



Continued Growth and Benefits of CMP Process Development Through CNSE

**NCCAVS
CMP USERS GROUP
2013 Spring Meeting
College of NanoScale Science & Engineering (CNSE)**

Frank Tolic
Associate VP for Business, Wafer Processing
*College of Nanoscale Science and Engineering
Albany, NY*



CNSE

The College of Nanoscale Science and Engineering (CNSE) of the State University of New York (SUNY) is a global education, research, development and technology deployment resource dedicated to preparing the next generation of scientists and researchers in nanotechnology.

By leveraging its resources in partnership with business and government, CNSE supports accelerated high technology education and commercialization, and seeks to create jobs and economic growth for nanotechnology-related industries.

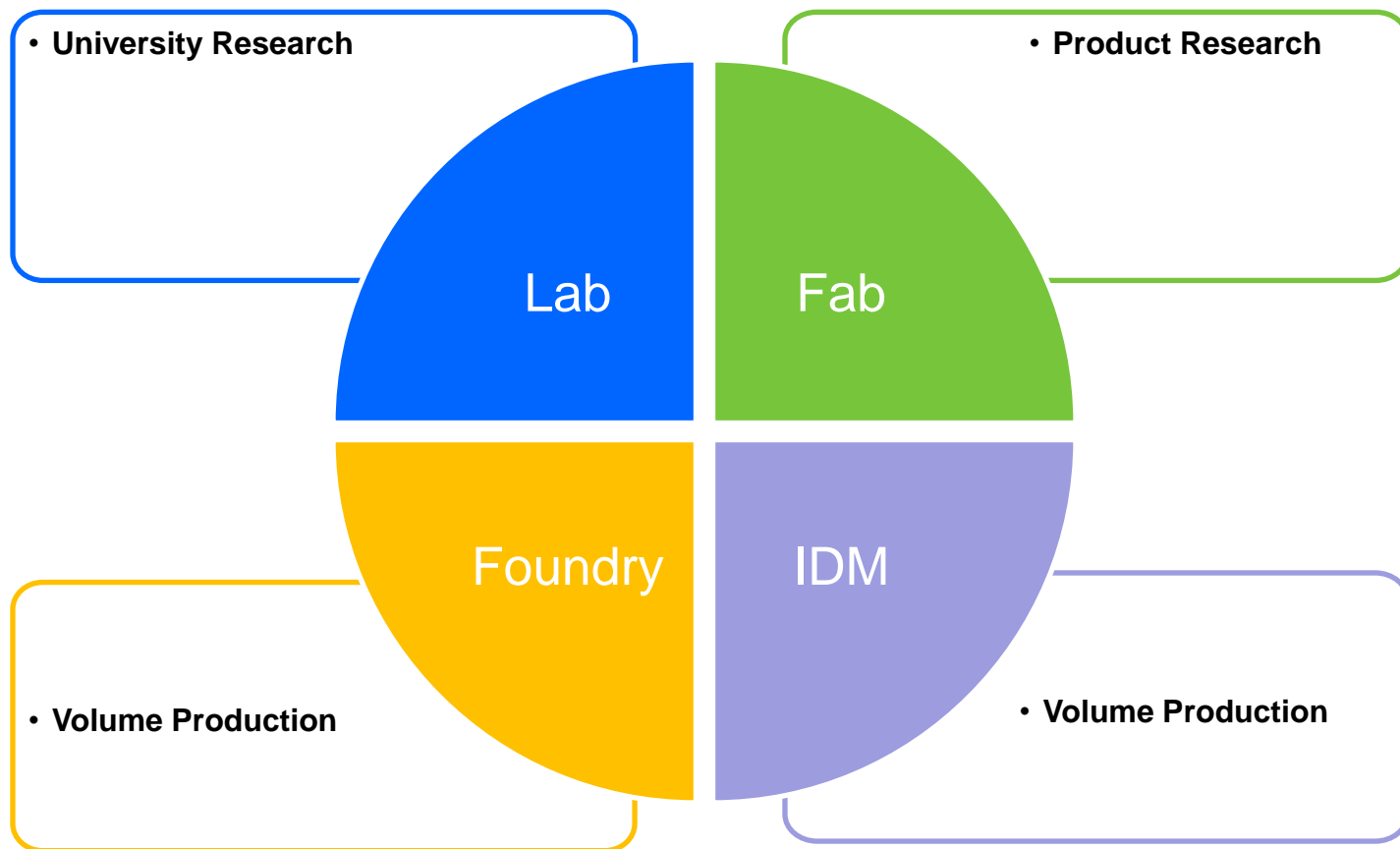


"You have an outstanding university. Now I want what's happening in Albany to happen across the country."



Contents

- **CNSE Nanotechnology Development Eco System**
- **CNSE CMP Center of Excellence (CoE)**
- **Faculty Research**
- **Engagement Levels**
- **450mm**
- **Conclusion**





- 200mm Faculty Research Lab
- Nanobioscience Constellation
- Collaborative Research
- Novel Devices
- Proof of Concept

Lab

- 300mm CSR / G450C
- Advanced Baseline
- Custom Development
- Product Development
- Product Validation

Fab



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Foundry

- STC MEMS Foundry
- Global Foundries
- Pilot Production
- Market Validation
- Volume Production

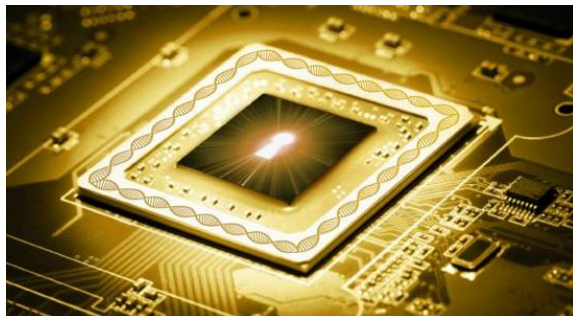
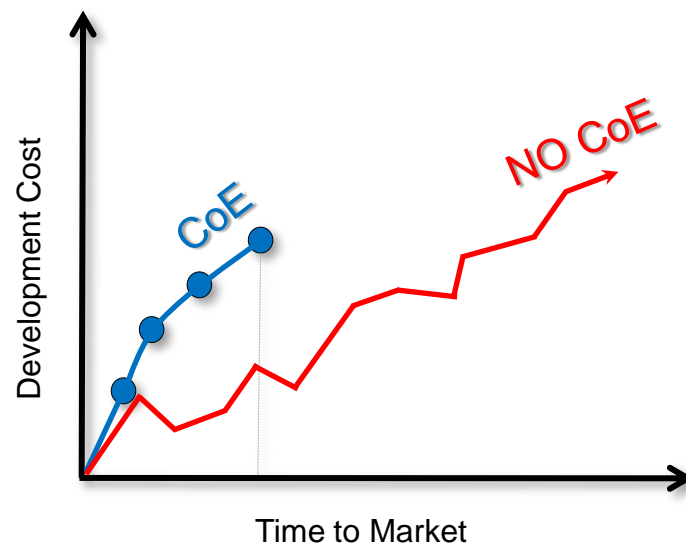
IDM

- IBM, Intel, Samsung, TSMC
- Product Commercialization
- Market Acceptance
- Market Share Growth
- Volume Production

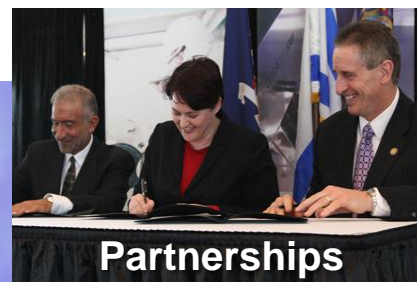
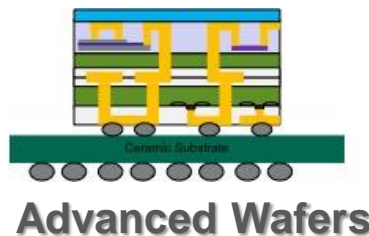


CNSE CMP CoE Development Service

- Center of Excellence (CoE) is a proven CNSE methodology currently used successfully by CNSE Equipment Makers and Others
- Benefits to Customer are:
 - Advanced technology platform for quick development
 - Minimize cycles of learning
 - Access to customers and their needs
 - Strategy for market share capture
 - Maximize research and development ROI



*Unlock your development
success with CNSE CoE*



CMP CoE





Dr. Sara Brenner: Dr. Brenner is a preventive medicine and public health physician serving as the CNSE Assistant Vice President for NanoHealth Initiatives and an Assistant Professor of Nanobioscience. She is leading health and safety research initiatives related to nanoparticle and nanomaterial exposures in the workplace and also serves as Chair of the steering committee for the CNSE-ISMI NanoHealth and Safety Center. Her research team incorporates theory from many disciplines to advance risk assessment and reduction strategies for occupational exposures, monitoring of materials that may impact population health and public safety, and the development of industrial practice standards for product safety.



