Heidelberg Laser Writer AZ300MIF Developer Use Guide

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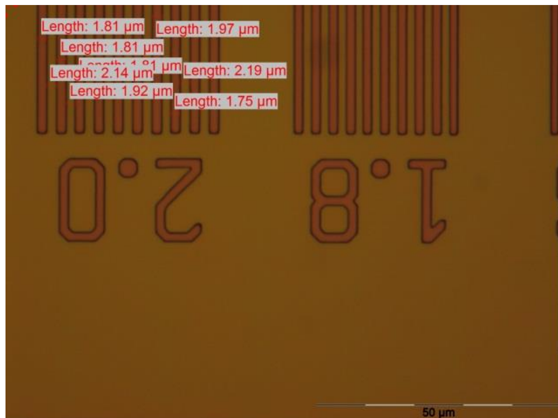
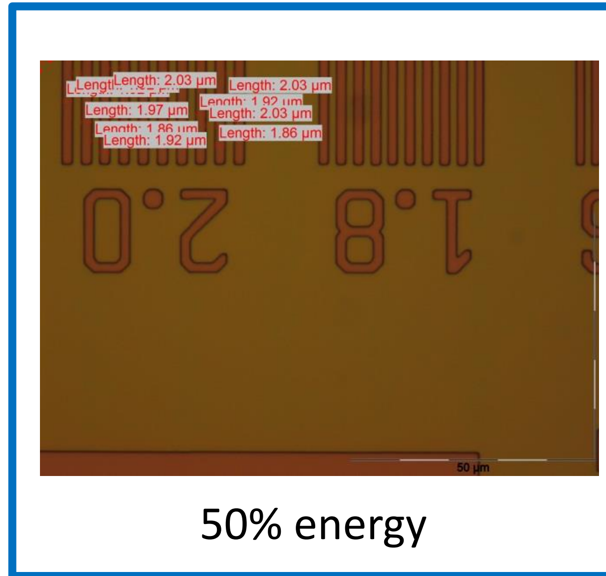
Introduction

- AZ400K:
  - Existing developer for Heidelberg laser writing process:
  - Chemical composition: Potassium borates (1.4N) in water, concentrate to be diluted by water (1:4)
  - Application: Best contrast and wall profile when used with AZ 4500 series photoresist
  - Issues
    - Concentrate dilution reliability when mixed with water
    - Procurement and logistic complexity for photolithography exposure and mask making
    - Cross contamination when mixed with AZ300MIF
    - Introduce metal ion in device fabrication, detrimental in CMOS device fabrication
    - Not a semiconductor industry standard in state-of-art fabs
- AZ300MIF
  - New developer for Heidelberg laser writing process
  - Chemical composition: Tetramethylammonium hydroxide (TMAH) (0.261N) in water
  - Advantages
    - No dilution is needed
    - Simplified procurement and logistics processes
    - Metal ion free
    - Semiconductor industry standard

