Beam Initiative

Founding Member

vistec Electron Beam

Cell Projection to Extend Shaped-Beam-Litho for New Applications

Matthias Slodowski, General Manager

Cell Projection
Early E-Beam Idea for New Applications Today

vistec Electron Beam

IBM, 1979

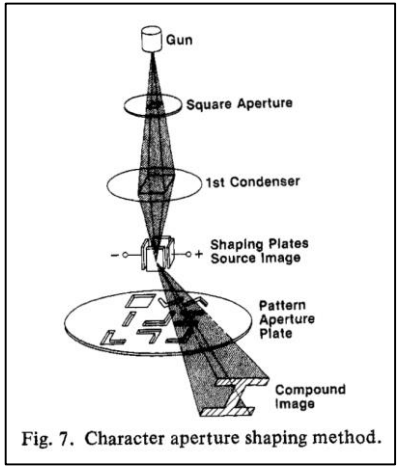


Fig. 7. Character aperture shaping method.

Source: H. C. Pfeiffer, IEEE Trans. Electron. Devices ED-26, 663, 1979

(Vistec), 1993

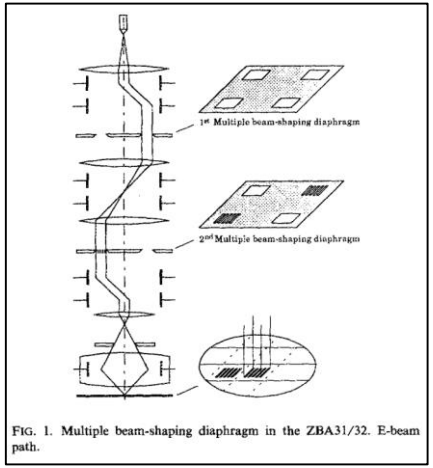
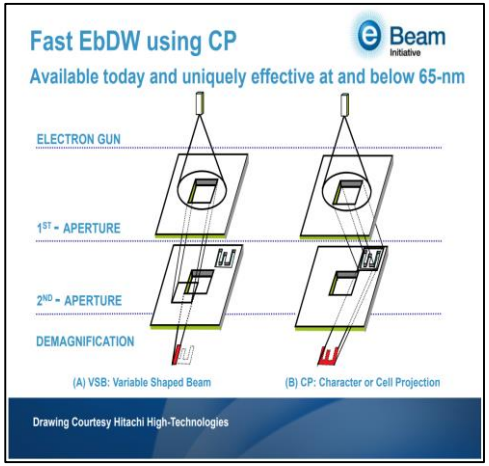


FIG. 1. Multiple beam-shaping diaphragm in the ZBA31/32. E-beam path.

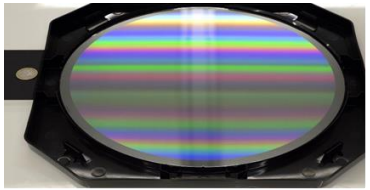
Source: Elsner, Hahmann, J. Vac. Sci. Technol. B, Vol. 11, No. 6, Nov/Dec 1993

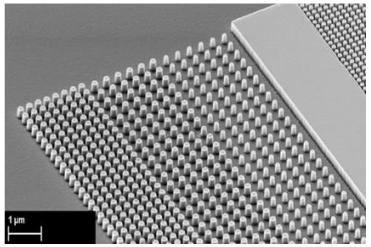
eBeam Initiative, 2009



Source: eBeam Initiative Website ebeam.org, Features Archive

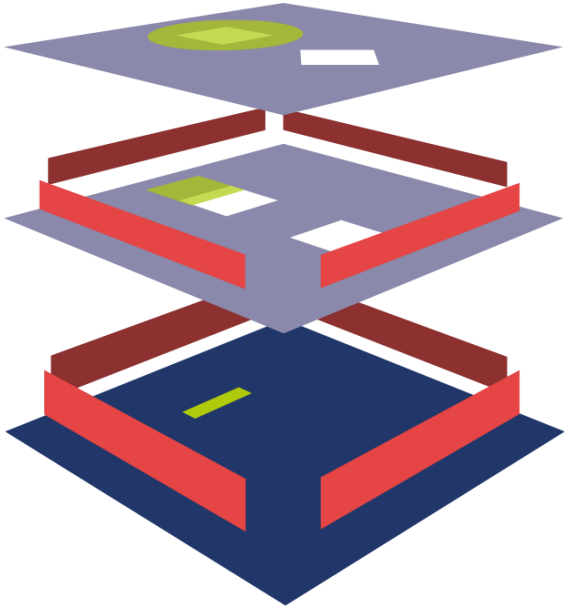
Applications, 2024





Source: Fraunhofer IOF, Jena / Germany

Variable Shaped Beam (VSB)



