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Potential Challenges of Metal-Oxide Based Photoresist and Subsequent Rework Removal

Benjamin L. Clark[1], Michael Kocsis[1], Michael Greer[1], Andrew Grenville[1], Takashi Saito[2], Koichi Hontake[2], Lior Huli[2], Richard Farrell[2], David Hetzer[2], Hiroie Matsumoto[2], Andrew Metz[2], Shan Hu[2], Fitrianto[2], Jeffrey Smith[2], Shinichiro Kawakami[3], Koichi Matsunaga[3], Masashi Enomoto[3], Jeffrey Lauerhaas[4], Anthony Ratkovich[4], David DeKraker[4]

Inpria Corporation[1]
TEL Technology Center, America, LLC[2]
Tokyo Electron Kyushu Limited [3] / TEL FSI, Inc.[4]

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EUV Photo Resist Design Principles

Small Molecular Building Blocks

Photocondensed Molecular Metal Oxides

High EUV Absorbance

Robust Etch & Mechanical Properties

EUV Photo Resist Development Strategy

Patterning Performance

Fab Integration (Lab-to-Fab)

Working with equipment, materials, consortia, university, and device manufacturer partners

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Transition From Lab-to-Fab

- Inpria Y-series photoresists contain organometallic complexes, which are soluble in commonly used fab solvents
- Demonstrating compatibility with fab equipment and processes is critical for integration in the fab
- Demonstrate:
  - Zero cross-contamination
  - Film coating and uniformity
  - Film defectivity analysis
  - Metal residue detection on Si backside and EBR region
  - Etch selectivity relative to conventional CAR
  - **Ability to rework without surface degradation**
    - **Particles**
    - **Metals**

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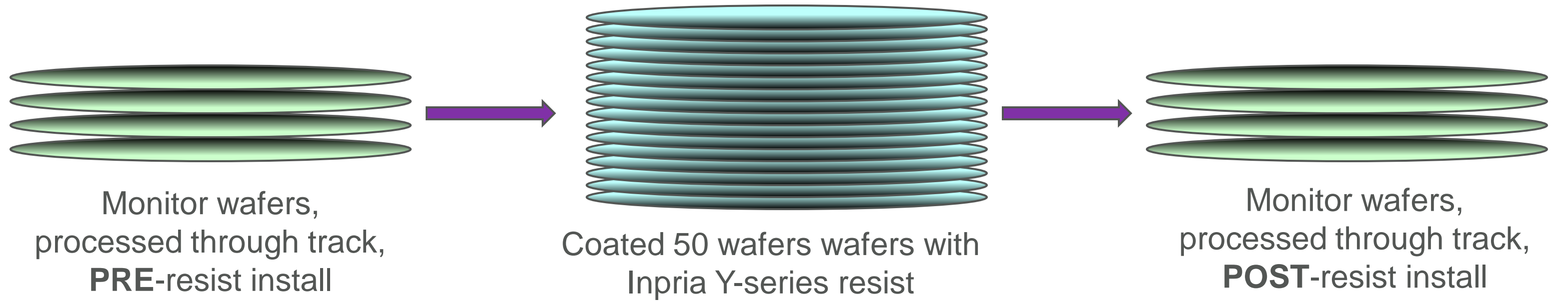
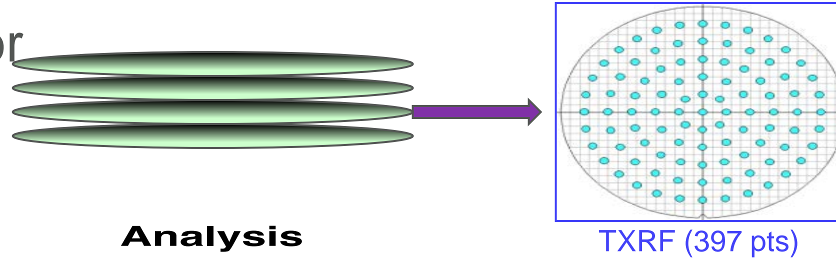
Cross-contamination check

