

The 42nd Annual NANO Testing Symposium



Senri Life Science Center
(Toyonaka, Osaka, Japan)
8–10 November 2022

<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

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1 Location

Technical Sessions:

Life Hall, the 5th floor, Senri Life Science Center
1-4-2, Shin-Senri-Higashi-Machi, Toyonaka
Osaka, 560-0082 JAPAN

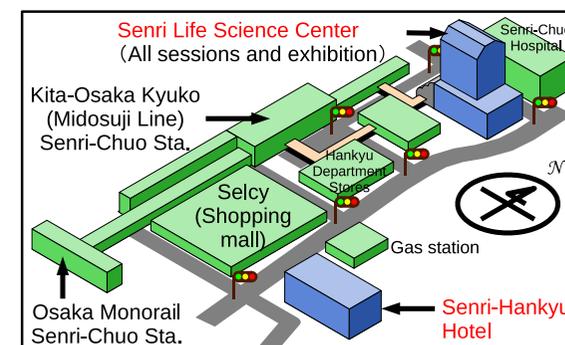
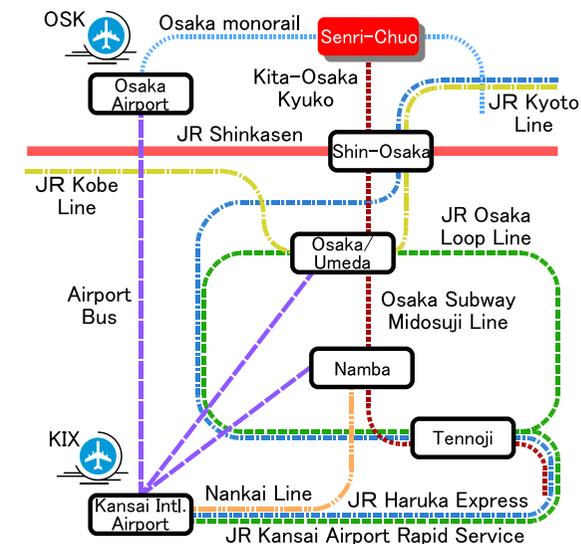
Phone: +81-6-6873-2010, FAX: +81-6-6873-2011

Exhibition:

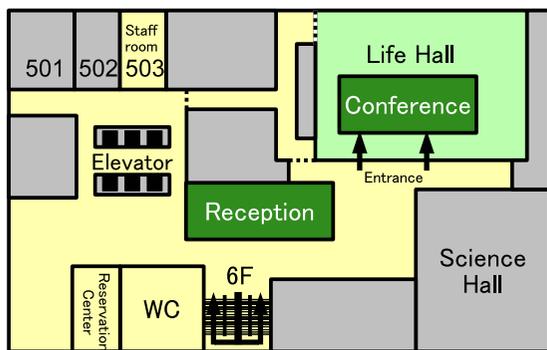
Senri Room, the 6th floor, Senri Life Science Center

Evening Session:

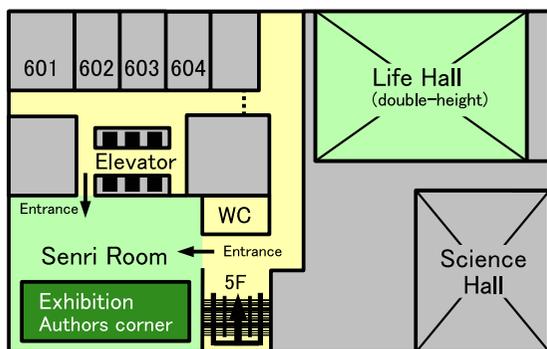
Life Hall, the 5th floor, Senri Life Science Center



2 Floor Map



Senri Life Science Center 5F



Senri Life Science Center 6F

3 Special Invited Talk

The following special invited talk will be given.

13:30–14:30, Wednesday, 9 November:

“Failure and Materials Analysis in the Logic Integrated Circuit Industry: Status and Challenges”

by Dr. David Su, *TSMC Retired*

4 Invited Talk

The following invited talks will be given.

