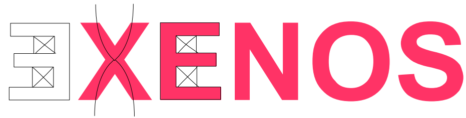


XPG2

XENOS 40 MHz Pattern Writer XPG2 – Update your Scanning Electron Microscope or FIB system to a next generation nanolithography tool !

Attached onto your existing or to be SEM or FIB, the XPG2 writer system will turn it into a state-of-the-art nanolithography-tool:

The XENOS **XPG2 Writer** is a system that creates pattern data and produces the respective deflection signals for beam steering of charged particle beams such as electron beams for semiconductor lithography applications or focussed ion beam systems.

When attached to a conventional scanning electron microscope, FIB or dual beam tool, it upgrades the system to perform advanced nanolithography on semiconductor or other materials.

The **XENOS XPG2** consists of a fast pattern generator in order to produce the deflection signal data for the patterns which are then written by the SEM, e-beam or FIB system, implementing intelligent writing schemes and shape primitives so as to take full benefit of limited deflection chain bandwidths. The system is supplied with user-friendly and application-based ECP design and control software. Firmware boot via USB also allows easy firmware updates as well as the implementation of new features without actual hardware changes or flash reprogramming.

KEY HARDWARE SPECIFICATIONS:

- **Writing Speed:** up to 40 Mpixels/s
- **Resolution:** 16 Bit with ultra low noise interface, writing field size of 50000 x 50000 pixels
- **Implemented Shapes:** dot, single pixel line, rectangular primitives (spiral or meanderfill), trapezoidals, triangles, parallelograms, arrays, 3rd order polynomials, circles, rings or ring segments, import of image files (*.bmp, *.jpg ...), GDS II and AutoCad *.dxf
- **Writing Clock:** 10 kHz up to 40 MHz in 1 kHz increments
- **Digital Full Bandwidth Field Correction:** scaling, rotation, orthogonality, shift
- **Mark Detection Input:** analog input for image detector output (adjustable gain and offset) with 12 Bit sampling, single line scan, selected area or full frame
- **Deflection Outputs:** Analog outputs up to +/- 10 V (galvanically isolated, adjustable)
- **Blanker Output:** TTL output with adjustable polarity or optional fibre optics output
- **PC Interface:** USB 2.0 compliant for pattern data, video data transmission, system control and firmware boot

KEY ECP SOFTWARE SPECIFICATIONS:

- **Exposure Patterns:** design of shapes (with hierarchy), dose and field size within the design
- **Batch Processing Files:** design of size and position of multiple writing fields for larger areas (with stitching between fields), controls for writing scheme (calibration, alignment, beam current control, user breaks...), automated cutting of shapes
- **Stage Control:** mapping of user coordinates, homing, absolute and relative positioning, predefined positions
- **Focus, Field and Stage Calibration:** calibration of deflection and stage coordinates (relative to laser interferometer coordinates if installed), feedback of the mechanical stage misalignment
- **Mark Detection and Alignment:** calculation of field correction parameters, scan control of the alignment marks

Enjoy 4 essential advantages:

Writing Speed

Pixelrates up to 40 MHz can be realized with the **XPG2** system. Thanks to intelligent writing algorithms, the limited deflection bandwidth of current FIBs or SEMs is taken into account. Optimized data transmission via USB and settling time calculation are matched to the writing speed in order to provide all advantages of fast writing.

Intelligent and Versatile Writing Primitives

In competing systems, curved structures like circles, rings or ellipsoids will be written by a polygonial approximation of the structures. Arising problems are due either to poor approximation or hugh amounts of data that have to be processed and that often result in unwanted artefacts due to undesirable blanking between the polygonial parts of the structures. The **XPG2** implements a polynomial scan logic of 3rd order that can generate and write those polynomials at maximum speed solely based on hardware and thus improved in comparison with our competitors. Circles or rings can therefore be written by concentrical single pixel rings (with spline interpolation), usually without balnking during the exposure.

Thus, maximum writing speed and approximation quality can be achieved with minimum data overhead and transmission time. Moreover, the sinusoidal shape of the deflection signals consumes much less deflection bandwidth than raster scanning of polygonial parts of the structures. Furthermore, the **XPG2** writing algorithm symmetrically uses the bandwidth of X- and Y- axis.

Extreme Flexibility

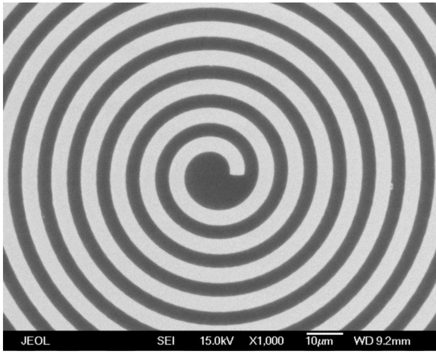
The modular system can be configured to suit your needs perfectly. The DSP kernel boots at startup via the USB link, therefore making kernel updates a mere cut and paste operation on the controlling PC. The Logic configuration can be updated within only a few minutes in order to supply new features.

