

NanoBuilder Software

Automatic fabrication of complex nanostructures using Thermo Scientific NanoBuilder Software

With Thermo Scientific NanoBuilder Software you systematically plan construction of multi-layer nanostructures by dividing CAD files into ordered projects to easily make full complex structures that were tedious or impossible before.

The Thermo Scientific™ NanoBuilder™ Software allows patterning of large and complex nanostructures accurately on multiple sites, supporting all DualBeam™ patterning processes: focused ion beam (FIB) milling, gas-assisted FIB milling, FIB induced deposition, and electron-induced deposition.

Different pattern processes can be assigned to each individual layer in the GDSII layout, and the user can define the sequence in which NanoBuilder Software executes these. Advanced alignment algorithms ensure that the individual layers are accurately aligned without unwanted exposure of the pattern area to ions or electrons (for sensitive samples the alignment process does not expose the site of interest to ion or electron beam irradiation). Finally, the patterning of all layers is executed fully automatically. Site lists can be created to repeat the nanostructure on multiple sites on a substrate.

NanoBuilder Software utilizes our patterning board with 16-bit resolution (64k × 64k pixels) and 40 MHz writing speed and directly controls all relevant instrument components such as ion and electron columns, the sample stage, and the gas injection systems (GIS).

Thermo Scientific NanoArchitect™ Software complements Thermo Scientific NanoBuilder Software; it allows the planning of patterning sequences on your desktop PC.

Key benefits

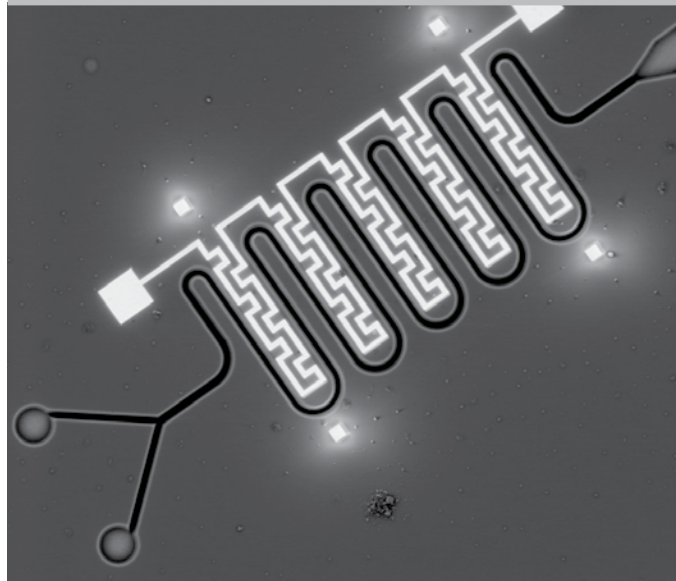
CAD-based prototyping

FIB and GIS optimized

Fully automated job execution, stage navigation, milling, and deposition

Automated alignment and drift control

Planning of patterning sequences on your desktop PC using Thermo Scientific NanoArchitect Software



NanoBuilder Software features and capabilities

Accurate positioning of multiple layers in nanophotonics

- Typical nanophotonics building blocks require nanometer precision manufacturing of micro-sized structures
- **Figure 1** shows a slot racetrack resonator, which is a photonic structure used to tightly confine light in a material with a low refractive index, which is typically used in optical sensors and modulators. The slot in the center of the racetrack waveguide amplifies the interaction with a contrast material
- **Figure 2** shows the almost perfect centering of the slot inside the track, demonstrating the superb alignment algorithm capabilities. Typically, the racetrack will be created using conventional nanofabrication techniques. The alignment functions of NanoBuilder Software can match the DualBeam patterning to the exact size and actual shape of prefabricated structures. This allows mix and match of DualBeam patterning processes with other techniques