Dr. James Castracane: Dr. Castracane is Professor (Founding Faculty) and Head of the Nanobioscience Constellation in CNSE. His research interests encompass fundamental materials science, 3D integration, nanobioscience, optoelectronics, MEMS, and emerging fields such as molecular electronics and spintronics. Under Dr. Castracane's guidance, CNSE has assembled a multi-faceted Nanobioscience program. He has received research funding from numerous Federal agencies including NIH, NSF, DOD, DOE, DARPA, and NASA as well as a significant portfolio of State and corporate sponsors. His publication record spans over 100 articles, numerous invited or keynote presentations and 14 patents issued/pending.



Dr. James Lloyd: Dr. Lloyd's research has been into physical modeling of materials degradation and designing testing procedures that provide the necessary tools to predict lifetime and demonstrate reliability through accelerated tests. This includes both developing theories and the related supporting experiments to avoid the sin of "overstressing" where failure is experienced but under conditions that are irrelevant to real life. In addition, reliability testing must be performed in a way that will enable data that can predict reliability over decades to be obtained in as short a time as possible, at most weeks and preferably hours. This requires the use of "Accelerated Testing" where failure mechanisms are exercised at elevated stress levels and the data obtained is extrapolated to more gentle use conditions.



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FACULTY RESEARCH REPORT



2012

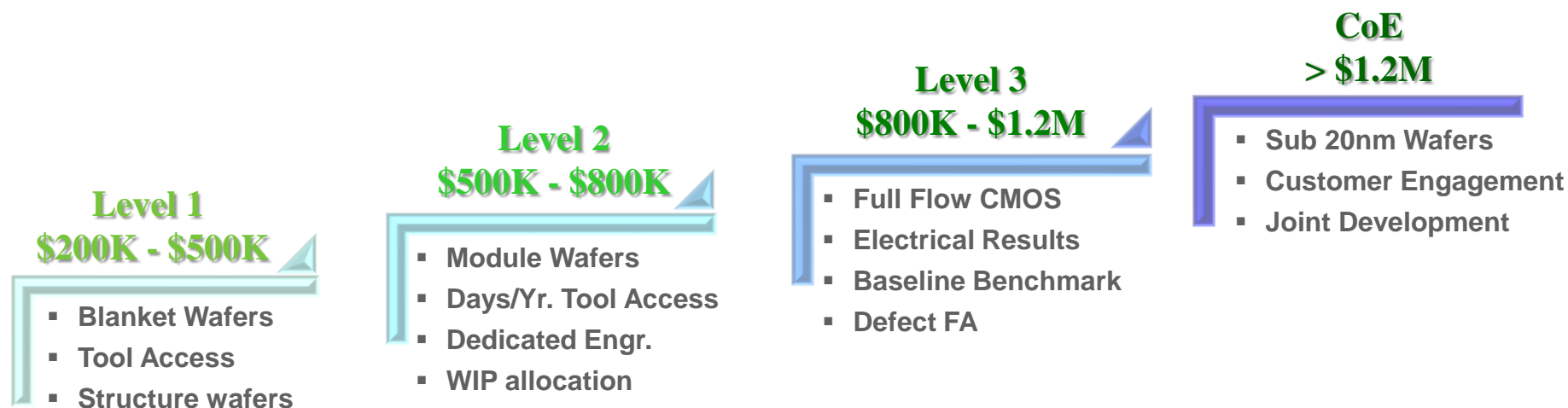
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Search: Faculty Report



CNSE CMP Engagement Levels



Strengths:

- Strong enabling relationships with technology leading IDM and OEM partners
- IP Independence
- Access to advanced lithography, films, metals, etch, and other novel process capability
- Technology capable infrastructure and research expertise
- FEOL & BEOL electrical test-mask and physical structures at the <28nm technology node
- Advanced sub 20nm wafers



450mm is here at CNSE





CNSE CMP Center of Excellence



For Your CMP Development Needs



At Premier Global Center of Nanotechnology





CMP Process Development – Defect Reduction

NCCAVS

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2013 Spring Meeting

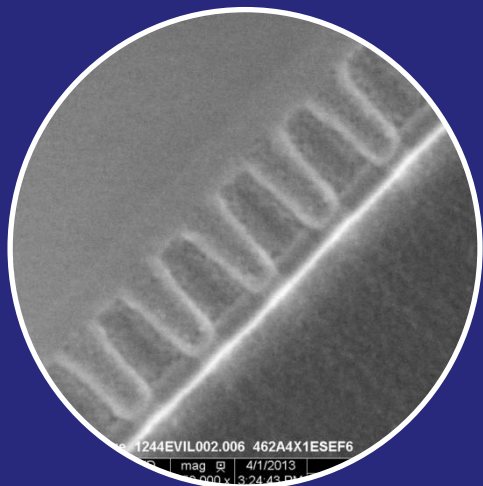
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Tricia E Burroughs

CNSE Engineering Research & Development, CMP

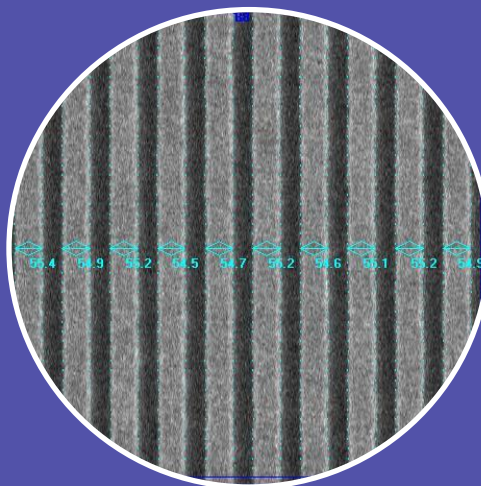
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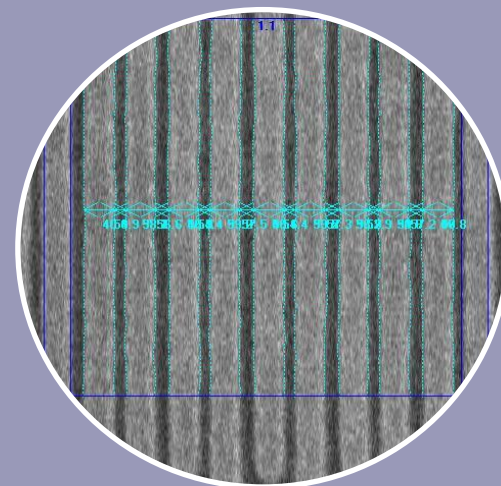
Empire II

28nm node = 32nm line



Empire

45nm node = 42nm line



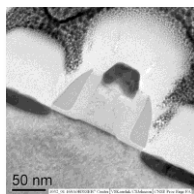
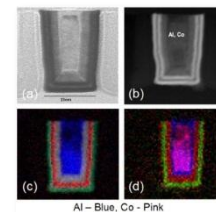
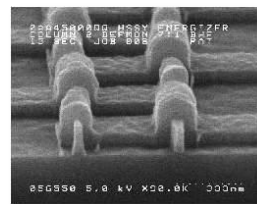
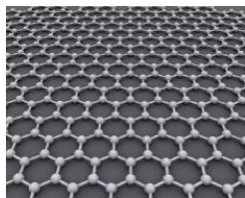
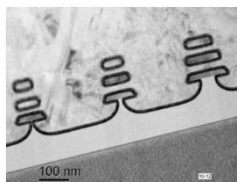
Intrepid