4 mm Write Head Exposures on Mask Plate

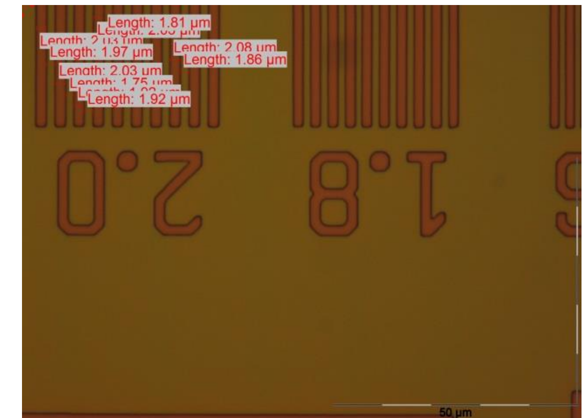


40% energy



50% energy

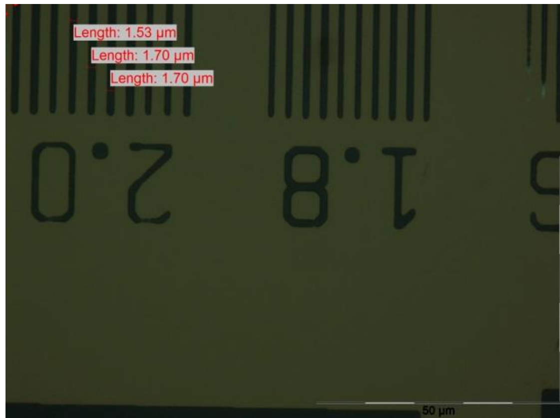
Best energy



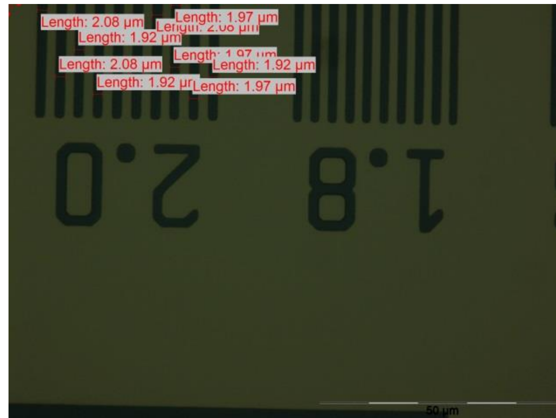
60% energy

- Nanofilm 4 inch soda lime glass mask plate coated with AZ1518 resist
- 4 mm write head, 10% filter
- Line and space pattern
  - 2 um/2 um (on design)
- AZ300MIF developer 60 s, DIW rinse 60 s and nitrogen blow to dry
- Best energy post develop: 50%

Cr Etch on Mask Plate

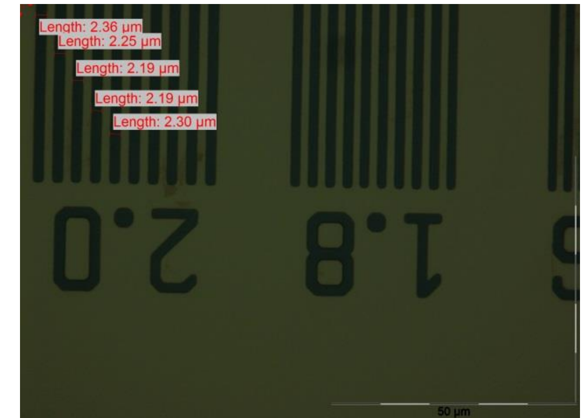


30% energy



40% energy

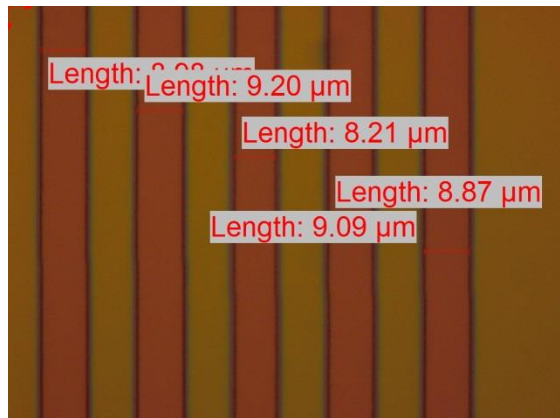
Best energy



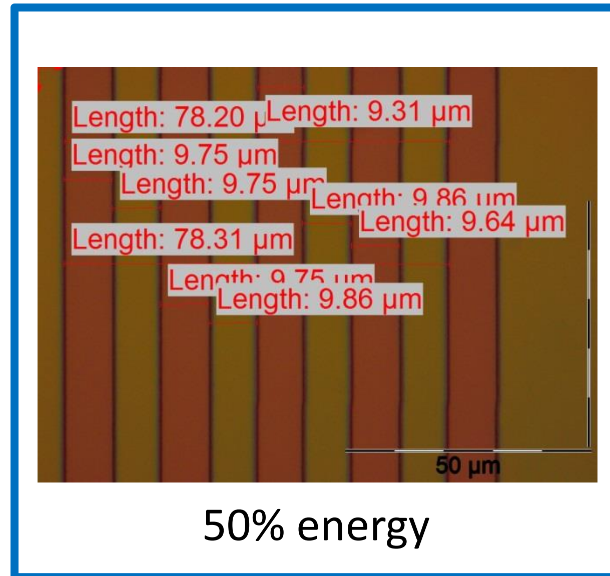
50% energy

- Nanofilm 4 inch soda lime glass mask plate coated with AZ1518 resist
- 4 mm write head, 10% filter
- Line and space pattern
  - 2 um/2 um (on design)
- AZ300MIF developer 60 s, DIW rinse 60 s and nitrogen blow to dry
- Standard Cr etch by Polos
- Best energy post Cr etch: 40%

