Multi-Beam Mask Writer – Enabling Tool for EUV Lithography

Patrick Mayrhofer, Christof Klein, and Elmar Platzgummer

IMS Nanofabrication GmbH
Schreygasse 3, 1020 Vienna, Austria

This presentation will give an overview of recorded tool performance data and availability. In addition, specific benefits of multi-beam writing by using curvilinear "ideal" ILT (inverse lithography technology) for EUV masks will be discussed.

IMS Nanofabrication's MBMW-101 (Fig. 1) multi-beam mask writer is already recognized as a value-adding tool in the mask shops of several important members of the high end mask industry.

The reliability in operation has been demonstrated, in particular the multi-beam generator (aperture plate system) and the data path have shown a high degree of stability: Virtually no lifetime limiting factor for the key components has been found.

Multi-beam writing has proven to meet industry expectations in terms of enabling a higher exposure dose for low sensitivity resists to ensure low LER (line edge roughness) and high pattern fidelity. MBMW series mask writer can handle enhanced pattern complexity without productivity tradeoff and accelerating cycle time. In fact, multi-beam mask writers are required to keep mask write times for leading-edge advanced layouts well below 24h.

Both CDU (critical dimension uniformity) and Registration (pattern placement accuracy) do not only meet the targeted 7 nm mask node requirements, as with recent tool improvements also 5 nm lithography requirements can be met. For instance, the introduction of a novel thermal expansion correction is leading the way to unprecedented placement accuracy across the complete mask area.

Hence, MBMW-101 has already become the preferred, if not the only practical solution for 193i ILT [1], NIL master template [1,2], and EUV mask writing.

The superior properties of multi-beam mask writer tools in terms of high resolution and simultaneously high throughput, even when realizing curvilinear patterns (Fig. 2), are enabling cost effective EUV mask writing.

References:

[1]   Hiroyuki Miyashita et al., "Practical performance evaluation of MBMW-101 for mask production", Dai Nippon Printing Co., Ltd., presented at SPIE Advanced Lithography 2018, San Jose, California, USA

[2]   Koji Ichimura et al., "Fabrication of full-field 1z template using multi-beam mask writer", Dai Nippon Printing Co., Ltd., presented at SPIE Advanced Lithography 2018, San Jose, California, USA
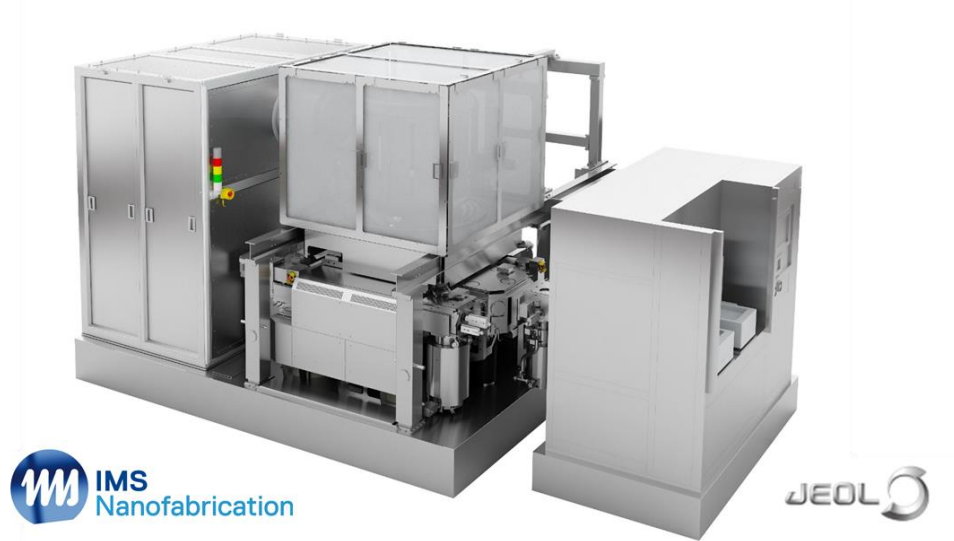
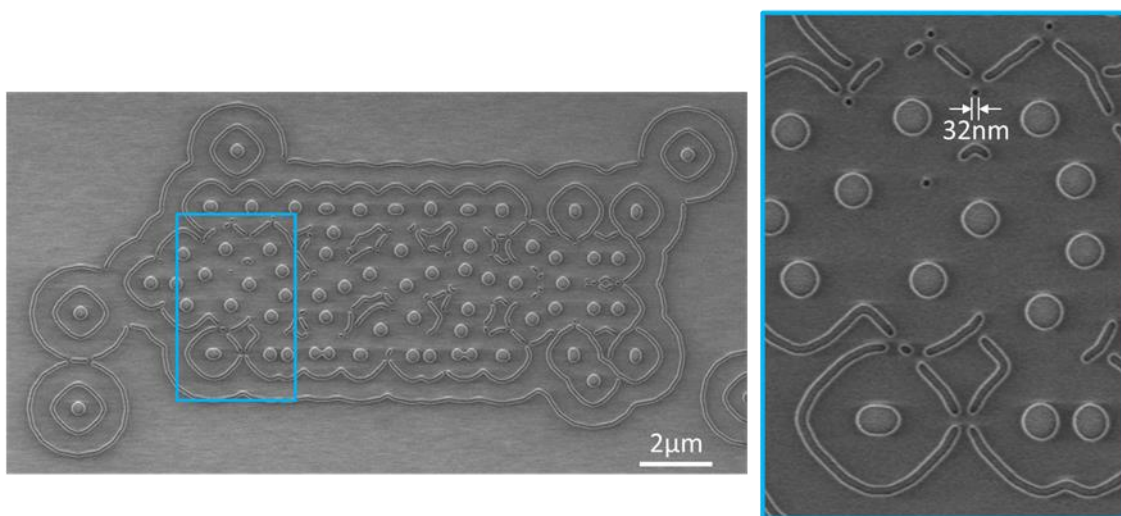| Beams	262,144 programmable beams
Beam energy	50 kV
Platform	JEOL platform with air-bearing stage
Mask write time for 7nm node	<10h (104mm x 132mm)

Fig. 1: IMS MBMW-101

Fig. 2: Curvilinear ILT (Inverse Lithography Technology)
test pattern