2022 FCMN Program

Monday, June 20

Tutorials
2:00 PM – 4:00 PM
Machine Learning
Instructors: Bryan Barnes (NIST) and Ali Mesbah (UC Berkeley)

4:00 PM – 6:00 PM
Metrology Techniques
Instructors: Paul van der Heide (Imec) and Alain Diebold (CNSE, SUNY Polytechnic Institute)

Reception and Registration
7:00 – 9:00 PM
Monterey Marriott

Tuesday, June 21

Registration
7:00 AM – 8:30 AM

Conference Opening
9:00 AM
Conference Opening
J. Alexander Liddle, NIST, Conference Co-Chair

Plenary
Session Chairs: J. Alexander Liddle (NIST) and Alain Diebold (CNSE, SUNY Polytechnic Institute)

9:15 AM
Dan Hutcheson, TechInsights, Heterogeneous Globalization: How the Structural Challenges with Integration, Geopolitics, Markets, and Business Will Affect Metrology in the Coming Years

10:00 AM
Coffee Break and Poster/Exhibit Viewing
10:30 AM
Rajiv Joshi, IBM, “From Deep Scaling to Deep Learning”

11:15 AM
Jeffrey Welser, IBM, “TBD”

12:00 PM – 1:30 PM
Lunch and Poster/Exhibit Viewing

Industry Trends
Session Chairs: Paul van der Heide (Imec) and Markus Kuhn (Intel)

1:30 PM
Sang Hyun Han, Nova, “A New Paradigm of Process Control Solutions for Advanced Semiconductor Devices”

2:00 PM
Jon Madsen, KLA Corporation, “CD-SAXS Technology and Other Disruptive Inline Metrologies”

2:30 PM
David Fried, Lam Research, “SEMulator3D and Introduction of Virtual Metrology”

3:00 PM
Coffee Break and Poster/Exhibit Viewing

Microscopies I: New Developments in Chemical/Property Characterization
Session Chairs: Markus Kuhn (Intel) and Songhee Han (Samsung)

3:30 PM
Juliette van der Meer, Bruker, “Latest Developments in X-ray Metrology for Semiconductor Structures”

4:00 PM
Umberto Celano, Imec, “The Reverse-Sample-Tip SPM approach: A Paradigm Shift in Data Collection”

4:30 PM
June Lau, National Institute of Standards and Technology, “Time-Resolved Transmission Electron Microscopy from 1 Hz to 10 GHz in Stroboscopic Mode”

5:00 – 6:30 PM
Poster Session (with Drinks and Hors d’oeuvres)

6:45 PM
Banquet at Hotel
Wednesday, June 22

Registration
7:45 AM – 8:30 AM

Tomographies: New Developments in 3D Analysis
Session Chairs: Frank de Jong (Thermo Fisher) and Ehrenfried Zschech (deepXscan)

8:30 AM
David Larson, Cameca Instruments, Inc., New Developments in Atom Probe Tomography

9:00 AM
Jean-Paul Barnes, CEA-Leti, “New Developments in Analytical 3D TEM/STEM Tomography”

9:30 AM
David Tien, ThermoFisher, “High Volume 3D SEM Metrology on Advanced Memory and Logic Devices”

10:00 AM
Coffee Break and Poster/Exhibit Viewing

New Developments in Chemical/Electrical Characterization
Session Chairs: Paul van der Heide (Imec) and Baohua Niu (TSMC)

10:30 AM
Brian Gorman, Colorado School of Mines, “Methods for Achieving Atomic-Scale Analytical Tomography”

11:00 AM

11:30 AM
Olivier Renault, CEA-Leti, “Photoelectron Spectroscopy in Device Technology: from XPS to HAXPES”

12:00 – 1:30 PM
Lunch and Poster/Exhibit Viewing

Microscopies II: New Developments in Dimensional Characterization
Session Chair: Ofer Adan (AMAT)