20 mm Write Head Exposures on Mask Plate

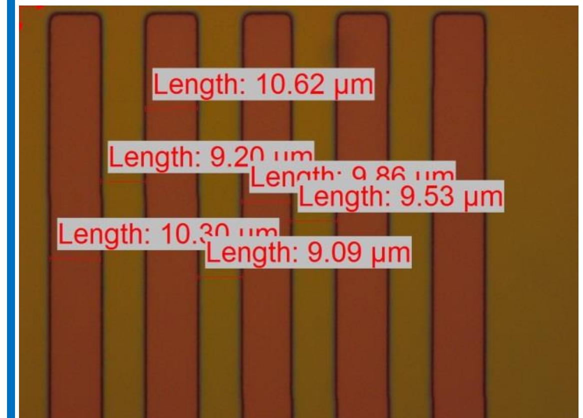


40% energy



50% energy

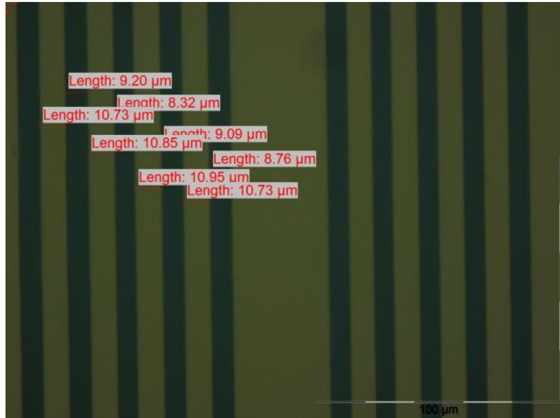
Best energy



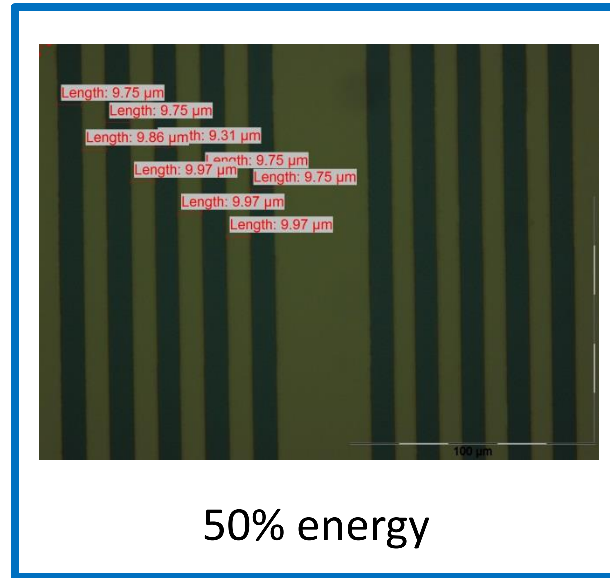
60% energy

- Nanofilm 4 inch soda lime glass mask plate coated with AZ1518 resist
- 20 mm write head
- Line and space pattern
  - 10 um/10um (on design)
- AZ300MIF developer 60 s, DIW rinse 60 s and nitrogen blow to dry
- Best energy post develop: 50%

