

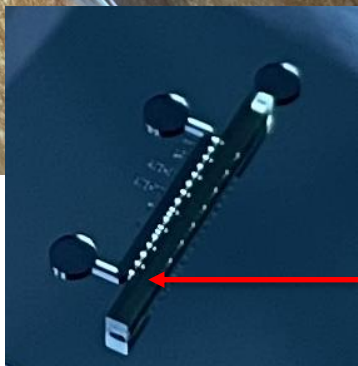
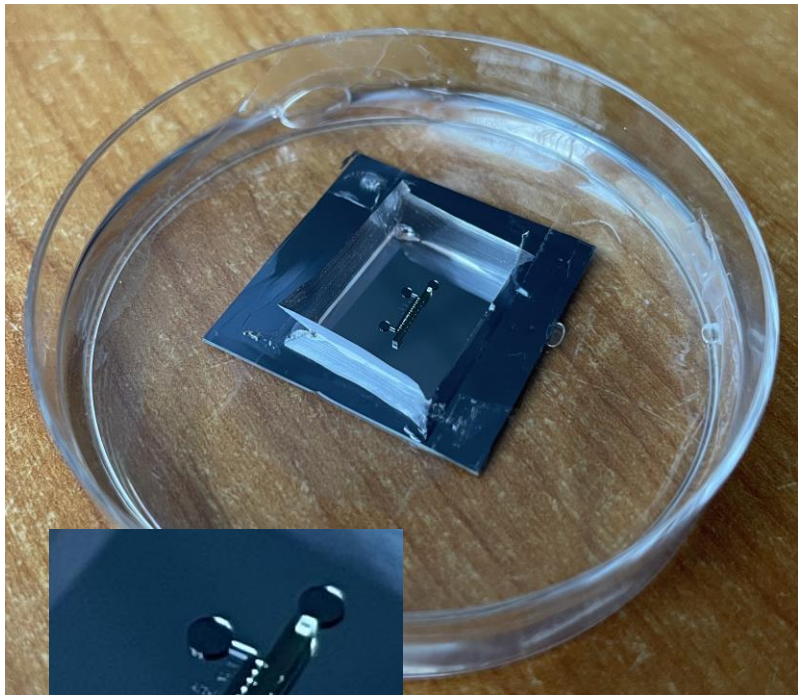
Lithographie laser bi-photons pour l'impression de moules PDMS dédiés à des applications micro-fluidique

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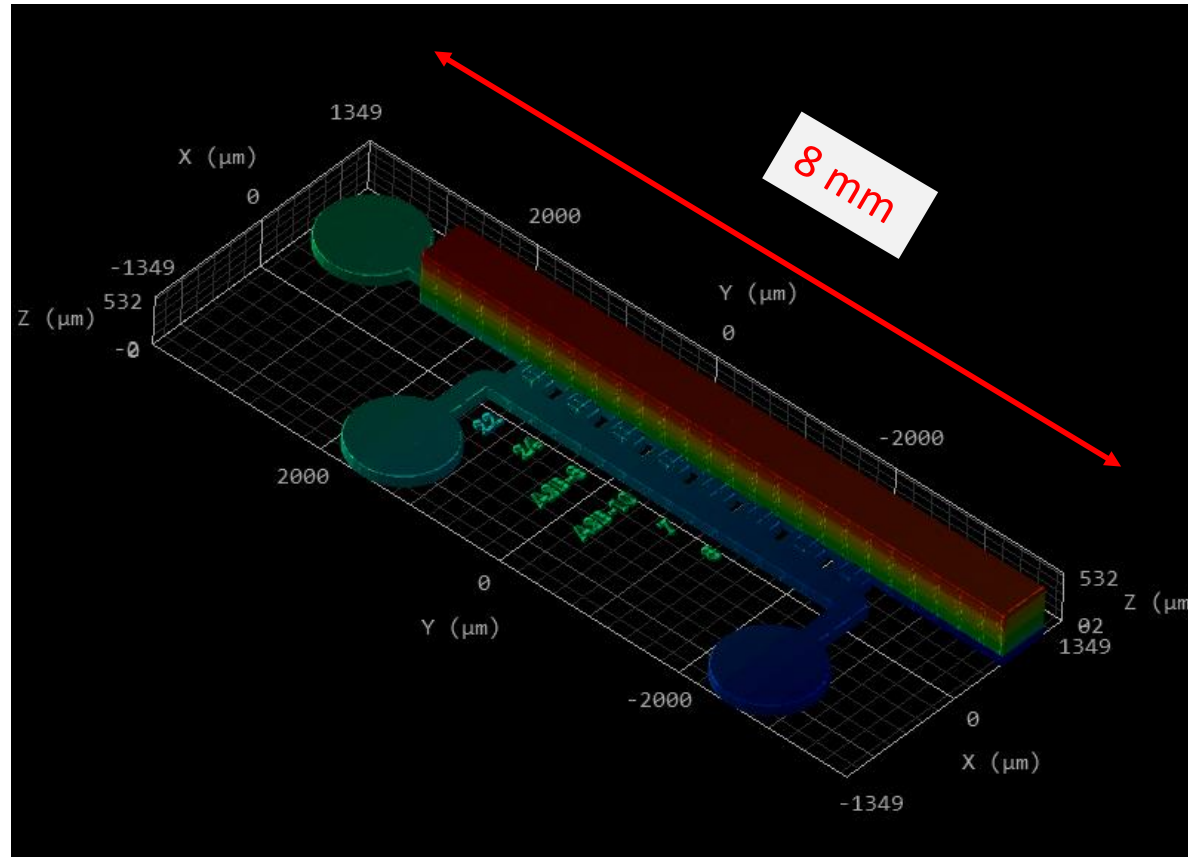
Fabien MESNILGRENTE – PF CALMON: Service TEAM (Techniques et Equipements Appliqués aux Micro et nanotechnologies)