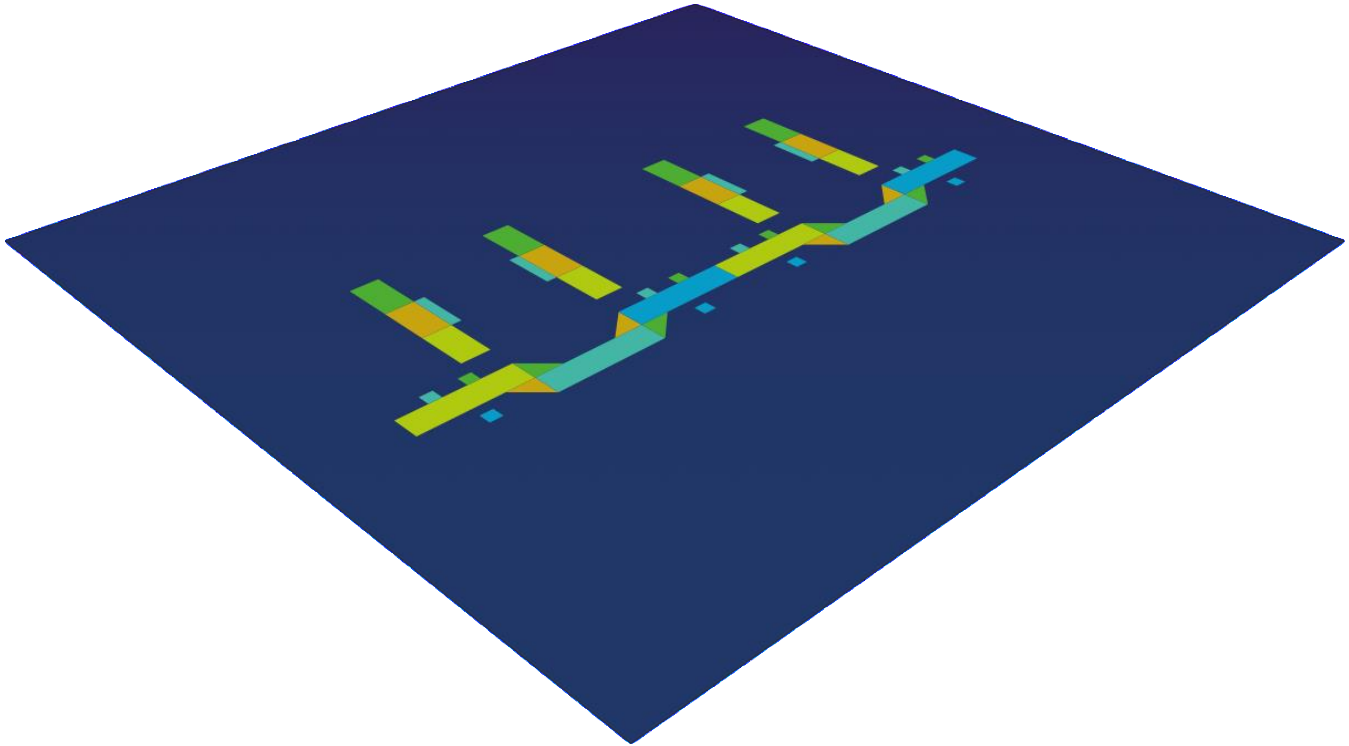
electron beam

shaping deflection

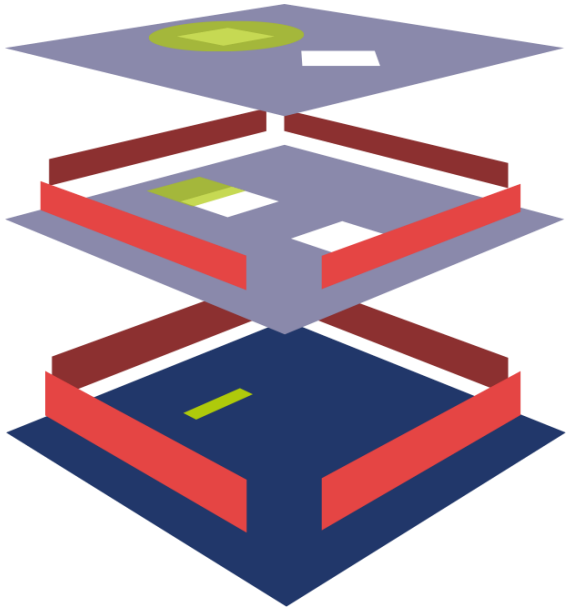
positioning deflection

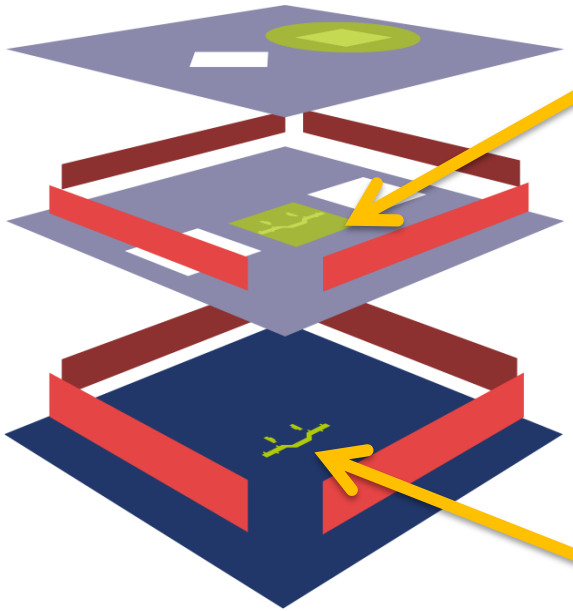
substrate

Variable Shaped Beam Writing



VSB and Cell Projection Seamlessly Integrated in the Same Hardware (switch electro-optically)



