Data Report

Report type	Photolithography assessment 0.5-50um lines
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Sample ID	abcd1234
Device ID	bcde2345
Fabrication by	Joe
Date of fabrication	2025-01-01
Date of measurement	2025-01-02

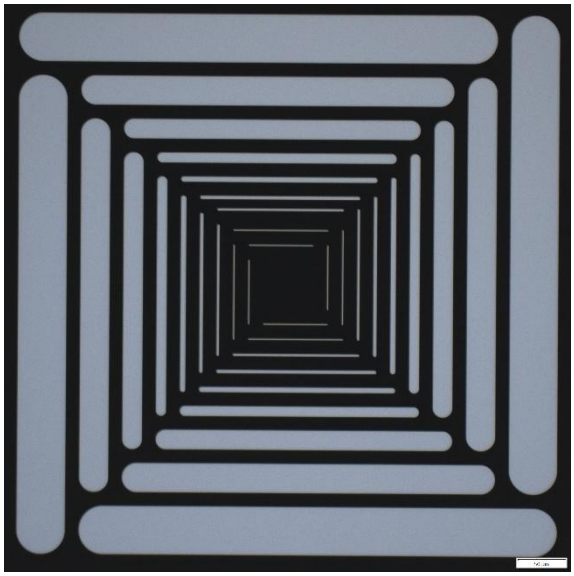

Figure 1: Microscopy image

Figure 2: Detailed image portions

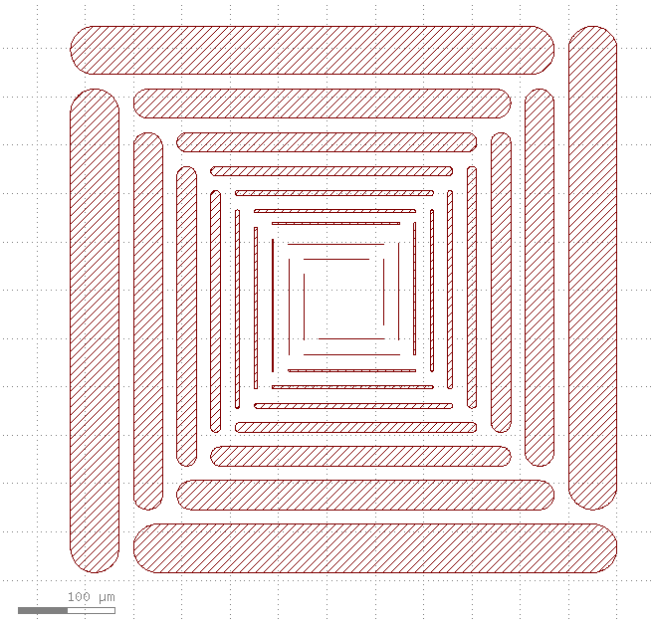

Figure 3: Target design pattern. Bars from 50 to 0.5um width

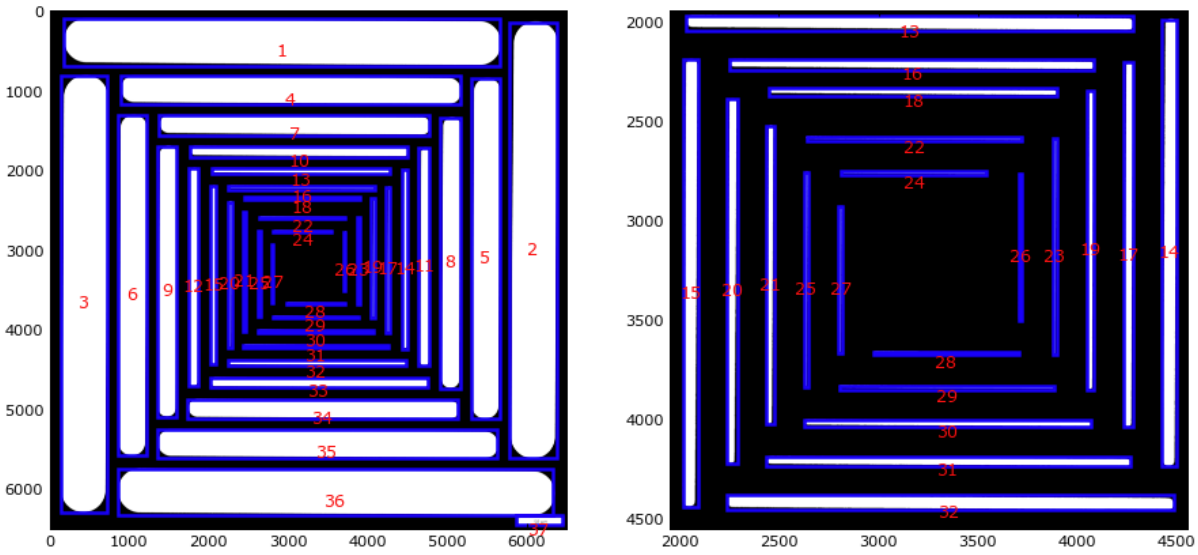

Figure 4: Automatic bar identification. 36/36 expected bars detected, no bars missing. No excess features detected.

expected_bar_width	bar_orientation	measured_bar_width	Measured - Expected (um)	Measured / Expected (um)
0.5	horizontal	1.494565	0.994565	2.989130
0.5	vertical	1.585145	1.085145	3.170290
1.0	horizontal	1.811594	0.811594	1.811594
1.0	vertical	1.902174	0.902174	1.902174
2.0	horizontal	3.260870	1.260870	1.630435
2.0	vertical	3.351449	1.351449	1.675725
3.0	horizontal	4.528986	1.528986	1.509662
3.0	vertical	4.528986	1.528986	1.509662
5.0	horizontal	6.748188	1.748188	1.349638
5.0	vertical	6.793478	1.793478	1.358696
10.0	horizontal	12.001812	2.001812	1.200181
10.0	vertical	12.047101	2.047101	1.204710
20.0	horizontal	22.282609	2.282609	1.114130
20.0	vertical	22.327899	2.327899	1.116395
30.0	horizontal	32.653986	2.653986	1.088466
30.0	vertical	32.699275	2.699275	1.089976
50.0	horizontal	53.351449	3.351449	1.067029
50.0	vertical	53.260870	3.260870	1.065217

Figure 5: Mean Measured bar width. Each measured bar width entry is the mean of the two detected bars with given expected bar width and bar orientation. Lengths are in um.