Cr Etch on Mask Plate

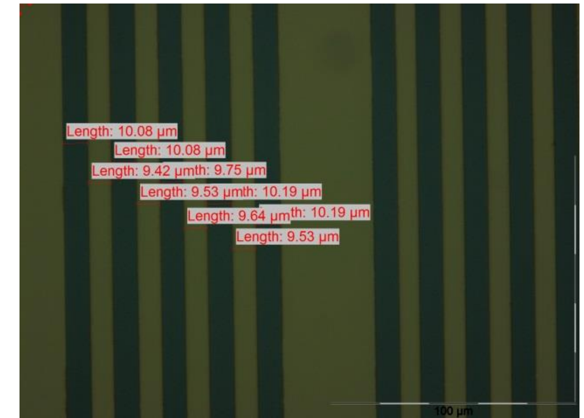


40% energy



50% energy

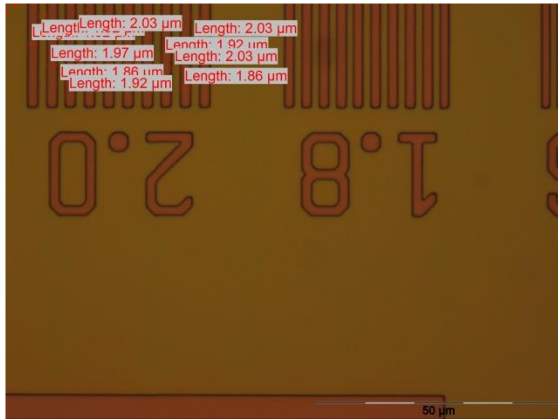
Best energy



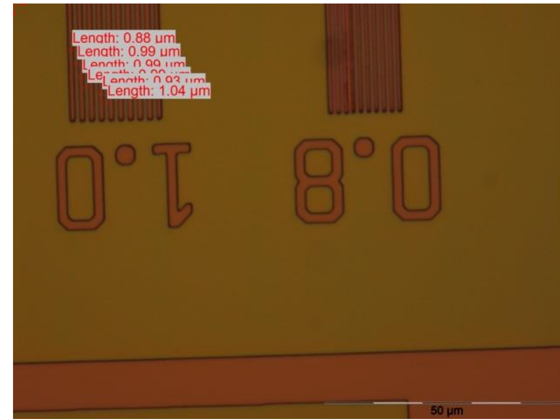
60% energy

- Nanofilm 4 inch soda lime glass mask plate coated with AZ1518 resist
- 20 mm write head
- Line and space pattern
  - 10 um/10um (on design)
- AZ300MIF developer 60 s, DIW rinse 60 s and nitrogen blow to dry
- Standard Cr etch by Polos
- Best energy post Cr etch: 50%

Resolution Post Develop



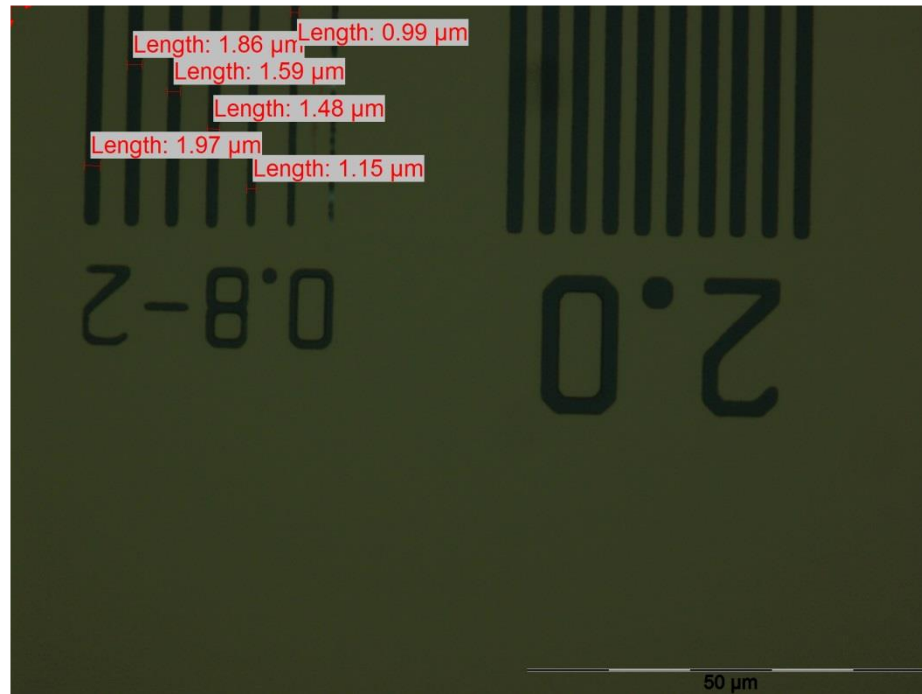
Line/Space: 2um/2um



Line/Space: 1um/1um

- Nanofilm 4 inch soda lime glass mask plate coated with AZ1518 resist
- 4 mm head, 50% energy, 10% filter
- AZ300MIF developer 60 s, DIW rinse 60 s and nitrogen blow to dry
- Post develop resolution: 1.0 um