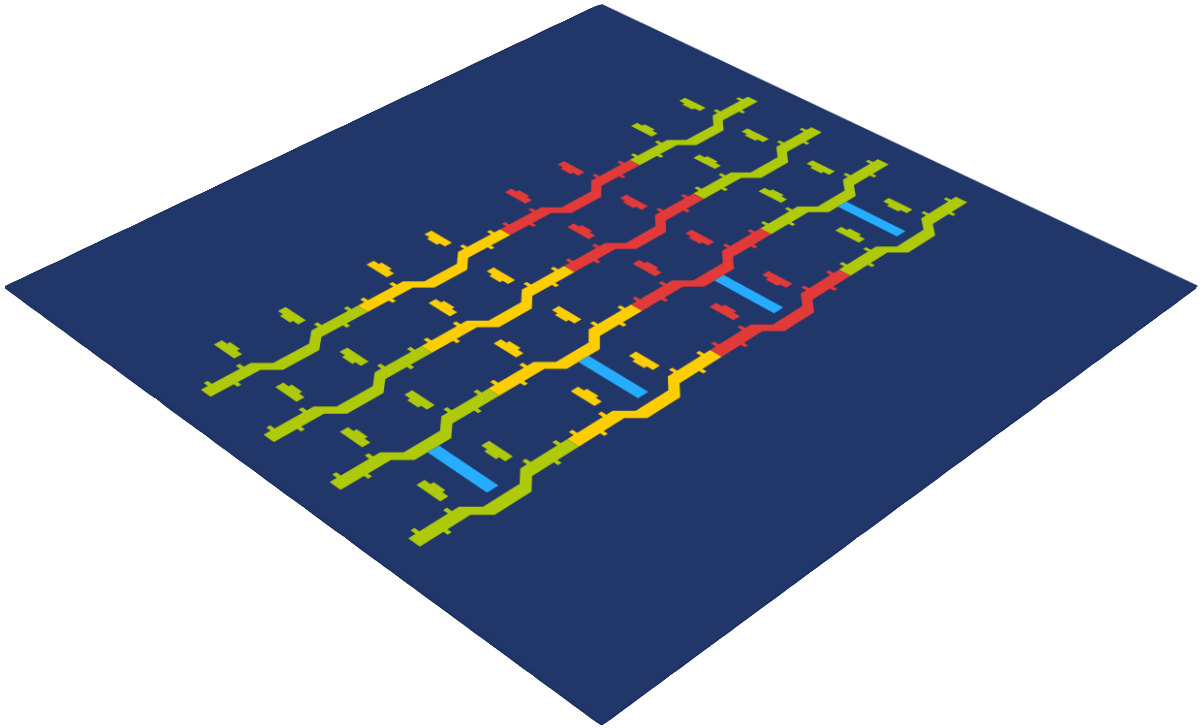


Mini-Reticle
in Stencil Chip
10.000 +

exposed Mini-Reticle
→ „Cell“ or
→ „Character“

VSB and Cell Projection Seamlessly Integrated in the Same Hardware (switch electro-optically)

vistec Electron Beam



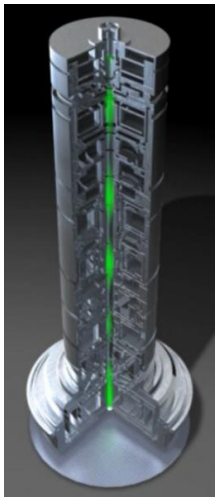
2 Tool Types: Both Shaped Beam + Cell Projection