1:30 PM

2:00 PM
Joseph Kline, NIST, “Xray Metrology Challenges for the Semiconductor Industry”

2:30 PM
Coffee Break and Poster/Exhibit Viewing
New Techniques for Emerging Devices / Beyond CMOS  
Session Chair: Ye Feng (Lam Research)

3:00 PM  
Vimal Kamineni, PSIQuantum, “Characterization and Metrology for Silicon Photonic Quantum Computing”

Advanced Manufacturing Metrology  
Session Chair: Tuyen Tran (Intel)

3:30 PM  
Yalin Xiong, KLA-Tencor, “Using Deep-wavelength Brightfield Inspection on EUV Printcheck and High NA EUV Development”

4:00 PM  
Tomek Brozek and Marcin Strojwas, PDF Solutions, “Observing Invisible Electrical Fails with eBeam DirectScan”

4:30 PM  

5:00 – 6:30 PM  
Poster Session (with Drinks and Hors d’oeuvres)

Thursday, June 23

Registration  
8:00 AM – 8:30 AM

EUV and Advanced Patterning  
Session Chair: Alain Diebold (CNSE, SUNY Polytechnic Institute)

8:30 AM  
Christina Porter, ASML, “Characterization and Metrology for EUV Implementation”

9:00 AM  
Andy Antonelli, ONTO, “Extending Optical Critical Dimension Metrology into the Mid-Infrared Range”

9:30 AM  
Ofer Adan, AMAT, “CD-SEM and e-Beam Overlay”

10:00 AM  
Coffee Break and Poster/Exhibit Viewing
Advanced Packaging  
Session Chairs: Ehrenfried Zschech (deepXscan)

10:30 PM  

11:00 AM  
**Kristina Kutukova**, *Fraunhofer IKTS*, “In-situ Micro-DCB / Nano-XCT Test to Ensure the Robustness of Leading-edge Cu/ULK BEOL Stacks”

11:30 AM  
**WenBing Yun**, *Sigray*, “High Throughput X-ray Imaging Systems for Wafer Level Packaging Applications”

12:00 – 1:30 PM  
Lunch and Poster/Exhibit Viewing

Emerging Materials and Devices  
Session Chair: Jean-Paul Barnes

1:30 PM  
**Thomas Nuytten**, *Imec*, “Raman and PL for Nanoscale Materials Characterization and Metrology”

2:00 PM  
**Peter Hopkins**, *National Institute of Standards and Technology*, “Measurement Challenges for Scaling Superconductor-based Quantum Computers”

2:30 PM  
**Paul van der Heide**, *Imec*, “Characterization of 2D Materials by ARPES”

3:00 PM  
Coffee Break and Poster/Exhibit Viewing

Spintronics-Based Devices  
Session Chair: Ajey Jacob (University of Southern California)

3:30 PM  
**Mathieu Munsch**, *Qnami*, “Development of NV Magnetometry for Spin Mapping at the Atomic Scale”

4:00 PM  
**David Cooper**, *CEA-Leti*, “TEM Imaging of Magnetic Domains, Memory Devices, etc.”
001, Thin EUV Photoresist Layers for Microelectronic Devices: Pivotal Benefits of the Orbitrap™ Mass Analyzer for Accurate Analysis
V. Spampinato¹, A. Franquet¹, D. De Simone¹, I. Pollentier¹, A. Pirkl², H. Oka³, and P. van der Heide¹
¹IMEC, Kapeldreef 75, 3001 Leuven, Belgium
²IONTOF GmbH, 48149 Muenster, Germany
³Electronic Materials Research Laboratories, FUJIFILM Corporation, Shizuoka 421-0396, Japan

C. Guyot, N. Gambacorti, J.P. Barnes, O. Renault, and T. Maindron
Univ. Grenoble Alpes, CEA, Leti, F-38000 Grenoble, France

