Fast-writing E-beam for large arrays of nano-holes

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Efficient nanoscale patterning of large areas is required for sub-wavelength optics. Here we use a fast-writing strategy described in [1], where electron beam lithography (EBL) with a focused Gaussian beam is used to define shapes directly. The serial technique is optimized for speed and pattern fidelity to a maximum writing speed of around 30 min/cm² for 200 nm periods in 2D lattices. The overall costs in terms of machine time and feasibility are assessed.

**Single shot Exposure**

 Conventionally, EBL uses multiple exposures of slightly overlaying spots. Instead, the fast-writing strategy uses the machine as a raster scan tool to write a large rectangle, using a beam step size larger than the spot size [1,2].

**Validation and Experimental Results**

The JEOL JBX-9500FS is a prototype EBL 100 keV system with electron-beam scanning speeds up to 100 MHz. Writing time tests of exposing 5 mm x 5 mm can be seen in Fig. 5 as function of dose. The effective current, that is the inverse slope is 28.0 nA, including time for calibration etc. Writing times are below 2 h/cm² and even a writing time of around 30 min/cm² for 40 µC/cm² can be achieved. Efficient calibration routines become imperative with this method.

**Conclusion**

An EBL writing time below two hours per cm² provides new possibilities where sub-wavelength structures can be used to provide functionality such as anti-reflective or plasmonic effects for large area applications in a cost-effective manner, similar to traditional parallel processing techniques.

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**References**


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