SB250

up to 200 mm wafer
up to 7 inch mask

SB3050

up to 300 mm wafer
up to 9 inch mask

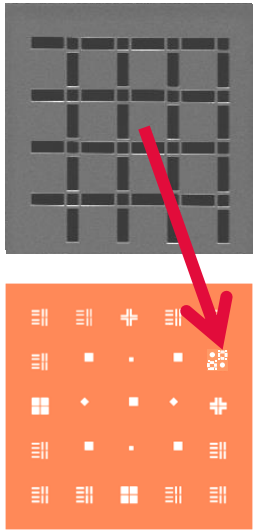


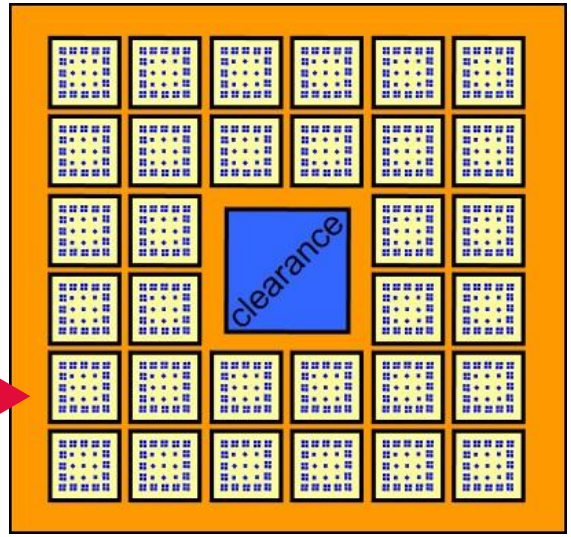
Cell Projection Hardware:
Etched Mini-Reticle on Stencil-Chip on Piezo-Stage

mini-reticle
etched into
silicon membrane

multi **stencil chip**
more than 10.000 reticles
(depending on size)

fully automatic **reticle positioning**
short range: by E-Beam deflection
long range: by piezo stage positioning





Data Preparation - General Remarks

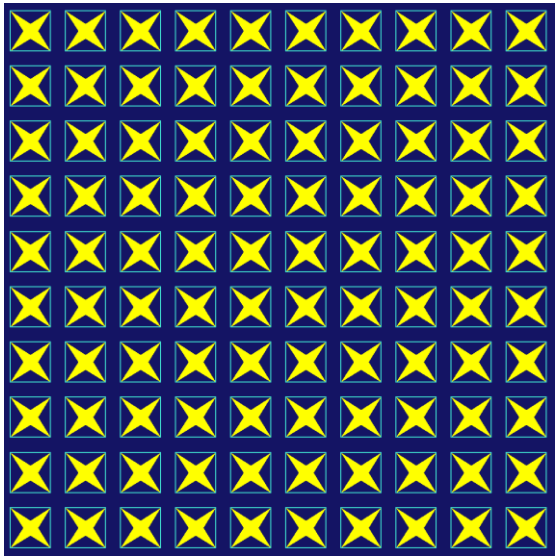
- Complete toolbox available in Vistec‘s
  propriatary ePLACE data preparation system.
- Seamlessly integrated with Variable Shaped Beam inluding all corrections.
- **NEW: Exact Mathematical Function** instead of layout
  can be used to create exposure data to prevent vertice artifacts when
  fracturing a layout.

- 3 Ways to do Cell Projection Data Preparation ...

Data Prep:
Way 1: Create Layout out of existing Mini-Reticles

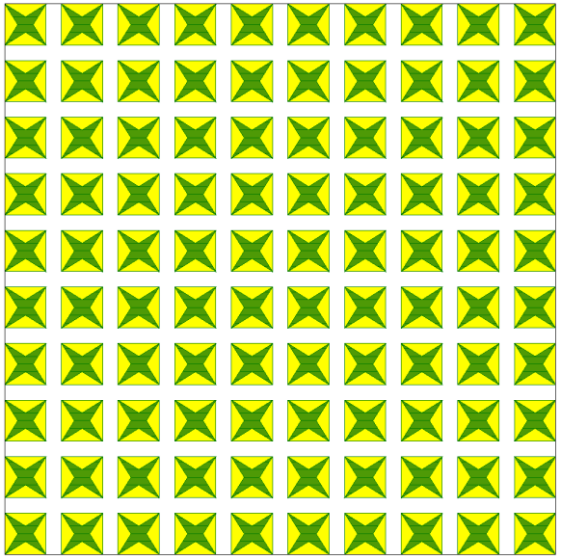
MR-Lib

Layout and marking boxes



ePLACE

Fractured Data (JES)

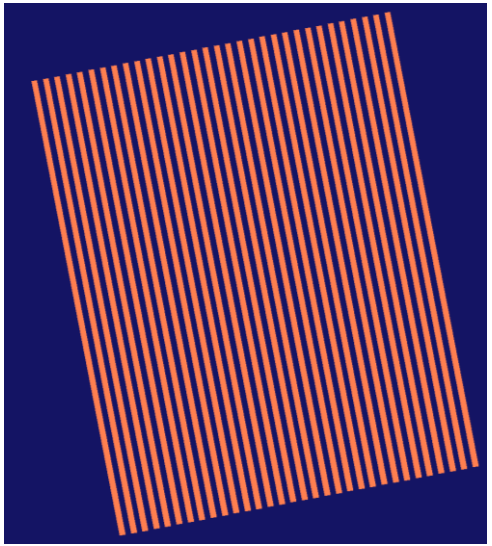


Layout is hierarchical and consists of Mini Reticles as basic cells.

