# NINE project 2010 April update

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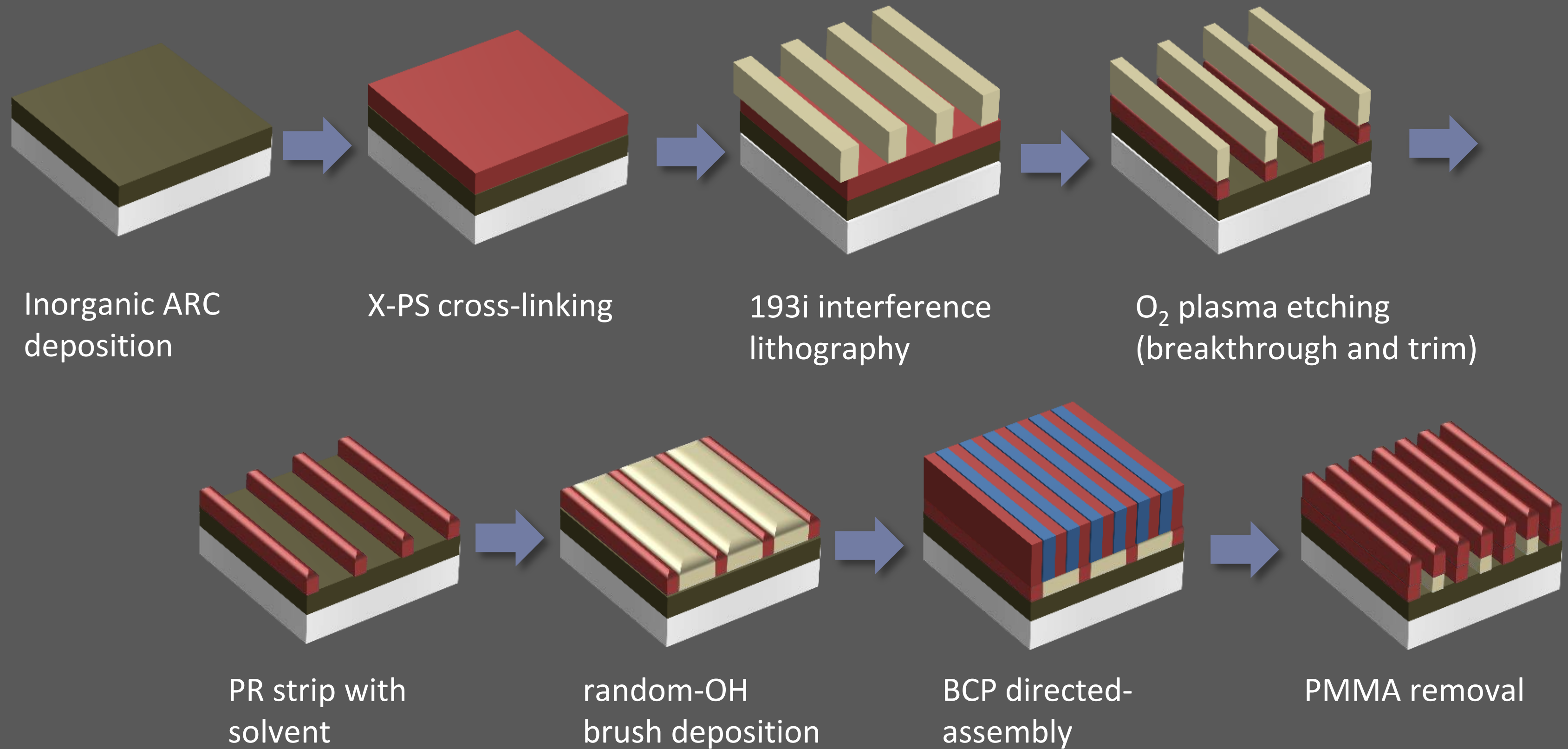
# Outline

- Process flow
- Optimization of key parameters
  - Line width of guiding patterns (by trim etch)
  - Background chemistry (using different brushes)
- An example of quasi-optimized BCP directed assembly
- Summary and future plan

