MANCHESTER 1824
The University of Manchester

RAITH EBPB5200 ELECTRON BEAM LITHOGRAPHY

Electron beam lithography (EBL) is used to fabricate nanoscale devices by patterning through the exposure of an electron beam sensitive resist. The University of Manchester has many years of experience and is extremely competent in the use of EBL. This knowledge has now been passed on to the National Graphene Institute where we have several EBL systems, most of which consist of a pattern generator attachment to a scanning electron microscope (SEM).

The Raith EBPG5200 in contrast is a dedicated system designed specifically for EBL with electron beam energy up to 100 kV. The use of 100 kV ensures that backscattered electrons remain mostly in the substrate and that the forwarding scattering angle is small, allowing for very narrow lines and dense arrays especially since proximity effects are also small at a high beam energy. Line widths down to 6 nm are possible with this tool.

Other advantages with 100 kV include a small spot size of <20 nm even at a high beam current of 20 nA as well as a high throughput which allows large area exposures such as a full 8 inch wafer or 6 inch photomask plate. This machine is isolated from vibrations both via an external platform and internal dampers as well as including beam position compensation for low frequency vibrations.

The Raith EBPG5200 is a fully automated machine with a 10 position airlock allowing continuous unattended operation with a high throughput. A laser interferometer stage is used to automatically calibrate the writefield and compensate for gain, rotation, keystone and pincushion errors. The laser stage also provides better than 12 nm field stitching and 12 nm overlay accuracy. The focus and stigmation are dynamically corrected over the entire deflection field and laser height measurement is used for continuous focus and writefield deflection correction during writing.

This EBL tool is available for collaborative work with academic as well as commercial clients and is critical for the fabrication of a wide variety of nanoscale devices on various substrates. Applications currently include photovoltaic devices, LEDs, quantum dots, waveguides,

plasmonic nano-optics, superconducting junctions, proton transport etc, which are in the focus of the work at Manchester.

Electron Source	Thermal Field Emission
Acceleration voltage	20, 50, and 100 kV
Beam Current	0.1 to 200 nA
Maximum Clock Rate	50 MHz
Main Field Beam Deflection	20 bit DAC
Maximum Field Size	1 mm x 1 mm
Minimum Theoretical Spot Size	2.2 nm
Stage Travel Range	210 mm x 210 mm
Laser Interferometer System	λ / 1024 (0.62 nm)
Automation	10 Position Airlock
Rapid Pattern Data Channel	
User Interface	GUI + Linux Command Line
Thermal Stability	< 50 nm / h (Open Loop)
Footprint	< 20 m2
Minimum Feature Size	6 nm
Stitching and Overlay Accuracy	< ± 12 nm
Wafer Writing	Holders for 3", 4", 6", and 8" Wafer Writing
Photomask Writing	Holders for 5" and 6" Mask Plate Writing
Piece Part Writing	Various Holders + 6" Mask Plate to Piece Part Adaptor