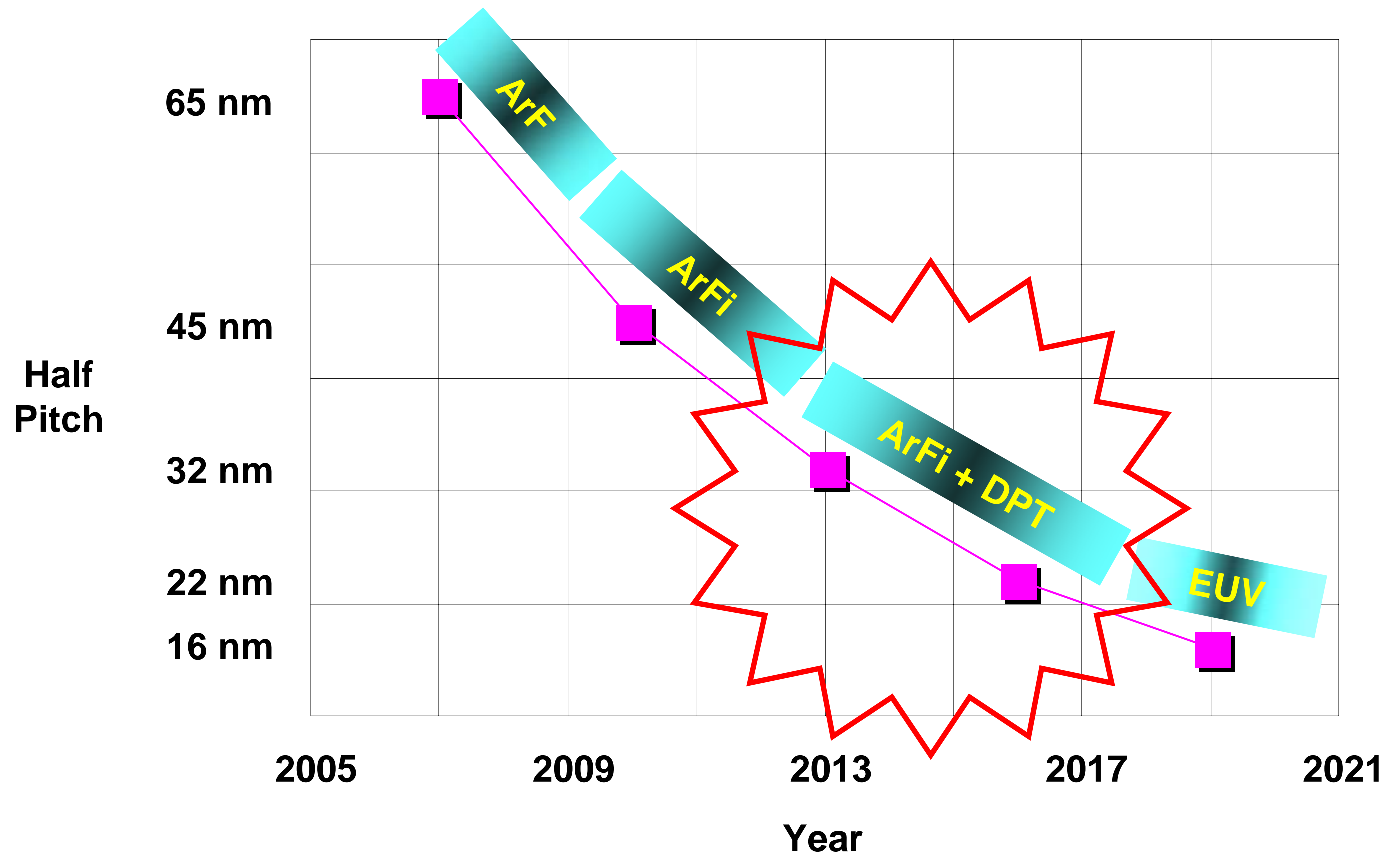
LithoVision | 2009

AZ® SOLID™ Coating
A Spin-On Solution For Double Patterning

AZ Electronic Materials

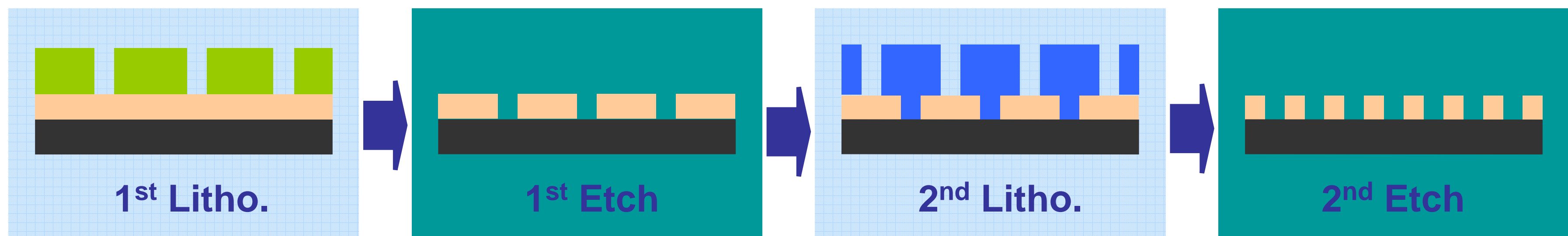
TECHNOLOGY TREND



Production-worthy Double Patterning Technology Needed now !

