Covering Letter

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Sample names and exposures:	cSAXS_HR01	KP130218
	cSAXS_HR02	KP130220c

Sample description

There two samples, HR01 being the far superior in every way and HR02 should only be used for risky tests or when a weaker phase shifter is required.

- Each sample is 16 joined chips (can and should be cleaved).
  - For single chip: 3mm x 3mm, 270µm thick Si chip with 1mm x 1mm Si3N4 membrane (250nm thick) in the center.
- Structures are made out of HSQ. Height for HR01 is ~700nm and for HR02 < 200nm. All structures are coated with 10nm layer of iridium using ALD.

Layout

The schematic of the layout is presented in the Figure 1. The numbered structures are as follows:

- **1, 2 & 3:** Gratings for detector alignment: 100, 200 and 1000 nm HSQ lines with 400, 800 and 4000 nm pitch (respectively). After ALD Ir coating these will result in something that acts as quite inefficient 200, 400 and 2000 nm pitch gratings; the HSQ fill factor is not optimized to get even pitch so there will be substantial "half orders", but these should only help in alignment. Linear gratings overlap in a 100µm x 100µm square area, forming a grid there. Asymmetry of the placing of these gratings should help you in distinguishing which set has which pitch.
- **4:** HR01: 16 Siemens stars with 18 HSQ and 36 Ir spokes. HR02: 25 similar Siemens stars (layout image is of the HR01). In both cases the Siemens stars are in 100 micron grid, so by moving in 100 micron steps the next one is easy to find. Outermost line width is 2 microns, innermost 10nm. Fill factor of the HSQ is 0.25, meaning 10nm Ir lines in 20nm pitch in the center, and smaller fill factor everywhere else. Rings placed at 1 micron, 500nm, 200nm, 100nm and 50nm line widths. The HSQ line width is not tuned to provide even spacing of the Ir lines, so the use of this test structure is only meaningful with imaging techniques that can provide the 10nm resolution or better (it wouldn't really be even if the spacing was tuned).