9:30–10:30, Tuesday, 8 November:

“The manufacturing and future of sony CMOS image sensor”

by Dr. Yukihide KEIGO, *Sony Semiconductor Manufacturing Corp.*

16:00–17:00, Wednesday, 9 November:

“The future opened up by quantum information and quantum biology –Why quantum now?–”

by Prof. Masahiro KITAGAWA, *Grad. Sch. Engineering Science*

5 Tutorial Session

The following tutorial sessions will be given.

13:30–14:30, Tuesday, 8 November:

“Scanning probe microscope technologies for characterization and analysis of semiconductor materials and devices”

by Prof. Yasuo CHO, *Tohoku University New Industry Creation Hatchery Center*

9:30–10:30, Thursday, 10 November:

“Recent Trends in International Symposiums Related to Failure Analysis”

by Dr. Kiyoshi NIKAWA, *Device Evaluation Technology Laboratory*

6 Panel Discussion

A panel discussion on “Depth Electrical Failure Analysis Technology for Increasingly Complex Device Structures” will be held on Thursday, 10 November 15:50–16:50 in the conference hall (Life Hall on 5F).

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 commercial sessions) in Senri room on 6F.

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 18:00–19:00, Wednesday, 9 November (Life hall on 5F).

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 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.

11 Registration Fee

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

Please pay the fee by 21 October 2022 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 click “Pay Now” button after you finish on-line registration.

12 Symposium Registration

Please register on line by using our website: <http://www-NANOTS.ist.osaka-u.ac.jp/> by 21 October 2022 (punctuality).

For preventing COVID-19 infections, this symposium is for pre-registration only, and we will not accept participation on the day. Thank you for your understanding.

13 Cancellation Policy

Cancellations must be submitted in an e-mail. Cancellations received by 17:00, 21 October 2022 (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 21 October 2022 or who fail to attend the event.

14 Accommodation Information

There is Senri Hankyu Hotel around the symposium site. The hotel is located close to the symposium site. You can go to the symposium site from the hotel by 5 minutes walk. If you want to stay at Senri Hankyu Hotel, please visit the hotel's web site and book a room. Please keep in mind that the reservation will be closed in the case all available rooms are booked.

<http://www.senri-htl.co.jp/>

15 Proceedings

Technical papers will be provided on electronic media (download). Download information will be announced on November 3, 2022. The conference program will be provided on print media.

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 (MIRISE Technologies)
 Yasuhisa HIGUCHI (Hitachi, Ltd.)
 Kazunobu KOJIMA (Osaka University)
 Toru KOYAMA (Fuji Electric Co., Ltd.)
 Suigen KYOH (Kioxia Corp.)
 Hitoshi MAEDA (Renesas Electronics Corp.)
 Kiyoshi NIKAWA (Device Evaluation Technology Lab.)
 Yoichi OSE (Hitachi High-Tech Corp.)
 Hirotohi TERADA (Hamamatsu Photonics)
 Masahiko TSUJITA (Sony Semiconductor Manufacturing Corp.)
 Yuichiro YAMAZAKI (TASMIT Inc.)

18 Secretariat

Yoshihiro MIDOH and Koji NAKAMAE
 Secretariat of the Institute of NANO Testing
 Miura 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

Tuesday, Nov. 8, a.m. / Life Hall

- (1) Opening remarks
 9:20 K. Nakamae / Chairman, The Institute of NANO Testing

Invited Talk I a.m., Tue 8

Chairman Hirotohi Terada

- (I1) The manufacturing and future of sony CMOS image sensor
 9:30 Y. Keigo / Sony Semiconductor Manufacturing Corp.