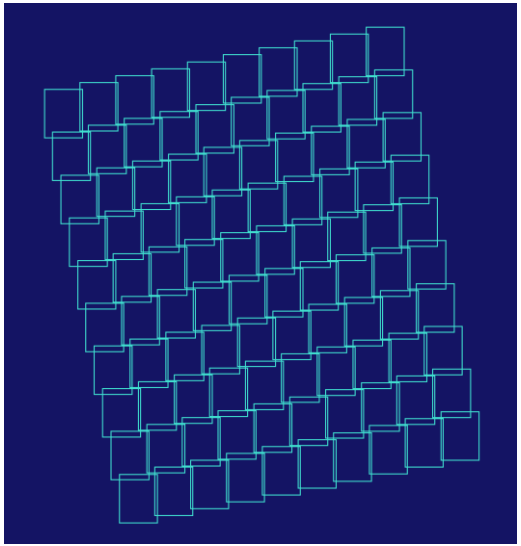
Cells are marked in yellow

Data Prep:
Way 2: Use Marking Boxes to support Cell Fracturing

Layout (slanted gratings)



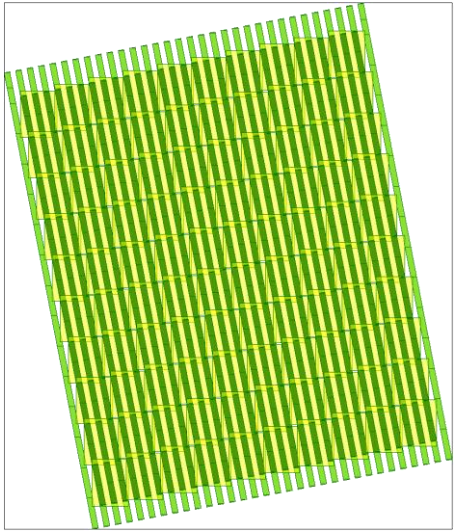
Marking boxes



MR-Lib

ePLACE

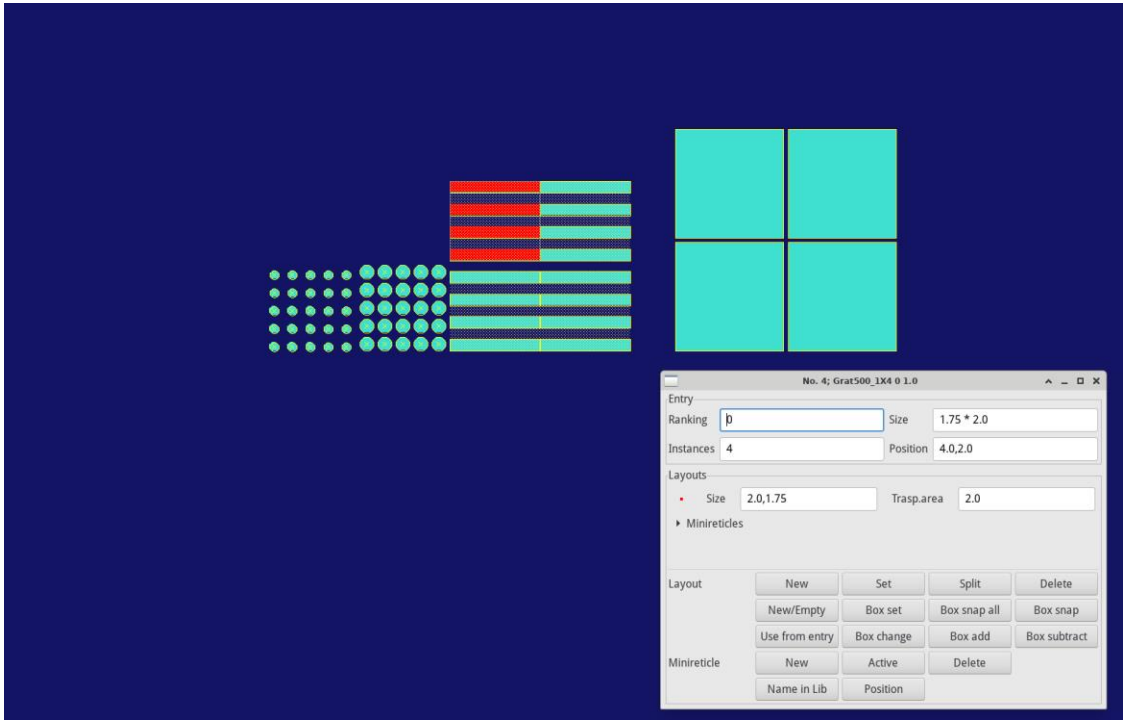
Fractured Data (JES)



Layout may be non-hierarchical.
No pre-cuts to MR size are required.