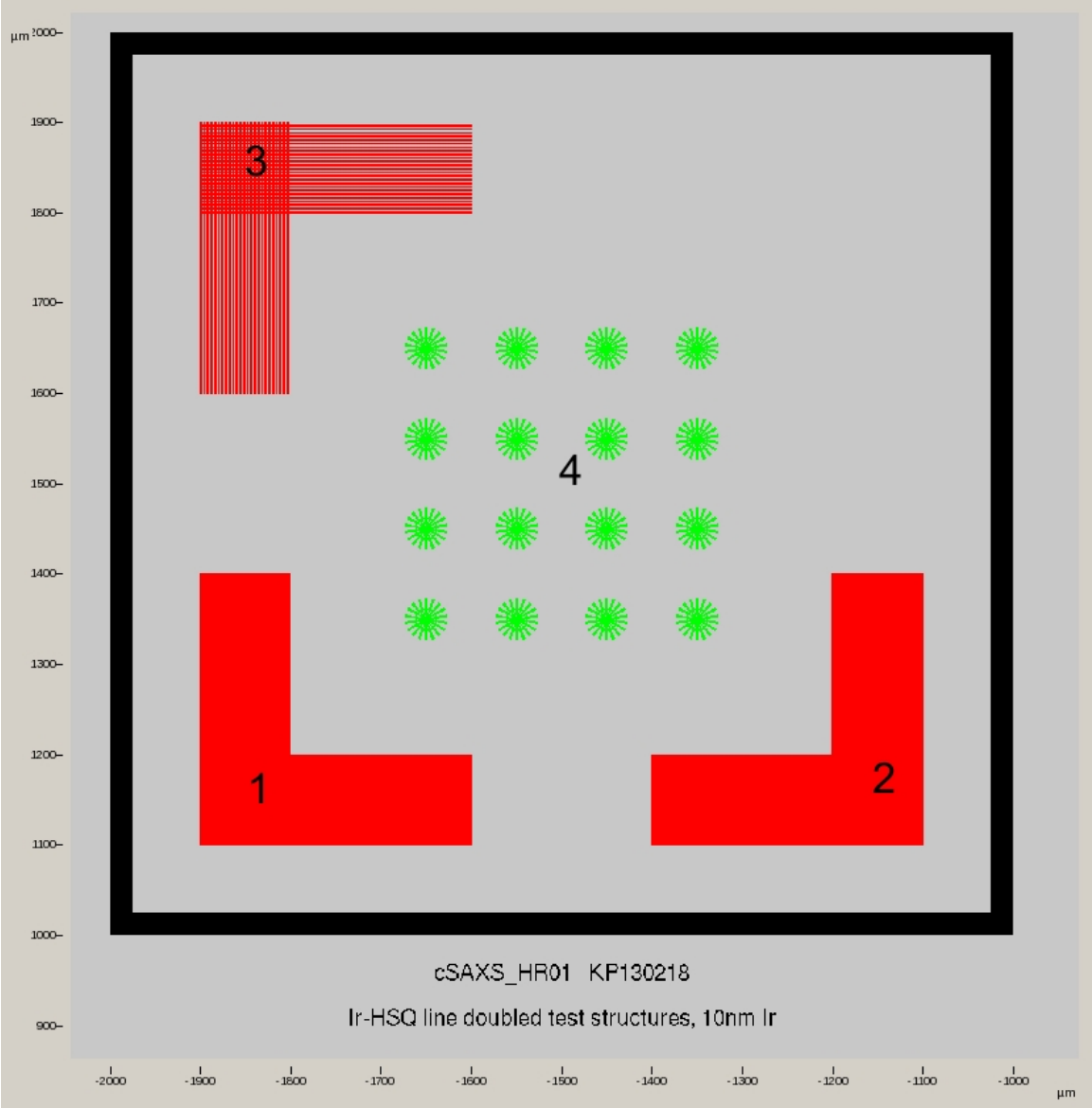


Figure 1: Layout of the HR01

Results

- The biggest problem first: there were severe adhesion problems in the HR02 sample, and also some in the HR01. An example overview SEM image is shown in Figure 2. The problems are usually in the linear grating parts, the grids are mostly fine. Also some of the Siemens stars might be missing, but if the star is there and seems to be OK in the optical microscope, the small structures have no problems either. So I would recommend always taking an optical microscope image when mounting a new sample, and then start to cross out the used ones from the image when you feel that one of them is starting to get damaged in the beam.
- The filling factor in the very center is not perfect, meaning the gap between Ir/HSQ/Ir stacks is more than 10nm. However, this is mostly an aesthetic problem, as the Ir/HSQ/Ir stack is anyways 10nm/10nm/10nm you should be able to prove that your resolution is better than that...