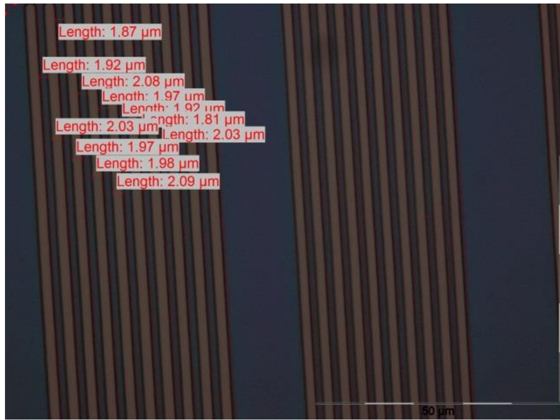
Resolution Post Cr Etch



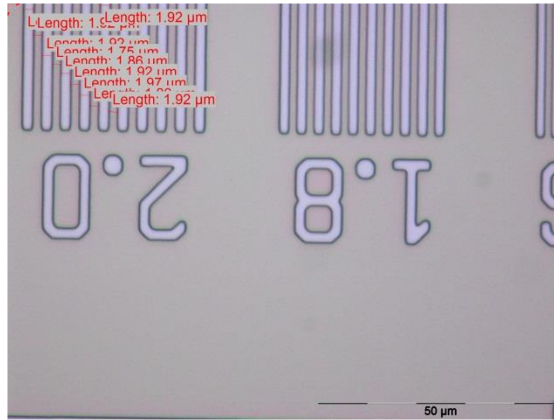
Pattern gradient: 0.8-2.0 um

- Nanofilm 4 inch soda lime glass mask plate coated with AZ1518 resist
- 4 mm head, 40% energy, 10% filter
- AZ300MIF developer 60 s, DIW rinse 60 s and nitrogen blow to dry
- Standard Cr etch by Polos
- Post Cr etch resolution: 1.0 um