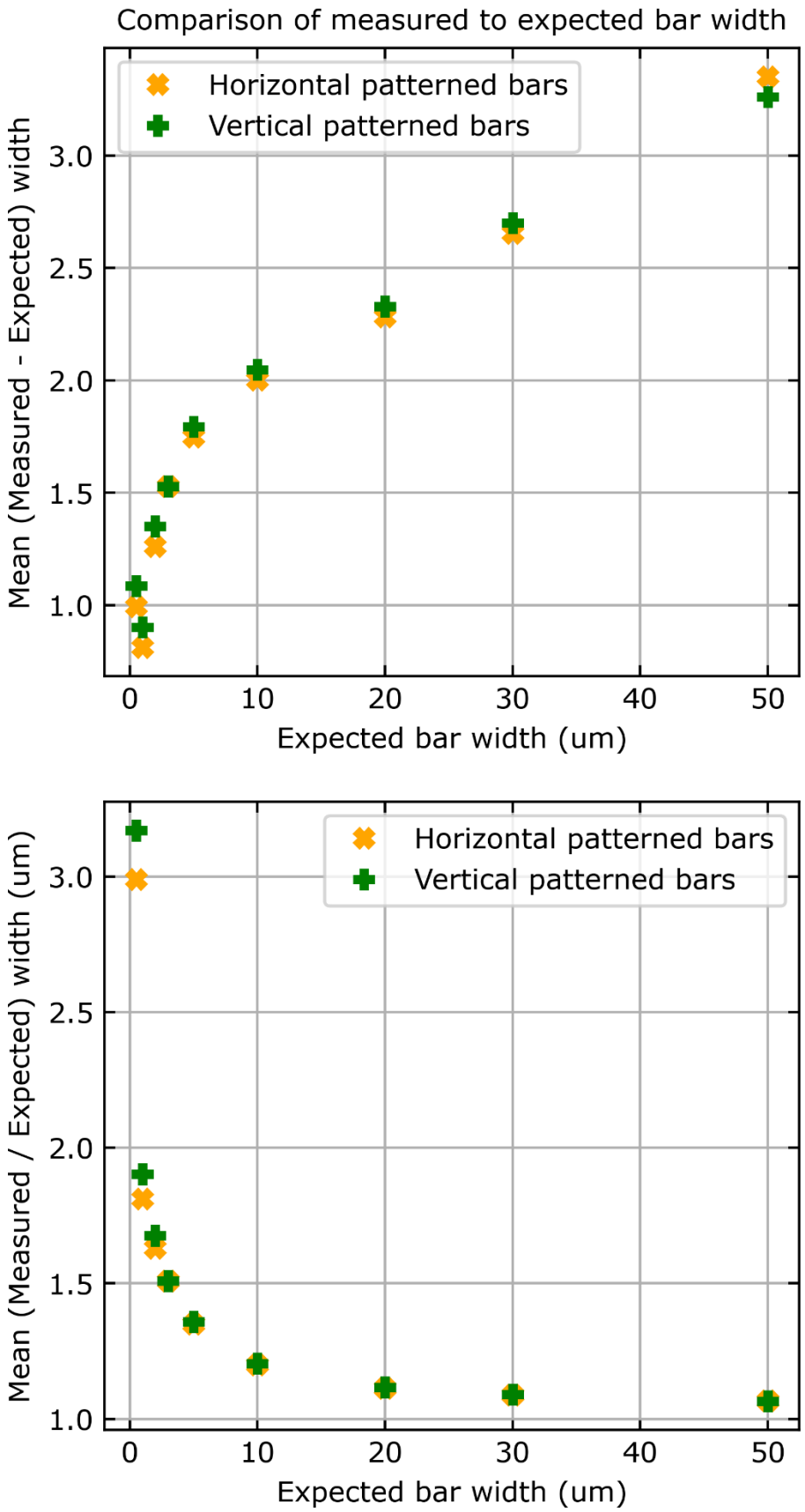

Figure 6: Absolute and relative difference of measured to expected bar width. All measured widths are greater than expected.

Summary discussion

At a high level we can say the patterning has gone well. All calibration bars in the pattern file are present and no major defects are visible. No dirt or other impurities are detected outside of the design area.

We see from this analysis, however, that the patterned bars exceed the width of the defined lithography pattern by up to 308%. All bars are larger than the target pattern width. The mean absolute excess width is greater for the largest bar type, peaking at 3.3 um for the 50 um bars, and drops to 1.03 um for the 0.5 um bars. As a ratio though this has the greatest impact on the smallest bars which have a width 3.07x the target pattern width. The vertical bars exceed their target width more than the horizontal bars.

These results all look consistent with a basic visual inspection of the bars (see figure 2). In the image we see clear smearing of the bars, particularly in the "North West" direction. This could be caused by energy leakage (maybe from in-film scattering) under the mask during the exposure process. This is consistent with the largest bars having a greater 3.3 um smearing due to the larger energy dump in these areas. The finest bars which receive fewer photons have leaked less but it has a proportionately larger impact on the desired pattern. Another possible explanation is the direction of deposition if there is overhanging resist at the edges. More information about the patterning process is needed to make a firm conclusion.