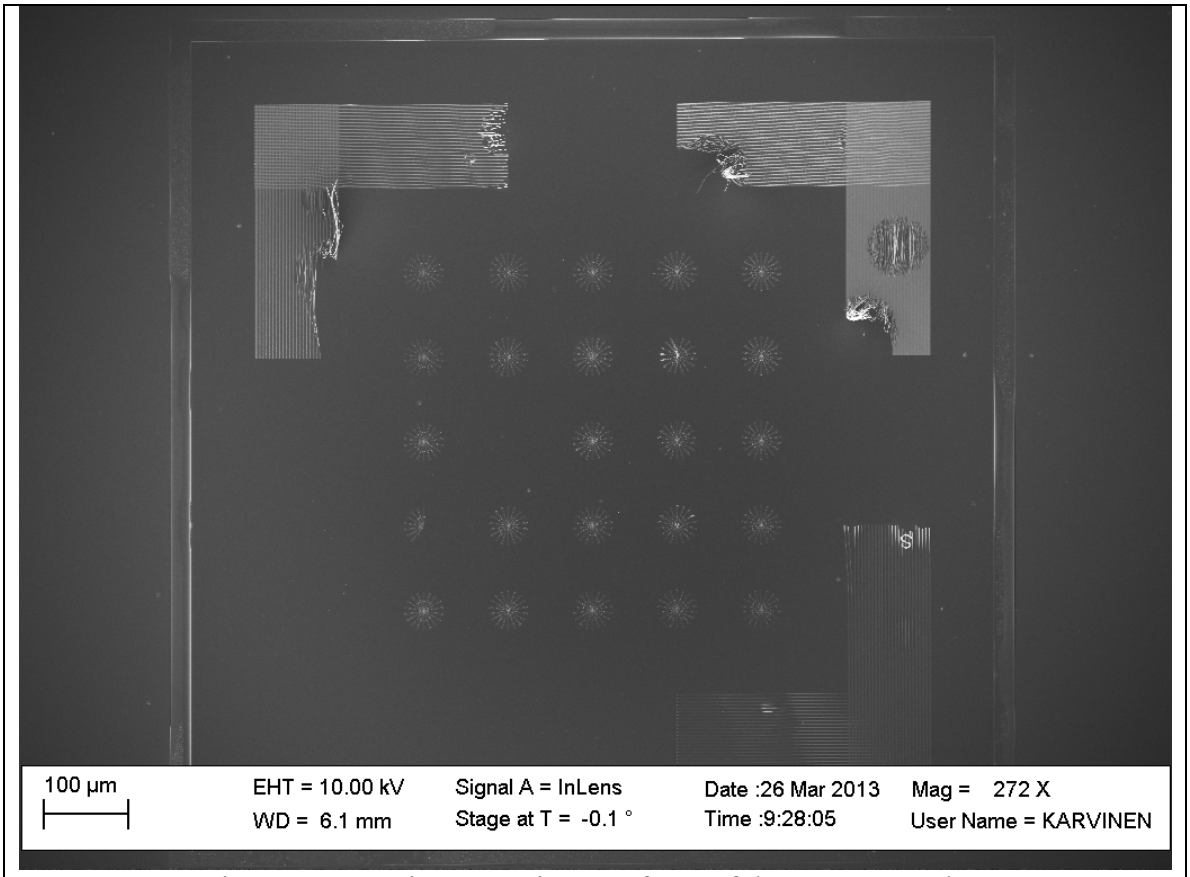


Figure 2: Overview SEM image of one of the HR02 samples.