003, Scanning Microwave Impedance Microscopy for Nanoscale Characterization and Metrology of Semiconductor Devices
Nicholas Antoniou¹ and Peter De Wolf²
¹PrimeNano Inc. 4701 Patrick Henry Dr., Santa Clara, CA
²Bruker Nano Surfaces & Metrology, 112 Robin Hill Road, Santa Barbara, CA

004, A Correlative Metrology Flow for Grains Analysis in Poly-Si Vertical Channel of 3D NAND Architectures
U. Celano¹,², T. Hantschel¹, D. Verreck¹, S.V. Palayam¹, A. Arreghini², A.D.L. Humphris³,⁴, M. Tedaldi³, C. O’Sullivan³, J.P. Hole³, P. Favia³, C. Drijbooms¹, G. Van den bosch³, M. Rosmeulen¹, and P. van der Heide¹
¹imec, Leuven, Belgium
²University of Twente, Enschede, The Netherlands
³Infinitesima Ltd., Hitching Court, Abingdon UK
⁴School of Physics, University of Bristol

005, Dopant Activation Evaluation in Si:P by Scanning Spreading Resistance Microscopy and Differential Hall Effect Metrology
Abhijeet Joshi¹, Umberto Celano²,³, Lennaert Wouters², Alexis Franquet², Valentina Spampinato², Paul van der Heide², Marc Schaeckers³, and Bulent M. Basol¹
¹Active Layer Parametrics (ALP), Scotts Valley, CA
²IMEC, Kapeldreef 75, 3001, Leuven, Belgium
³Faculty of Science and Technology and MESA+ Institute for Nanotechnology, University of Twente, Enschede, The Netherlands

006, Comparison of Dopant Activation in Si as Characterized by Spreading Resistance Profiling (SRP) and Differential Hall Effect Metrology (DHEM)
Kun-Lin Lin¹, Chia-He Chang², Abhijeet Joshi³, and Bulent M. Basol²
¹Taiwan Semiconductor Research Institute (TSRI), National Applied Research Laboratories, Hsinchu 300091, Taiwan
²Active Layer Parametrics (ALP), 5500 Butler Lane, Scotts Valley, CA
007, Improved Geometrical Correction in Micro Four-point Probe Measurements with Three Omega Correction
Neetu Rani Lamba, Braulio Beltrán-Pitarch, Benny Guralnik, Ole Hansen, Nini Pryds, and Dirch Hjorth Petersen
1Department of Energy Conversion and Storage, Denmark Technical University (DTU), Building 310, DK-2800 Kgs Lyngby, Denmark
2CAPRES - a KLA company, Diplomvej 373B, DK-2800 Kgs. Lyngby, Denmark

008, AKONIS: SIMS Excellence Brought To The Fab
AS. Robbes, O. Dulac, K. Soulard, R. Liu, S. Choi, and D. Jacobson
1CAMECA, 29 quai des grésillons 92622 Gennevilliers Cedex
2CAMECA Instruments Inc., 5500 Nobel Drive, Madison, WI, USA

009, Successes and Challenges in Applications of a Laboratory-Based Scanning XPS/HAXPES Instrument
K. Artyushkova, J.E. Mann, B. Schmidt, A. Vanleenhove, T. Conard, P. -M. Deleuze, and O. Renault
1Physical Electronics Inc., 18725 Lake Drive E, Chanhassen, MN 55317, USA
2IMEC, 3001 Leuven, Belgium
3Univ. Grenoble-Alpes, CEA, Leti, 38000 Grenoble, France

010, Characterization of Electronic Materials Using the PHI VersaProbe 4 Multi-Technique XPS Scanning Microprobe
J. E. Mann, B. Schmidt, and K. Artyushkova
Physical Electronics, 18725 Lake Drive East, Chanhassen, MN

011, Robust, Quantitative IR-AFM For Use In An In-FAB Multimodal Metrology Scheme
M.S. Selman, R.W. Herfst, D. Piras, S. van Luijn, and M.H. van Es
1Optomechatronics, TNO, Stieltjesweg 1, 2628CK, Delft, The Netherlands
2Optics, TNO, Stieltjesweg 1, 2628CK, Delft, The Netherlands

