

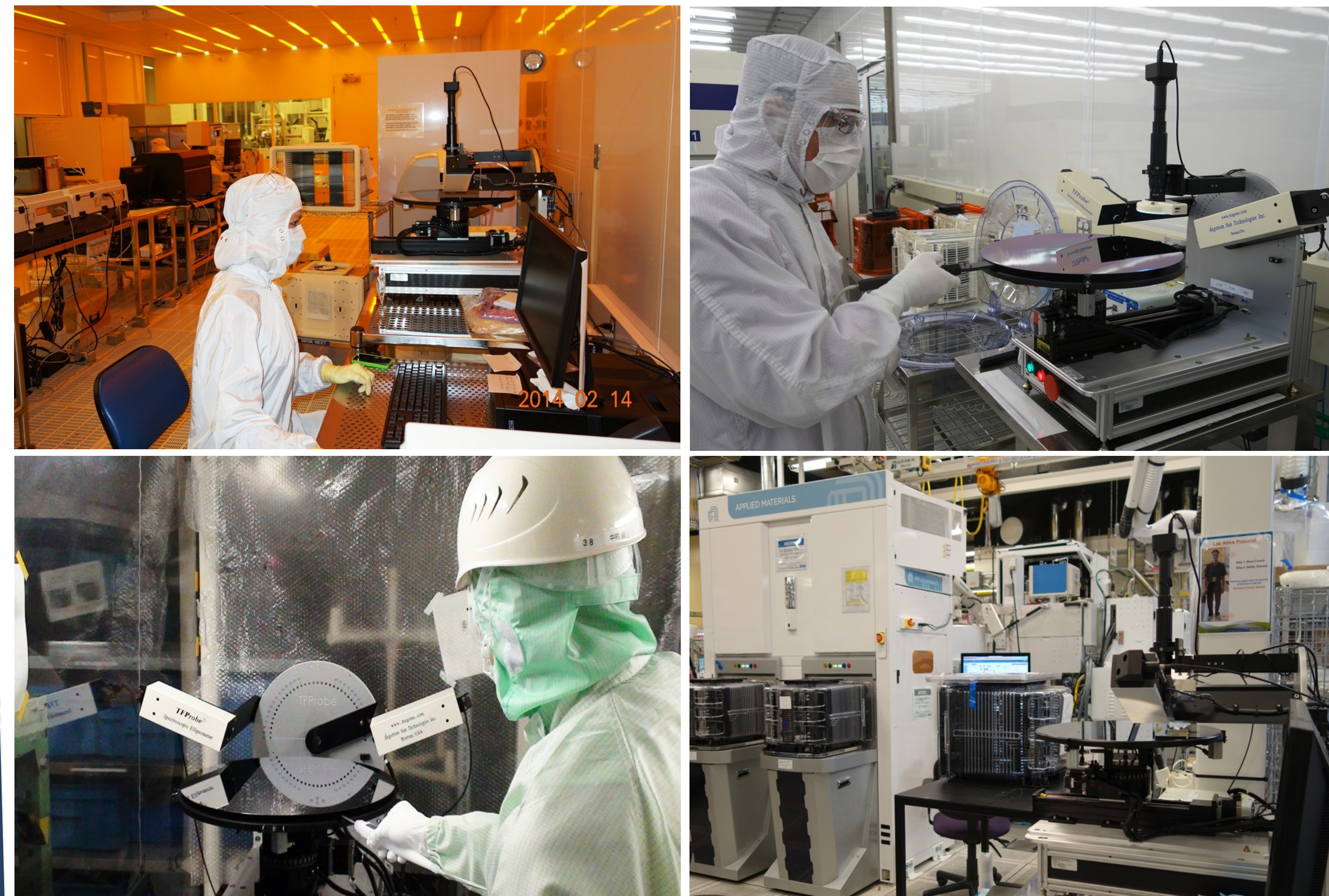


Some Experience in Characterizing Thin Films on Next Generation 450mm Wafer with Spectroscopic Ellipsometry

