TriFact
Solutions, Inc.

Third Party Resist Supplier Evaluation of TriFact Solutions, Inc. DI Water Heater Model TFS 4000-TP Pattern Area Defects

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Project Objective

- **Study the effect of a heated deionized (DI) water rinse on the formation of post develop pattern defects.**

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Equipment

- TEL Mark 8 coat/develop tool
- TriFact Solutions DI water Heater Model TFS 2000-TP
- Tridak Low Volume Dispense Assembly
- ASML PAS5500/850 stepper
- K-T8100 Top Down CD SEM
- K-T2135 Defect Inspection tool
  - Narrowband illumination with a Hg-Xenon light source and filtered wavelength.
  - Inspection wavelength around 580nm.

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KLA-Tencor2135 Defect Inspection Parameters

- KLA2135 Defect Inspection tool
  - Pixel setting: **0.25** μm
  - Inspection Mode: Array
  - Threshold: 20
  - Filter set: f2
  - Inspected area: **69.07** sq./cm. Patterned Resist Area
    35.85 sq./cm. Unexposed Resist Area
    35.06 sq./cm. Bulk Exposed Resist Area

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Results Summary Table
Pattern Area Defects

DI Water Rinse Time	Standard Rinse Temperature		Heated Rinse Temperature	
	Defect Count	Defect Density (defects/sq. cm.)	Defect Count	Defect Density (defects/sq. cm.)
20 sec.	166	2.40	112	1.62
20 sec.	237	3.43	117	1.69
20 sec.				
40 sec.	251	3.63	118	1.71
40 sec.	269	3.89	116	1.68
40 sec.			224	3.24
60 sec.	133	1.93	138	2.00
60 sec.	120	1.74	144	2.08
60 sec.	156	2.26	74	1.07
80 sec.	179	2.59	79	1.14
80 sec.	204	2.95	73	1.06
80 sec.			68	0.98

The heater setting is at 40°C but the actual temperature at the DI water rinse nozzle is 36°C. This is due to the length of exposed tubing between the heater assembly and the dispense tip. For this evaluation, the heater was not able to be configured closer to the DI water dispense nozzle.

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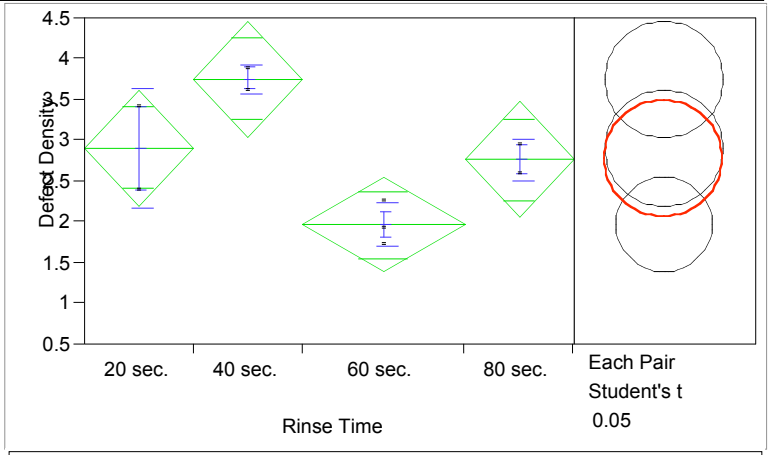
JMP Analysis Results of Defect Density's Pattern Area Defects

Standard DI Water Rinse Temp. (21°C)