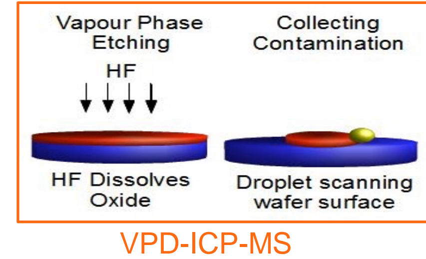
Experiment schematic:



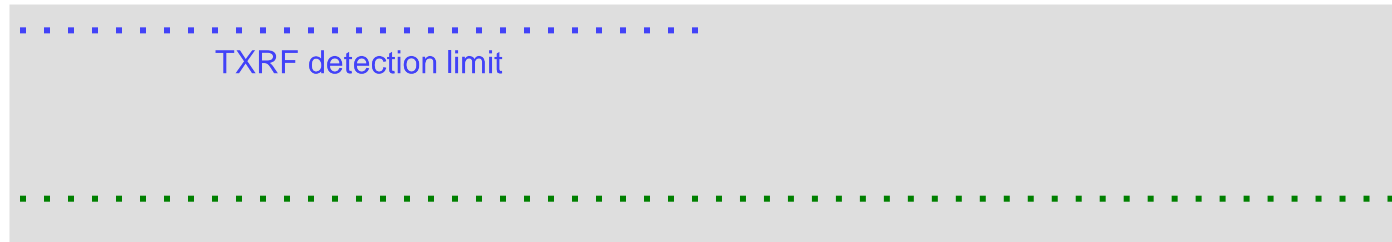
Both sides of all monitor wafers analyzed with two techniques:



TXRF (397 pts)



VPD-ICP-MS



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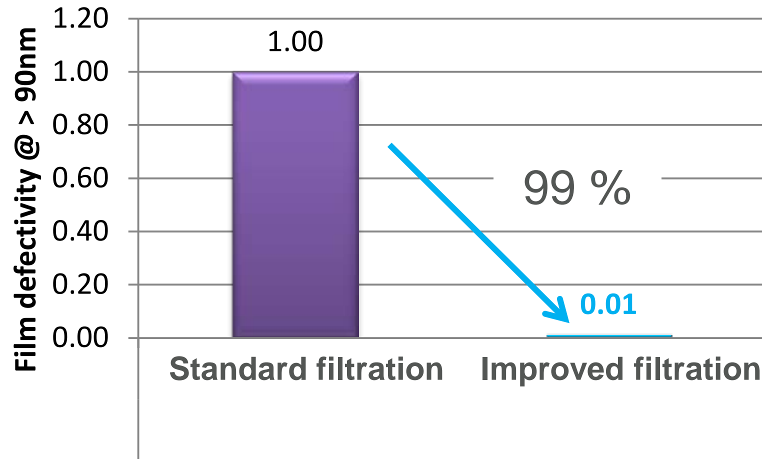
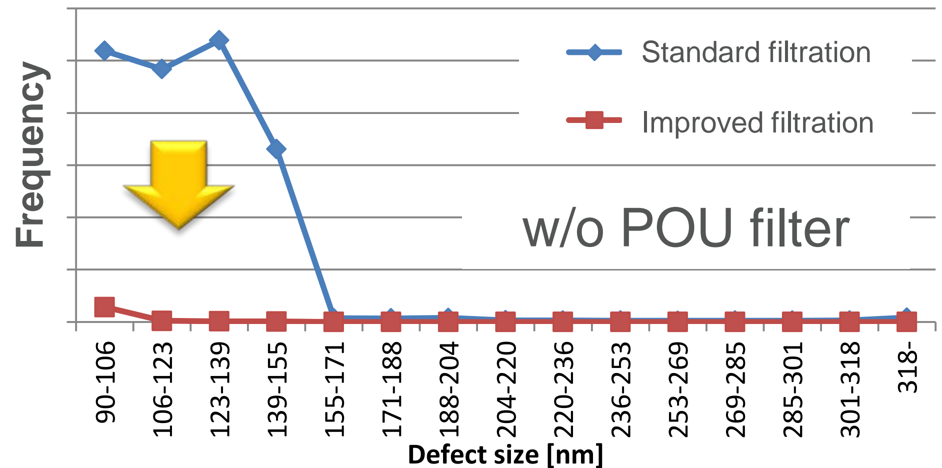
Coating Metrics – Defectivity