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450mm Ellipsometry Tool Development History

- ❑ Industry's transition to next generation 450mm processing started not long time ago
- ❑ April, 2009: Invited by ISMI and participated 450mm program to develop thin film metrology tool
- ❑ July 2009: Introduced by ISMI at Semicon West 2009
- ❑ September, 2009: Received first mechanical 450mm size wafer from ISMI to develop 450mm prototype tool
- ❑ March, 2010: Delivered first table top tool to Hitachi Kokusai Electric Inc, Toyama works, Japan
- ❑ July 2010: Introduced by ISMI at Semicon West 2010; more than 25 450mm wafers had been measured with TFProbe SE 450mm tool
- ❑ December, 2010, Introduced by ISMI at Semicon Japan 2010
- ❑ June, 2011: Delivered 2nd tool to ISMI (G450C), Albany, NY
- ❑ July, 2011: Introduced by ISMI at Semicon West 2011
- ❑
- ❑ 2013 -2014: Upgraded 450mm Tool in field to a 1.5mm edge exclusion capability

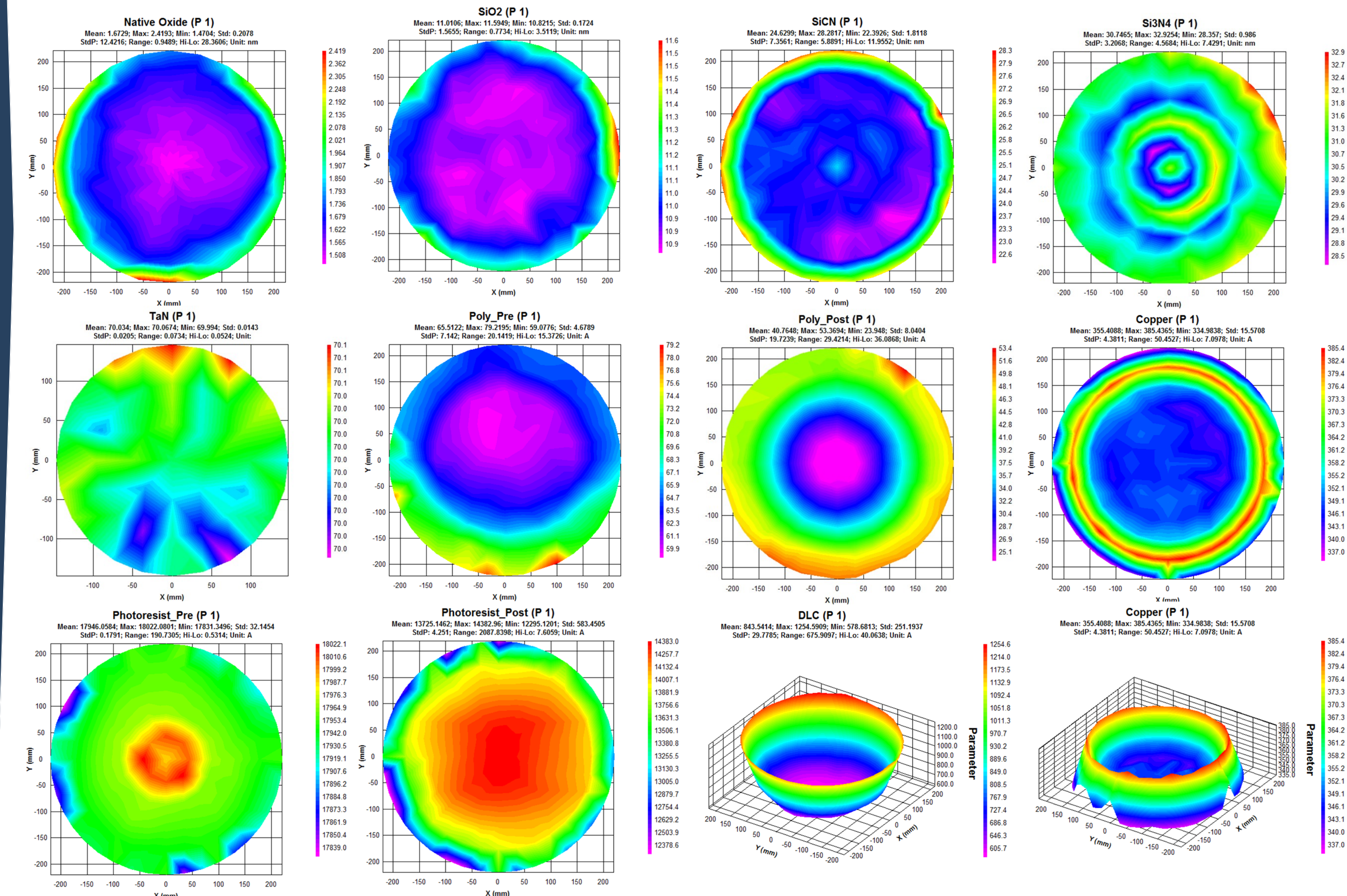


Tool's Configuration:

- ❑ 250 to 1000nm wavelength range (190nm optional)
- ❑ 40 to 90 degree incident angle, Typical setup at 70 degree
- ❑ Table top compact design with Rho-Theta Mapping stage
- ❑ 450mm size wafer and also suitable for 300mm application
- ❑ Add-on vision system, Special safety design for wafer handling
- ❑ One button click operation under operator mode
- ❑ Allow advanced user to create various recipes under engineer mode;
- ❑ Support linear, polar and arbitrary mapping pattern design
- ❑ Integrated all-in-one Advanced TFProbe software for system configuration, measurement, data management, recipe setup, regression analysis, pattern definition, 2D/3D graphics presentation, run under Windows Operation system
- ❑ Convenient cylinder operation for loading/unloading wafer with wafer wand

Application Recipe Development

Almost all typical thin film applications in semiconductor have been developed like Oxides, SiN_x, SiCN, SiO_x, Low K, SiC, TaN, TiN, DLC, aC, Poly Si, TaSi, Cu, photoresist....



