

SPR-220-7.0-Photoresist Photolithography Process using UCSB GCA6600 Wafer Stepper

Purpose: Characterize SPR-220-7.0 photoresist photolithography process with the variation of exposure time and focus offset using stepper mask aligner. High aspect ratio imaging is possible with this resist over a good range of exposure and focus.

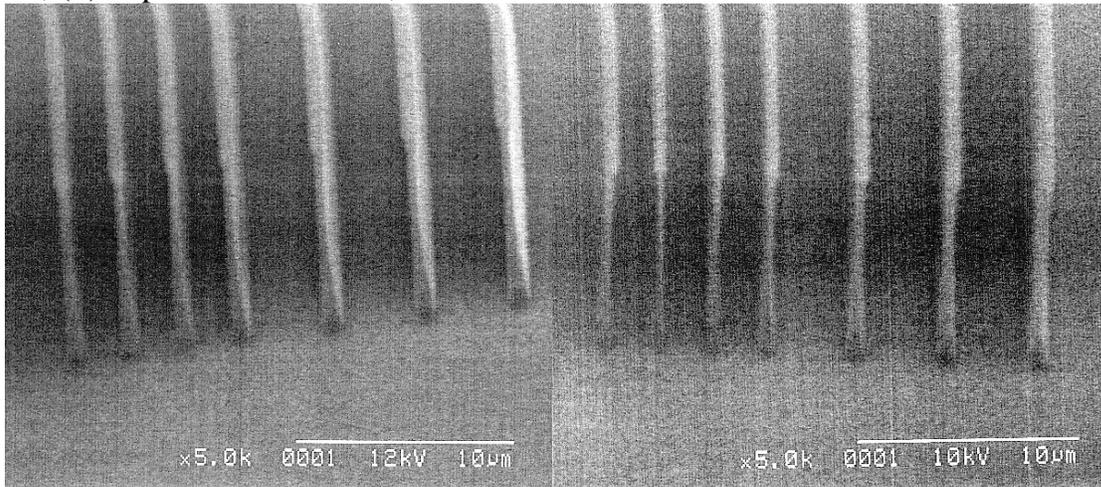
Procedure:

- Wafer (4-inch Si wafer) solvent (acetone: 2 minutes; methanol: 1 minute) clean, DI water resin, and N₂ blow dry.
- Wafer dehydration at a hot-plate temperature of 110 °C for 5 minutes.
- Spin-on HMDS at 4000 rpm for 30s.
- Spin-on SPR-220-7.0 photoresist at 2500 rpm for 30 s.
- Soft bake at a hot-plate temperature of 115 °C for 90 s.
- Expose the resist using the stepper mask aligner: 6×6 dice with the exposure time ranging from 3 to 4.5 s, step size=0.3 s; the focus offset ranging from -50 to 0, step size=10.
- Sit in air 20' after exposure, step up to 50C for 60 s.
- Post-exposure bake at a hot-plate temperature of 115 °C for 90 s.
- Develop the exposed resist using MF-701 developer for 120 s.

Results and Discussions:

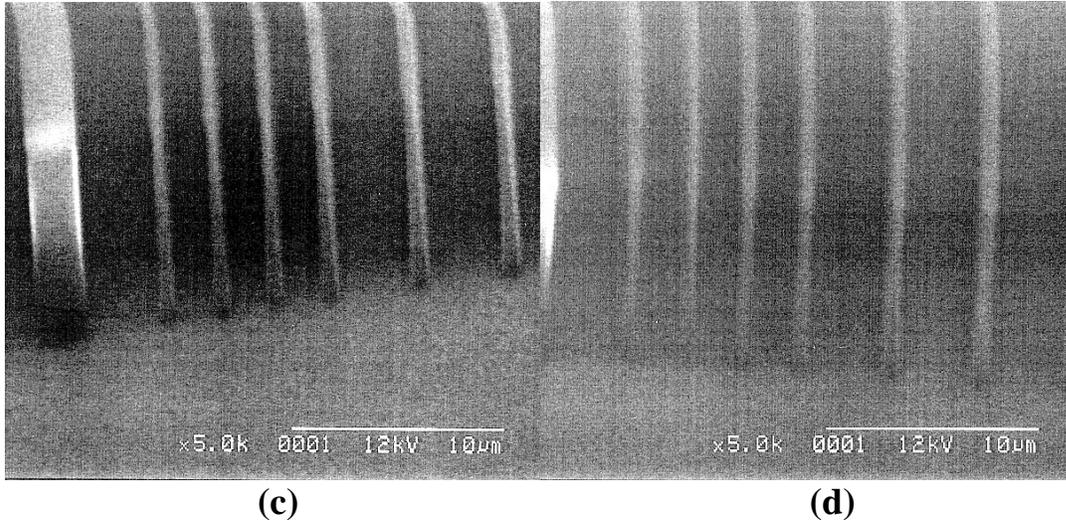
1) Isolated Lines

Figure 1. SEMs of isolated lines. Size on mask is a 1.3 um wide line. The actual line dimension is ~ 1.0um by the images. (a) exposure time=4.2 s, Focus Offset 0; (b) exposure time=4.5 s, Focus Offset 0. (c) exposure time=4.2 s, Focus Offset -10; (d) exposure time=4.5 s, Focus Offset -10.