- Defectivity improvement in resist manufacturing
  - Comparison between two resists synthesized with standard and improved filtration without POU filter





Improved filtration methods during resist manufacturing helps reduce film defectivity

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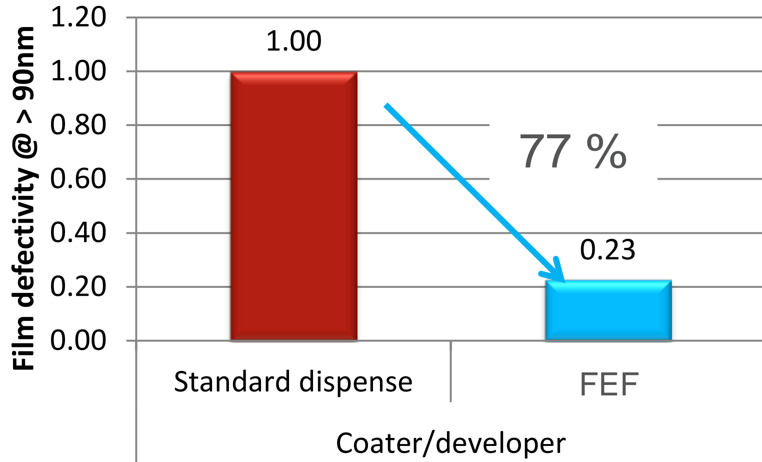
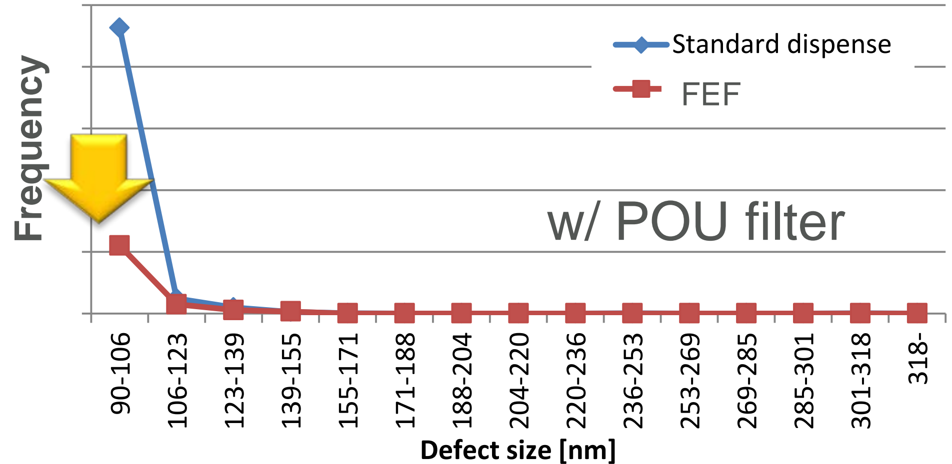
Coating Metrics – Defectivity

- Defectivity improvement by Coater / Developer
  - Comparison between standard dispense system and FEF (Filtration Enhanced Function) with POU filter





FEF on Coater / Developer system also helps to reduce film defectivity

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Etch Rate Test

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Etch rate comparison under standard Si-ARC/OPL etch condition

	Conventional CAR resist		Inpria YA series		Inpria YA series with hard bake	
	Initial	After etch	Initial	After etch	Initial	After etch
X-SEM images X300k					Shrunk by bake	
PR thickness	49 nm	30 nm	15 nm	9 nm	9 nm	7 nm
Initial – after	⊿19 nm		⊿6 nm	> 3 X	⊿2 nm	> 9 X

Inpria resist obtained more than 9X higher etch resistance compared to conventional EUV CAR resist under typical Si-ARC / OPL etch condition, same processing time.