012, Mueller-matrix Scattered-field Microscopy for the Measurement of Finite Deep Sub-wavelength Nanostructures
Xiuguo Chen, Cai Wang, Tianjuan Yang, Jing Hu, Jiahao Zhang, and Shiyuan Liu
State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, Wuhan 430074, China

013, A See-Through Metrology Toolbox for Fast Gate-All-Around Device Characterization
1imec, Leuven, Belgium
2Nova Measuring Instruments Ltd., Israel
3Applied Materials Israel, Ltd. (Israel)
014, In-line Multi-scale Thickness And Roughness Characterization For FD-SOI HVM
E. Cela, J.-M. Billiez, M. Bene, and O. Pfersdorff
SOITEC, Parc Technologique des Fontaines, 38190 Bernin, France

015, Thin Films and Nano-gratings Study Using X-ray Standing Waves Excited by an in-lab X-ray Source
K. Matveevskii¹, K.V. Nikolaev², S.N. Yakunin², R. Fallica³, M.D. Ackermann¹, and I.A. Makhotkin¹
¹MESA+ Institute for Nanotechnology, University of Twente, Enschede, the Netherlands
²NRC Kurchatov Institute, Moscow, Russia
³IMEC, Leuven, Belgium

J-P Barnes¹, Y. Mazel¹, A. Tempez², S. Legendre³, and E. Nolot¹
¹Univ. Grenoble Alpes, CEA, Leti, F-38000 Grenoble, France
²HORIBA France SAS, Palaiseau, France

017, Turn-Key Compressed Sensing System for Electron Microscopy
E.L. Principe¹, J.J. Hagen¹, B.W. Kempshall², K.E. Scammon², Z. Russel³, M. Therezien³, T. McIntee³, S. DiDonna³, and A. Stevens⁴
¹Synchrotron Research, Inc.
²PanoScientific, LLC
³Ion Innovations
⁴Optimal Sensing

018, SEM Charging of Floating Metal Structures in Dielectric
Matthew Hauwiller¹, Charlie Mann¹, Luca Grella², Kai Zhu², Liang Huang², Peter Mach¹, Tony Gao¹, Brent Voigt¹, and Karen Terry¹
¹Seagate Technology, 7801 Computer Ave, Minneapolis, MN
²KLA Corporation, 1 Technology Dr, Milpitas, CA

019, An Analysis of Polymer Nanoparticle Size Distribution Using Cryo-EM and a Comparison to Other Techniques
Suwen Liu, Courtney Culkins, Audrey Froelich, and Benjamin Newcomb
Entegris, Inc. 129 Concord Road, Billerica, MA

020, Actinic EUV Mask Inspection via Coherent Diffractive Imaging Using Tabletop High Harmonic Sources
Bin Wang¹, Michael Tanksalvala¹, Nathan Brooks¹, Clayton Bargsten², Grant Buckingham², Margaret Murnane¹, and Henry Kapteyn¹,²
¹JILA, University of Colorado Boulder and NIST, 440 UCB, Boulder, CO
²KMLabs Inc., 4775 Walnut St., Building 102, Boulder, CO

021, Localization Microscopy for Nanoelectronic Manufacturing
Craig R. Copeland, Ronald G. Dixson, Andrew C. Madison, Adam L. Pintar, B. Robert Ilic, and Samuel M. Stavis
National Institute of Standards and Technology, Gaithersburg, MD
022, An Unconventional Tradespace of Focused-Ion-Beam Machining
Andrew C. Madison\textsuperscript{1}, John S. Villarrubia\textsuperscript{1}, Kuo-Tang Liao\textsuperscript{1,2}, Joshua Schumacher\textsuperscript{1}, Kerry Siebein\textsuperscript{1}, B. Robert Ilic\textsuperscript{1}, J. Alexander Liddle\textsuperscript{1}, and Samuel M. Stavis\textsuperscript{1}
\textsuperscript{1}National Institute of Standards and Technology, Gaithersburg, MD
\textsuperscript{2}University of Maryland, College Park, MD

