



## E-Beam Lithography

The New Jersey Nanotechnology Consortium has an extensive capability and experience in high resolution, e-beam lithography, including one of the few e-beam tools in the country dedicated to nanolithography. We have the resources, tools and expertise to help you create, evaluate and prototype your design fast – and reduce your overall time to market with a proven device design or proof of concept to proceed to the next development step. In general, the number of available e-beam lithography machines is limited by the cost (approximately \$6M) so there is typically a high demand and a long wait for access to the latest e-beam lithography equipment. However, NJNC members have quick and cost-effective access to the latest e-beam technology and expertise. The NJNC's e-beam Nanolithography Facility is one of the few locations in the country that has the latest generation of e-beam tools, the JEOL JBX9300FS, allowing us to deliver a wide range of e-beam lithography services and to support members' research and development milestones.



## World-Class E-Beam Tools and Expertise

The NJNC e-beam Nanolithography Facility provides members with the following capabilities:

### Cost-effective device development

- Combines high resolution lithography and high precision pattern placement in a single tool
- Rapid prototyping – Shorter turnaround time to evaluate and firm up designs
- Ability to make small quantities and customizations fast
- Fine pitch adjustment software for fine grating period adjustment (e.g. DWDM applications)
- Flexibility to perform many experiments on a single wafer

### Flexible Materials Usage

- Silicon, SOI
- GaAs, InP, GaN
- Dielectric, Metals
- Membranes (e.g., X-ray optics)
- Square mask blanks

### Advanced Prototyping of New Devices

- Electronics
- Photonics
- X-ray optics

### Finer Patterns and Address Grids

- 1 nm address over 500 $\mu$ m writing field
- Sub-optical resolution patterning – below 100 nm to 25 nm

### Stable Operation

- More precision of pattern over a longer period of time

### E-Beam Nanolithography Facility

- 100kV operating voltage
- 25 MHz Deflection Rate (50 MHz, 3Q '03)
- 4 nm minimum spot
- 1 nm address grid
- Multiple substrate capability
  - Wafers: 2 - 8"
  - Mask plates: 4 - 6"
  - Small-piece holder
  - 300mm Upgradeable
- On-the-fly shot clock adjustments

## Direct Write E-Beam Lithography – a Cost-Effective Approach

The NJNC's direct write e-beam lithography tool is optimized for high resolution and high precision pattern writing, unlike those found in commercial mask shops which emphasize writing speed and pattern placement accuracy.

While DUV optical step and repeat or scanner tools continue to offer far greater exposure throughput when pilot lots of wafers are needed to provide volume numbers of chips, the cost of a high resolution photomask can be a barrier to using advanced optical lithography. The NJNC's direct write e-beam lithography offers an alternative approach to DUV optical tools when design iterations or process development are best served by a rapid revision process or, of course, when the critical dimensions are below 100 nm.

## NJNC – the Experts in E-Beam Lithography

NJNC experts have been working with e-beam technology for over 20 years and have been involved with a wide variety of projects. Recent activities include:

- T-Gate process for III-IV Transistor work
- Silicon Nanotransistors
- Triangular and rectangular probes for measuring transport properties of molecular transistor materials

The NJNC is also one of the few organizations with both the specialized equipment and the knowledge to provide these types of customized lithography services:

- E-beam lithography on wide range of substrates 2"-8" wafers, with options for 12"
- Optical lithography: 193nm, 248nm, Contact Printing
- Ability to mix and match Deep UV (248nm) and e-beam lithography.

## NJNC E-Beam Project Adaptability

- Nanostructures: dot arrays, metal probes, meshes
- Photonics: gratings, quarter wave shifted gratings, phase grating masks
- Advanced Electronics: Silicon MOS, T-gates for III-V transistors, templates for overlap Josephson Junctions for quantum computing
- X-Ray Diffractive Optics: fresnel zone plates in Ni and Ge for soft x-rays, Bragg Fresnel zone plates for hard x-rays

## Move from Concept to Commercialization Quickly with the NJNC

The NJNC is your partner of choice for e-beam lithography. We can provide you with cost-effective access to the resources, tools and expertise you need to take e-beam devices from concept to working prototype fast.

Please visit [www.njnano.org](http://www.njnano.org), or call us at +1 (877) NJNC-ORG (656-2674) with any questions or to discuss your e-beam support needs. Our technical experts will work with you to prepare a comprehensive statement of work, and put together a proposal incorporating pricing information for your specific project.

For more information about the New Jersey Nanotechnology Consortium please visit [www.njnano.org](http://www.njnano.org) or contact us at: +1 (877) NJNC-ORG (656-2674)  
Copyright © 2003 New Jersey Nanotechnology Consortium  
All rights reserved. Printed in U.S.A.

### NJNC E-Beam Services

#### Electron Beam Lithography

Schedule file (SDF) and Job file (JDF) Preparation  
E-beam system calibration and exposure

#### Standard Sample Mount for:

6mm X 10mm  
8mm X 12mm  
10mm X 12mm  
12mm X 20mm  
1/4 of 2 inch wafer  
2,3,4,5,6,8 inch wafers  
4 X 0.060 inch mask  
5 X 0.090 inch mask  
6 X 0.250 inch mask

#### Data Services

Data Conversion GDS II to JEOL 52 v3.0 format using JBXFILER  
Data Conversion GDS II to JEOL 52 v3.0 format using CATS  
Data Conversion JEOL01 to JEOL 52 v3.0 format using JBXFILER  
Data Conversion JEOL51 to JEOL 52 v3.0 format using JBXFILER  
Data Conversion GDS II to JEOL 51 format using JEBCAD  
Data Conversion JEOL01 to JEOL 51 format using JEBCAD  
Graphic Inspection of J01 data using JEBCAD  
Graphic Inspection of J51 data using JEBCAD  
Graphic Inspection of GDS II data using JEBCAD  
Graphic Inspection of JEOL52 v3.0 data using JBXFILER  
DW2000 pattern design CAD  
L-Edit pattern design CAD  
Zone Plate Pattern Generation using SUNY StonyBrook program

#### Specimen Prep

Wet cleans  
Vapor Priming in HMDS  
Resist Spin (All samples) Manual Dispense  
Resist Spin for 8 inch MOS clean silicon: edge bead and backside removal  
Hot Plate and Oven Bakes  
Contact Angle Goniometer for HMDS process optimization

#### Analysis and Inspection

Thin Film Characterization  
Ellipsometer, Stylus Profilometer, Nanospec  
Optical Microscopy  
FESEM: JEOL JSM 6700F, Hitachi S900

#### Metallization

SEM Coater (Au)  
Denton Thermal Evaporator for Ge and AuPd  
Nickel Electroplating