Oneway Analysis of Defect Density By Rinse Time

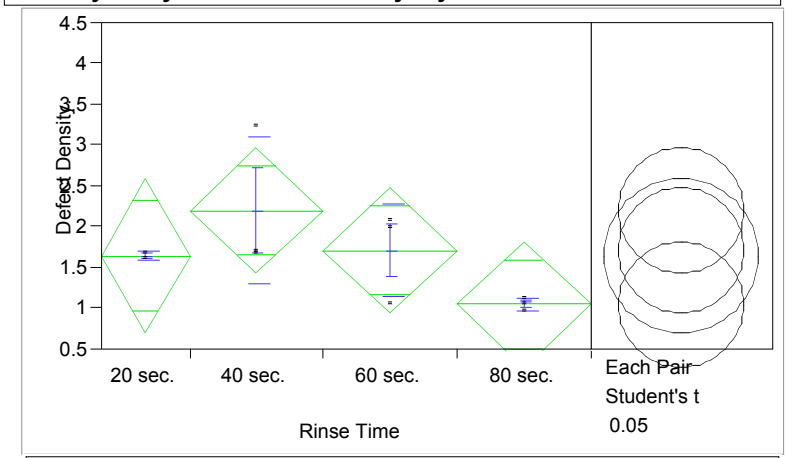


Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
20 sec.	2	2.91500	0.728320	0.51500	-3.629	9.4587
40 sec.	2	3.76000	0.183848	0.13000	2.108	5.4118
60 sec.	3	1.97667	0.263122	0.15191	1.323	2.6303
80 sec.	2	2.77000	0.254558	0.18000	0.483	5.0571

Heated DI Water Rinse Temp. (40°C)

Oneway Analysis of Defect Density. By Rinse Time



Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
20 sec.	2	1.65500	0.049497	0.03500	1.210	2.0997
40 sec.	3	2.21000	0.892132	0.51507	-0.006	4.4262
60 sec.	3	1.71667	0.561456	0.32416	0.322	3.1114
80 sec.	3	1.06000	0.080000	0.04619	0.861	1.2587

With a standard rinse temperature, a 60sec. rinse time significantly reduces post develop defects.

A heated DI water rinse produced lower counts at a shorter rinse and continues to maintain or reduce that count with extended rinse time. An 80 sec rinse was on significantly different than the 40 sec rinse.

Note: 40°C is the set point temperatures on the heating assembly. Actual temperature at the Nozzle is 36°C.

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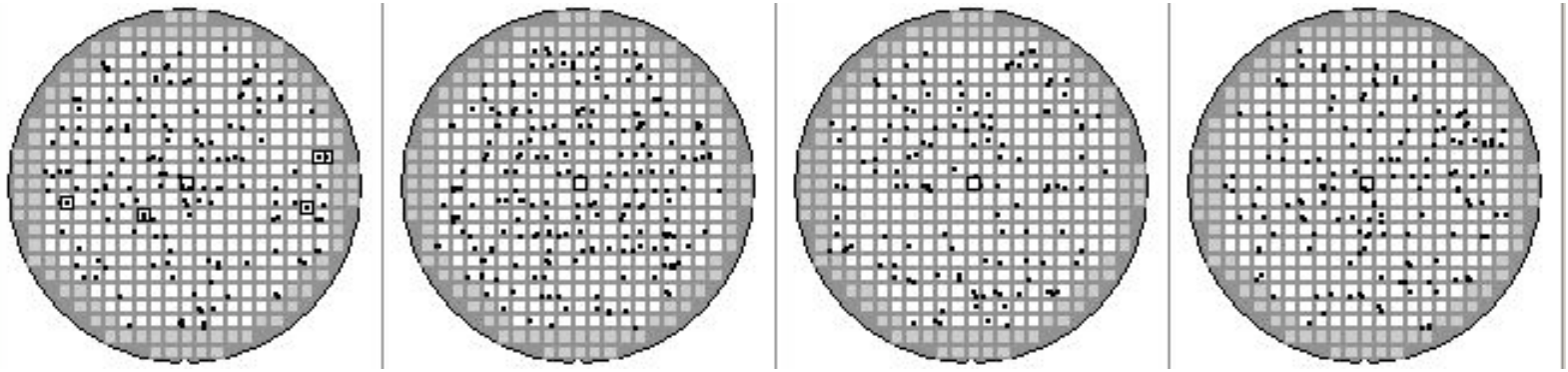
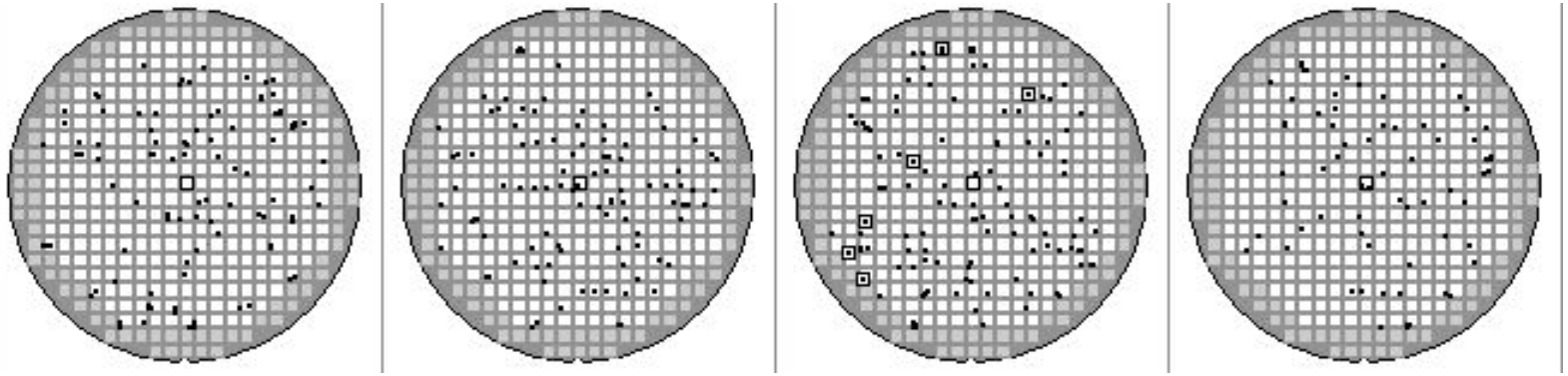
Wafer Maps
Pattern Area Defects