Moules PDMS par Litho Laser 3D

> Objectif: Fabrication de puces micro-fluidique

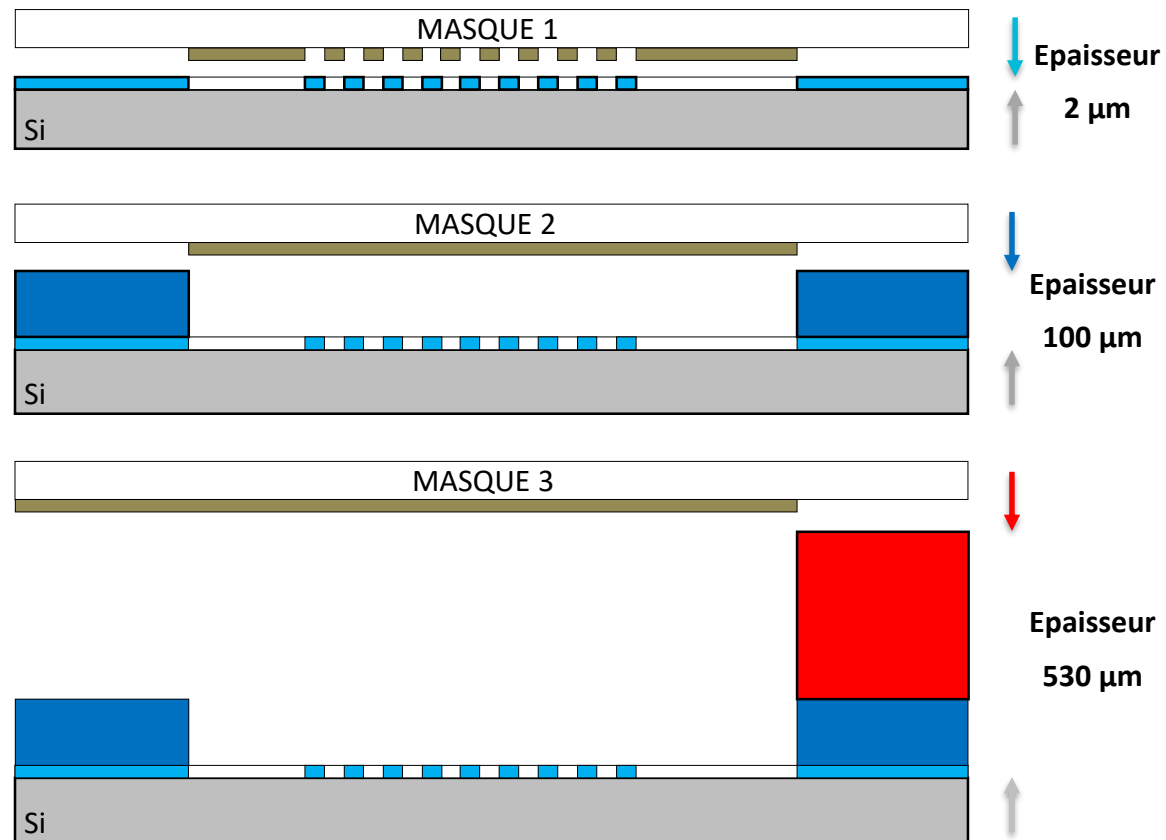
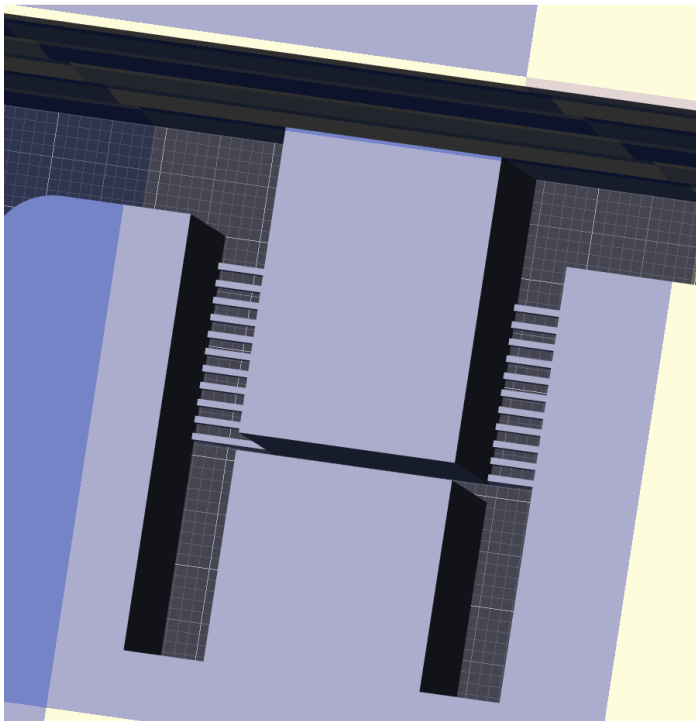