# Chemically patterned substrate fabricated by 193i-IL



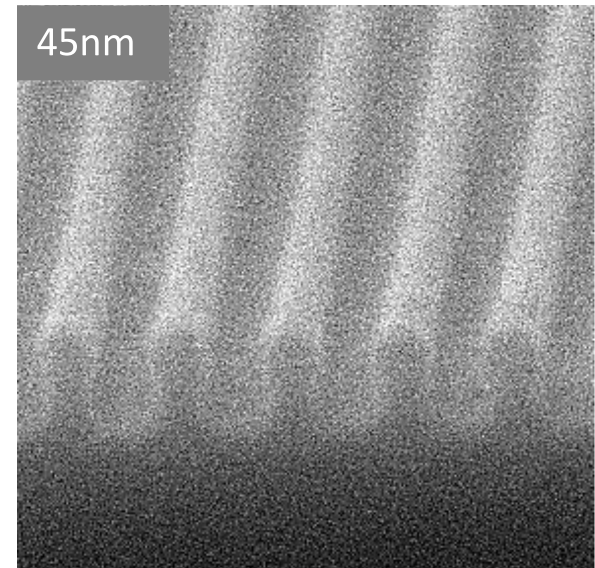
# Thickness effect of the inorganic ARC on PR profile

SiN thk =7.8nm
PR
SiN
100nm

15nm

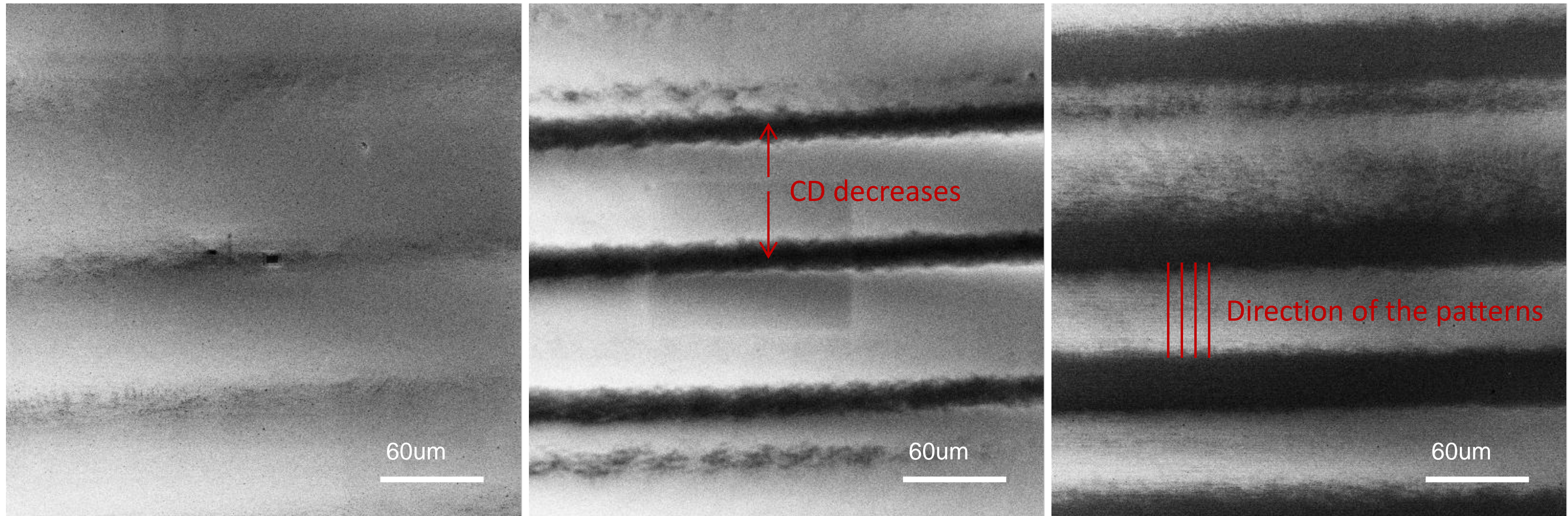
22nm

- Samples are made during 09' Dec, before the PM (preventive maintenance) of the 193i-IL tool. (Dose=110 pulses)
- Experiments show that 8~20nm of UW's PECVD nitride is suitable as an ARC.
- Non-optimized ARC will result in "hot-air balloon" shape of profile.
- Characterization of the optical properties of the nitride film is under-going.