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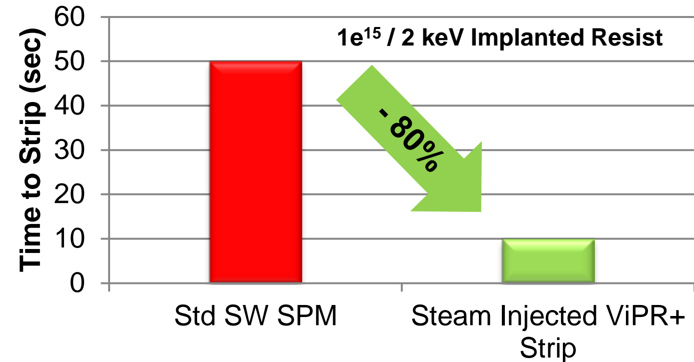
TEL ORION™ –hp for Rework

- Unique closed chamber with novel ViPR™ process using SPM + Steam
- Aggressive strip process to remove resist and other organic containing layers with minimum process time & chemical use

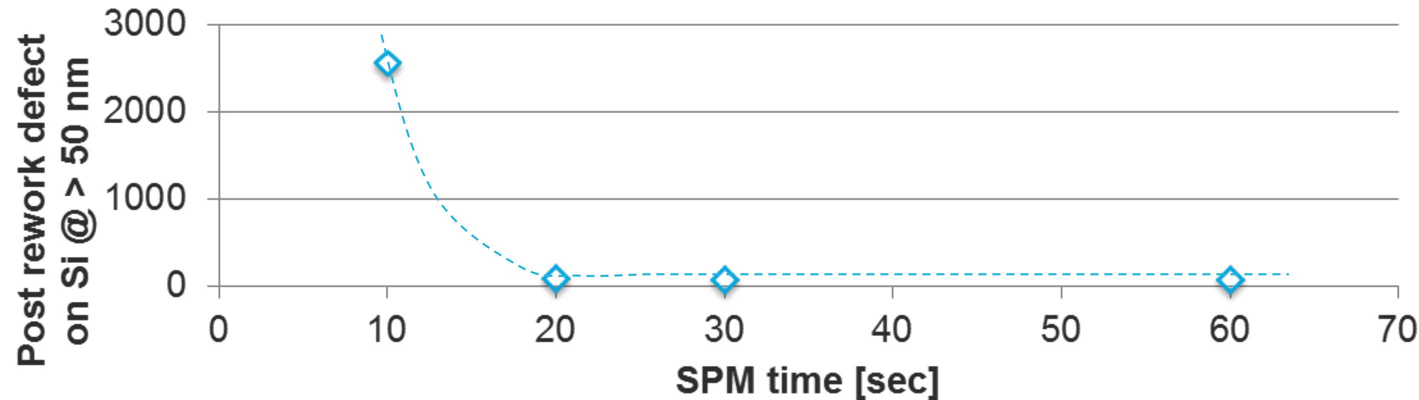
Challenge	Removal
High dose (>E15) implant DUV	✓
Tri-layer (Si-ARC up to 43% Si)	✓
Amorphous C	✓
Plasma Doped (PLAD)	✓



Rework Test

ORION™-hp

- **Resist strip test with steam injected SPM + SC1**
  - **Steam Injected SPM time varied; SC1 time fixed**



Resist component	Method	Detection Limit (E10 atoms/cm2)	Post rework			
			10 sec	20 sec	30 sec	60 sec
Metal	TXRF	5	< 5	< 5	< 5	< 5

- Inpria resist stripped successfully with steam injected SPM
  - Metal level below detection limit with ≥ 10sec process time
  - Defects at baseline levels with ≥ 20sec process time

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Conclusions

- Inpria resist compatibility with CLEAN TRACK™ LITHIUS Pro™ - EUV coater/developer has been demonstrated
- Inpria resist stripped successfully with steam injected SPM
- Metal level below detection limit with ≥ 10sec process time
- Defects at baseline levels with ≥ 20sec process time

Acknowledgements

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Thank you

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