Résine IP-S
Dureté > 200 MPa



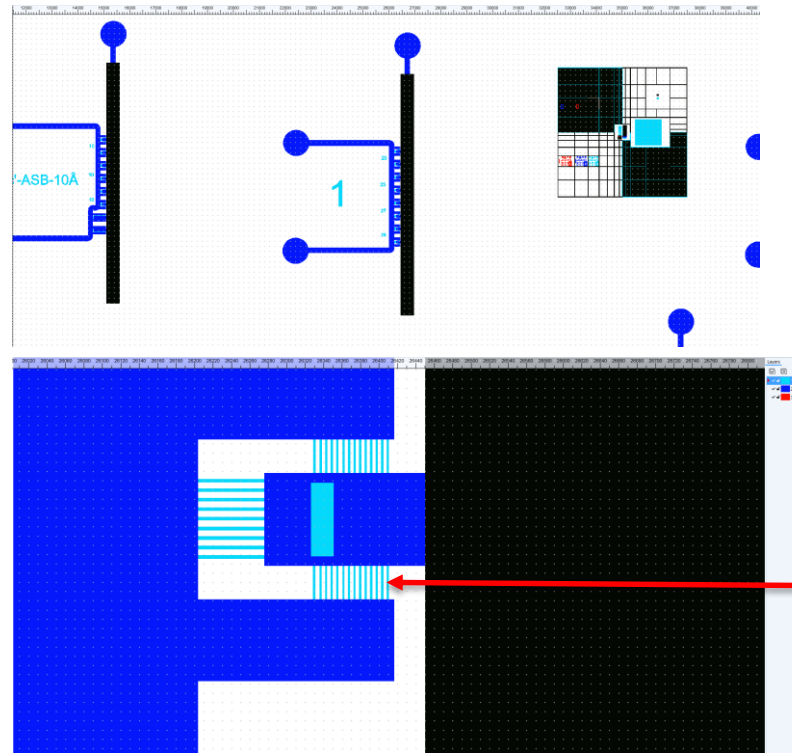
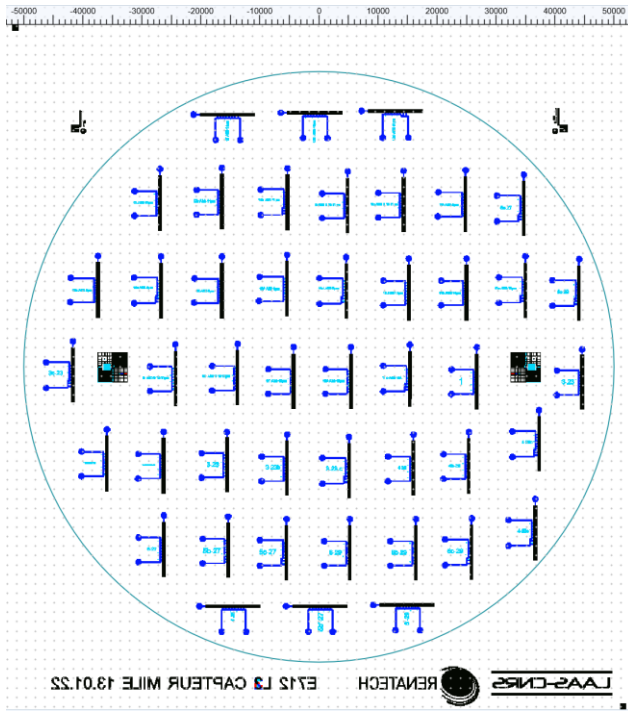
Moules PDMS par Litho Laser 3D