..... 10:30~10:50 Authors corner & break

Metrology and Inspection a.m., Tue 8

Chairman Yuichiro Yamazaki

- (2) Domain adaptation for image classification with different physical noise characteristics
 10:50 D. Nishihara^(a), Y. Midoh^(a), Y. Ng^(b), O. Yamane^(b), G. Ito^(b), T. Fujiwara^(b), J. Shiomi^(a), and N. Miura^{(a) / (a)Grad. Sch. Information Science and Technology, Osaka Univ., (b)Institute of Memory Technology Research & Development, KIOXIA Corp.}
- (3) Development of in-line measurement method for transistor threshold voltage using SEM
 11:15 K. Nojima^(a), Y. Suzuki^(a), A. Hamaguchi^(a), M. Hosokawa^(b), and M. Kubo^{(b) / (a)Advanced Memory Development Center, KIOXIA Corp., (b)Advanced Process & Device Development Group, Western Digital}

..... 11:40~12:00 Authors corner & break

..... 12:00~13:30 Lunch Break

Tuesday, Nov. 8, p.m. / Life Hall

Tutorial I p.m., Tue 8

Chairman Yasunori Goto

- (T1) Scanning probe microscope technologies for characterization and analysis of semiconductor materials and devices
 13:30 Y. Cho / New Industry Creation Hatchery Center, Tohoku Univ.

..... 14:30~14:50 Authors corner & break

Power Device Analysis I p.m., Tue 8

Chairman Toru Koyama

- (4) Defective analysis of reverse IV characteristics in GaN schottky barrier diodes
 14:50 Y. Goto, K. Watanabe, Y. Nagasato, and H. Fujiwara / MIRISE Technologies

- (5) P/N junction visualization of semiconductor devices using DPC/iDPC/dDPC technique
15:15 N. Nakanishi^(a), H. Maeda^(b), S. Sadayama^(a), K. Kawano^(a), and Y. Kunimune^{(b) / (a)} NanoPort Japan, Thermo Fisher Scientific, ^(b)Analysis & Evaluation Technology Dept., Renesas Electronics Corp.

..... 15:40~16:00 Authors corner & break

Power Device Analysis II p.m., Tue 8

Chairman Yasuhisa Higuchi

- (6) Nanoscale fluctuation analysis on capacitance-voltage profiles of SiO₂/SiC by time-resolved scanning nonlinear dielectric microscopy
16:00 K. Yamasue^(a) and Y. Cho^{(b) / (a)} Research Institute of Electrical Communication, Tohoku Univ., ^(b)New Industry Creation Hatchery Center, Tohoku Univ.

- (7) Characterizations of deep defects in homoepitaxially grown B-doped diamond crystal
16:25 O. Maida, S. Ichikawa, and K. Kojima / Grad. Sch. Engineering, Osaka Univ.

..... 16:50~17:10 Authors corner & break

Wednesday, Nov. 9, a.m. / Life Hall

FIB & Application a.m., Wed 9

Chairman Yoichi Ose

- (8) Improved alignment method for FIB sampling
9:30 M. Kaneko / Research Organization for Advanced Engineering, Shibaura Institute of Technology
- (9) VC imaging by Xe plasmaFIB
9:55 S. Sadayama, K. Kawano, and N. Nakanishi / Nanoport Japan, ThermoFisher Scientific

..... 10:20~10:40 Authors corner & break

Commercial Session a.m., Wed 9

Chairman Hitoshi Maeda

- (C1) Introduction of TDR (time domain reflectometry) analysis service using terahertz technology
10:40 K. Inomata, H. Kawahara, and H. Tsukui / Evaluation Analysis Dept., Renesas Engineering Services Co., Ltd.

- (C2) Analysis for electro-magnetic noise -3D imaging-
10:48 H. Murai and T. Ajioka / SDK, Inc.

- (C3) Introduction of hamamatsu emission microscope with X platform
10:56 M. Fujiwara, A. Kataoka, K. Kudo, and S. Suzuki / Business Promotion 3rd Dept., System Div., Hamamatsu Photonics

- (C4) CAD-navigation system AZSA-HS
11:04 K. Konishi / Sales Gr, Astron. Inc.