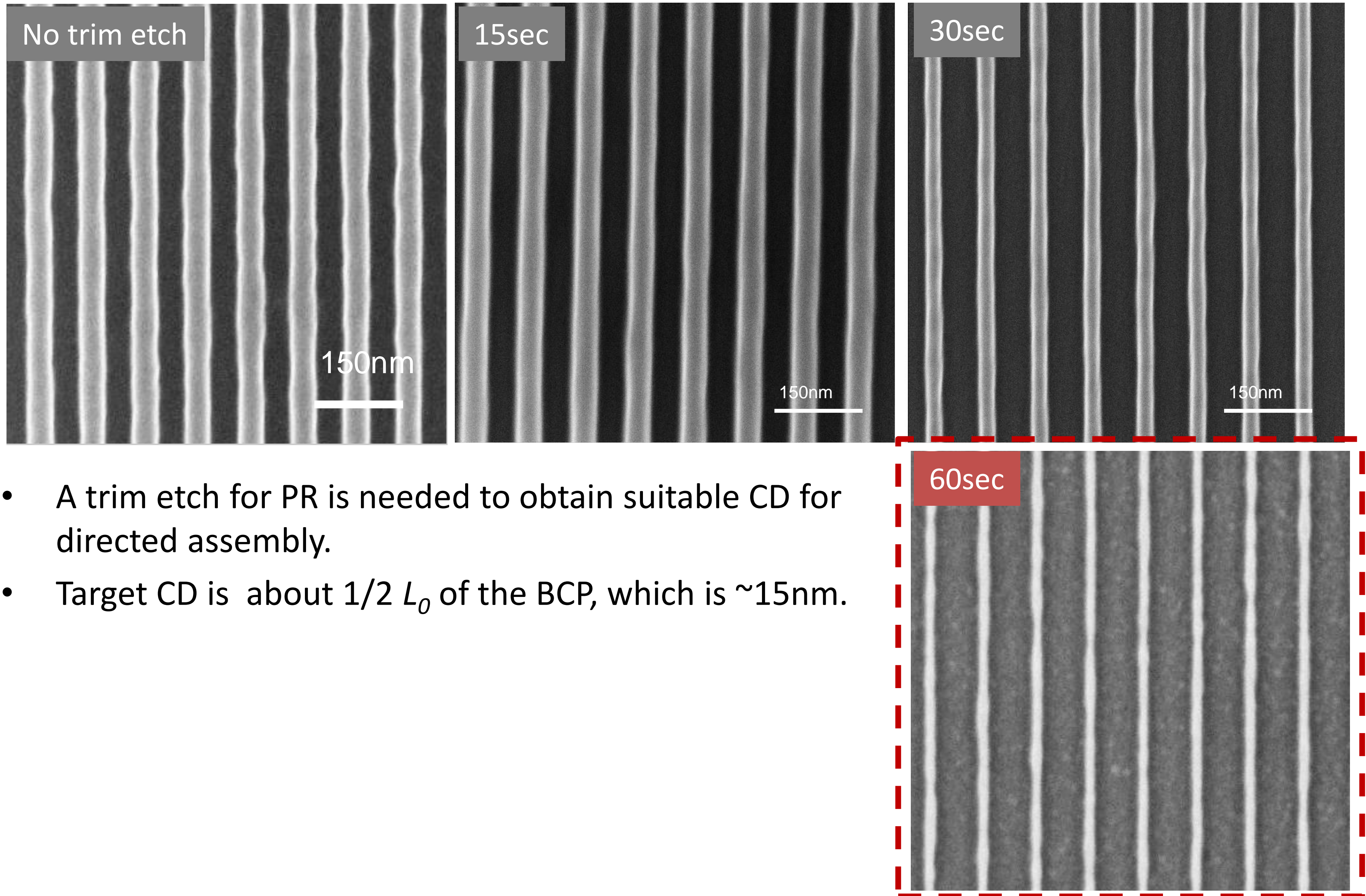


# Spatial uniformity within an exposure field

- Grating pattern over ~1 in.$^2$ are obtained. Segments of parallel lines with ~50um in length can be obtained.
- Nitride 8nm, 110pulses, one exposure field cut into four ~1cm-by-1cm chips. Some spatial differences and CD variation in one specific direction was observed.
- CD along the other direction is relatively stable.