Cells are marked in yellow
VSB shots in green

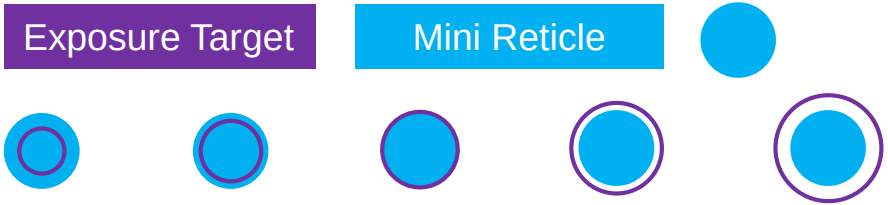
Data Prep:
Way 3: Identify Cell Candidates in Arbitrary Layouts

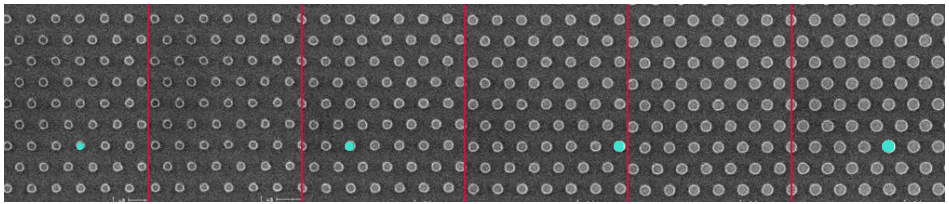


ePLACE

offers tools to identify Mini Reticle candidates

Data Prep:
Continuous CD Tuning of Cells by Dose





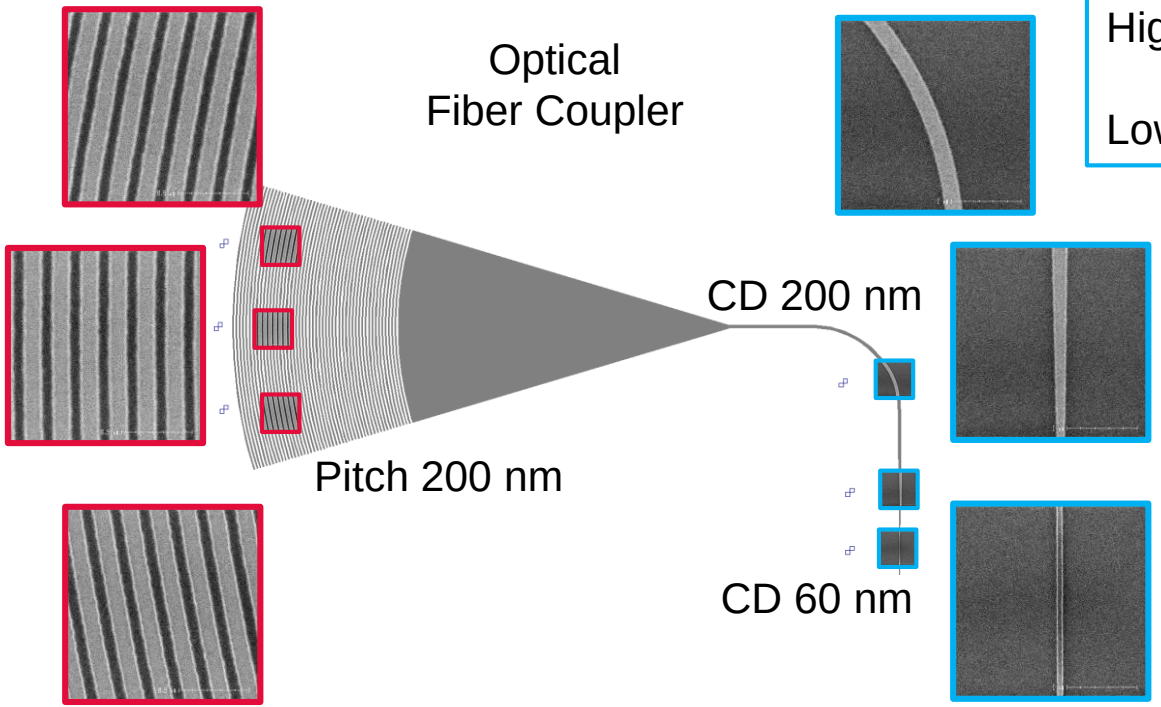
82.71 nm **101.00 nm** 120.55 nm 137.76 nm