023, X-ray CD: Powerful Metrology Solution for HAR Memory Structure
Jin Zhang, Khaled Ahmadvai, Peter Kawakami, Oscar del Carpio, Leandro Campos, Matt Davis, and Osman Sorkhabi
Lam Research Corporation, Fremont, CA

024, Slicing Through Thin Samples at Atomic Resolution
Ioannis Alexandrou\textsuperscript{1}, Maarten Wirix\textsuperscript{1}, and Sean Zumwalt\textsuperscript{2}
\textsuperscript{1}Thermo Fisher Scientific, De Schakel 2, 5651 GH, Eindhoven, The Netherlands
\textsuperscript{2}Thermo Fisher Scientific, 5350 NE Dawson Creek Dr, Hillsboro, OR 97124, USA

025, Defect Inspection in Semiconductor Image Using Histogram Fitting and Neural Networks
Jinkyu Yu\textsuperscript{1}, Songhee Han\textsuperscript{2}, and Chang-Ock Lee\textsuperscript{1}
\textsuperscript{1}Department of Mathematical Sciences, KAIST, Daejeon 34141, Korea
\textsuperscript{2}Samsung Electronics, Yongin, Kyungki-do 17113, Korea

026, Modeling and Model Validation for Electron Beam Nanometrology
John S. Villarrubia, Glenn Holland, and András E. Vladár
National Institute of Standards and Technology, Microsystems and Nanotechnology Division, 100 Bureau Dr., Gaithersburg, MD

027, A Metrology Scanning Electron Microscope for Traceable Measurements
Bradley Damazo\textsuperscript{1}, András E. Vladár\textsuperscript{1}, Olivier Marie-Rose\textsuperscript{2,1} and John Kramar\textsuperscript{1}
\textsuperscript{1}National Institute of Standards and Technology, Microsystems & Nanotechnology Division, 100 Bureau Drive Gaithersburg, MD
\textsuperscript{2}Prometheus Computing, LLC, 110 Buzzard's Roost Road, Cullowhee, NC

028, Oxidation of Copper in the Presence of Graphene
Mykhailo Savchak, Ieva Narkeviciute, and Bhadri Varadarajan
Lam Research Corporation, Tualatin, OR

029, Studying Diamond Content In Microwave Nanocrystalline Diamond Film by XRD and Ellipsometer
Lixia Rong, Thai Cheng Chua, Christian Valencia, Vicknesh Sahmuganathan, and Biao Liu
Applied Materials, 3100 Bowers Avenue, Santa Clara, CA

030, Quantifying & Controlling 3D Device Processes With Mass Metrology
Hendrik Hans\textsuperscript{1} and Pierre Morin\textsuperscript{2}
\textsuperscript{1}Lam Research
\textsuperscript{2}Imec
031, **Operando Metrology for Real Time Monitoring of Complex Optical Stacks**  
R. Elizalde1, J.-P. Nieto1, C. Licitra1, J. Fort2, K. Paul2, T. Egan2, E. Budiarto2, and E. Nolot1  
1Univ. Grenoble Alpes, CEA, Leti, F-38000 Grenoble, France  
2Applied Materials

032, **Full Wafer Process Control Through Object Detection Using Region-Based Convolutional Neural Networks**  
Thomas Alcaire1,2, Delphine Le Cunff1, Jean-Hervé Tortai2, Sebastien Soulan2, Virginie Brouzet1, Romain Duru1, and Christophe Euvrard1  
1STMicroelectronics, 38920 Crolles, France  
2Univ. Grenoble Alpes, CNRS, CEA/LETI-Minatec, Grenoble INP, LTM, F-38054 Grenoble, France