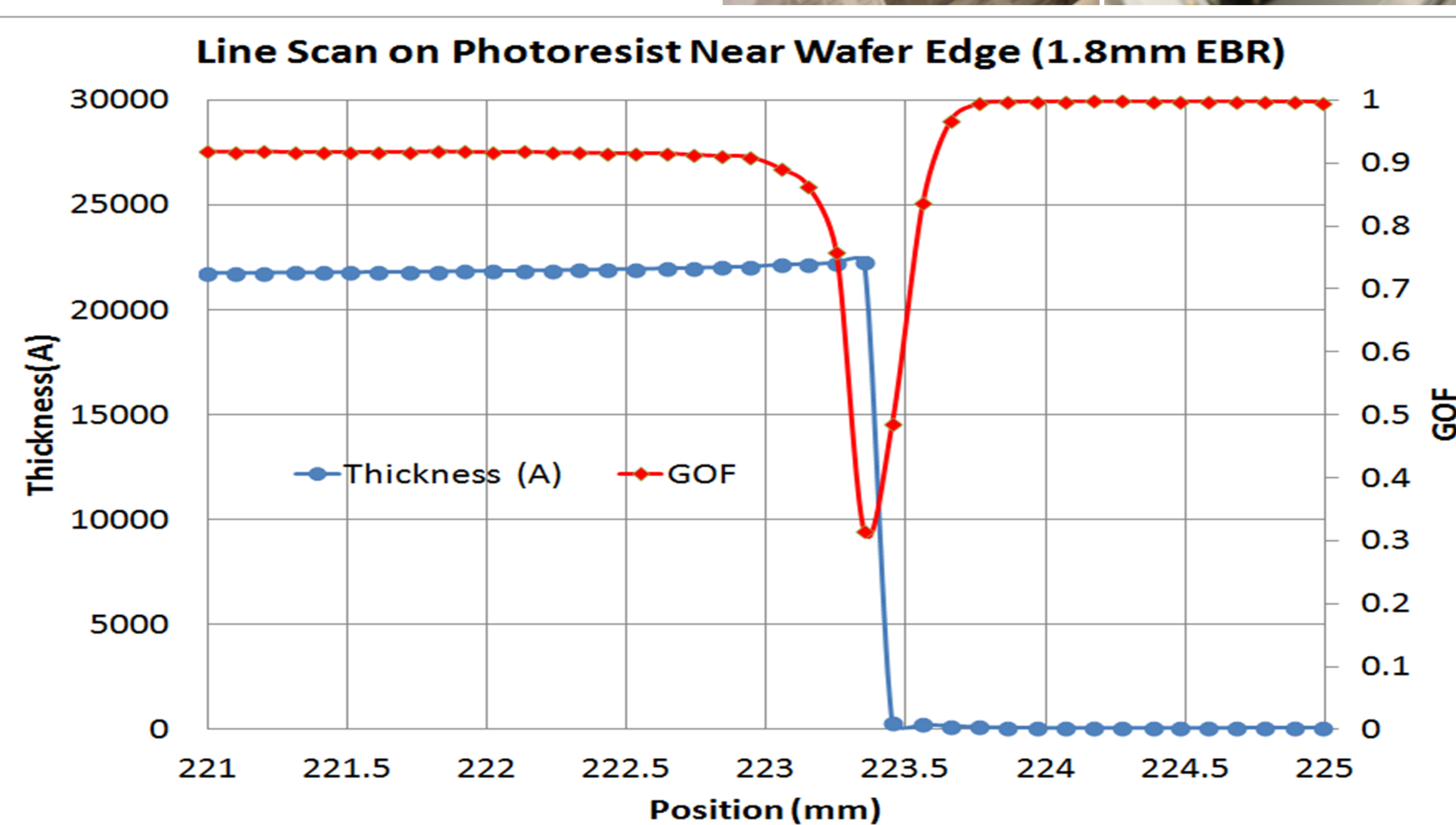