14nm node = 28nm line





CNSE Technology Roadmap



Exploratory

Development

3D Packaging

MRAM
RRAM

Photonics

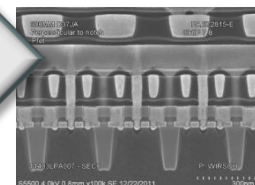
Derivatives

Nanowires

III-V

Graphene

STT
Logic



65nm LP CMOS

28nm LP
CMOS

Prototyping

22nm
FinFET

14nm
FinFET

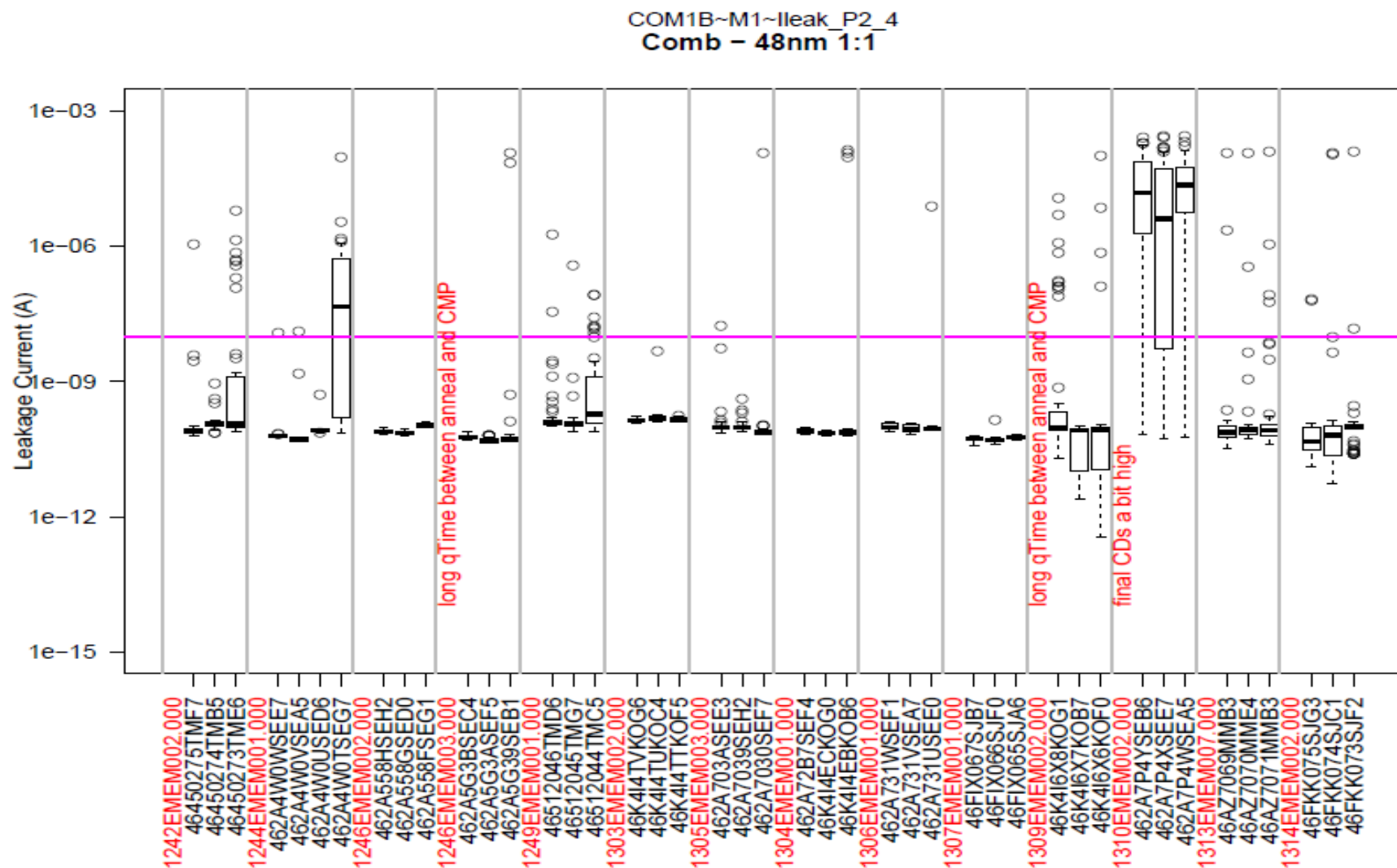
10nm
FinFET

7nm
TBD

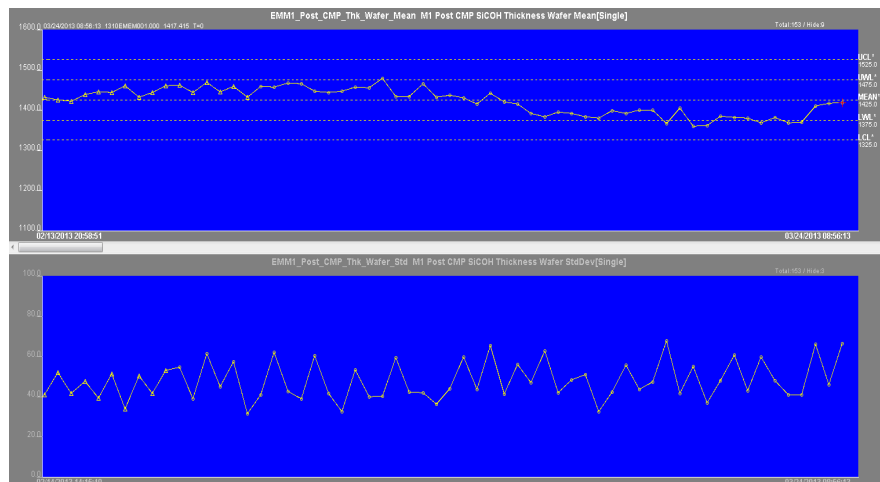
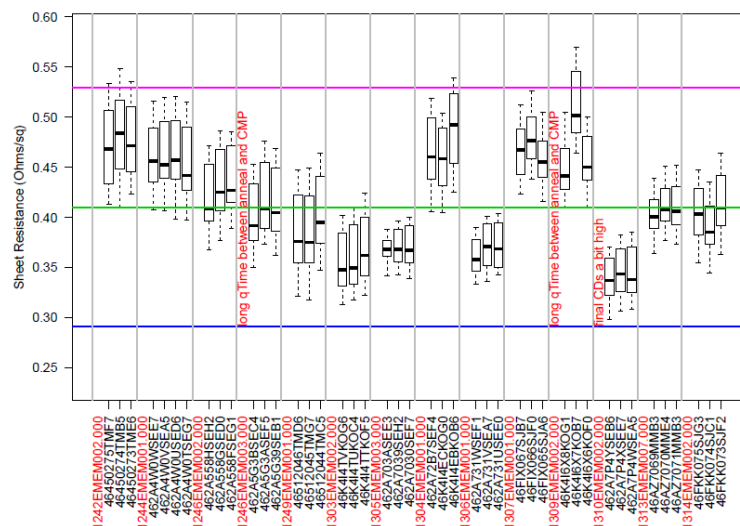
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018