Current Technology for Double Patterning

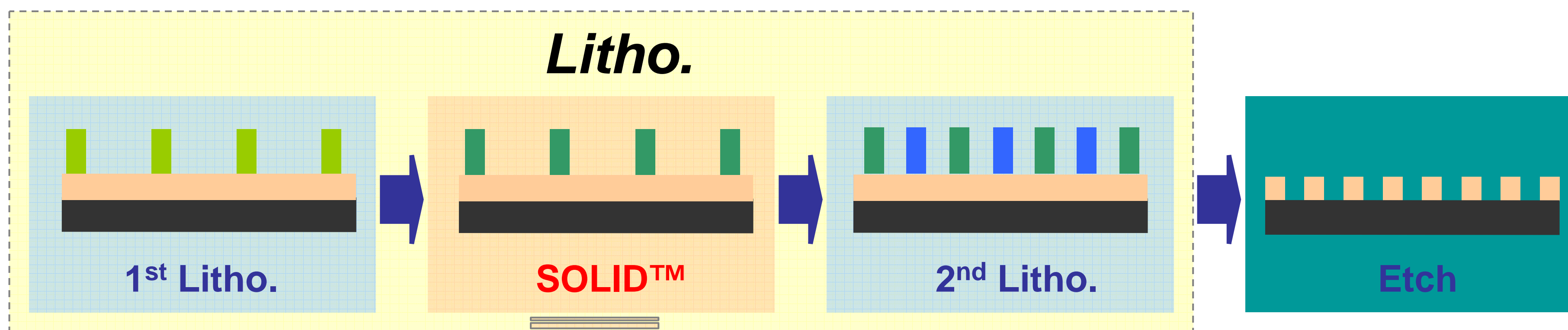
Litho – Etch – Litho - Etch



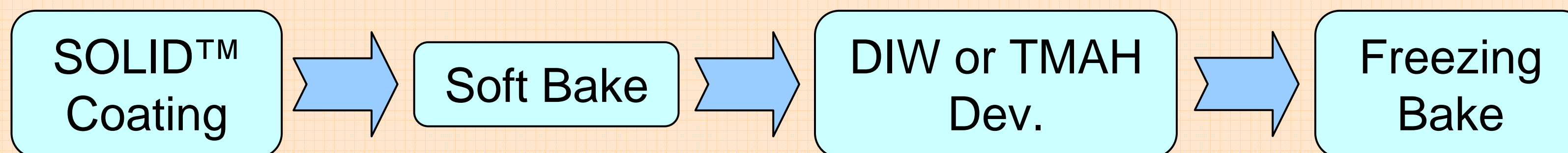
- Two etch steps (process complexity)
- Low throughput
- High cost of ownership