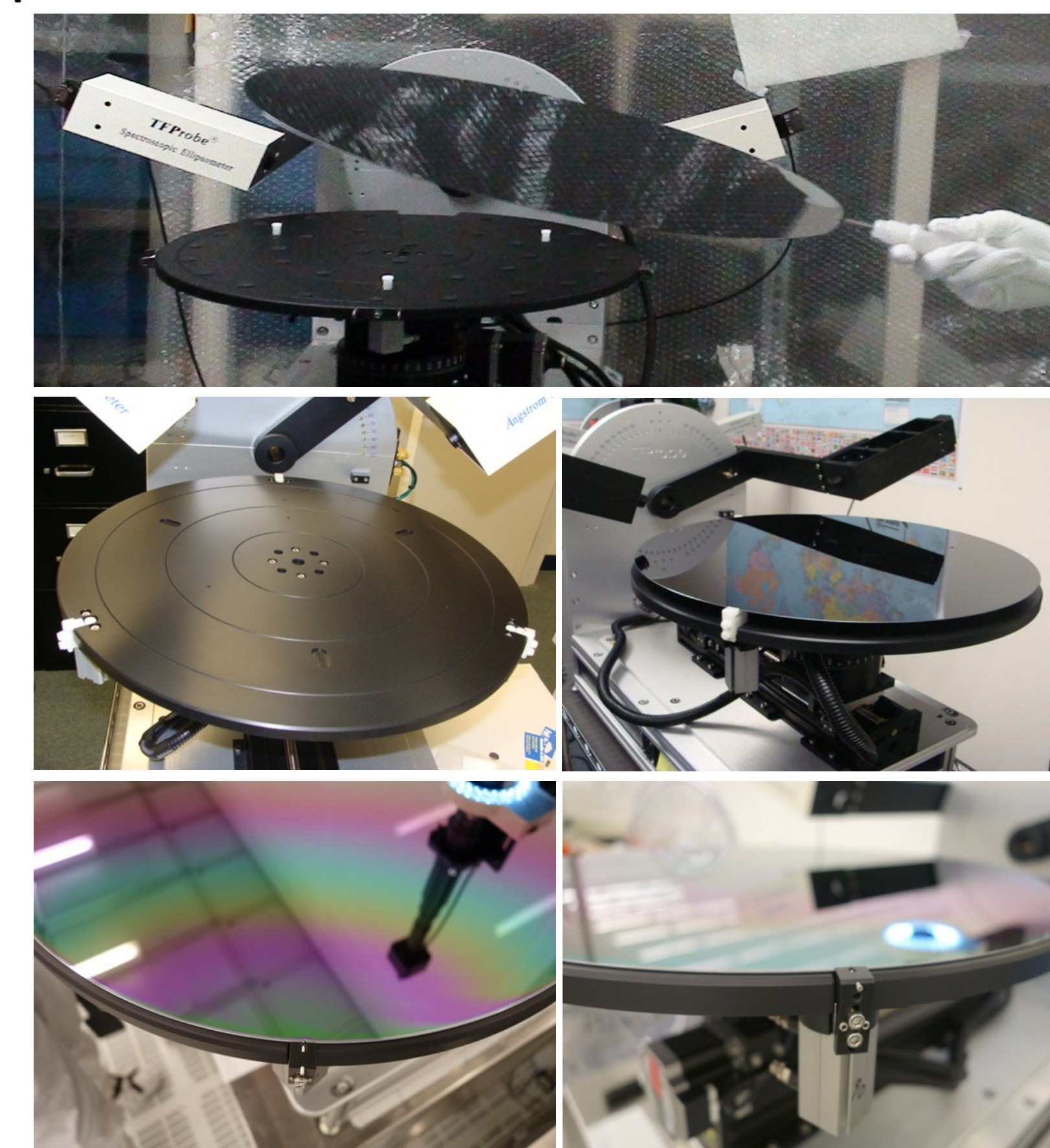
Tool Capability Improvements