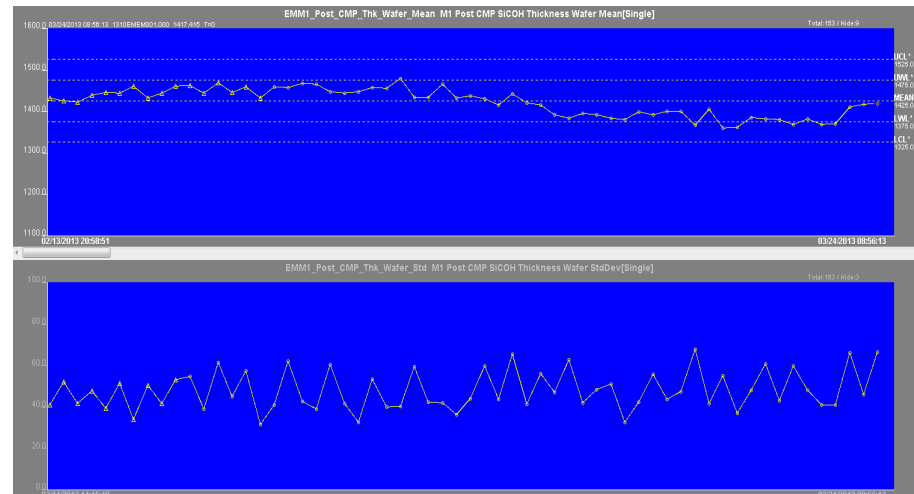
Empire – Parametric Trend Charts



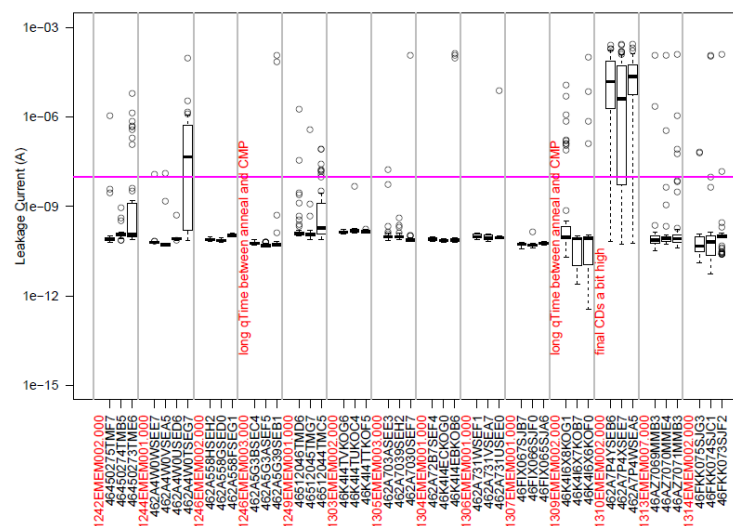
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SPM1B~M1~Ileak_P1_3
SERP - 48nm 1:1

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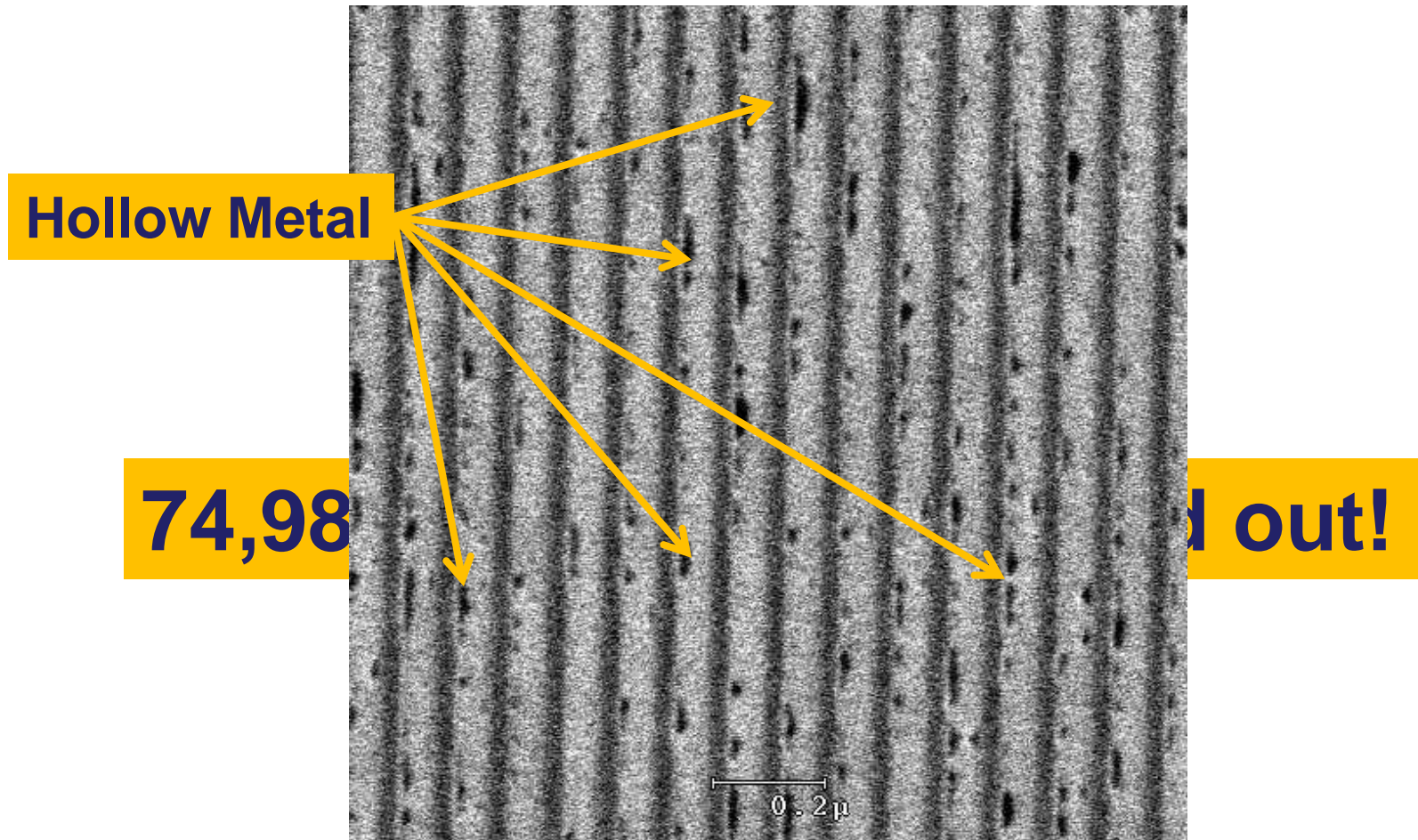
COM1B~M1~Ileak_P2_4
Comb - 48nm 1:1



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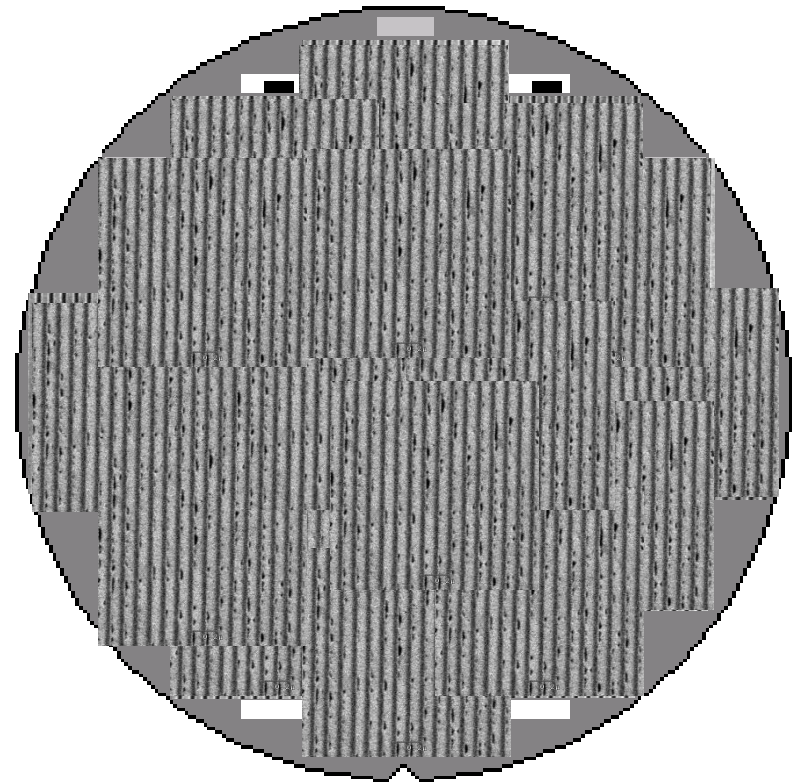