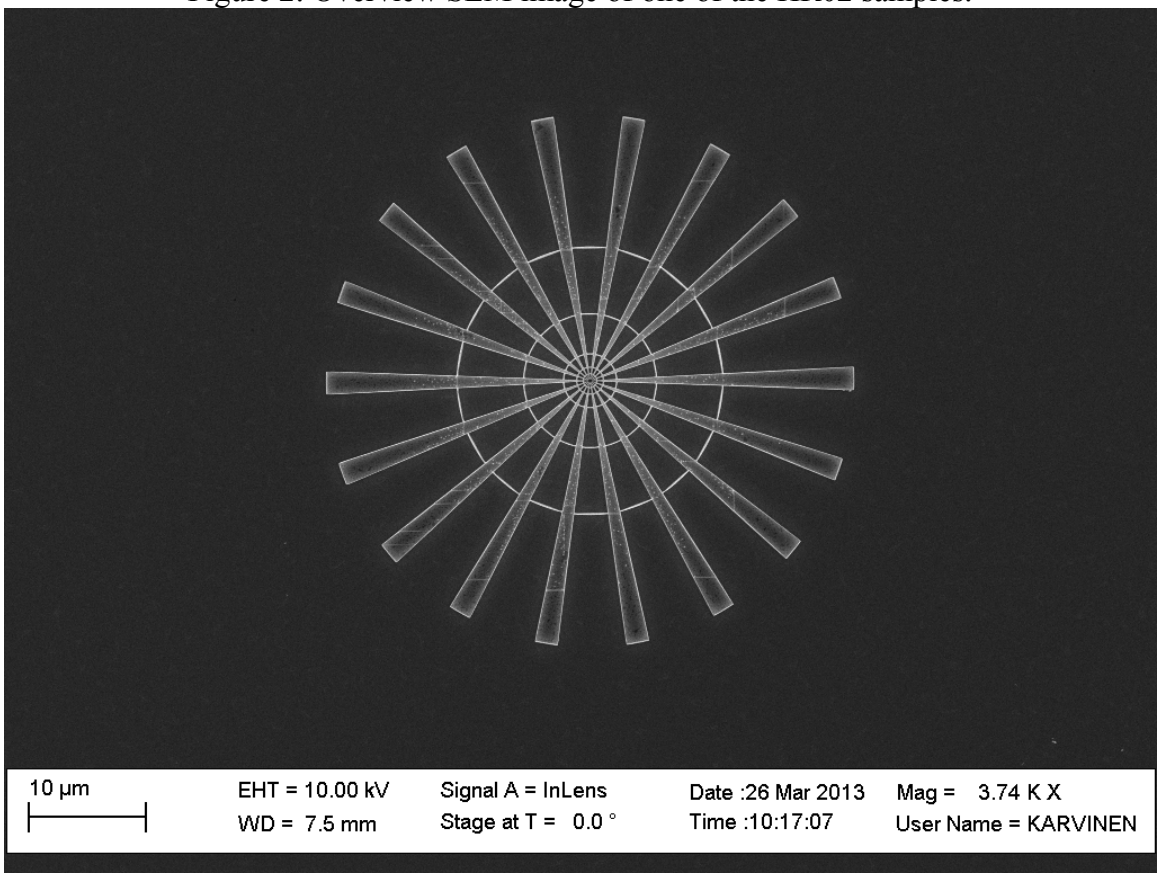


Figure 3: One Siemens star from the HR01 set.