033, **Metrological Software Platform to Speed Up Characterization Time and Accuracy for Semiconductor**  
Julien Baderot, Hervé Ozdoba, Bertrand Darbon, Sergio Martinez, and Johann Foucher  
Pollen Metrology 122 Rue du Rocher de Lorzier, Novespace A, 38430 Moirans France

034, **Liquid-metal-jet and High-resolution X-ray Technology for Nanoelectronics Characterization and Metrology**  
Bjorn Hansson, Emil Espes, Julius Hallstedt, and Anasuya Adibhatla  
Excillum AB, Jan Stenbecks Torg 17, SE-164 40, Kista, Sweden

035, **Temperature Dependent Thermal Conductivity Measurements of Thin Oxide Films Via Steady State Thermoreflectance - WITHDRAWN**  
John T. Gaskins, David H. Olson, Taylor M. Bates, and Patrick E. Hopkins  
Laser Thermal Analysis, Inc., 937 2nd St. SE Charlottesville, VA

036, **EUV Mask Actinic Defect Inspection and Ptychographic Review with Vectorial CDI Method**  
Chuangchuang Chen, Wenjie Li, Pinxuan He, Honggang Gu, and Shiyuan Liu  
State Key Laboratory of Digital Manufacturing Equipment and Technology, Huazhong University of Science and Technology, Wuhan, Hubei 430074, China

037, **EUV Imaging Reflectometer for Non-Destructive Compositional Mapping of Nanoelectronics**  
Yuka Esashi1, Michael Tanksalvala1, Nicholas W. Jenkins1, Christina L. Porter1, Galen P. Miley2, Bin Wang1, Naoto Horiguchi3, Matthew N. Jacobs1, Michael Gerrity1, Henry C. Kapteyn1,4, and Margaret M. Murnane1  
1STROBE Science and Technology Center, JILA, University of Colorado Boulder, 440 UCB, Boulder, Colorado  
2Department of Chemistry, Northwestern University, 2145 Sheridan Road, Evanston, IL  
3Imec, Kapeldreef 75, 3001 Leuven, Belgium  
4KMLabs, Inc., 4775 Walnut St., Suite 102, Boulder, Colorado
038, Half Wavelength Contact Acoustic Microscopy (HaWaCAM): a Novel Semiconductor Metrology Technique
P.L.M.J. van Neer1,2, B.A.J. Quesson1, M.S. Tamer3, K. Hatakeyama3, M.H. van Es3, M.C.J.M van Riel3, and D. Piras3
1Department of Acoustics and Sonar, TNO, the Netherlands
2Medical Imaging, ImPhys, Delft University of Technology, the Netherlands
3Department of Optomechatronics, TNO, the Netherlands

039, Accelerating Accuracy and Speed of Packaged-Device Nanoscale Characterization and FA Using a Novel LaserFIB Workflow
William Harris1, Cheryl Hartfield1, Vignesh Viswanathan2, and Longan Jiao2
1Carl Zeiss Microscopy LLC, White Plains, NY
2Research Microscopy Solutions, Carl Zeiss Pte Ltd, Singapore

040, Machine Learning-assisted Characterization of Hafnia-based Ferroelectric Thin Films
Amir Kordijazi1, Steven Consiglio2, Dina Triyoso2, Kandabara Tapily2, Asif Khan3, Gert Leusink2, and Alain Diebold1
1Colleges of Nanoscale Science and Engineering, SUNY Polytechnic Institute, Albany, New York, USA
2TEL Technology Center, America, LLC, Albany, New York, USA
3School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA

041, Recommissioning the Length Scale Interferometer at the National Institute of Standards and Technology and Application to Length Traceability for Nanoelectronic Manufacturing
Ronald G. Dixson1, John A. Kramar1, Thomas W. LeBrun1, Olivier Marie-Rose2, and William B. Penzes1
1National Institute of Standards and Technology, Gaithersburg, Maryland
2Prometheus Computing, LLC., Sylva, North Carolina