DPT Process using AZ® SOLID™

Spin-On Liquid to Inhibit Dissolution



SOLID™ Process

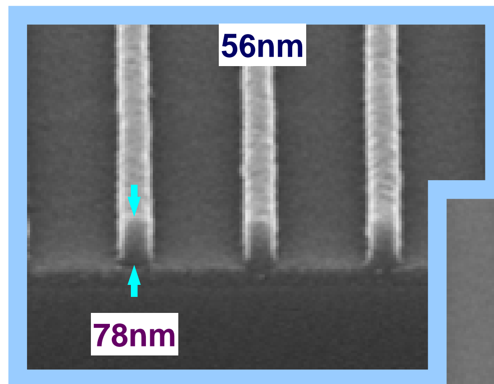


Only one etch step required. Wafer stays in litho section though 2nd imaging.

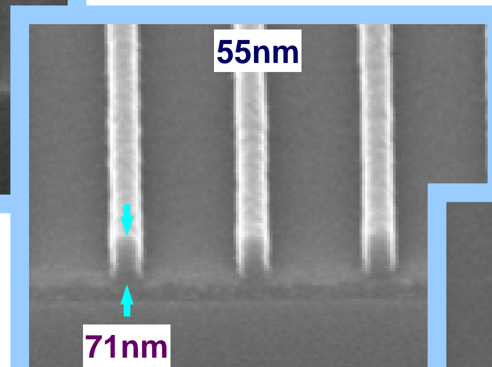
Overall Target Requirements for Spin-on Freezing Material

- Attachment on 1st pattern < 5nm (Goal : <2.5nm)
- Complete protection of 1st resist pattern from 2nd resist process
- Minimal top loss of 1st pattern during process
- Minimal scum, low added defectivity
- Wide compatibility with mainstream immersion resists
- Same resist applicable for both 1st and 2nd layers
- Good alignment capability through spin-on freezing process

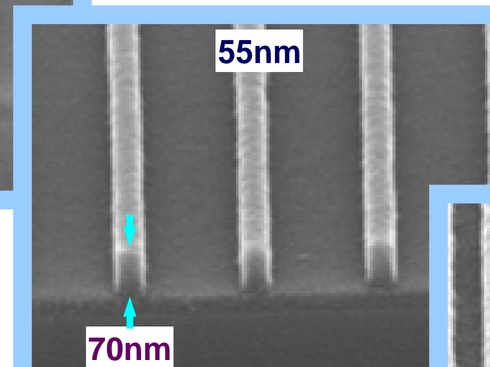
Freezing Process with AZ® SOLID™



After 1st Litho.

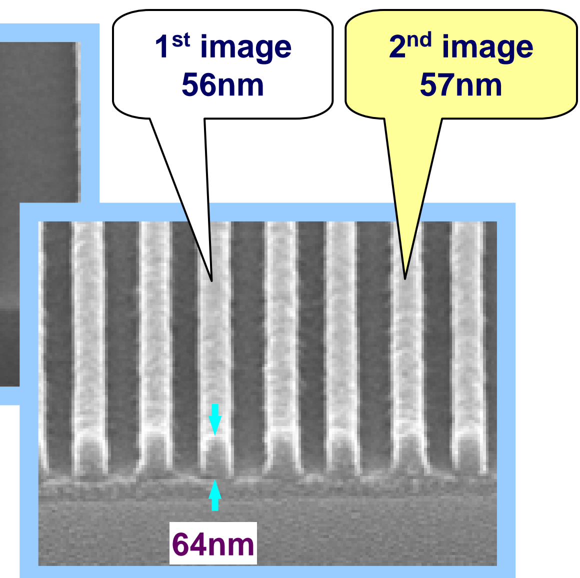


After SOLID™ Dev.