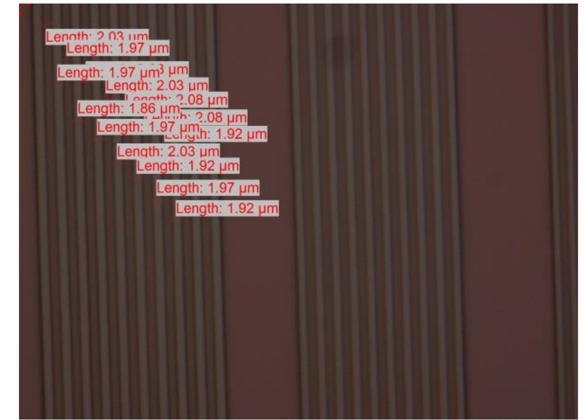
4 mm Write Head Exposures on Si Wafer



AZ1505 on wafer



LOR3A/AZ1505 on wafer



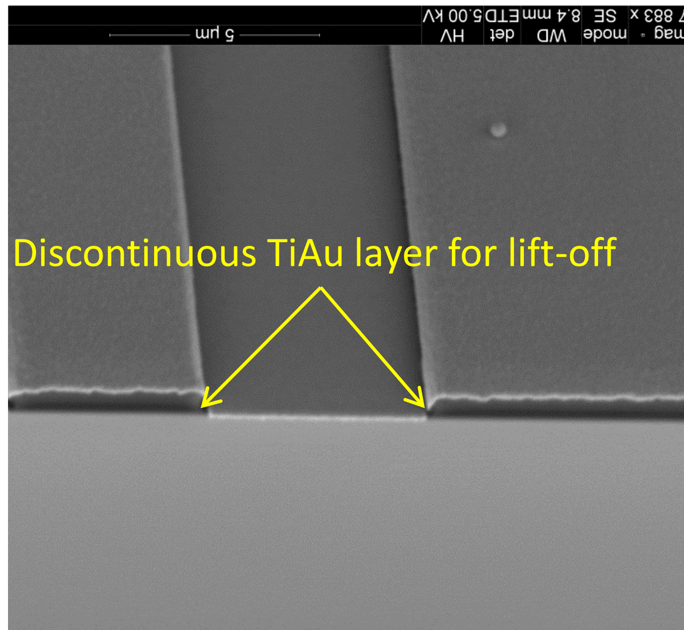
LOR5A/AZ1505 on wafer

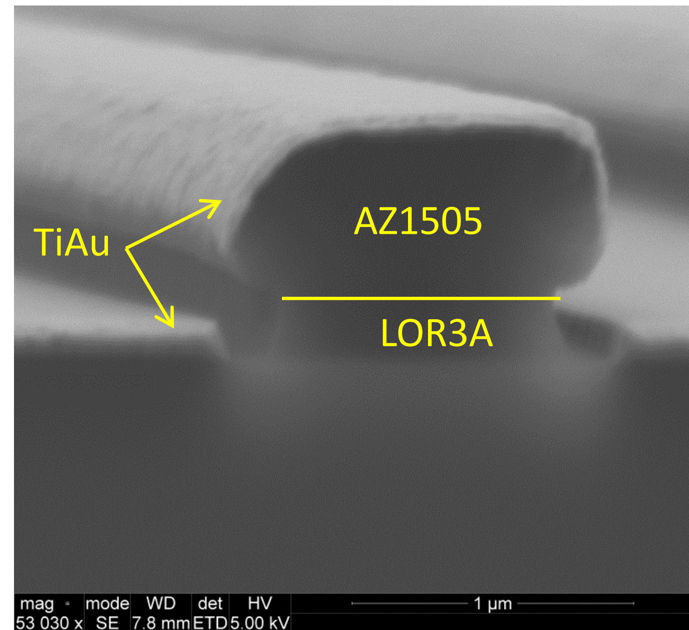
Substrate	Materials	Process	Defoc	Energy	Develop
Si wafer	AZ1505	AZ1505 4000rpm/40s, PAB 90°C/60s	2050	40%	AZ300MIF 60s
Si wafer	LOR3A/AZ1505	LOR3A 4000rpm/40s, bake 175°C/5 min. AZ1505 4000rpm/40s, PAB 90°C/60s	2000	40%	AZ300MIF 60s
Si wafer	LOR5A/AZ1505	LOR5A 4000rpm/40s, bake 175°C/5 min. AZ1505 4000rpm/40s, PAB 90°C/60s	2050	40%	AZ300MIF 60s

- 4 mm write head, 10% filter
- Line and space pattern

  2 um/2 um (on design)

Metallization on Bilayer for Lift-off

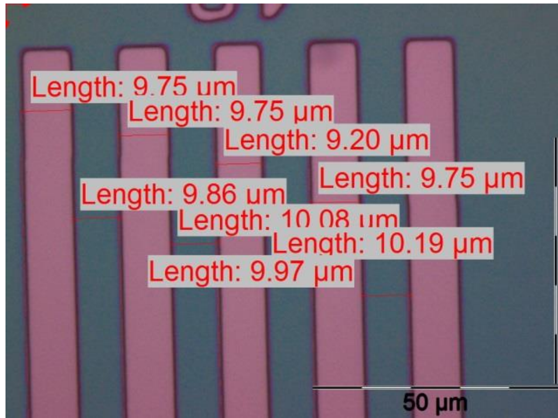




Process condition

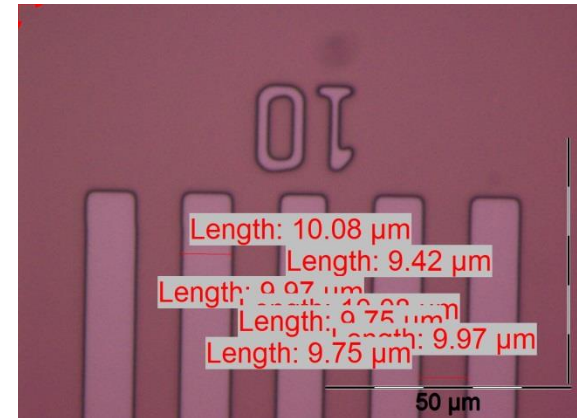
- LOR3A/AZ1505, 4mm head, 10% filter, 50% energy, AZ300MIF 60s
- Angstrom evaporator, Ti10Au90 (100nm)
- Quantum ESEM, high vac, 5kV

