Multi column cell writer architecture and a correction technique for consistent CD uniformity between column cells

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Combination of Multi-Column-Cell (MCC) architecture and Cell Projection (CP) exposure method are considered as one of realistic ways to enhance the throughput of EB-writer. However, the system has more than one gun, column and CP-mask, and it is suspected to be difficult to suppress the variances for each column characteristics, especially of the CD-controllability.

We will report that the CD-control for multi column system is possible by a simple dosage modulation technique, like a method for single-column tools, which was evaluated in the MCC-Proof of Concept (POC) tool consisted of 4-Column Cell (CC).

MCC tool executes a concurrent exposure onto a substrate by multiple-CCs. In the execution, the synchronization of CCs are not requested, becuase the tool is carefully designed to make each CC posible to do asynchronous works by independent stage position feedback system and dynamic scheduling software. Therefore it is sufficient to control the stage in accordance with the busiest CC.

It is necessary to apply dosage adjustment by modulation of blanker switching intervals to get appropriate CD controls for compensating the difference of current density or difference of beam blur for each CC. This is the significant reason why MCC tool is designed to do asynchronous works for allowing the difference of exposure the time of CCs.

To confirm the consistence of the proximity effect correction by dosage modulation and the above mentioned variance correction between each CC, the CD dependence on dosage relation i.e. CD-dose curves (Fig.1) must be confirmed to be the same for each CC for around appropriate line width.

Main subject of the discussion in the conference is the coincidence of CD-dose curves of all CCs of the MCC-POC tool, whose configuration is the same as the previous report by ASET in EIPBN 2009 [1)]. We also report the recent improvements of overlay accuracy on photo-etched Si-wafer, field-stitching accuracy, CC-stitching accuracy (Table1) and a minimum resolution result on a Si-wafer and a Quartz-6025 substrate.

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1) A. Yamada, H. Yasuda, and M. Yamabe, J. Vac. Sci. Technol. B **27,** 2518 (2009).

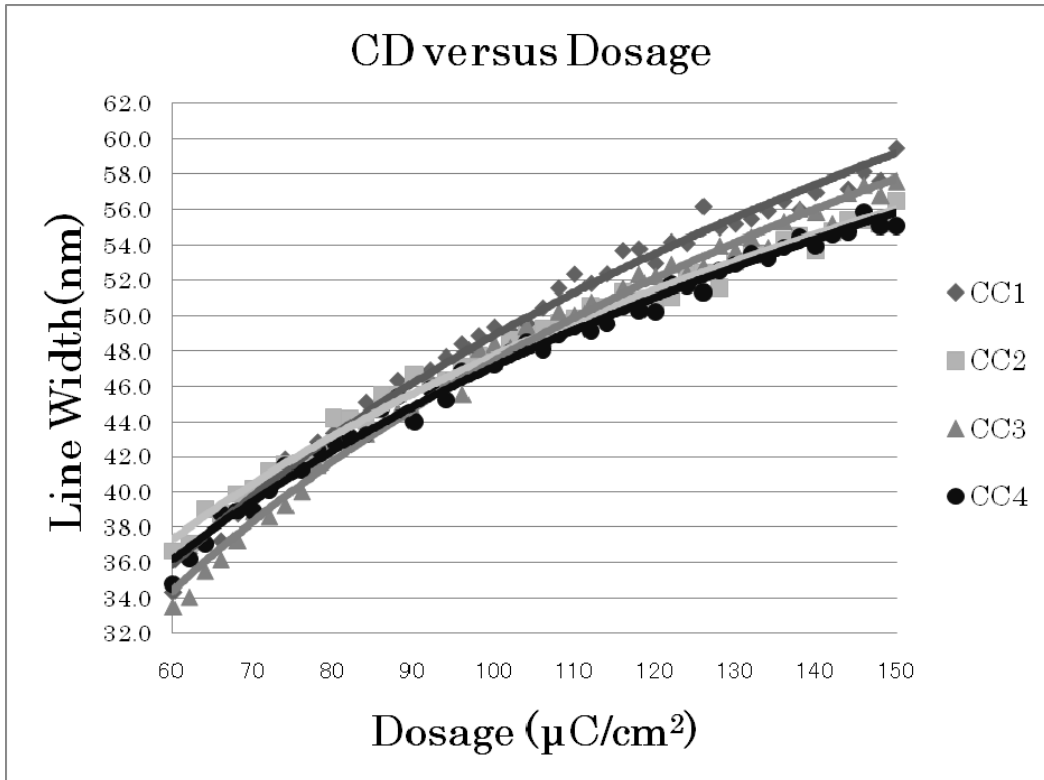

Fig.1. Comparison of CD-Dose curves of 4CCs. Each curve represents resist line width exposed by 50 nm beam in width vs. exposure dosage. Deference between CCs is observed. Just dose condition to obtain target line width varies from 106.4 to114.3 uC/cm2. We will discuss about the error-budget of these difference and the result of CC-independent dosage modulation technique for correcting them.

Table1. Recent evaluation result of MCC-POC tool. Each value is 3-deviation of errors in X and Y direction in nano-meter.

Evaluation Item	CC1	CC2	CC3	CC4	Remarks
CCn to CC(n+1) Stitch	4.7 4.9	4.7 6.6	4.0 5.1	4.8 5.1	CC4 stitch is relative to CC1
Major-Fields Stitch	5.8 5.7	5.9 7.0	5.6 6.4	5.6 5.7	±50micro-meter deflection
Minor-Field Stitch	5.5 4.9	5.7 5.7	4.7 5.6	4.7 5.2	±5micro-meter deflection
Overlay on photo pattern	4.3 4.5	3.8 5.1	4.2 4.7	4.0 4.4	Si-etched wafer marked by ArF