High-resolution large-scale patterning

- Creation of a 1 mm long 2-layer structure that incorporates < 50 nm structures requires the highest patterning resolution in a large field of view (FOV). NanoBuilder Software and 16-bit patterning allow for large-scale accurate patterning
- **Figure 3** shows a long structure with many small structures embedded. As the close-up shows, these have typical line widths of < 50 nm. The overall structure is 1 mm long and 10 nm deep and was milled at 1 nA 30 kV

NanoBuilder application example

Combined deposition and etching of nanofluidic building blocks

- Nanofluidics requires fast prototyping of complex small structures
- **Figure 4** shows a building block of a nanofluidic device in which a fluidic channel is FIB-milled into the substrate material and a metallic electrode is accurately positioned into the meanders of the fluidic channel. The fluidic channel is 300 nm wide and was milled with 1 nA FIB current; the metal line consists of a 200 nm high platinum layer deposited with 100 pA FIB current
- NanoBuilder Software fabricates this device within a total patterning time of less than 10 minutes. The NanoBuilder Software alignment functions ensure that FIB milling and FIB-induced deposition are automatically aligned with respect to each other. Structures such as the one in Figure 4 could be used as resistive heaters in lab-on-a-chip

Features of Thermo Scientific automated NanoPrototyping solutions

Body Table Header	GDSTODB	NanoBuilder
Import GDSII files	✓	✓
GDSII viewer	✓	✓
Convert to Thermo Scientific stream files	✓	
Automated alignment and drift control		✓
Automated job execution		✓
Multi-site support		✓
Integrated editing of microscope properties		✓
Alignment without exposing the site of interest		✓

NanoBuilder features and capabilities

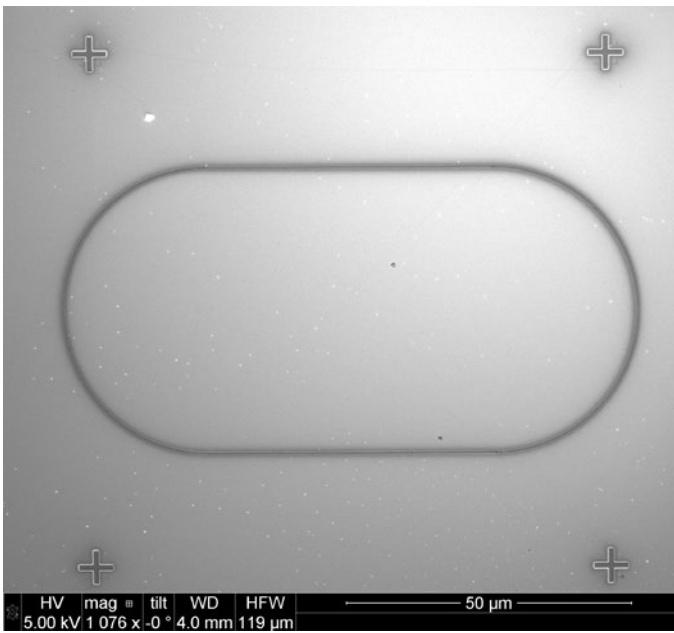


Figure 1. Slot racetrack resonator, consisting of an 800 nm wide trench. The slot is a second trench, 300 nm wide, in the exact center of the first trench. The overall structure is 100 x 50 μm .

