologies, [c]Electron Microscope Solution Systems Design Dept, Hitachi High-Technologies, [d]Marketing Dept, Hitachi High-Technologies

(22) *17:10* Failure analysis of Al / Cu bonding by in-situ observation using environmentally controlled high voltage electron microscope
J. Yamaki[a], H. Tamegai[a], H. Maeda[a], H. Tsukui[a], T. Maeda[b], N. Ikarashi[c], and S. Arai[c] / [a]Element Analysis Section Evaluation Analysis Dept., Renesas Engineering Services Co., Ltd., [b]Advanced Process Engineering Section, Renesas Semiconductor Package & Test Solutions Co., Ltd., [c]Institute of Materials and Systems for Sustainability, Nagoya Univ.

····· 17:35～17:55 Authors corner & break ·····

Tuesday, Nov. 20, p.m. / KFC Hall 2nd

Metrology and Inspection p.m., Tue 20

Chairman Yuichiro Yamazaki

(23) *14:20* Prediction of signal characteristics of burried defect in sample by SEM image simulator
T. Yokosuka[a], C. Lee[a], K. Kurosawa[b], H. Kawano[b], and H. Kazumi[b] / [a]R&D Group, Center for Technology Innovation -Energy, Hitachi Ltd., [b]Process Control Systems Research and Development Dept., Hitachi High-Technologies Corp.

(24) *14:45* Depth measurement technique for extreme deep holes using back-scattered electron images with high accelerating voltage SEM
C. Ida[a], A. Hamaguchi[a], Y. Suzuki[a], T. Nishihata[b], M. Osaki[b], M. Tanaka[b], and T. Yamamoto[c] / [a]Advanced Memory Development Center, Toshiba Memory Corp., [b]Hitachi, Ltd., [c]Hitachi High-Technologies Corp.

(25) *15:10* Development of standard sample for next generation pattern inspection tool
I. Susumu and T. Uchiyama / Nano-Defect Inspection Research Dept., Evolving nano process Infrastructure Development Center (EIDEC)

····· 15:35〜15:55 Authors corner & break ·····

Physical Analysis II — p.m., Tue 20

Chairman Yoichi Ose

(26) *15:55* Non-destructive, high throughput ultrahigh sensitivity micro x-ray fluorescence techniques as an alternative to SIMS for dopant and composition analysis
D.W. Yun, D.B. Stripe, S. Lewis, S. Lau, and X. Yang / Sigray, Inc.

(27) *16:20* Improved signal intensity in carrier distribution imaging of few-layer MoS2 by scanning nonlinear dielectric microscopy
K. Yamasue and Y. Cho / Research Institute of Electrical Communication, Tohoku Univ.

(28) *16:45* Development of 2D carrier distribution measurement method by simultaneous measurement of dC/dV (polarity) and dC/dz (density) based on SNDM
T. Yamaoka[a], K. Watanabe[b], S. Hasumura[b], R. Hirose[b], T. Ueno[b], and K. Mizuguchi[c] / [a]Application Development Dept., Hitachi High-Technologies, [b]Design Dept., Hitachi High-Tech Science, [c]Marketing Dept., Hitachi High-Technologies

(29) *17:10* Local evaluation of Al2O3 passivation layers for monocrystalline silicon solar cells by super-higher-order scanning nonlinear dielectric microscopy
K. Kakikawa[a], Y. Yamagishi[a], K. Tanahashi[b], H. Takato[b], and Y. Cho[a] / [a]Research Institute of Electrical Communication, Tohoku Univ., [b]Fukushima Renewable Energy Institute, Advanced Industrial Science and Technology

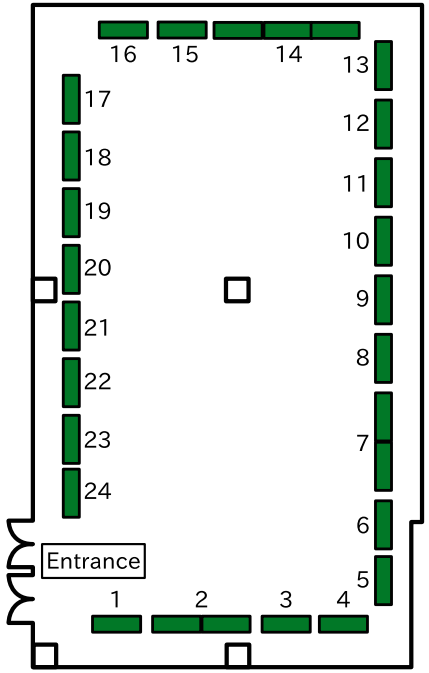
····· 17:35〜17:55 Authors corner ·····

20 Author Index

● Numbers show presentation numbers in the technical program.