- > Procédés de lithographie optique – 3 niveaux de masques
- > Période de 2 ans – Une partie techno de travaux de thèse



Moules PDMS par Litho Laser 3D

- > Procédés avec des films DF, des films Suex et de la résine SU8: problèmes d'alignement et de respect des côtes.

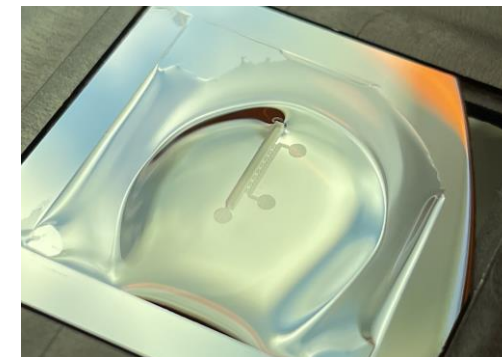


Lignes 2 μm

Moules PDMS par Litho Laser 3D

- > Nanoscribe PP GT+ – Résine IP-S
- > Résolution 3D MF DiLL – Objectif x25
- > Novembre – Décembre 2022

The screenshot shows the DeScribe 2.7 software interface. On the left, a text window displays the STL file metadata for 'Moule-ej_data.gw'. The main area shows a 3D model of a mold with a central channel and two circular features. The axes are labeled in micrometers (μm). On the right, the 'Model' panel shows the 'Scaling' section with a red box around the 'Absolute (μm)' values: X: 2696.6, Y: 7746.248, and Z: 530. The 'Lock aspect ratio' checkbox is checked. Below the scaling section, 'Mesh statistics' show 12372 triangles and 'Dimensions' are listed as X: 2696.6 μm, Y: 7746.248 μm, and Z: 530 μm. The 'Volume' is 2.112 mm³.



Dépôt d'une goutte de résine

Pas de recuit

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> Slicing 1 μm

The screenshot shows the DeScribe 2.7 software interface. On the left, a code editor displays the STL file content for 'Moule-ej_data.gwl'. A red box highlights the slicing parameters:

```

22 % Slicing
23 % SlicingMode: Fixed
24 % Distance: 1
25 % SimplificationTolerance: 0.05
26 % FixSelfIntersections: on
  
```

The central 3D view shows a blue mold structure on a black grid. The right-hand side features a 'Model' control panel with the following settings:

- Input:** Moule-ej.STL
- Transformation:** Undo, Redo, Reset
- Orientation:** X, Y, Z axes
- Scaling:**
 - X: 2696.6 μm (Relative: 1000)
 - Y: 7746.248 μm (Relative: 1000)
 - Z: 530 μm (Relative: 1000)
 - Lock aspect ratio
- Mesh statistics:**
 - Number of triangles: 12372
 - Dimensions: X: 2696.6 μm , Y: 7746.248 μm , Z: 530 μm
 - Volume: 2.112 mm^3
- Display options:**
 - Disable preview
 - Disable default calculations

The bottom status bar shows 'Line 33, Column 29' and the system tray includes the date '2023-01-13' and time '09:53'.