- (C5) Approach to massive data acquisition by FE-SEM
11:12 Y. Takahoko^(a), S. Takeuchi^(a), and S. Tachibana^{(b) / (a)} Beam Technology & Analytical Systems Product Div., Solution Development Dept., Hitachi High-Tech, ^(b)Beam Technology Systems Business Div., Business Planning for Beam Technology Systems Dept., Hitachi High-Tech

- (C6) Introduction of FE-SEM JSM-IT800<i>/</i> that can observe of the entire surface for 8 inch wafer
11:20 N. Asano, Y. Okano, T. Fukuda, and S. Asahina / EP Business Unit, JEOL Ltd.

- (C7) Derivation of switching waveforms from internal-cell layout
11:28 M. Nikaido, T. Takahashi, Y. Sawamura, and K. Hirai / EDA Product Div., TOOL Corp.

- (C8) NANO robotics solutions for electron microscopes
11:36 Y. Nakayama / Sales Dept, APOLLOWAVE Corp.

- (C9) Advanced electrical characterization and visualization of defects through nanoprobeing and in situ conductive AFM
11:44 G. Johnson / Research Microscopy Solutions, Carl Zeiss Microscopy LLC

- (C10) Centrios HX introduction
11:52 H. Tanaka^(a), J. Miller^(b), and D. Pan^{(c) / (a)} Field Application, FEI Company Japan Ltd., ^(b)Analytical Instruments Materials and Structural Analysis, Thermo Fisher Scientific, ^(c)Applied Materials

- (C11) Introduction of helios 5 laser PFIB expanding analytical capability
12:00 K. Murata / Electronics Sales Development, Thermofisher Scientific

- (C12) 3D chemical mapping by SPECTRAL CT
12:08 Y. Kodama, T. Okawa, and N. Suzuki / LifeScience & Materials, TOYO Corp.

- (C13) High-precision evaluation of SiC power device by SIMS
12:16 H. Yuutaro / Toshiba nanoanalysis

..... 12:24~13:30 Lunch Break

Wednesday, Nov. 9, p.m. / Life Hall

Special Invited Talk p.m., Wed 9

Chairman Yasuo Cho

- (S1) Failure and materials analysis in the logic integrated circuit industry: Status and challenges
13:30 D. Su / TSMC Retired

..... 14:30~14:50 Authors corner & break

Fault Localization p.m., Wed 9

Chairman Kiyoshi Nikawa

- (10) Low temperature failure analysis with high resolution for quality level of automotive image sensor
14:50 H. Fujita, M. Tsujita, K. Itami, K. Ishibuchi, T. Nukumizu, and T. Kawamura / Device Engineering Div. Device Analysis Engineering Dept., Sony Semiconductor Manufacturing Corp.

- (11) TFI, LLSI, and ESLIT for fault localization in advanced FinFET devices
15:15 N. Matsui, S. Wada, and Y. Oka / Evaluation Analysis Dept., Renesas Engineering Services

..... 15:40~16:00 Authors corner & break

Invited Talk II p.m., Wed 9

Chairman Koji Nakamae

- (12) The future opened up by quantum information and quantum biology –why quantum now ?—
16:00 M. Kitagawa^{(a)(b) / (a)} Grad. Sch. Engineering Science, Osaka Univ., ^(b)Center for Quantum Information and Quantum Biology, Osaka Univ.

..... 17:00~17:20 Authors corner & break

17:20~18:00 NANOTS2021 Awards, Group Photo, Networking

Evening Session

p.m., Wed 9

Chairman Hirotooshi Terada

18:00 Evening session of NANOTS is a special session for
discussing on research trend around the world and the
future perspective.

