Electron Beams in Individual Column Cells of Multi Column Cell (MCC) System

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Association of Super-Advanced Electronics Technologies (ASET) Mask Design, Drawing, and Inspection Technology Research Department (Mask D2I) started a 4-year development program* for the total optimization of mask design, drawing, and inspection technologies to reduce photomask manufacturing costs in 2006. At the Mask Writing Equipment Technology Research Laboratory, we are developing an e-beam exposure system introducing concepts of MCC (multi column cell), CP (character projection), and VSB (variable shaped beam), which has several times higher throughput than currently commercially available e-beam writing systems. We have designed an e-beam system made up of four column cells for the proof-of-concept (POC) of MCC with CP and VSB technologies.

Figure 1 shows a lens unit of the MCC column in the POC system. The lens unit has four electromagnetic lenses in a permalloy frame. Each of the lenses has its coil and electromagnetic pole piece, whose diameter is less than 70mm. The lens units were assembled to make a MCC column of four column cells (CCs) as shown in Fig.2. Now, the column is on a test bench. The gun unit at the top of the column has four electron guns to emit electron beam into beam path of each column cell. We are investigating beam characteristics, i.e. shaped beam profiles, deflection distances, and aberration corrections of the beam in each CC. In the presentation, we will show following investigation results.

(1) Comparison of shaped beam profiles between CCs.
(2) Comparison of deflection field characteristics between CCs.
(3) Electromagnetic interferences between CCs.
(4) Electrostatic interferences between CCs.

We already have four electron beams through these four CCs exposing Ta marks on a stage in the test bench. Above results are measured with mark detection and knife-edge methods of the Ta marks.

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Figure 1. A lens unit of the MCC column in the POC system. The lens unit has four electromagnetic lenses in a permalloy frame. Each lens diameter is less than 70mm.

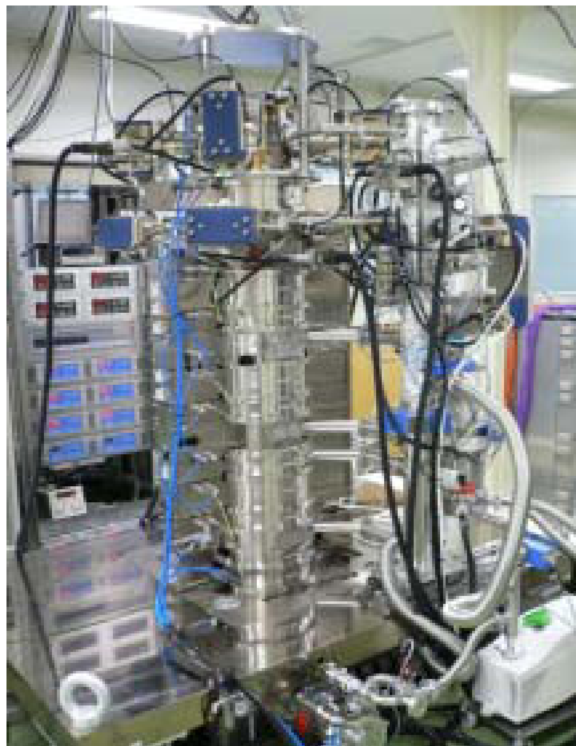

Figure 2. A MCC column of four column cells (CCs) on a test bench. We already have four electron beams passing through four CCs.