21 Exhibition

Date & time:
Monday, 19 November 2018, 13:00–17:00
Tuesday, 20 November 2018, 9:00–16:00
Venue: KFC Hall Annex on 3rd floor



(The exhibition floorplan is subject to change without notice.)

1. TOKI COMMERCIAL CO., LTD:
   analysis probing system
2. HAMAMATSU PHOTONICS K.K.: C4
   Semiconductor Failure Analysis Systems
3. TOOL CORPORATION: C3
   Link Functions in LAVIS-plus
4. Astron, Inc: C2
   Navigation system AZSA
5. ITES Co., Ltd.:
   Failure analysis of power devices
6. Hitachi High-Technologies Corporation: C10
   Focused Ion and Electron Beam System Ethos NX5000
7. HiSOL, Inc.:
   HiSOL ANALYSIS
8. JEOL Ltd.:
   Introduction of analytical service in JEOL Ltd.

9. Canon Marketing Japan Inc.:
   Bring synchrotron XRF/XAS/XRM capabilities to your lab by Sigray, Inc.
10. aBeam Technologies Japan, Inc.:
   The Latest Products of aBeam Technologies
11. Nippon Scientific Co., Ltd.:
   Dry Decapper MP101
12. Marubun Corporation: C6
   Proposal of analysis solution
13. Oki Engineering Co., Ltd.:
   The New Failure Analysis System using Lock-In Thermal Emission
14. Thermo Fisher Scientific Group FEI Company Japan Ltd.: C7,C8,C11
   EFA systems, FIB, SEM and TEM Systems for Device Analysis and Circuit Edit
15. Infinite Solutions Inc.: C1
   Teseda DFT Analysis System & Nanotronics 3D Surface Measurement System
16. Nippon Barnes Co., Ltd.:
   The world's best resolution, Thermal analysis system "T-Imager"
17. BN TECHNOLOGY CORPORATION: C5
   Extreme precise lapping/polishing machine Bni series
18. Toshiba Nanoanalysis Corporaion:
   Services of visualizing current paths by magnetic field microscopy & observing internal structures by 3D X-ray microscopy
19. RKD Asia Pacific Corporation:
   The Industry Leader in Semiconductor Sample Preparation Equipment
20. Carl Zeiss Co., Ltd.:
   High resolution and nondistructive 3D failure analysis
21. TOYO Corporation: C9
   New SEM and FIB-SEM product
22. Renesas Engineering Services Co., Ltd::
   Intoroduction of device and element reliability evaluation and failure analysis.
23. NanoTech Solutions Inc.:
   TEM Holder for In-Situ testing on nanoscale (DENS Solutions)
24. Aitrans Corporation:
   Delayer product AP-1000

22 List of Associate Members

(in alphabetic order, 1 September 2018)

- aBeam Technologies, Inc.
- AD Science Co.
- ADVANTEST CORPORATION
- AITRANS corporation
- Applied Materials, Inc.
- ASTRON Inc.
- ATE Service Corp.
- BN TECHNOLOGY CORPORATION
- Carl Zeiss Co.,Ltd.
- Canon Marketing Japan Inc.
- FEI Company Japan Ltd.
- Hamamatsu Photonics K.K.
- HiSOL, INC.
- Hitachi High-Tech Science Corporation
- Hitachi High-Technologies Corporation
- Infinite Solutions Inc.
- ITES CO., Ltd.
- JEOL Ltd.
- MARUBUN CORPORATION
- Nano Tech Solutions Inc.
- NGR Inc.
- Nippon BARNES Company, Ltd.
- Nippon Scientific Co., Ltd
- Oki Engineering Co., Ltd.
- Oxford Instruments K.K.
- Park Systems Japan Inc.
- Renesas Engineering Services, Co., Ltd.
- Shining Technology Corporation
- Toki Commercial Co., Ltd.
- TOOL CORPORATION
- Toshiba Nanoanalysis Corporation
- TOYO Corporation
- YXLON International K.K.
- Zurich Instruments

(Rev.: 11-6–2018)