20 mm Write Head Exposures on Si Wafer



AZ1505 on wafer

LOR3A/AZ1505 on wafer



LOR5A/AZ1505 on wafer

Substrate	Materials	Process	Defoc	Energy	Develop
Si wafer	AZ1505	AZ1505 4000rpm/40s, PAB 90°C/60s	1900	40%	AZ300MIF 60s
Si wafer	LOR3A/AZ1505	LOR3A 4000rpm/40s, bake 175°C/5 min. AZ1505 4000rpm/40s, PAB 90°C/60s	1900	40%	AZ300MIF 60s
Si wafer	LOR5A/AZ1505	LOR5A 4000rpm/40s, bake 175°C/5 min. AZ1505 4000rpm/40s, PAB 90°C/60s	1900	50%	AZ300MIF 60s

- 20 mm write head
- Line and space pattern
  10 um/10 um (on design)

New DWL 66 Heidelberg Parameter Summary

Substrate	Materials/Process	Write head	10% Filter	Defoc (um)	Spot size correction x (nm)	Spot size correction y (nm)	Developer	Energy
Cr Mask Blank	**AZ1518 (Pre-coated)**	**4 mm**	**Yes**	**1650**	**-100**	**-100**	**AZ300MIF 60s**	**40%**
Si	AZ1505 4000rpm/40s, 95C/60s	4 mm	Yes	2050	-100	-100	AZ300MIF 60s	40%
Si	LOR3A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	4 mm	Yes	2000	-100	-100	AZ300MIF 60s	40%
Si	LOR5A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	4 mm	Yes	2050	-100	-100	AZ300MIF 60s	40%
Cr Mask Blank	**AZ1518 (Pre-coated)**	**20 mm**	**No**	**2000**	**0**	**0**	**AZ300MIF 60s**	**50%**
Si	AZ1505 4000rpm/40s, 95C/60s	20 mm	No	1900	0	0	AZ300MIF 60s	40%
Si	LOR3A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	20 mm	No	1900	0	0	AZ300MIF 60s	40%
Si	LOR5A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	20 mm	No	1900	0	0	AZ300MIF 60s	50%

4mm	20 mm
AODO= -2000	AODO= -2060
Ramp= -1.210	Ramp= -1.241

Expiring DWL 66 Heidelberg Parameter Summary

Substrate	Materials/Process	Head	10% Filter	Defoc (um)	Spot size correction x (nm)	Spot size correction y (nm)	Developer	Energy
Cr Mask Blank	**AZ1518 (Pre-coated)**	**4 mm**	**Yes**	**1650**	**-100**	**-100**	**AZ400K:H_2O = 1:4 60s**	**80%**
Si	AZ1505 4000rpm/40s, 95C/60s	4 mm	Yes	2050	-100	-100	AZ400K:H_2O = 1:4 60s	80%
Si	LOR3A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	4 mm	Yes	2000	-100	-100	AZ400K:H_2O = 1:4 60s	70%
Si	LOR5A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	4 mm	Yes	2050	-100	-100	AZ400K:H_2O = 1:4 60s	80%
Cr Mask Blank	**AZ1518 (Pre-coated)**	**20 mm**	**No**	**2000**	**0**	**0**	**AZ400K:H_2O = 1:4 60s**	**80%**
Si	AZ1505 4000rpm/40s, 95C/60s	20 mm	No	1900	0	0	AZ400K:H_2O = 1:4 60s	70%
Si	LOR3A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	20 mm	No	1900	0	0	AZ400K:H_2O = 1:4 60s	80%
Si	LOR5A 4000rpm/40s, 175C/300s AZ1505 4000rpm/40s, 95C/60s	20 mm	No	1900	0	0	AZ400K:H_2O = 1:4 60s	80%

4mm	20 mm
AODO= -2000	AODO= -2060
Ramp= -1.210	Ramp= -1.241