19:00

Location:

Life Hall

Program:

- International trends in failure analysis
(K. Nikawa)

..... 19:00 Close

Thursday, Nov. 10, a.m. / Life Hall**Tutorial II**

a.m., Thu 10

Chairman Hirotooshi Terada

(T2) Recent trends in international symposiums
related to failure analysis

K. Nikawa / Device Evaluation Technology Laboratory

..... 10:30~10:50 Authors corner & break

Data Analysis

a.m., Thu 10

Chairman Yoichi Ose

(12) Data-driven search algorithm of multiple
governing equations from complex system data

Y. Midoh, T. Takemoto, J. Shiomi, and N. Miura / Grad. Sch. Information Science and Technology, Osaka Univ.

(13) A study on improving accuracy of LSM image
positioning to layout using deep learning

S. Nomura, N. Matsui, S. Wada, and Y. Oka / Evaluation Analysis Dept., Renesas Engineering Services Co., Ltd.

..... 11:40~12:00 Authors corner & break

..... 12:00~13:30 Lunch Break

Thursday, Nov. 10, p.m. / Life Hall**Physical Analysis I**

p.m., Thu 10

Chairman Suigen Kyoh

(14) Cross-sectioning with broad Ar ion beam of
aimed internal structure by microfocus X-ray CT
system

Y. Nakajima^(a), R. Masuko^(b), and A. Shunsuke^(a) /
^(a)JEOL, ^(b)JEOL

(15) Two-photon photoemission spectroscopy for
evaluation of surface carrier recombination
lifetime of GaAs (110)

S. Ichikawa, O. Maida, and K. Kojima / Grad. Sch.
Engineering, Osaka Univ.

..... 14:20~14:40 Authors corner & break

Physical Analysis II

p.m., Thu 10

Chairman Kazunobu Kojima

(16) Variation reduction technique for low-irradiation
STEM-EDS mapping

T. Ide, T. Takahashi, Y. Shimada, A. Sugiyama,
H. Maeda, and Y. Kunimune / Analysis and Evaluation
Technology Div., Renesas Electronics

(17) Analysis method by wet etching for junction
leak of semiconductor device using silicide
process

K. Komatsu, H. Maeda, and K. Arima / Analysis &
Evaluation Technology Dept. Device Technology Dev.
Production and Technology Unit., Renesas Electronics
Co., Ltd.

..... 15:30~15:50 Authors corner & break

Panel Discussion

p.m., Thu 10

15:50 Theme: Depth Electrical Failure Analysis
/ Technology for Increasingly Complex Device
Structures

Moderator: Masahiko TSUJITA / Sony Semiconductor
Manufacturing Corp.

(P1) Defect Z-depth determination using lock
in-thermography

H. Tanaka / Field Application, FEI Company Japan Ltd.

(P2) TBD

N. Chinone / Systems Div., Hamamatsu Photonics K. K.

(P3) Failure analysis of 3D NAND flash memory
using nano-prober and FIB-SEM

Y. Ii and T. Kuboyama / Hitachi High-Tech Corp.

..... 16:50~17:10 Networking with panelists

(18) Closing remarks

17:10 K. Nakamae / Chairman, The Institute of NANO Testing

20 Author Index

• Numbers show presentation numbers in the technical program.

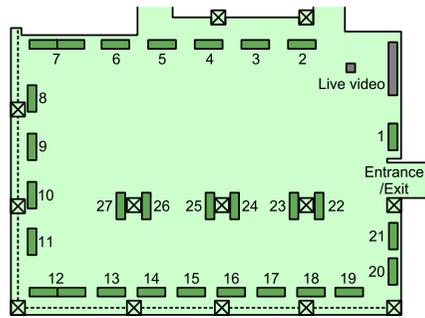
A-D	Kawano, K. 5, 9	Nomura, S. 13
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Johnson, G. C9	Nikawa, K. T2	Watanabe, K. 4
Kaneko, M. 8	Nishihara, D. 2	Yamane, O. 2
Kataoka, A. C3	Nojima, K. 3	Yamasue, K. 6
Kawahara, H. C1		Yuutaro, H. C13
Kawamura, T. 10		

21 Exhibition

Date & time:

Tuesday, 8 November 2022, 13:00–17:00
Wednesday, 9 November 2022, 9:30–17:00
Thursday, 10 November 2022, 9:30–17:00