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> Structure alvéolaire

The screenshot displays the DeScribe 2.7 software interface. The main window shows a 3D model of a honeycomb structure (alveolar structure) in a blue color, rendered on a grid. The left sidebar contains a file explorer and a console window showing the following parameters:

```

1 % File generated by DeScribe 2.7
2 %
3 % Creation time
4 % 2022-12-13T16:43:31+01:00
5 %
6 % Source file
7 % Type: Mesh
8 % Path: C:\GWL\PPC\Tiphaine\run 19\Moule-ej.STL
9 %
10 % Volume
11 % 2.112 mm³
12 %
13 % Bounding box
14 % Minimum X: -1348.3 Y: -3873.124 Z: 0
15 % Maximum X: 1348.3 Y: 3873.124 Z: 530
16 %
17 % Transformation
18 % Scaling X: 1000 Y: 1000 Z: 1000
19 % Rotation X: 0 Y: 0 Z: 0 W: 1
20 % Translation X: -1348.3 Y: -9505.615 Z: 0
21 %
22 % Slicing
23 % SlicingMode: Fixed
24 % Distance: 1
25 % SimplificationTolerance: 0.05
26 % FixSelfIntersections: on
27 %
28 % Shell
29 % HatchingDistance: 0.5
30 % ContourCount: 12
31 % BaseSliceCount: 2
32 % Angle: auto
33 % ConcaveCornerMode: Sharp
34 %
35 % Scaffold
36 % HatchingDistance: 0.5
37 % Type: Triangles
38 % WallSpacing: 20
39 % FloorSpacing: 20
40 % WallLineCount: 2
41 % FloorSliceCount: 2
42 % Offset X: 0 Y: 0 Z: 0
43 % Stagger: off
44 %
45 % Splitting
46 % Mode: Rectangular
47 % BlockSize X: 274 Y: 254 Z: 100
48 % Offset X: 50 Y: 121.5 Z: 0
49 % Shear: 5
50 % Overlap: XY: 2 Z: 1
51 % BlockWidth X: 284.836 Y: 264.836 Z: 101
52 % BlockOrder: Lexical
    
```

The right sidebar shows the 'Scaffold' settings panel with the following options:

- Scaffold parameters:**
 - Hatching distance: 0.5
- Scaffold type:**
 - Triangles
 - Tetrahedron
 - Planes
 - Hollow
- Scaffolding:**

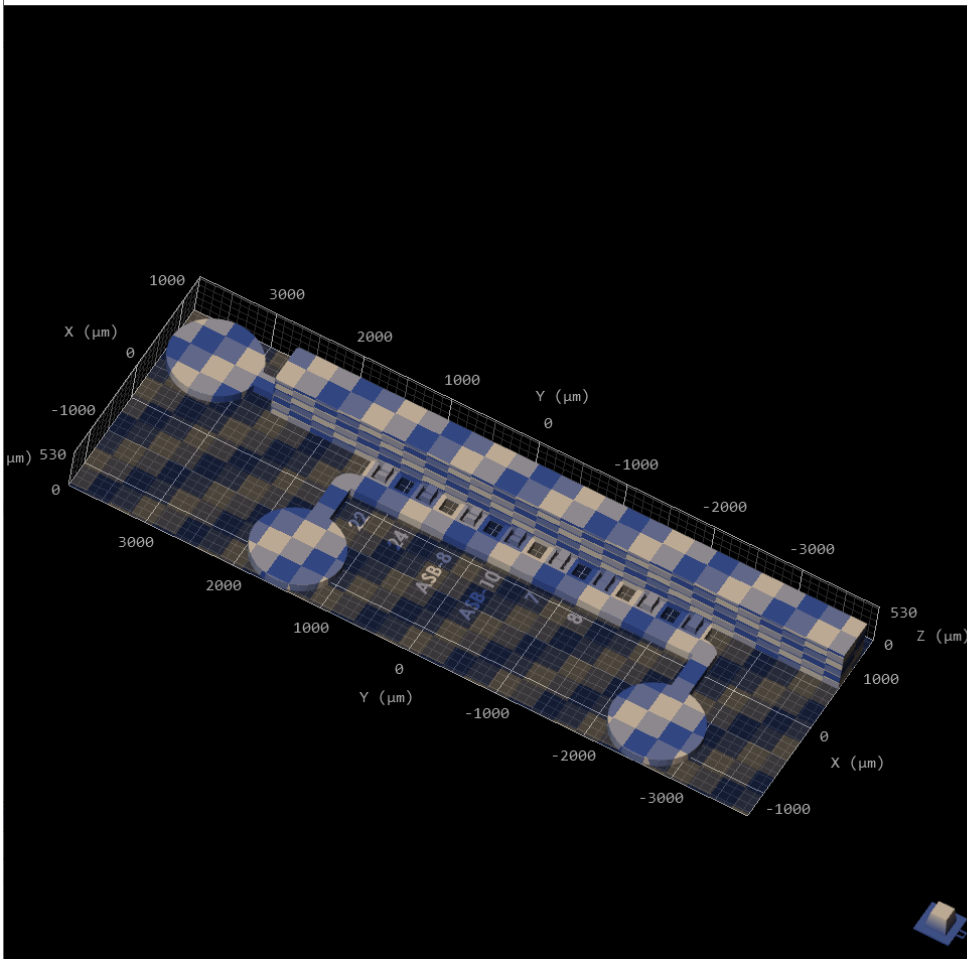
	Spacing	Thickness
Walls (vertical)	20	2
Floors (horizontal)	20	2
- Scaffold offset:**
 - X: 0 Y: 0 Z: 0
 - Secondary scaffold walls
 - Stagger scaffold walls
- Display options:**
 - Clipping:**
 - Axis: X Y Z
 - Offset: [Slider]
 - Show scaffold
 - Show mesh overlay
 - Disable preview
 - Disable default calculations