After Freezing

BARC:	AZ® ArF-1C5D
Resist:	AZ® AX2110P
Exposure:	Nikon NSR-S306D (NA 0.85)
Reticle:	att-PSM (6%)

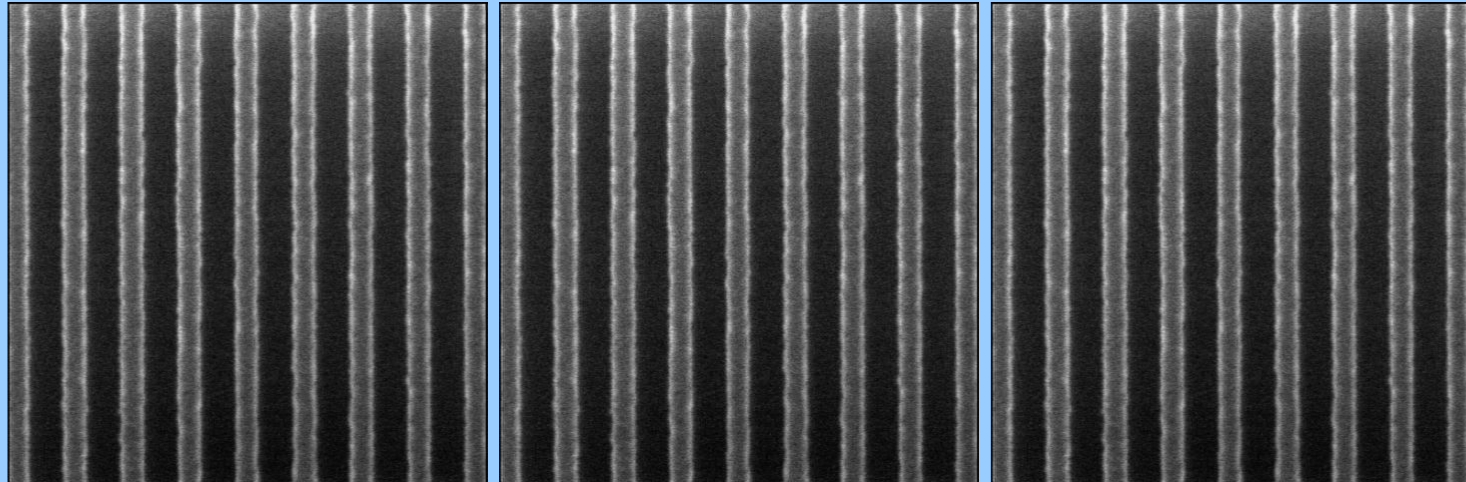


Final DP Image

- ❖ CD and profile of 1st pattern stable throughout the process.
- ❖ Minimal resist loss through process

Effects of SOLID™ Process on LER/LWR

BARC: AZ® ArF-1C5D, Resist: AZ® AX2110P, Exposure: Nikon NSR-S306D, Reticle: att-PSM (6%)