Latest Digital Electronics, User Friendly Software and First Class Accessories

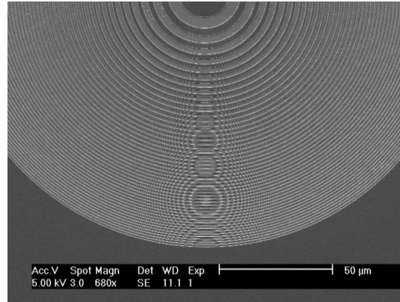
The complete deflection signal generation is implemented in a programmable logic device (FPGA) with 16/32 bit per axis. Especially the field correction does not use bandwidth limiting multiplying analog DACs, but is fully digitally built, therefore working up to maximum writing speed without any distortions in the resulting deflection signal.
The exposure dwell time is generated linearly with sub nanosecond resolution.
Our CAD and control software ECP has been written by experienced lithography users, subsequently making ECP a user friendly and lithography user specific system. ECP is available for Linux or Windows whilst the CAD part can be used at liberty within the workgroup.
A set of different specimen stages and fast beam blanker is available to complete the system.

Intelligent and versatile writing primitives

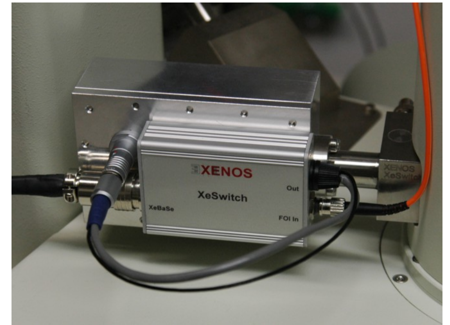
Electrostatic beam blanker



Spiral structure exposed with
XPG2 and JEOL JSM-6480
into PMMA (70 nm) on Si

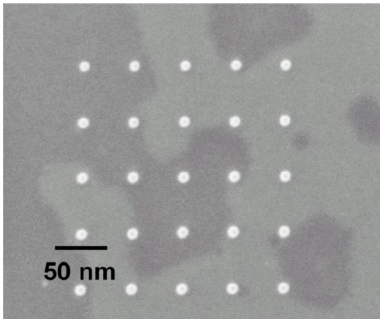


Fresnel lens exposed with XPG2
and FEI XL30 FEG SEM at **12.5 MHz** into PMMA (100 nm) on Si,
overall exposure time 80 seconds

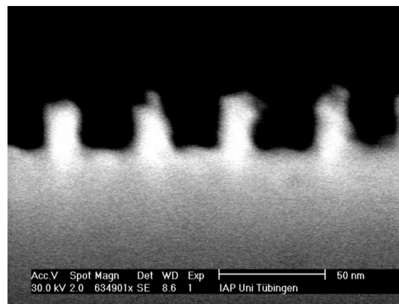


XENOS XeSwitch
fast electrostatic Beam Blanker
25 ns on/off times,
fibre optical interface

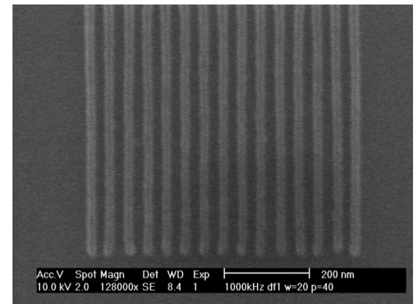
High resolution



Sub 10 nm dots exposed with
XPG2 connected to ZEISS 1530
(*University of Pittsburgh*)

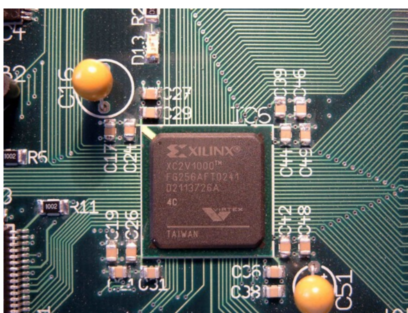


Sub 20 nm lines patterned with
HSQ resist on Si
(*courtesy Institute of Applied Physics , University of Tübingen*)

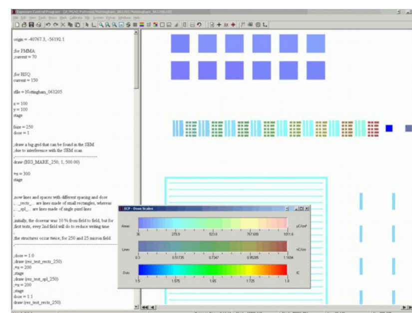


20 nm lines patterned with
HSQ resist on Si
(*courtesy Institute of Applied Physics , University of Tübingen*)

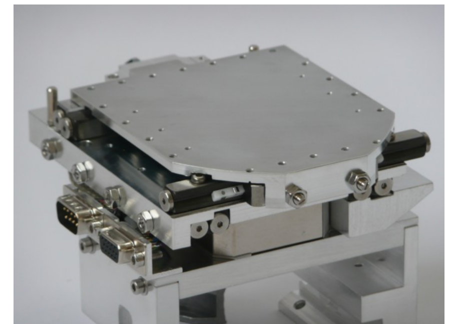
Latest digital electronics, user friendly software and first class accessories



High-end electronics
DSP and Gate Arrays



ECP CAD and control program



XeMove compact laser stages, 55 to 120 mm travel
10 nm measurement resolution

Further Informations

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