The bottom status bar shows 'Line 33, Column 29' and the system tray includes the date '2023-01-13' and time '10:04'.

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> Raccordements de champs

Import STL - C:\GWL\PFC\Tiphaine\run 19\Moule-ej.STL



Scaffold Output Save

Output options

Base file name: Moule-ej [Browse]

Job file: Moule-ejb_job.gwl

Data file: Moule-ejb_data.gwl

Fixed STL file: Moule-ejb_fixed.stl

Scan mode: Piezo Galvo

Z-Axis: Piezo Microscope z-drive

Array

Splitting

Splitting mode: None Rectangular Hexagonal

Block size: X: 274 Y: 254 Z: 100

Block offset: X: 50 Y: 121.5 Z: 0

Block width: X: 284.8 μm Y: 264.8 μm Z: 101 μm

Block shear angle: 5

Block overlap: 2

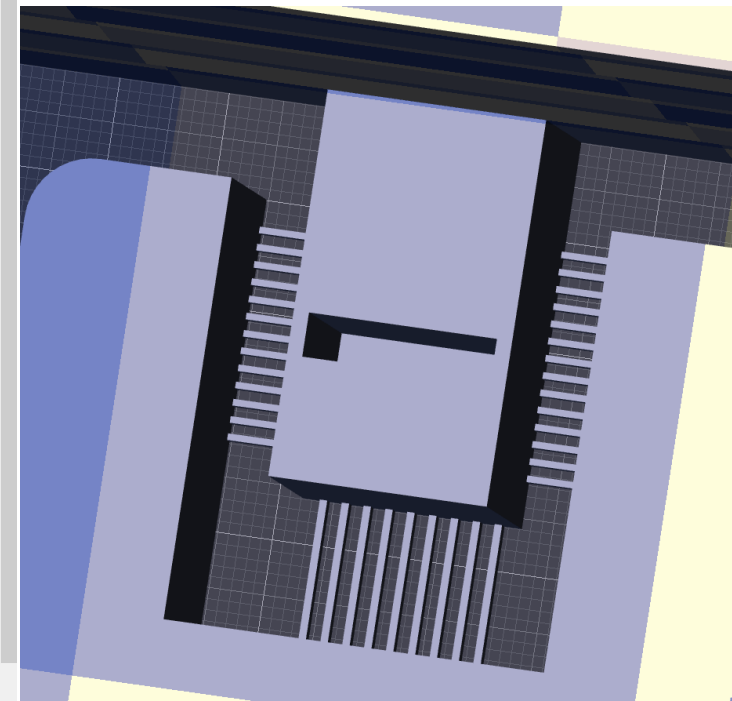
Layer overlap: 1

Block order: [Icon] [Icon] [Icon]