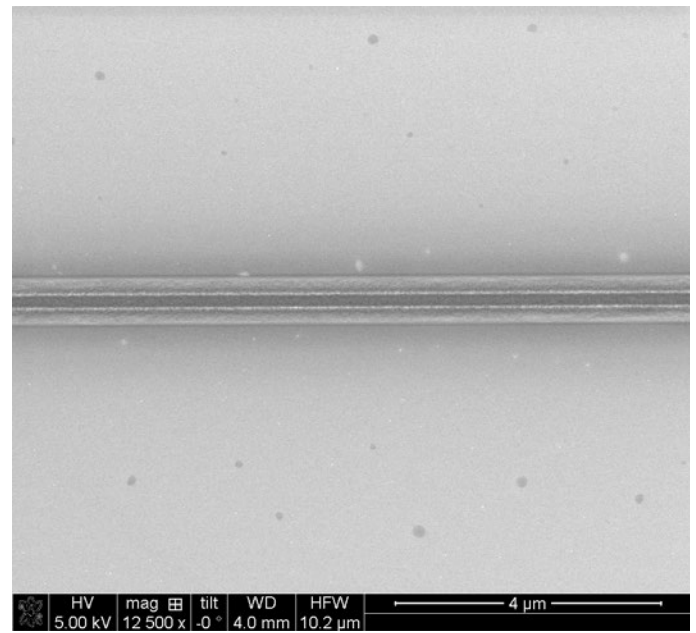


Figure 2. Close-up of the 300 nm wide slot inside the 800 nm wide racetrack. Note the excellent alignment.

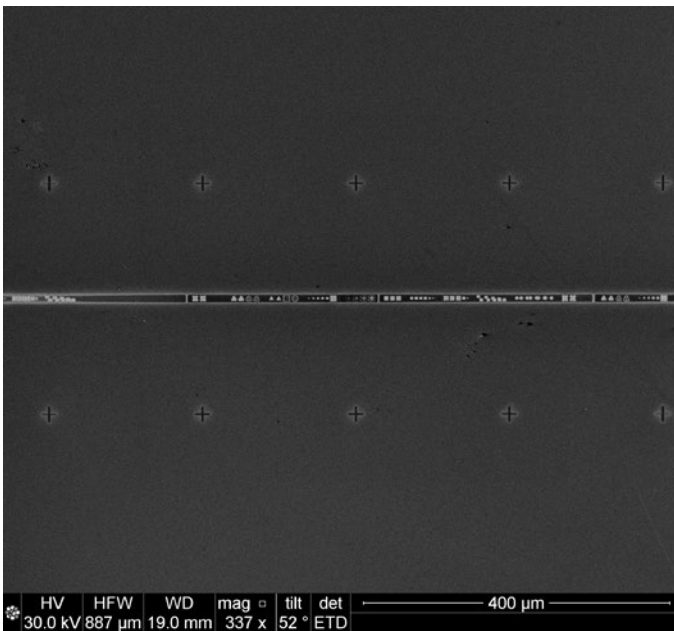


Figure 3. Line strip.

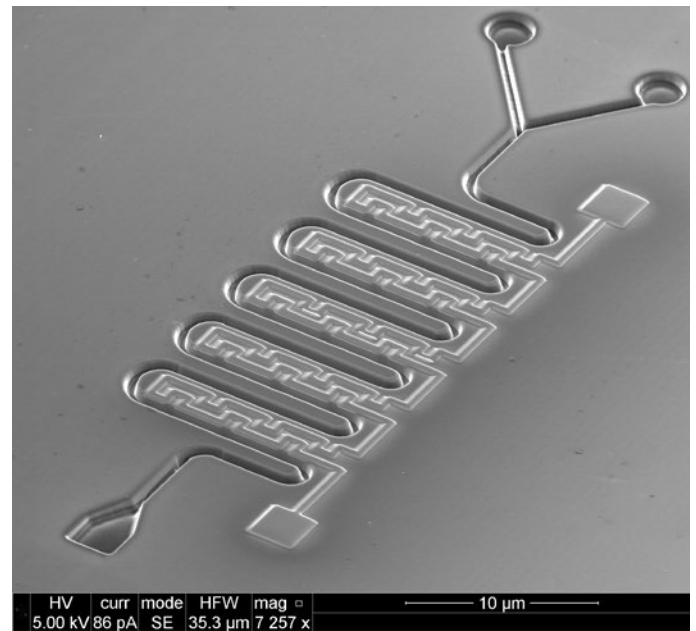


Figure 4. Nanofluidics building block.