◆ Set-up Defect Inspection & Review



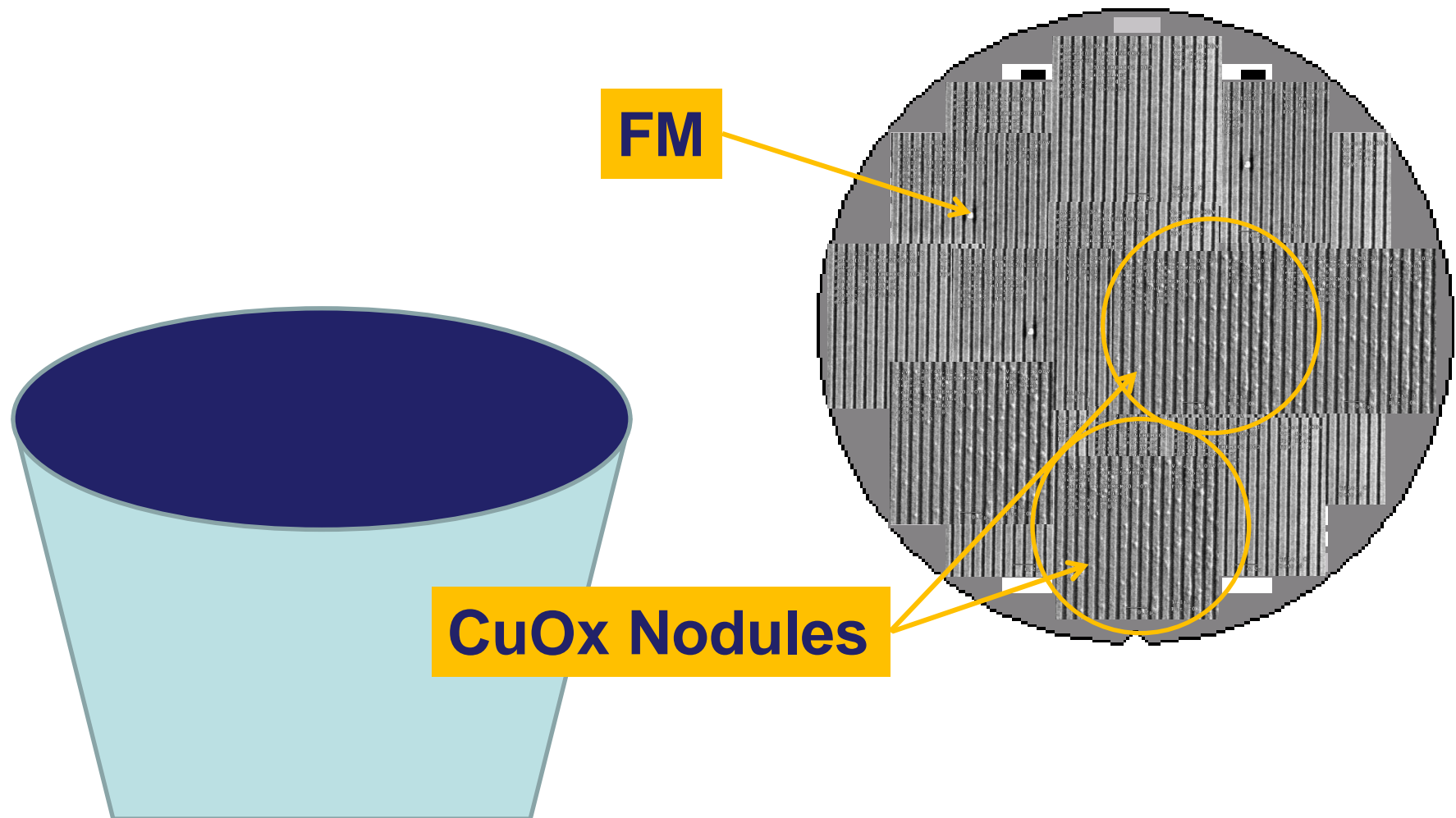


◆ Binning of Nuisance Defects



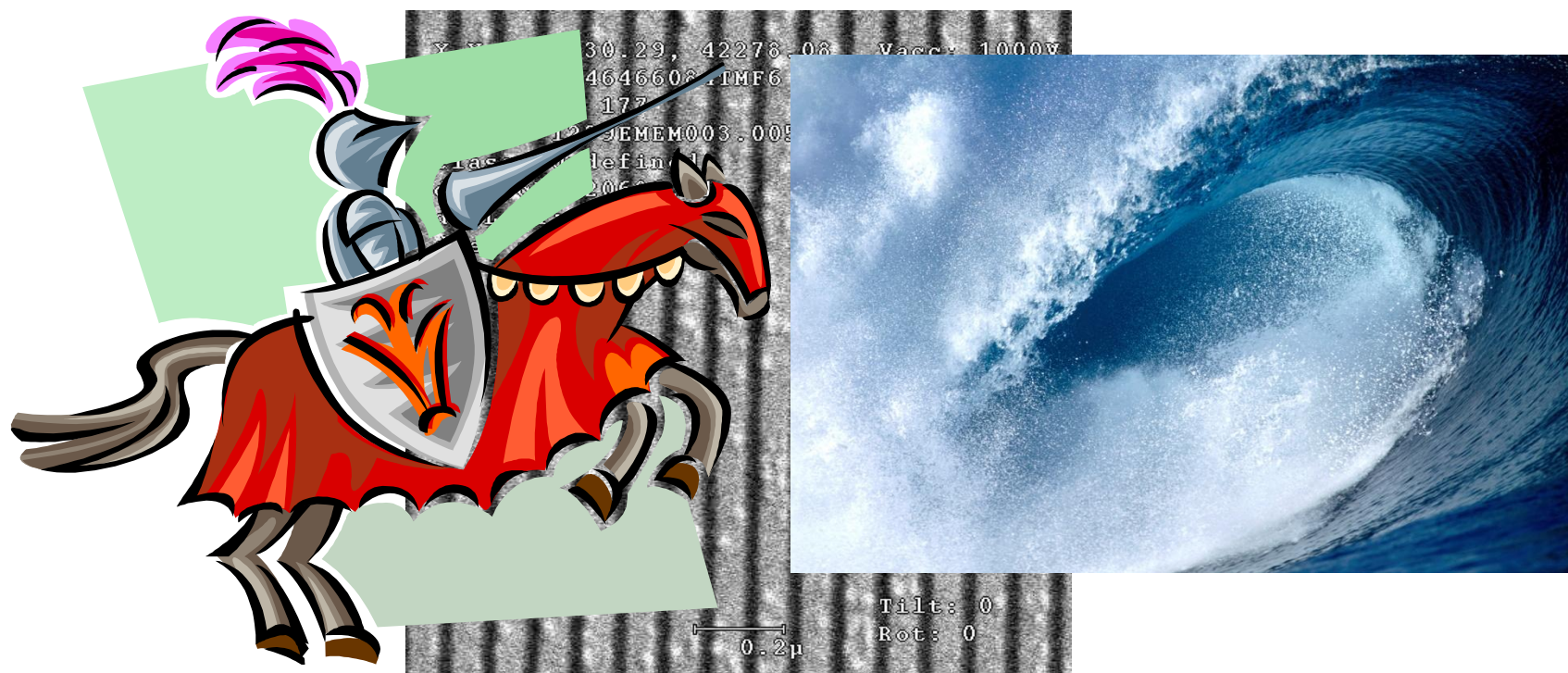


◆ Binning of Nuisance Defects





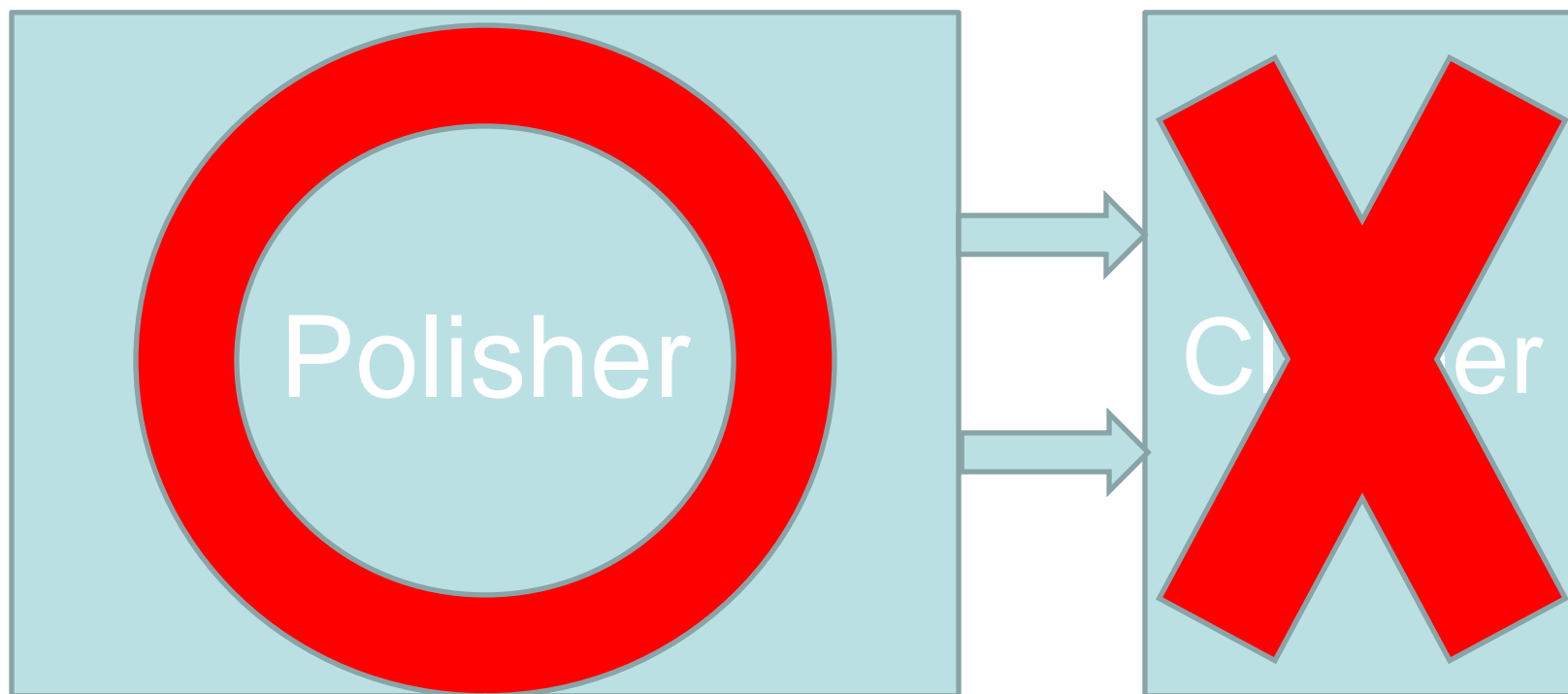
- ◆ DIW dip test of Cu produces CuOx nodules