Avoid flying blocks

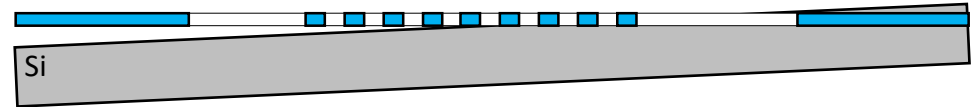
Group neighboring blocks

Backlash correction



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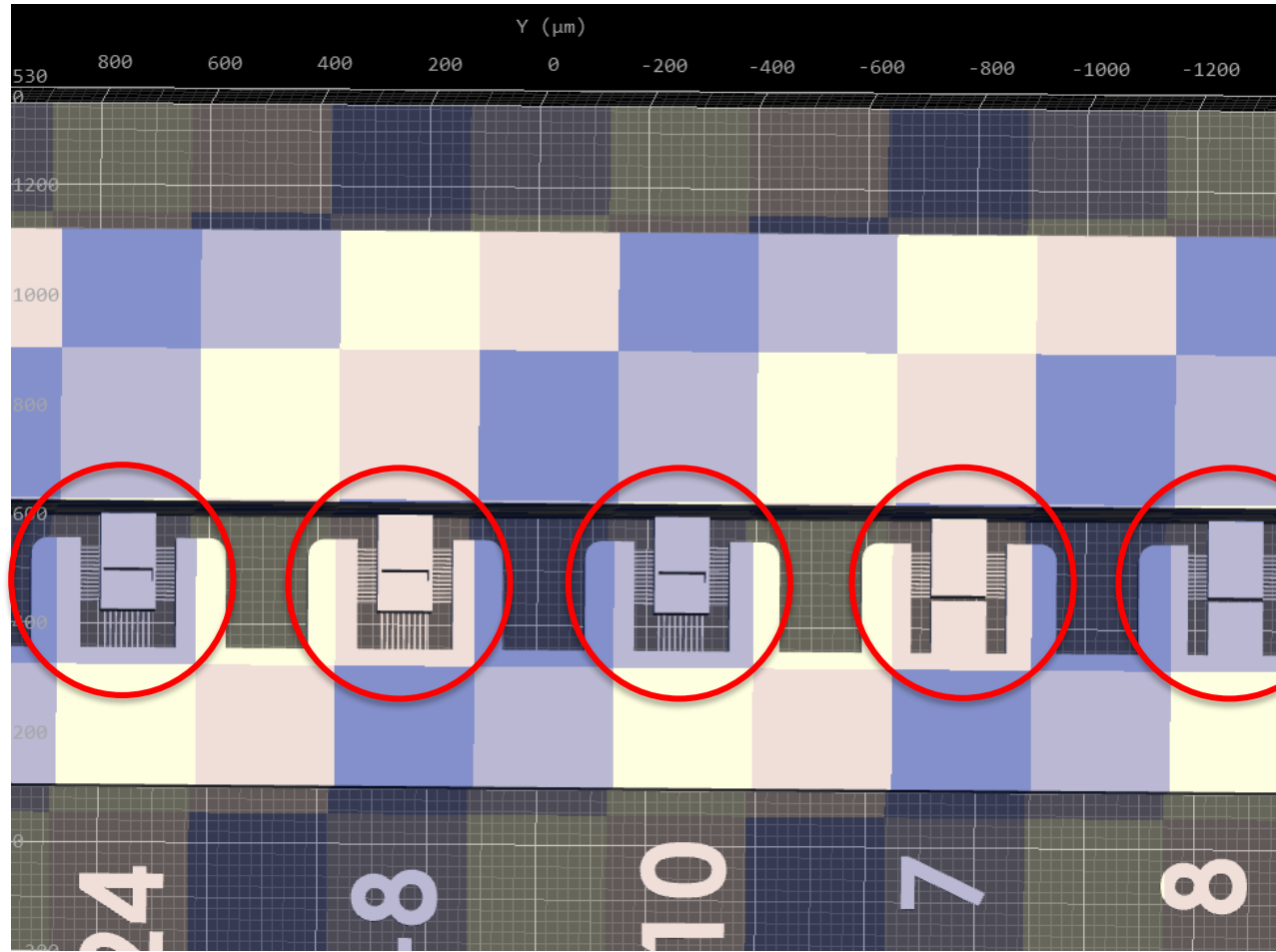
> Correction de planéité



```

Moule-em_data.gwl* - DeScribe 2.7
File Edit 3D Preview Debug Window Help
Moule-em_data.gwl* x
91
92 MoveStageX -598
93 MoveStageY 254
94 MoveStageX 50
95
96 AddZDrivePosition -100
97
98 % BLOCK 7/1/0
99 include Moule-em_files\Moule-em_7_1_0.gwlb
100
101 MoveStageX 274
102
103 FindInterfaceAt SinterfacePos
104
105 % BLOCK 8/1/0
106 include Moule-em_files\Moule-em_8_1_0.gwlb
107
108 MoveStageX 274
109
110 AddZDrivePosition -100
111
112 % BLOCK 9/1/0
113 include Moule-em_files\Moule-em_9_1_0.gwlb
114
115 MoveStageX -598
116 MoveStageY 254
117 MoveStageX 50
118
119 AddZDrivePosition -100
120
121 % BLOCK 7/2/0
122 include Moule-em_files\Moule-em_7_2_0.gwlb
123
124 MoveStageX 274
125
126 FindInterfaceAt SinterfacePos
127
128 % BLOCK 8/2/0
129 include Moule-em_files\Moule-em_8_2_0.gwlb
130
131 MoveStageX 274
132
133 AddZDrivePosition -100
134
135 % BLOCK 9/2/0
136 include Moule-em_files\Moule-em_9_2_0.gwlb
137
138 MoveStageX -2242
139 MoveStageY 254
140 MoveStageX 50
141
142 AddZDrivePosition -100
  