CD-SEM measurement

Data Prep:
Curvilinear features

Angle-independent characteristic

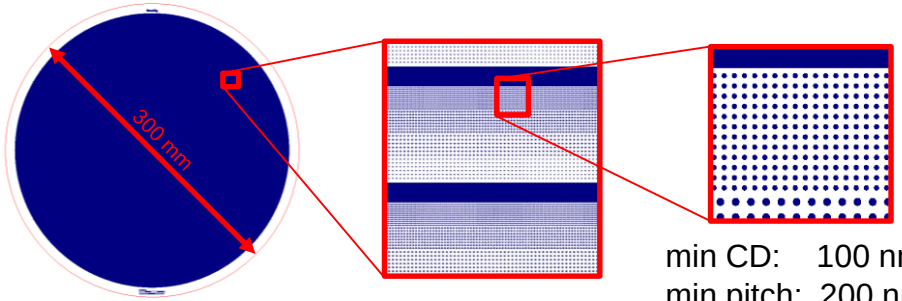
High diffraction efficiency



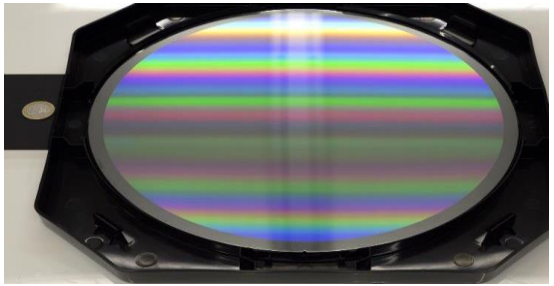
High pattern fidelity

Low scattering

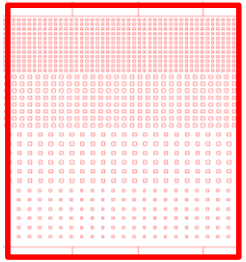
Application Example 1:
Effective Medium Blazed Grating



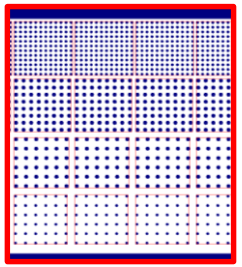
min CD: 100 nm
min pitch: 200 nm

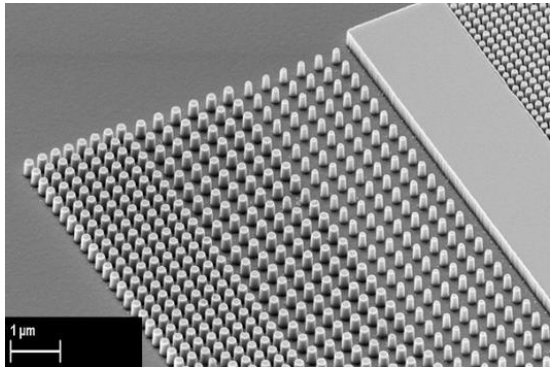


VSB, squares
2.5 months



CP, dots
1 day





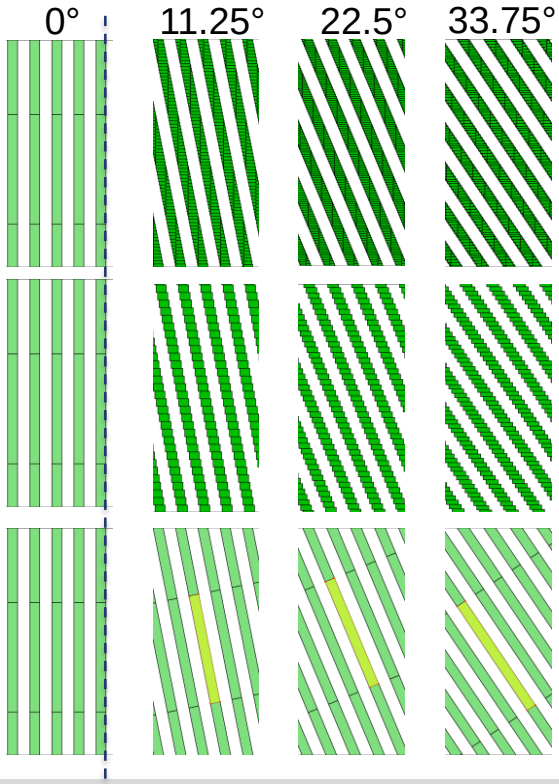
Source: Fraunhofer IOF, Jena / Germany

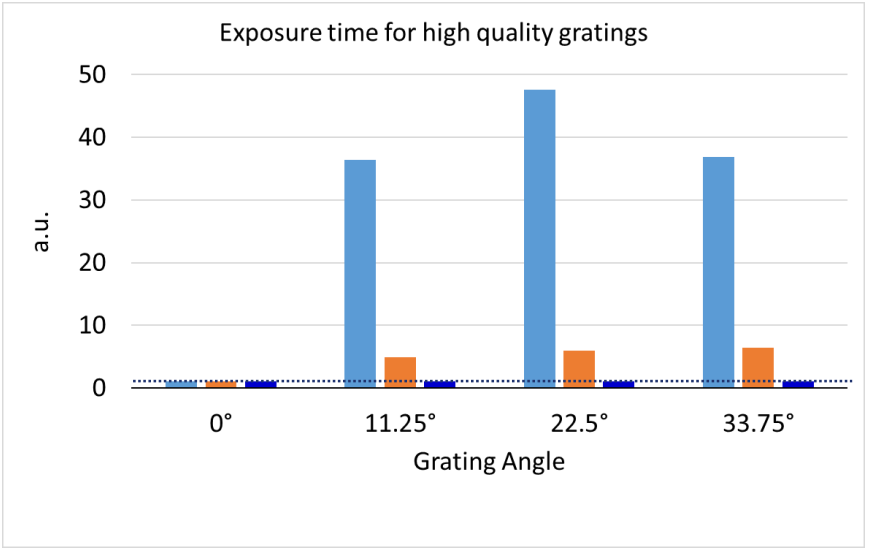
Application Example 2:
High Quality Any Angle Gratings