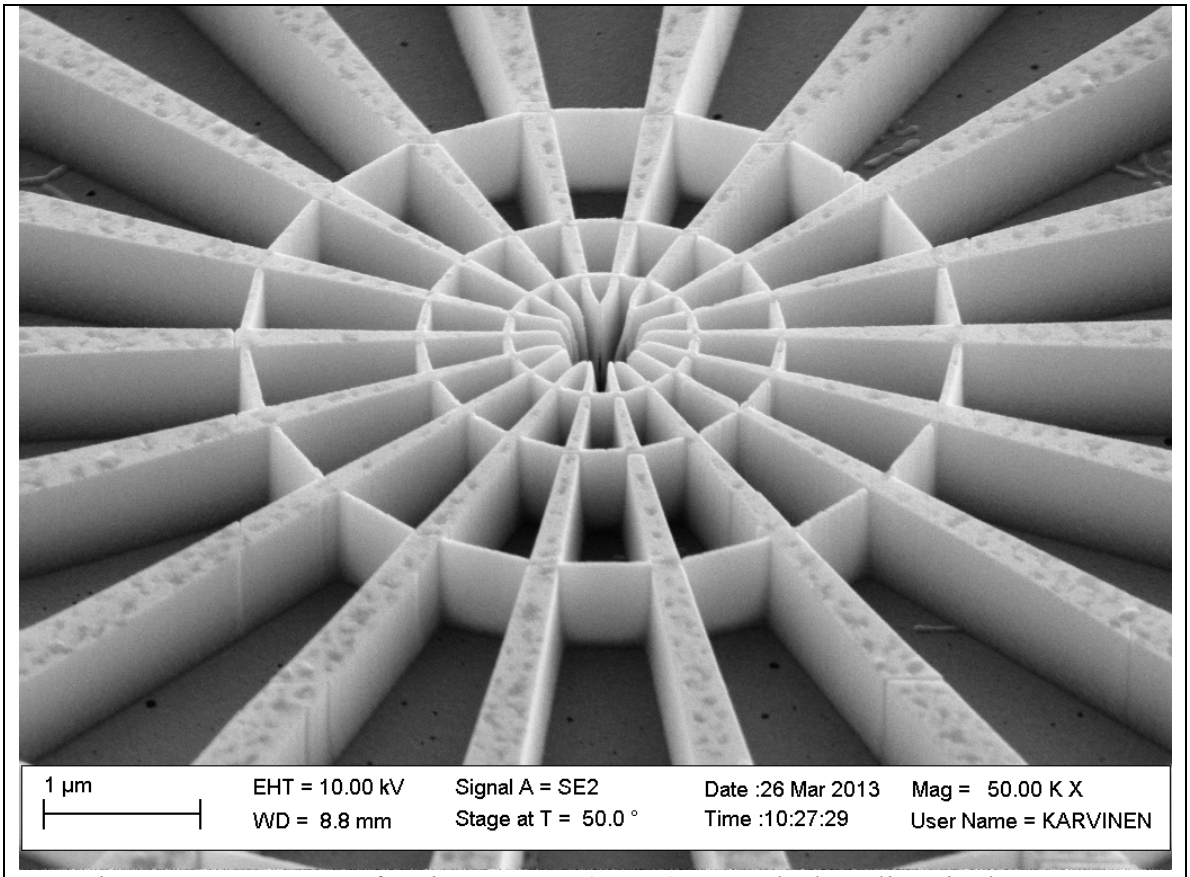


Figure 4: Center part of a Siemens star (HR01). Note the bent lines in the center.

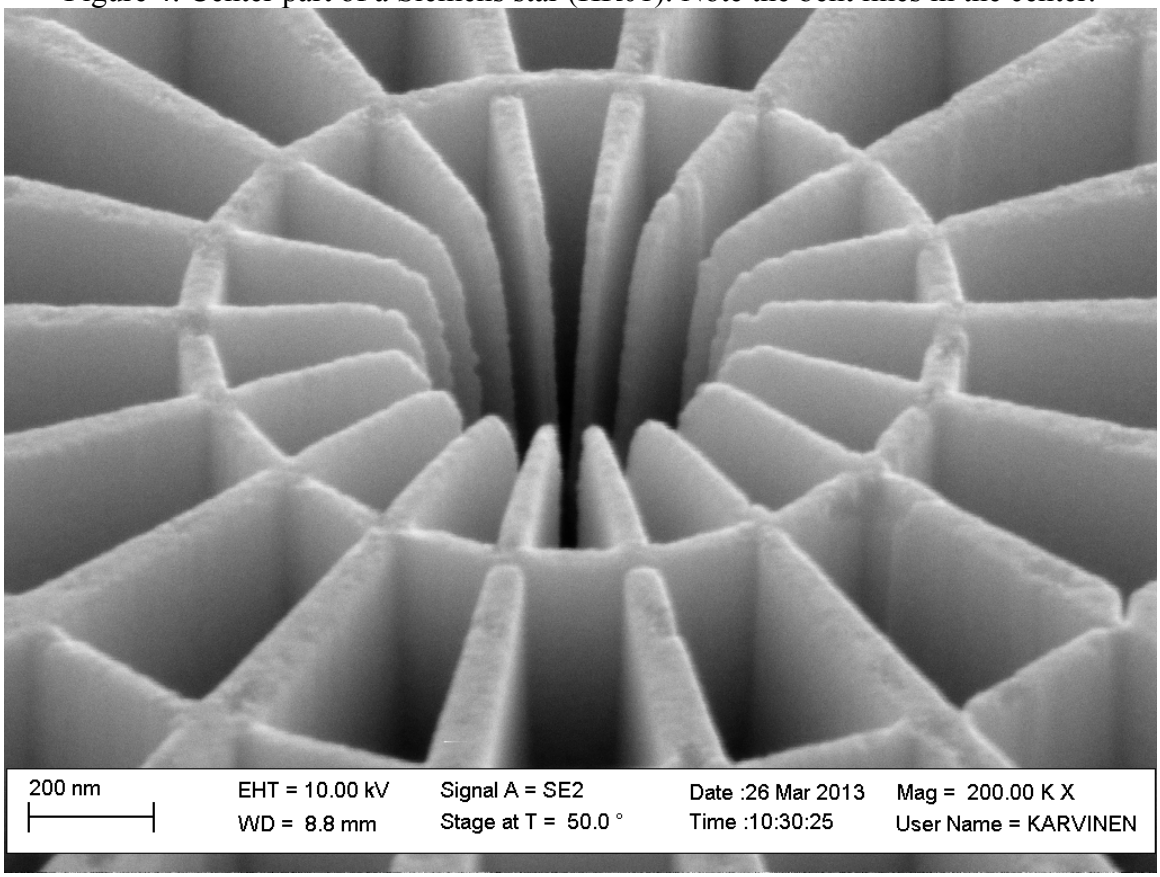


Figure 5: A close up of another Siemens star without the bending defect (HR01).

