Additional and correction patterning of resist layer using scanning probe lithography

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Scanning probe lithography (SPL) is a very simple method for high-resolution patterning less than 100 nm in air. From the viewpoint of through-put, SPL should focus on delineation of fine pattern (less than 100 nm), thus, additional and correction patterning of micro or sub-micro order patterned resist, which is fabricated by other lithography (photo-lithography, electron beam (EB) lithography, and so on), is promising use application. In order to confirm additional and correction patterning by SPL, sub-micron patterns were fabricated by EB lithography. The EB resist was ZEP520A (ZEON Co., Ltd.) and film thickness was 40 nm. Additional and correction patterning was carried out by a SPL system (MPS-1000, Sumitomo Precision Products Co., Ltd.). At first, defects or target patterns were observed by atomic force microscope (AFM) mode of the SPL system. Then, SPL probe moved to target area and fine patterns were patterned by applying voltage to SPL probe. The alignment accuracy is ± 5 nm because of closed-loop control system. Patterning conditions were bias voltage of -36.0 V and -37.0 V, current value of about 10 pA[1], and tip-scanning speed of 1 μm/s and 2 μm/s (Fig. 1). After the SPL patterning, sample was developed by ZED-N50 (ZEON Co., Ltd.) for 1 min.

Figure 2 shows scanning electron microscope (SEM) micrographs of after additional patterning to an isolated 410 nm line pattern. The delineated line width was 70 nm. Figure 3 shows SEM micrographs of before and after correction patterning of defect pattern. The defect line was connected by SPL. Figure 4 shows SEM micrographs of the lift-off Cr with 20 nm thickness patterns using corrected pattern of Figure 3. This Cr layer acts as hard mask for dry etching.

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[1] L. Anggraini, et al., *ITB J. Sci.* **42 A (1)**, (2010), 1-10

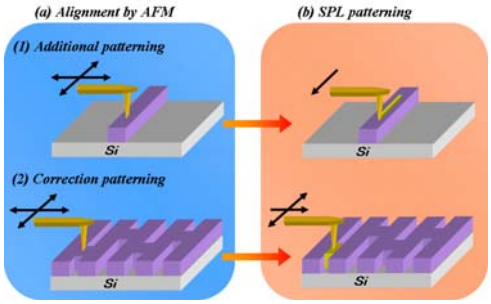

Figure 1: Schematic of two kinds of SPL process. Additional patterning process is (1). Correction patterning process is (2).
(a) Alignment by AFM
(b) SPL patterning

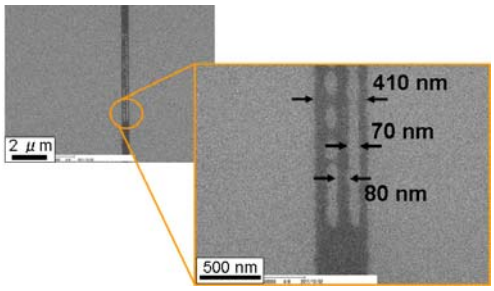

Figure 2: SEM micrographs of after additional patterning to an isolated 410 nm line pattern. It was patterned at a bias voltage of -36.0 V, and the tip-scanning speed was 2 μm/s. The delineated line width on the isolated line pattern was 70 nm.

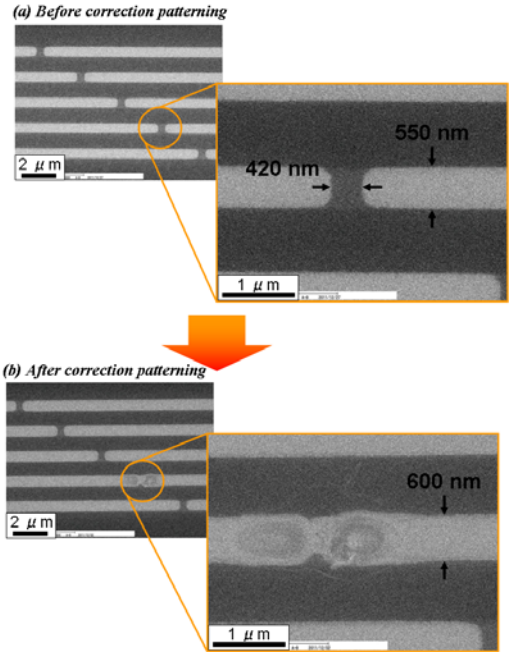

Figure 3: SEM micrographs of before and after correction patterning of defect line. It was patterned at a bias voltage of -37.0 V, and the tip-scanning speed was 1 μm/s.

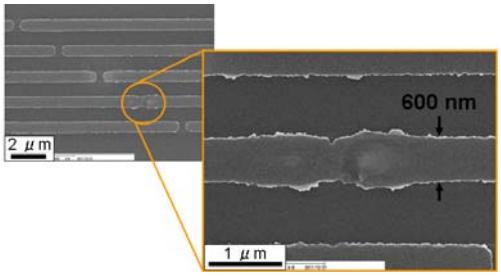

Figure 4: SEM micrographs of the corrected pattern after the lift-off by Cr. The Cr line width was 600 nm.