- ◆ Incomplete passivation of Cu surface

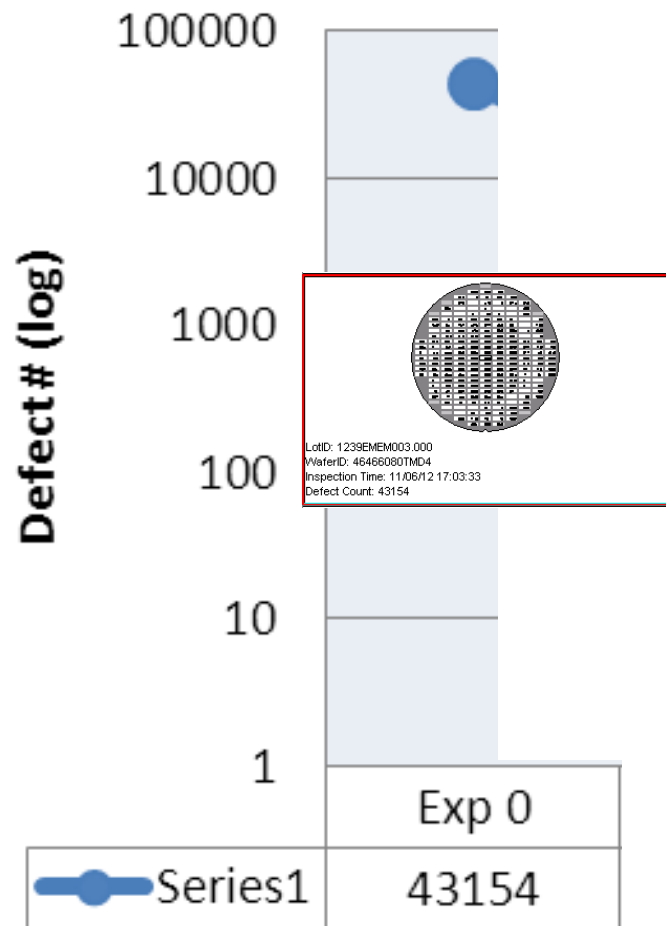


◆ Picture of Cu Ox & FM



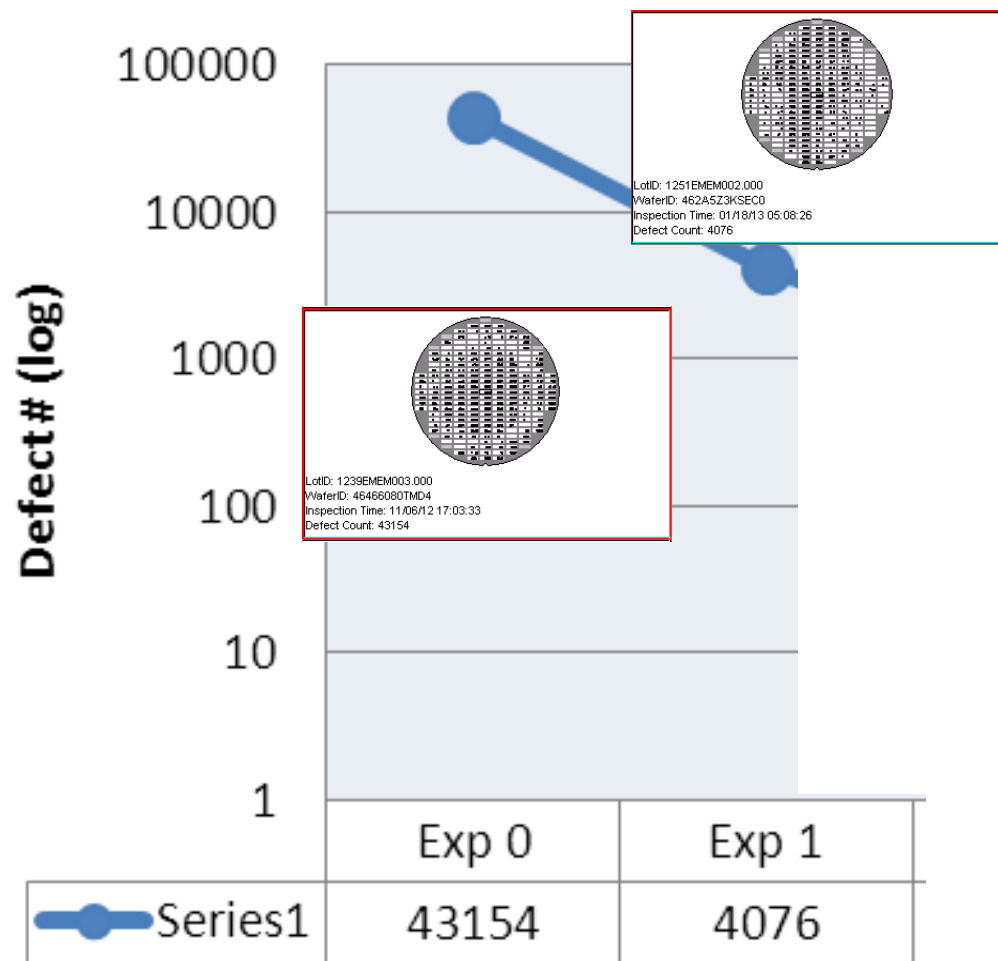


Number of Defect vs. BTA Experiment



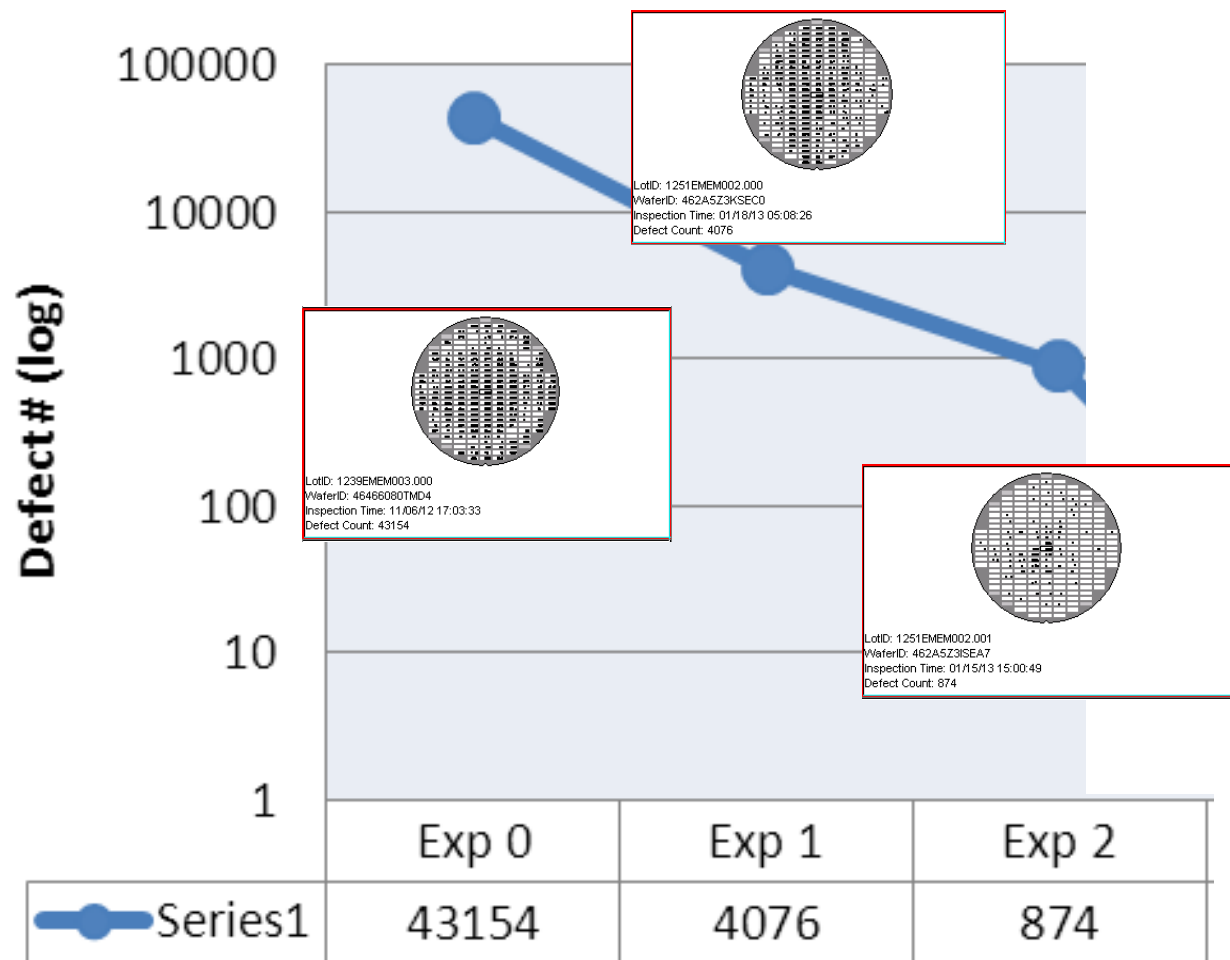


Number of Defect vs. BTA Experiment



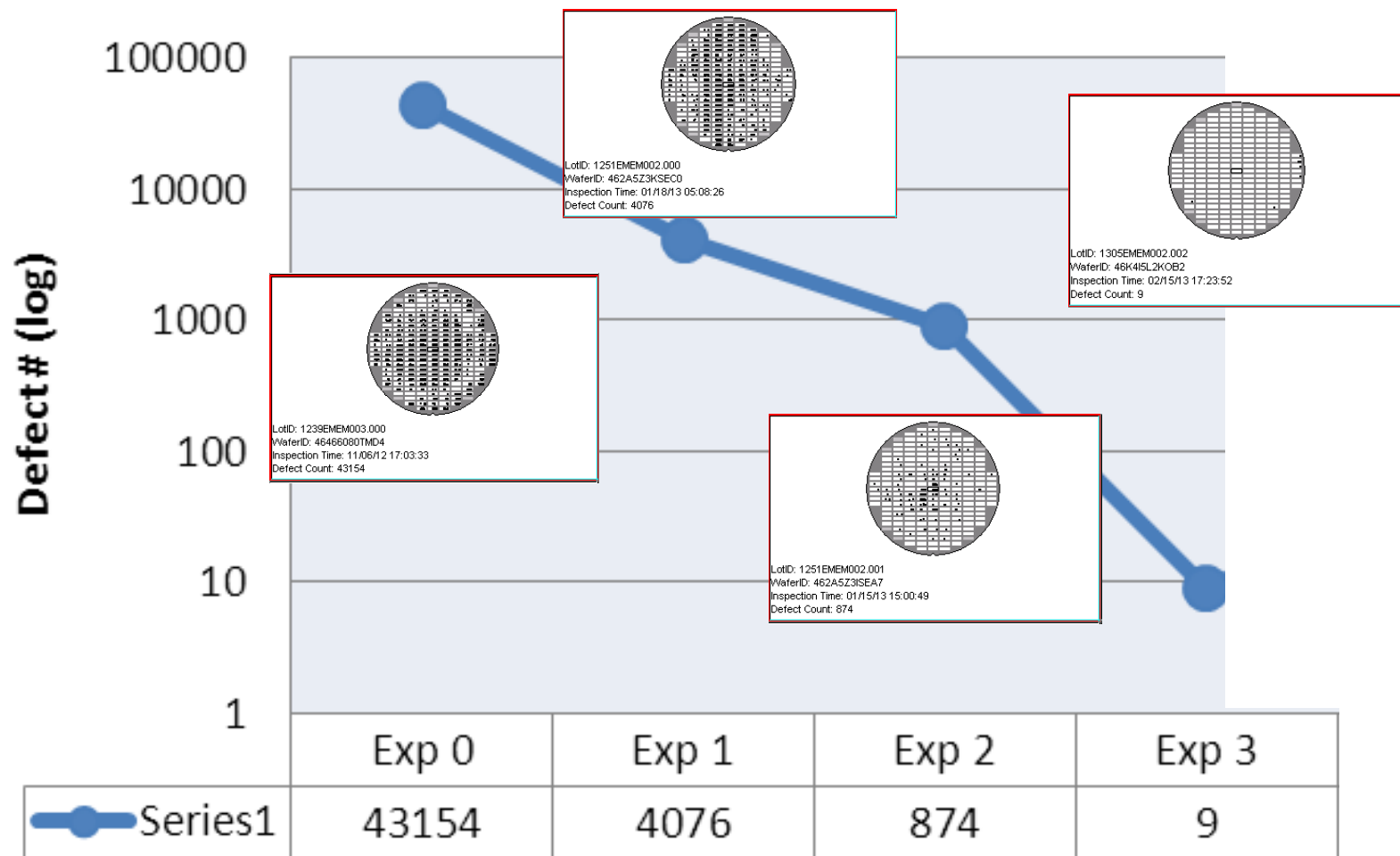


Number of Defect vs. BTA Experiment