NanoBuilder features and capabilities

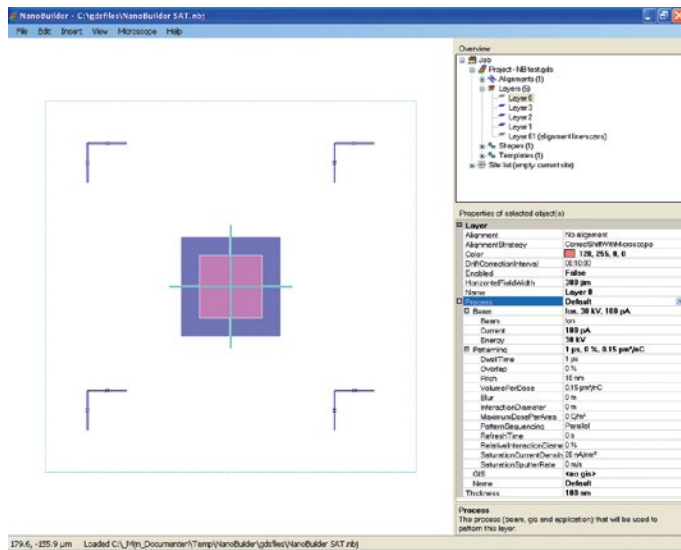


Figure 5. The NanoBuilder UI during layer parameter definition.

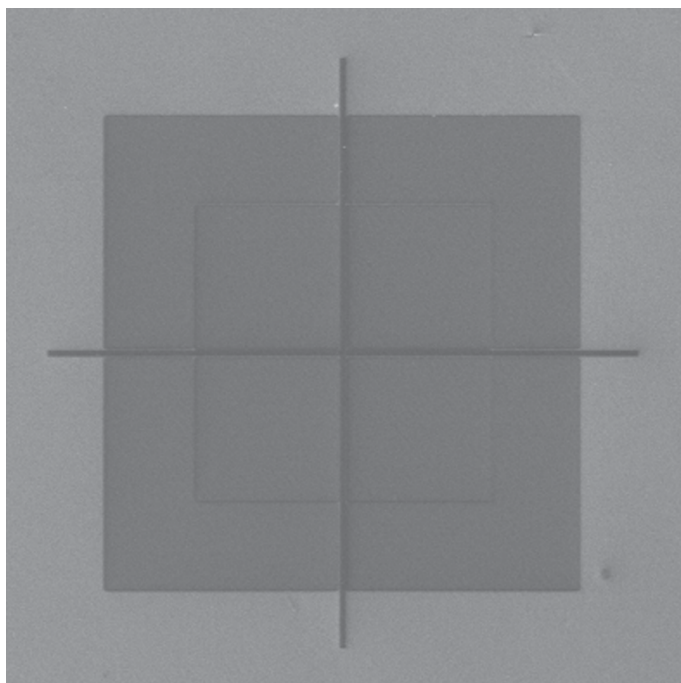


Figure 6. The patterned area.
Note that no extra exposure occurred during alignment.

Summary

The process of creating a job for execution is:

- Import the desired GDSII design Files
- Set the tool parameters for the different layers

Product structure

- NanoArchitect Software creates individual patterning processes and defines the execution sequence (standalone PC)
- NanoBuilder Software incorporates all NanoArchitect Software functionalities to enable execution of the patterning process on the tool
- NanoBuilder LTL™ Software is a Limited Time Licence of NanoBuilder Software if you need patterning capabilities for a defined project period

Licensing

Every NanoBuilder Software or NanoBuilder LTL Software license incorporates one NanoArchitect license.

System requirements

- NanoBuilder Software/ NanoBuilder LTL Software
 - Thermo Scientific Small DualBeams* systems
 - 16-bit scan generator
 - Latest released system software version
- NanoArchitect Software
 - Windows® XP operating system

Please ask your local Thermo Fisher Scientific representative to verify whether your system can be upgraded with NanoBuilder Software.

Find out more at thermofisher.com/EM-Sales