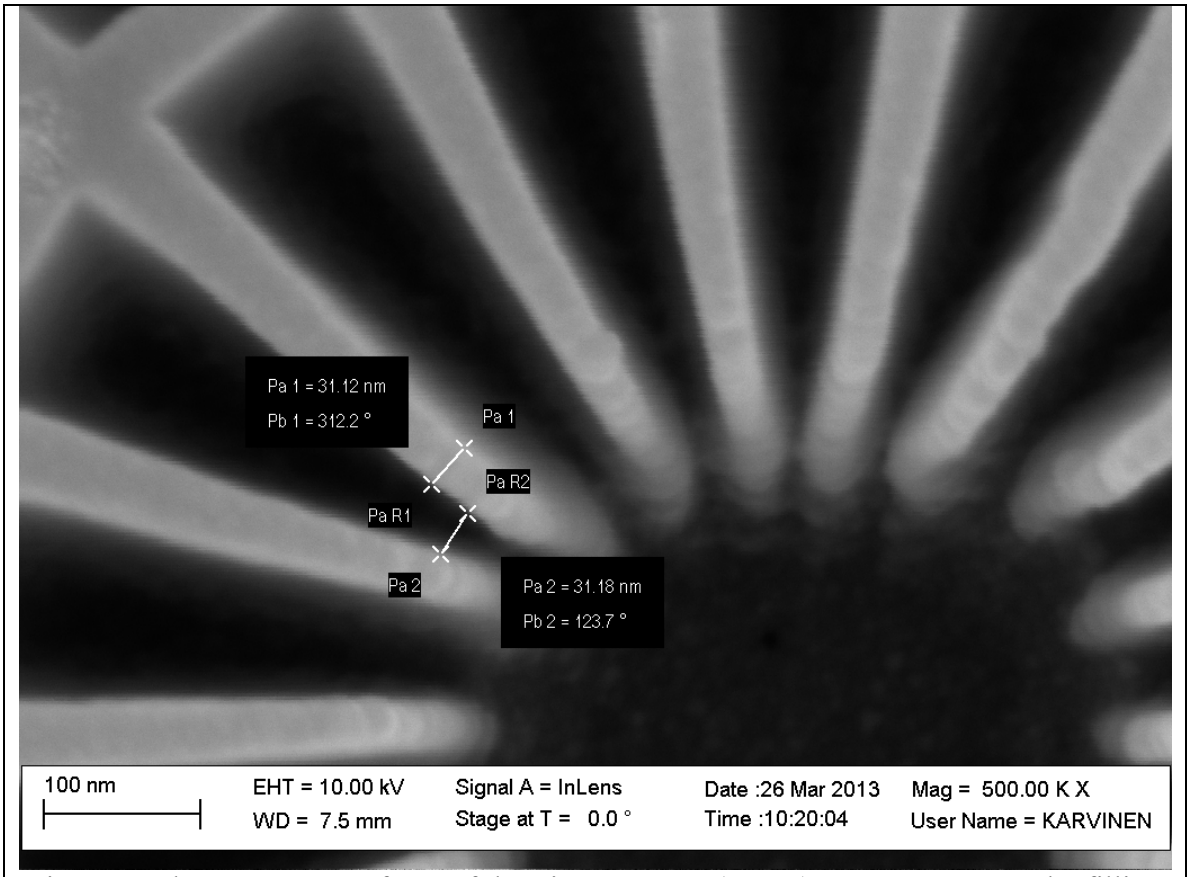


Figure 6: The very center of one of the Siemens stars (HR01). As you can see, the filling factor is not perfect as the HSQ lines do not reach as far as they should; this results in a structure that's like "10nm Ir, 10nm HSQ, 10nm Ir, 30nm gap" repeated.