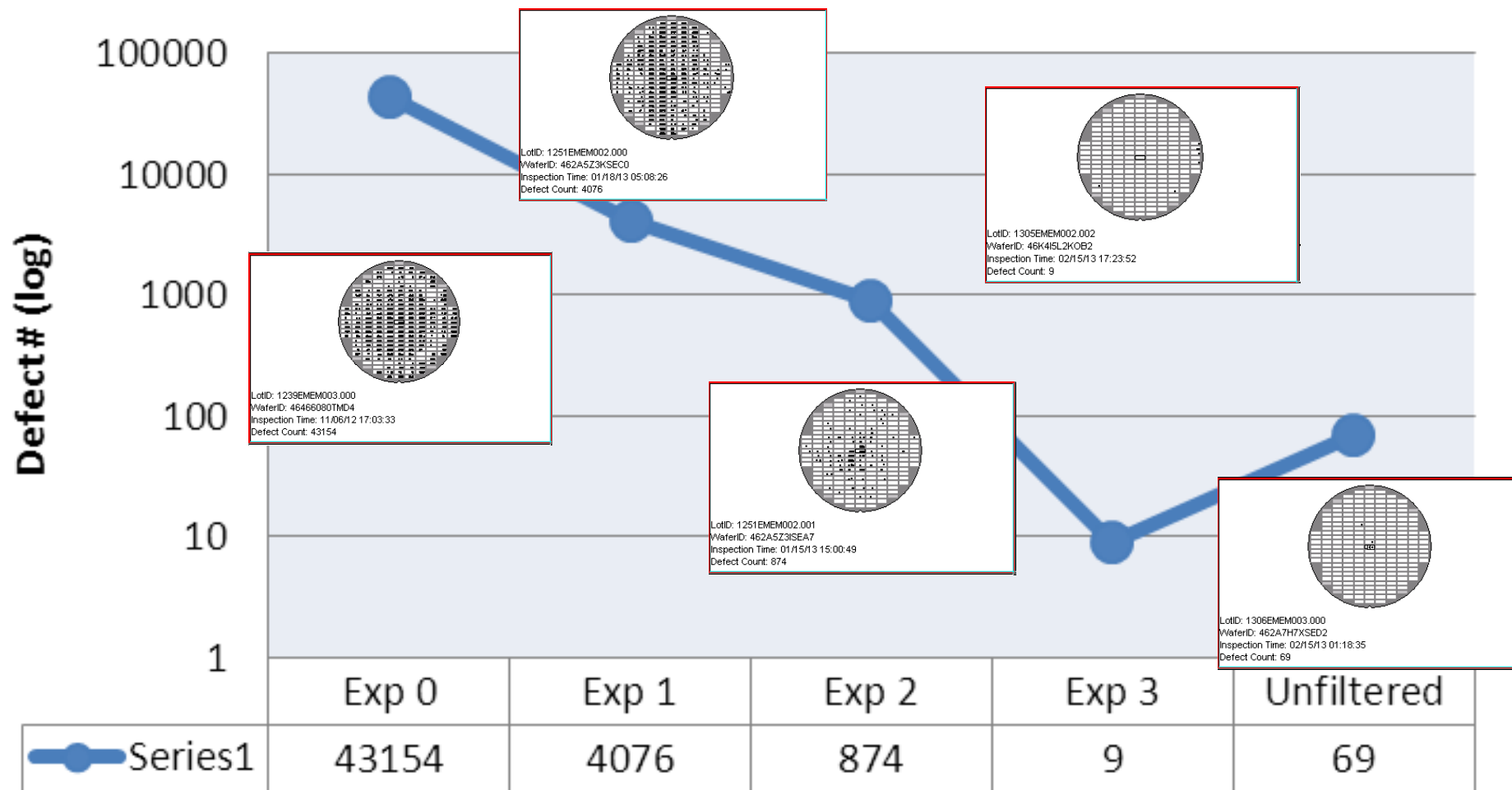


Number of Defect vs. BTA Experiment



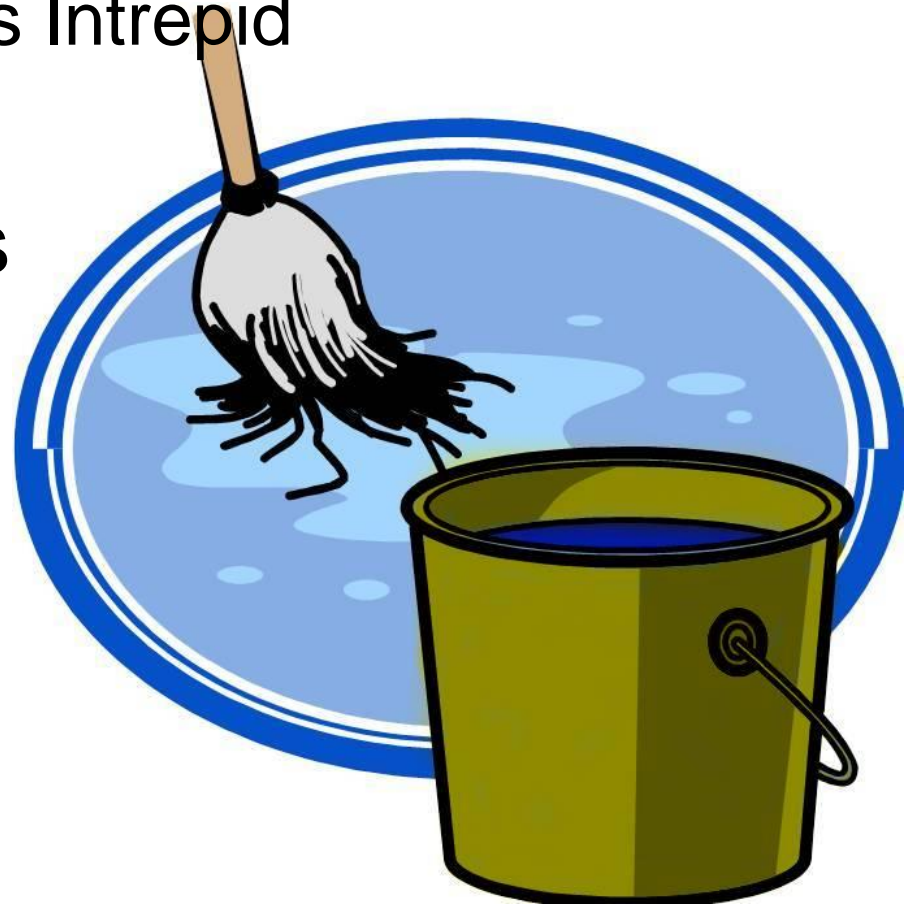


Number of Defect vs. BTA Experiment





- ◆ Transfer learning to other BEOL masks
 - ❖ Empire vs Empire II vs Intrepid
- ◆ Transfer to Full Flows





- ◆ Several nodes of BEOL mask in development
- ◆ Monitor Health of Line flows for fab changes
- ◆ Defect Reduction programs
- ◆ Quick issue identification and solutions
 - ❖ Metrology
 - ❖ Cross-sections
 - ❖ FA Lab
 - ❖ PLY tooling



- ◆ I would like to thank the CNSE engineering and integration team in support of continuing development
- ◆ Special regards to Dan Steinke, Corbet Johnson, and Ilyssa Wells for their work on the PLY reduction team