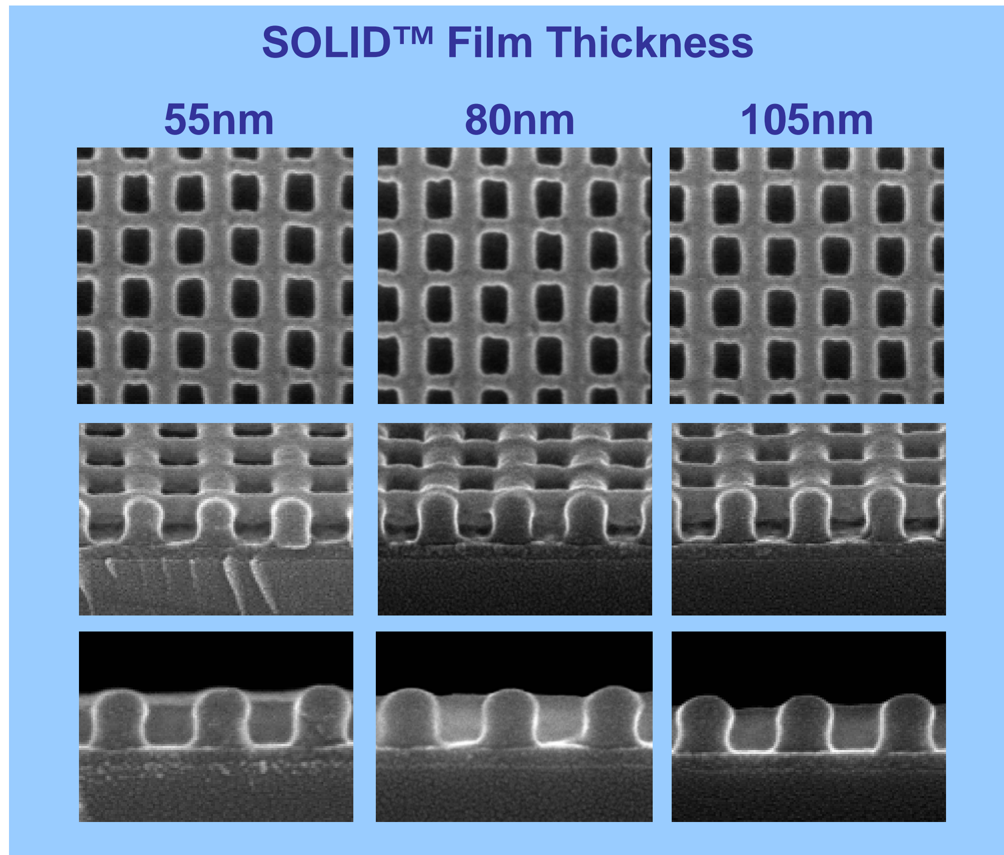


	After 1st litho.	After SOLID™ Dev.	After Freezing Bake
LER (nm)	4.3	3.2	3.8
LWR (nm)	6.4	4.8	5.3

❖ **Some LER/LWR improvement seen with SOLID™ process.**

X-Grid Contact: FT Dependency

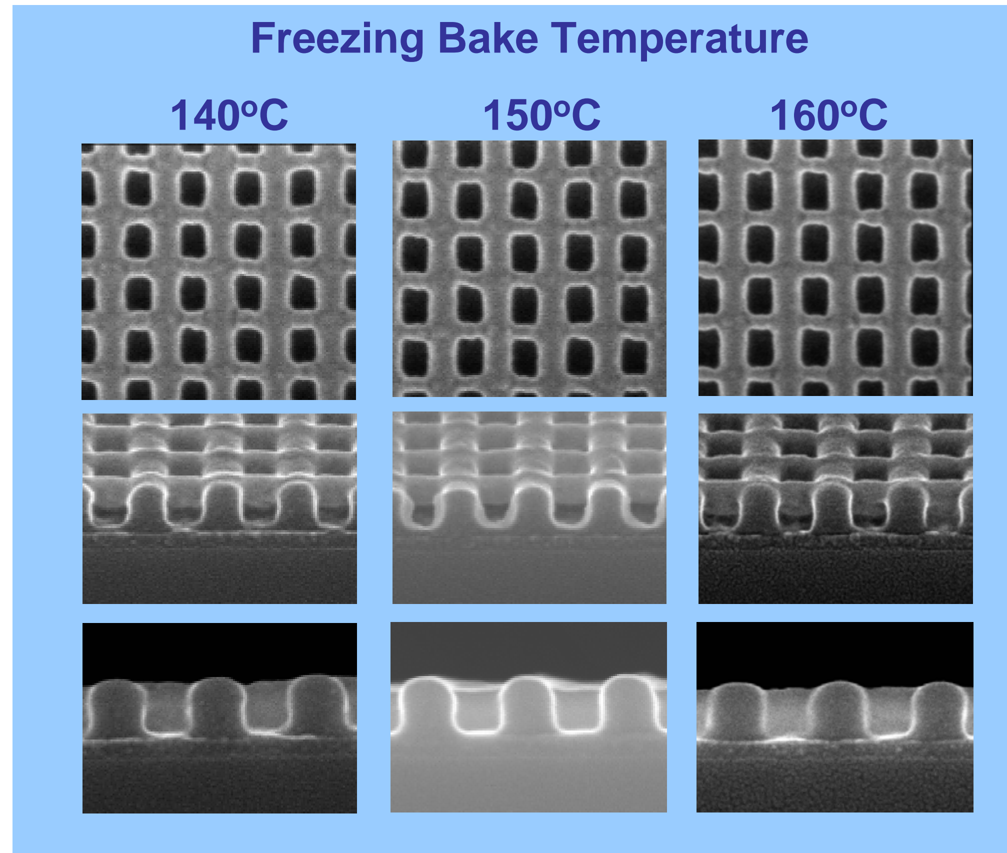
BARC: AZ® ArF-1C5D, Resist: AZ® AX2110P, Exposure: Nikon NSR-S306D, Reticle: att-PSM (6%)