	Rinse Time 20 sec.	Rinse Time 40 sec.	Rinse Time 60 sec.	Rinse Time 80 sec.
Standard Rinse Temp (21°C)				
Heated Rinse Temp (40°C)				

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Classification Codes
Pattern Area Defects

- **Sm Dark – Small dark point defects (<0.25µm in size).**
- **Sm Bright – Small light point> defects (<0.25µm in size).**
- **Rnd/Med Dark – Round and darker than the background.**
- **Irr Dark – Irregular shape and darker than the background.**
- **Irr Bright – Irregular shape and brighter than the background.**
- **Macro – Greater than 10µm in size.**

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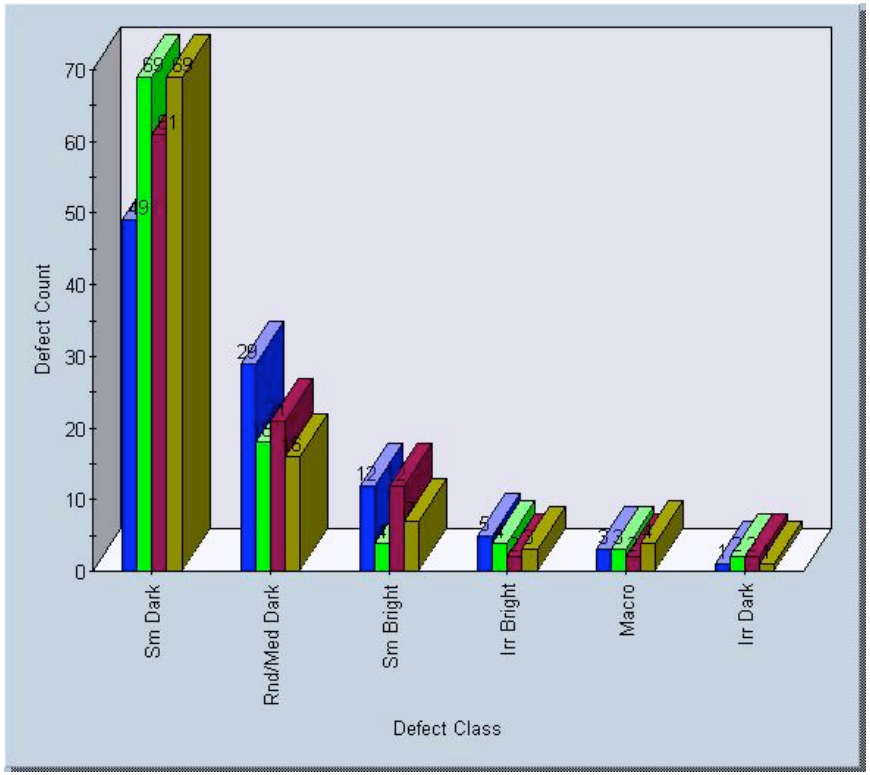
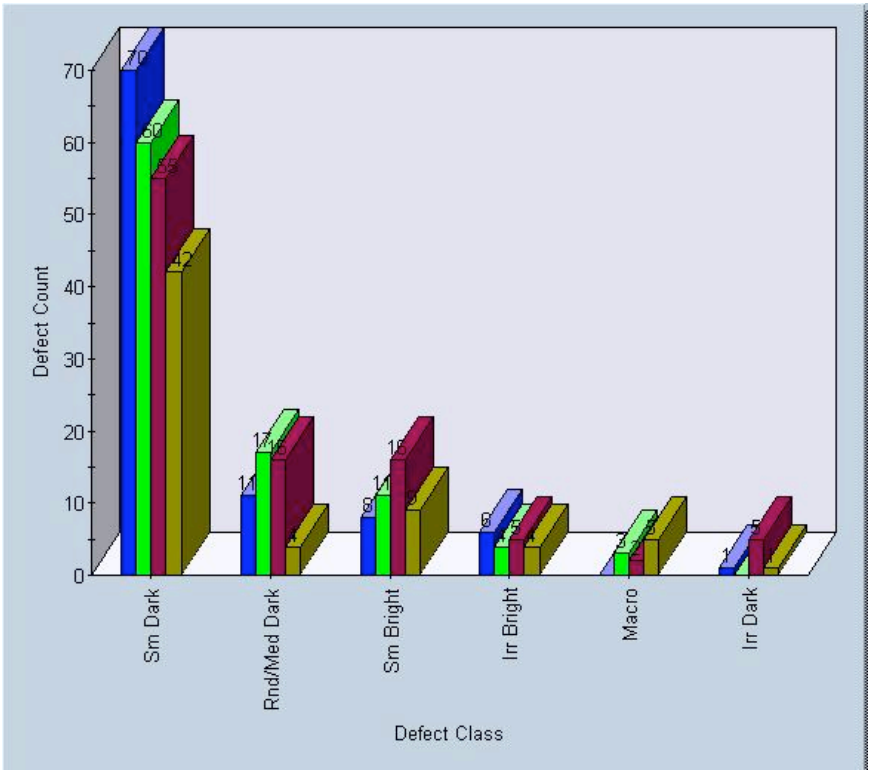
Pareto Charts
Pattern Area Defects