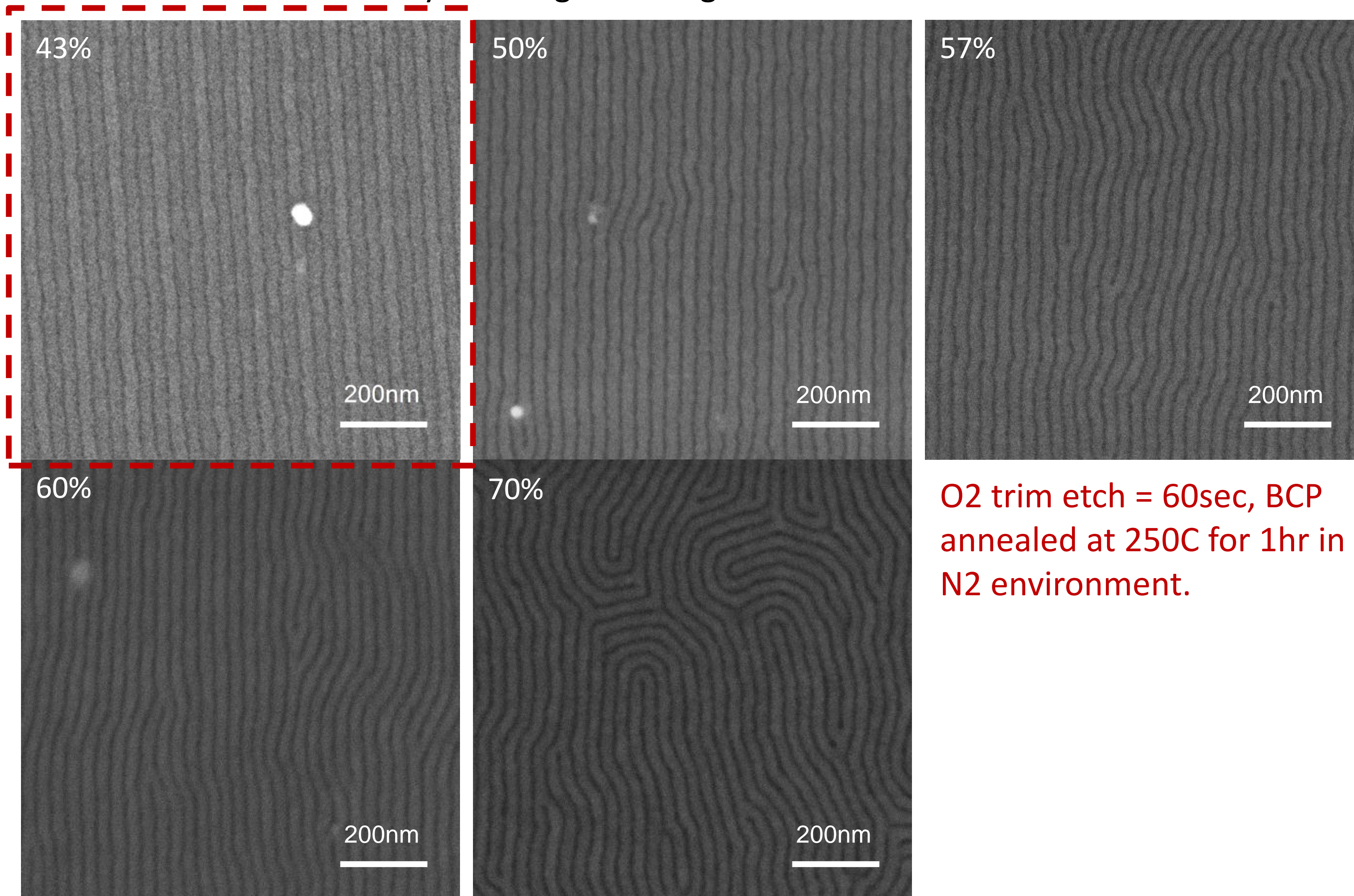
# O2 trim etch for PR (and X-PS)




- A trim etch for PR is needed to obtain suitable CD for directed assembly.
- Target CD is about 1/2 $L_0$ of the BCP, which is ~15nm.

# Background chemistry effect on directed assembly

- Random copolymer brushes with different PS content (shown in the images) are used to control the chemistry at background region.



X-PS/43%-OH
Pitch of the final structure = $L_0$=30nm
BCP annealed at 250C for 1hr
Film thickness ~23nm.

A different spot of the same sample

# Summary and future plan

**Summary**

- A 3X density multiplication with a 30nm-pitch final feature size (derived from 90nm pitch guiding pattern) is demonstrated.
- Quasi-optimized CD and background chemistry could result in a very large area of perfection.
- PMMA block can be selectively removed for subsequent pattern transfer.

**Future plan:**

- PMMA removal and pattern transfer.
- Start working on hexagonal array patterns.

# BACKUP

# Non-optimized background chemistry

- Starting from 70% of PS content in the brush composition, “island-hole” structures (non-flat surface) will form.
- Local, small area of perfect assembly may still be observed.