❖ **No obvious dependency on coating film thickness of SOLID™.**

X-Grid Contact: Effects of Freezing Bake

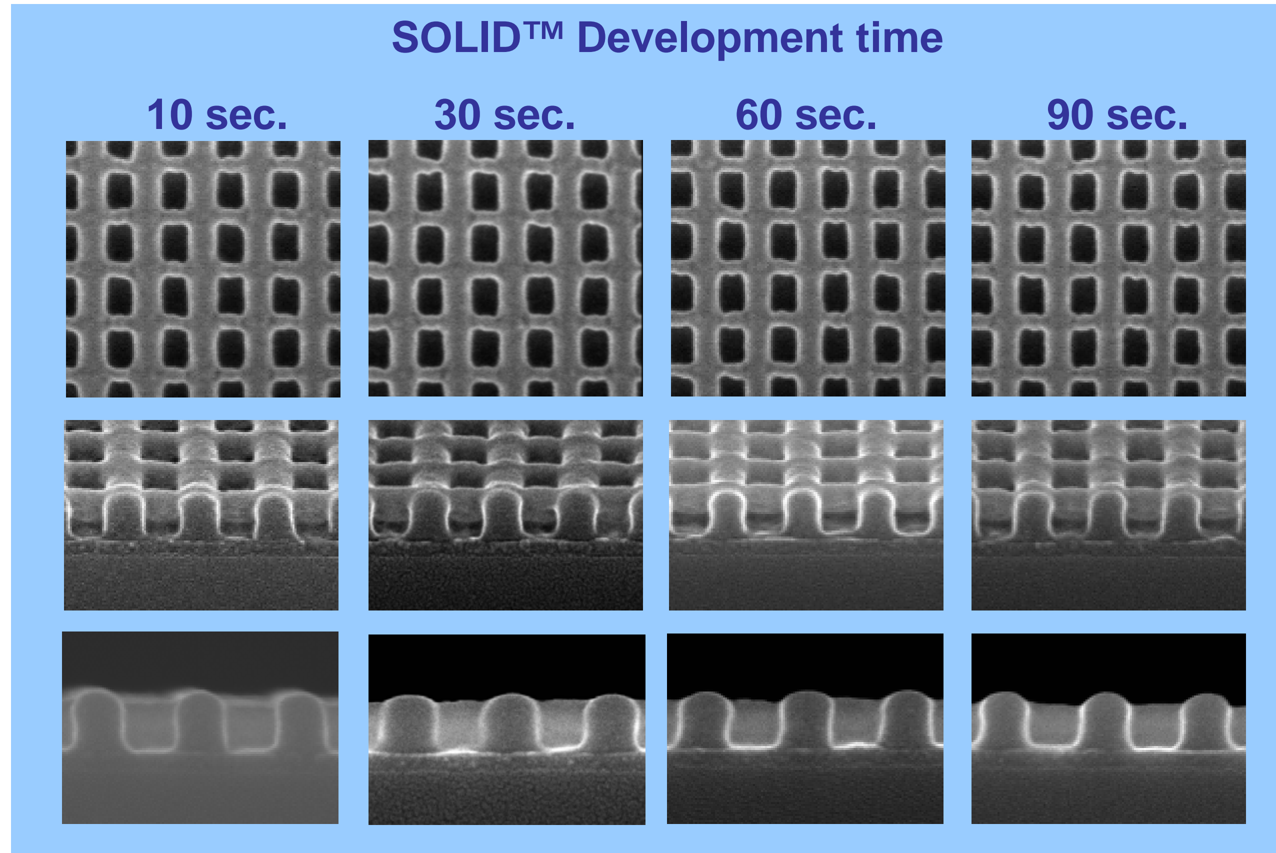
BARC: AZ® ArF-1C5D, Resist: AZ® AX2110P, Exposure: Nikon NSR-S306D, Reticle: att-PSM (6%)