Standard VSB Approximation

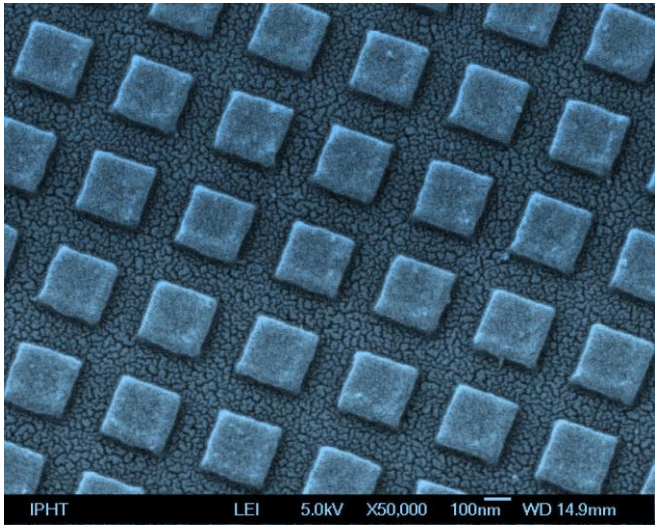
Sophisticated VSB Approximation

Cell Projection

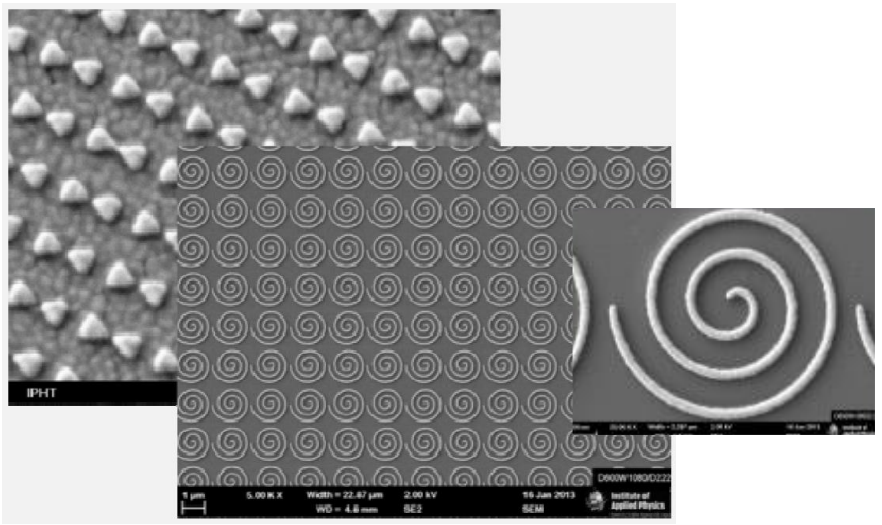




Application Example 3:
Metamaterials: Small Structures + High Fidelity + Large Areas



Plasmonic Nanostructures



Bow Tie & Spiral Arrays

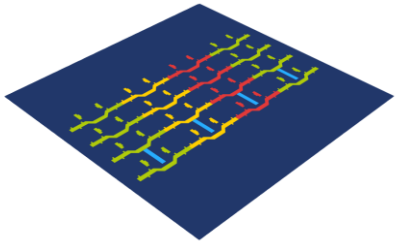
Source: IPHT Jena, Germany

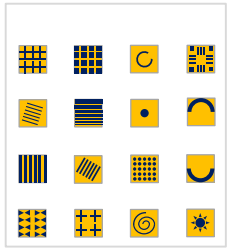
Shaped Beam + Cell Projection Fits New Applications

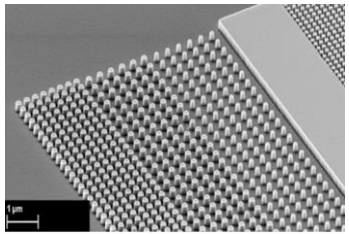
- Cell- or Character Projection has a long E-Beam history in different flavours.
- Vistec‘s solution is fully automated and seamlessly integrated with Variable Shaped Beam.
- Sophisticated and proven Hard- and Software is available, like more than 10.000+ mini reticles and appropriate Data Prep tools.
- Cell Projection increases throughput AS WELL AS pattern fidelity.
- Cell Projection fits especially optics and photonics mastering applications.

Thank you for your attention !

and the whole Vistec team for its contributions.







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