Venue: Senri room on 6rd floor



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

1. ITES Co., Ltd.:
Introduction of power semiconductor evaluation and analysis
2. Hitachi High-Tech Corporation: (C5)
Innovation, Synergy, Solutions - New EM Lineup
3. Hanwa Trading Corporation:
Signatone, Probe Station and Micro positioner
4. ASTRON, Inc: (C4)
CAD-Navigation system AZSA-HS
5. Nippon Barnes Company Ltd.:
Lock-in Thermography “NBC LIT SCOPE II”
6. Hightec Systems Corporation:
JIACO MIP Decapsulation System & Neocera Magma MFI For Failure Analysis
7. Thermo Fisher Scientific: (C10)(C11)
EFA systems, FIB, SEM and TEM systems for Device Analysis and Circuit Edit
8. APOLLOWAVE Corporation: (C8)
NANO ? Robotics Solutions for Electron Microscopes
9. Park Systems Japan Inc.:
Park AFM Failure Analysis
10. Carl Zeiss Co., Ltd.: (C9)
FIB-SEM with fs laser for high throughput 3D analysis and lamella preparation
11. TOYO Corporation: (C12)
TESCAN FIB-SEM system and SPECTRAL CT

12. HiSOL, Inc.:
Total Solution for Failure Analysis Process
13. Semilab Japan:
Defect Inspection Tool En-Vison
14. Nippon Scientific Co., Ltd.:
Laser Decap System PL201D and others
15. LTEC Corporation:
Device reverse engineering service
16. Renesas Engineering Services Co., Ltd.: (C1)
Introduction of TDR (Time Domain Reflectometry) analysis service using terahertz technology
17. TOOL Corporation: (C7)
Advanced Failure Analysis Technique using LAVIS-plus
18. Hamamatsu Photonics K.K.: (C3)
Semiconductor failure analysis systems
19. TOKI COMMERCIAL CO., LTD.:
Semiconductor Failure Analysis Tools
20. JEOL Ltd.: (C6)
Electron microscope for failure analysis
21. Nano Tech Solutions Inc.:
Pulse Laser based Sample Preparation microPREP PRO
22. Sankyo Densai: (C2)
EMC 3D imaging system
23. Hakuto Co., Ltd.:
Denton 社製 Ion Beam Delaying
24. Kobelco Research Institute, Inc:
Combining multiple analysis methods for power devices
25. TOSHIBA NANOANALYSIS CORPORATION: (C13)
High value-added 3D nano-level analysis
26. Oki Engineering Co., Ltd.:
Nonvolatile memory eMMC performance evaluation
27. Marubun corporation:
Failure analysis solution

22 List of Associate Members

(in alphabetic order, 15 September 2022)

- Aamilia Japan G.K.
- AD Science Co.
- ADVANTEST CORPORATION
- AITRANS corporation
- APOLLOWAVE Corp.
- Applied Materials, Inc.

- ASTRON Inc.
- ATE Service Corp.
- Atomicscale Electromagnetic Field Analysis Platform
- Canon Marketing Japan Inc.
- Carl Zeiss Co.,Ltd.
- FEI Company Japan Ltd.
- Hakuto Co., Ltd.
- Hamamatsu Photonics K.K.
- Hanwa Trading Corp.
- HiSOL, INC.
- Hitachi High-Tech Science Corporation
- Hitachi High-Tech Corporation
- Hightec Systems Corp.
- ITES CO., Ltd.
- JEOL Ltd.
- KOBELCO RESEARCH INSTITUTE, INC.
- LTEC Co.
- MARUBUN CORPORATION
- Nano Tech Solutions Inc.
- NIKON SOLUTIONS CO., LTD.
- Nippon BARNES Company, Ltd.
- Nippon Scientific Co., Ltd
- Oki Engineering Co., Ltd.
- Park Systems Japan Inc.
- Renesas Engineering Services, Co., Ltd.
- SDK, Inc.
- Semilab Japan
- Shining Technology Corporation
- TASMIT, Inc.
- Toki Commercial Co., Ltd.
- TOOL CORPORATION
- Toshiba Nanoanalysis Corporation
- TOYO Corporation

(Rev.: 10-28-2022)