❖ **No obvious dependency on freezing bake temperature is observed.**

X-Grid Contact: Effects of Dev. Time

BARC: AZ® ArF-1C5D, Resist: AZ® AX2110P, Exposure: Nikon NSR-S306D, Reticle: att-PSM (6%)



- SOLID™ development time has minimal affect.

CD Uniformity of SOLID™ Process

BARC: AZ® ArF-1C5D, Resist: AZ® AX2110P, Exposure: Nikon NSR-S306D, Reticle: att-PSM (6%)

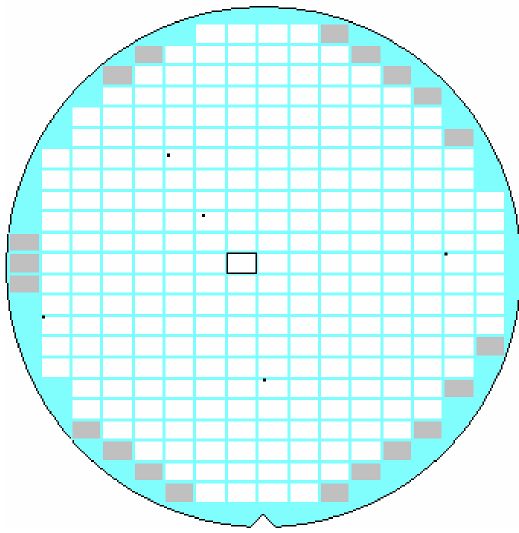
Items	After 1st litho.		After Double Patterning			
			1st image		2nd image	
	AVG.	Sigma	AVG.	Sigma	AVG.	Sigma
CDU (nm)	53.2	1.8	53.3	1.7	48.2	2.2
LER (nm)	4.2	0.5	4.6	0.8	4.0	0.6
LWR (nm)	6.2	0.8	6.5	1.1	6.3	0.8

❖ **Minimal affect on CD uniformity through SOLID™ process.**

Defectivity of SOLID™ Process

BARC: AZ® ArF-1C5D, Resist: AZ® AX2110P, Exposure: Nikon NSR-S306D, Reticle: att-PSM (6%)

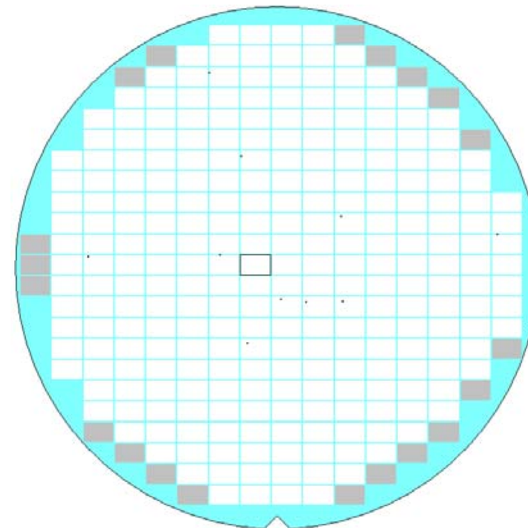
After SOLID™ process



Defect Density

0.13 defects/cm²

After 2nd flood exposure
[Simulated double patterning process]



Defect Density

0.40 defects/cm²

- **No defects added by SOLID™ process.**

Conclusions

- ***AZ® SOLID™ spin-on freezing material provides a solution for Litho-Litho-Etch double patterning technology with minimal top loss, negligible CD change, acceptable scum/footing and low added defectivity.***

- ***AZ is continuing further improvement with intensive collaboration with major device manufacturers toward production-worthy product for 3X nm and beyond design rule devices.***

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