- ❑ Wafer Handling Safety Consideration: Edge Protection; Pistol Cylinder operation, Loading/Unloading Wafer with Wafer Wand
- ❑ Positioning Precision and 1.5mm Edge Exclusion Capability
- ❑ Various Films modeling improvement
- ❑

1st Generation Lift Pins Design

2nd Generation Lift Pins Design

3rd Generation Lift Pins Design



ISMI Supplier Acknowledgement

ISMI 450 mm Program would like to acknowledge the following companies for their support and participation in the 450 mm Program:

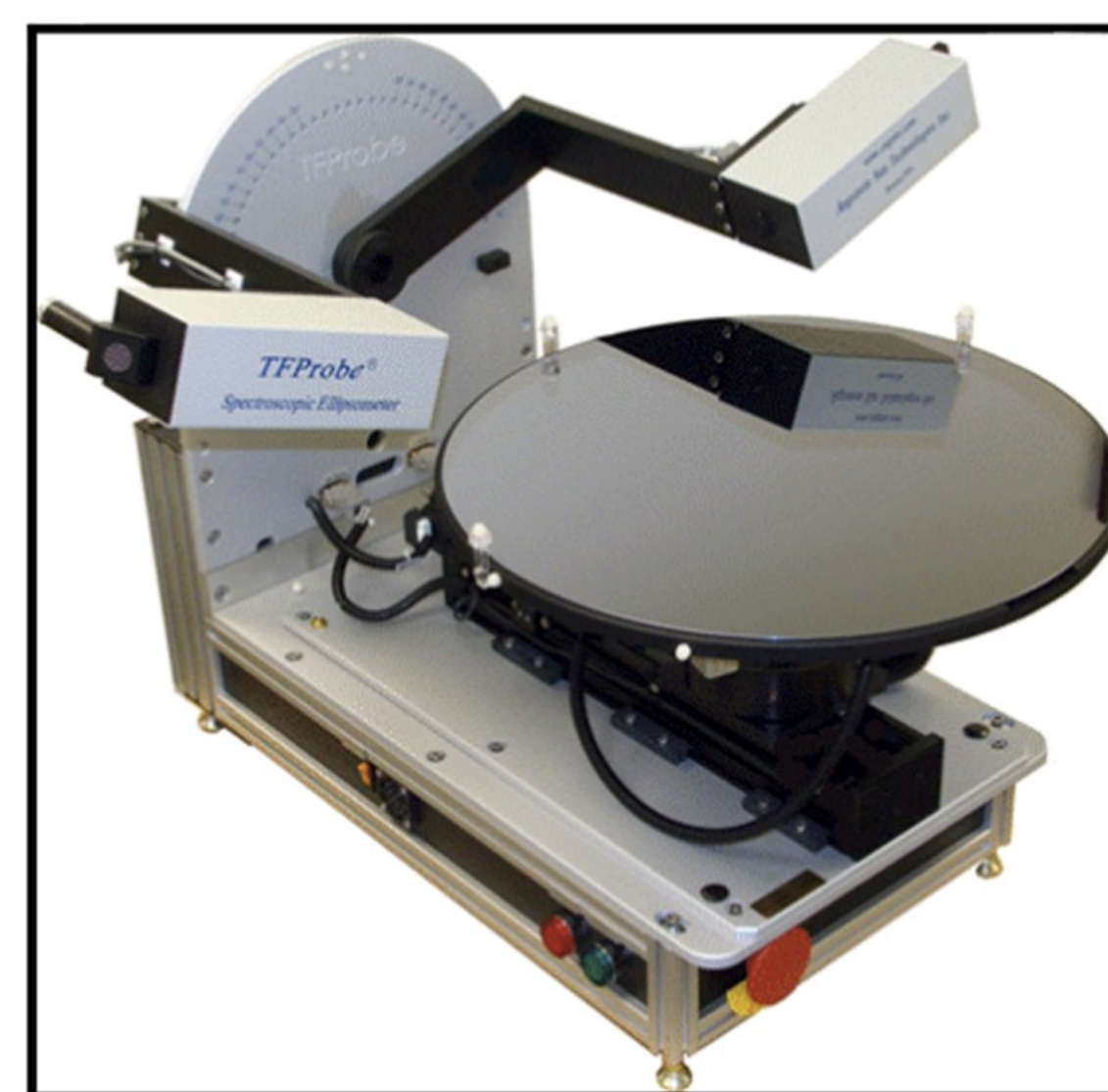
Angstrom Sun
Brooks Automation
CyberOptics Corp
Genmark Automation
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SUMCO
TDK

Asyst Technologies
CDE
Entegris, Inc.
Gudeng Precision Industrial
Hirata Corp
Nanophotonics
SSEC
Sinfonia



ISMI 450mm Metrology

- Particle Inspection, Edge Inspection, Film Thickness



- Particle Inspection / Edge Inspection
 - Measured over 150+ 450mm wafers to date
- Thin film measurement ellipsometer
 - Measured over 25+ 450mm wafers to date

Summary and Acknowledgement

Thanks International Sematech Manufacturing Initiative (ISMI) for providing opportunity to develop ellipsometry tool for 450mm application. Thanks Lam Research (Novellus), Applied Materials and Other Companies for Support in implementing Angstrom Sun Tech's 450mm metrology tool for processing tool development.

References

ISMI 450mm Industry Briefing, Slide 10, July 2009 by Mr. Tom Jefferson and Mr. Tom Abell (Intel) at Semicon West 2009

ISMI 450mm Industry Briefing, Slide 20, July 2010 by Mr. Sung-Wook Park(Samsung) and Paul Cherry (Intel) at Semicon West 2010