(a)

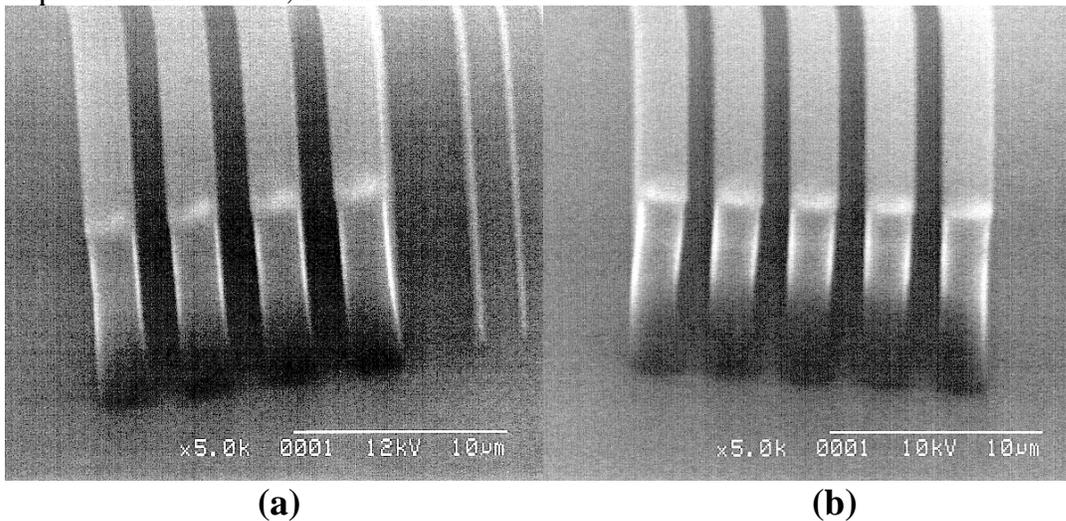
(b)

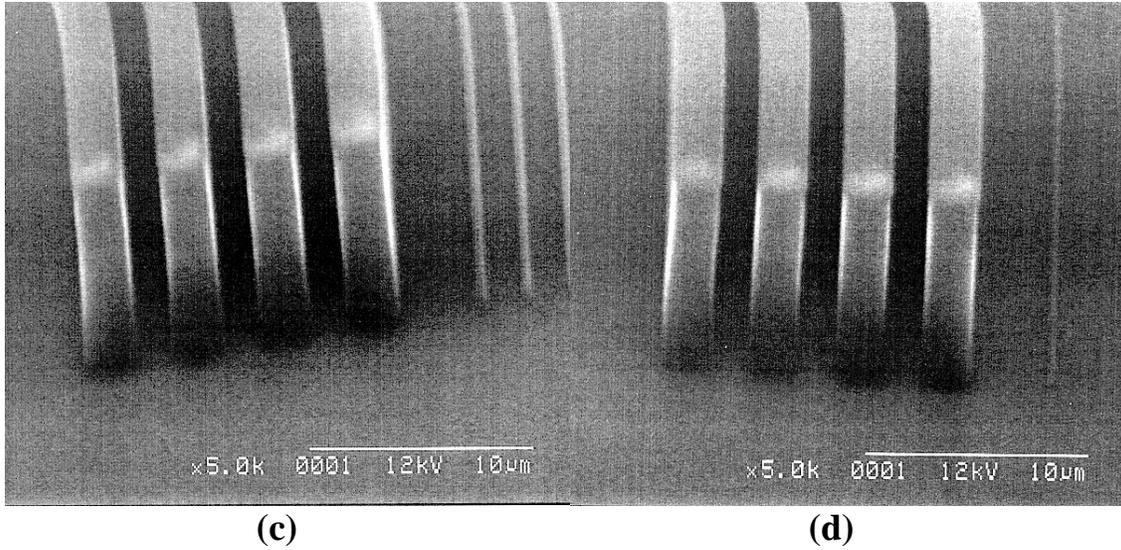


Note: The resist thickness is $\sim 7.0 \mu\text{m}$. In this range of focus offsets and exposure times, the resist can image $1 \mu\text{m}$ lines. In order to get $1 \mu\text{m}$, you need to bias the mask to larger lines for this thick resist. Negative focus offset looks slightly better (less taper)

2) Isolated Spaces

Figure 2. SEMs of isolated spaces. Size on mask is a $1.0 \mu\text{m}$ wide space (except for (b) which is a $0.75 \mu\text{m}$ mask opening). The actual line dimension is $\sim 1.25 \mu\text{m}$ by the images (1.0 for (b)). (a) exposure time= 4.2 s , Focus Offset 0 ; (b) exposure time= 4.5 s , Focus Offset 0 . (c) exposure time= 4.2 s , Focus Offset -10 ; (d) exposure time= 4.5 s , Focus Offset -10 .





Note: The resist thickness is $\sim 7.0 \mu\text{m}$. In this range of focus offsets and exposure times, the resist will image $1\mu\text{m}$ designed openings as $1.25 \mu\text{m}$ openings in the resist. $1\mu\text{m}$ actual spaces can be realized for the larger focus offsets and exposure times. More room may be available if a positive focus offset is used.