One wafer classified per process condition. Up to 100 defects classified per wafer.

Standard Rinse Temperature (21°C)



Heated Rinse Temperature (40°C)



Rinse Time

- 20 sec
- 40 sec
- 60 sec
- 80 sec

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Optical Images of Defect Types
Pattern Area Defects

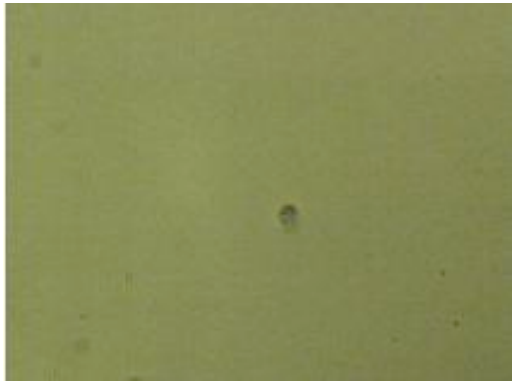
Sm dark

Sm bright

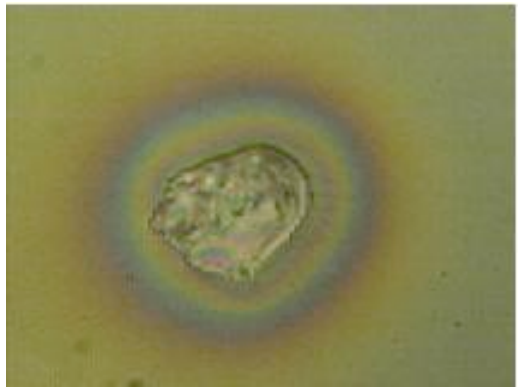
Rnd/Med Dark

Irr bright

Irr Dark



Macro



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Results Summary
Pattern Area Defects

- **Analysis of the defect density's show:**
  - **With a standard rinse temperature, a 60sec. rinse time significantly reduces post develop defects.**
  - **A heated DI water rinse produced lower counts at a shorter rinse and continues to maintain or reduce that count with extended rinse time. An 80 sec rinse was on significantly different than the 40 sec rinse.**

- **Review of defects show:**
  - **Using a standard rinse temperature, increasing the rinse time saw in increase in Sm Dark and a reduction in Rnd/Med dark defects.**
  - **A heated DI water rinse reduced Sm Dark.**