```

Détection
Interface
Si - Résine



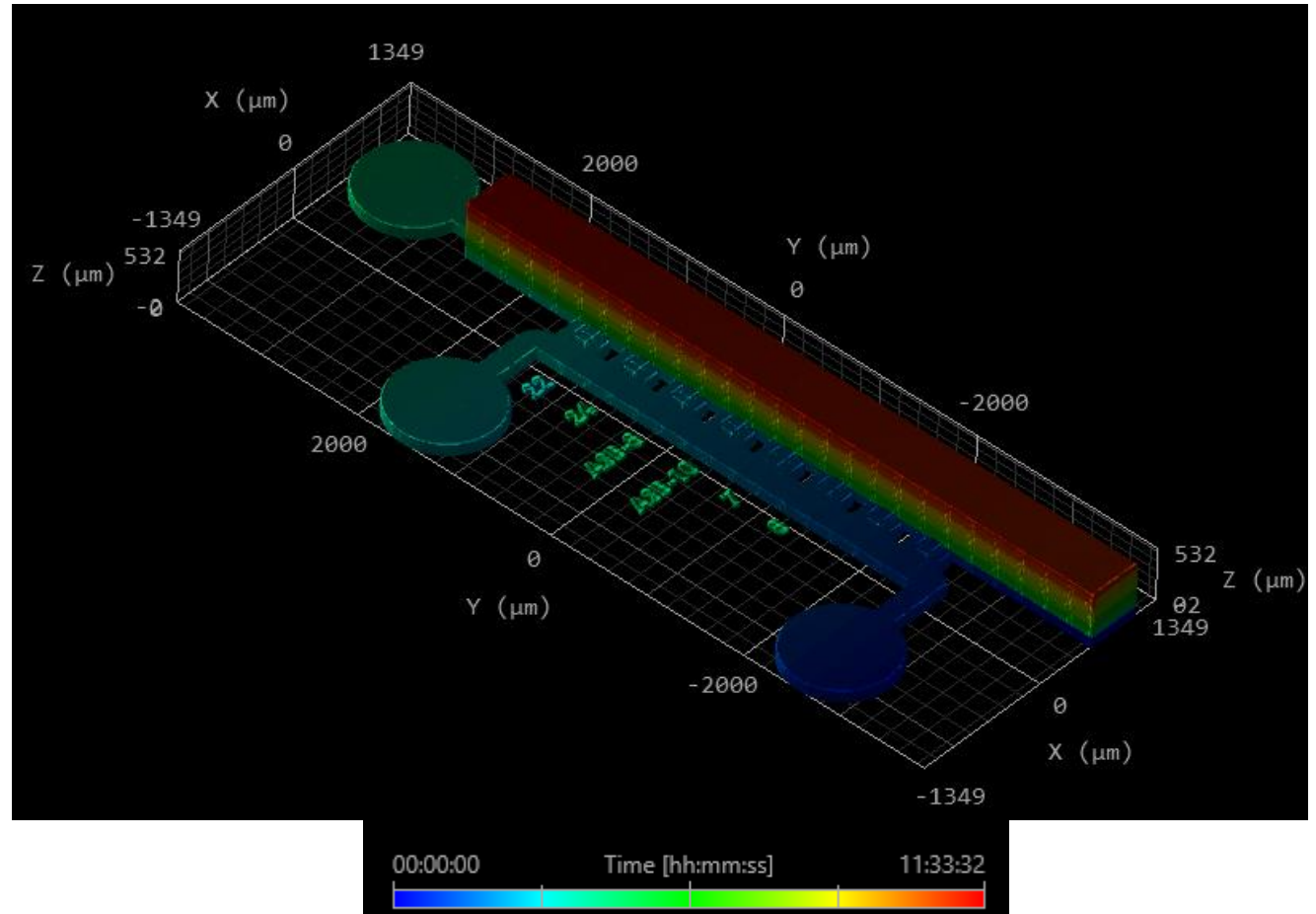
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> Paramètres d'écriture

Moule-ej_job.gwl - DeScribe 2.7
File Edit 3D Preview Debug Window Help

```

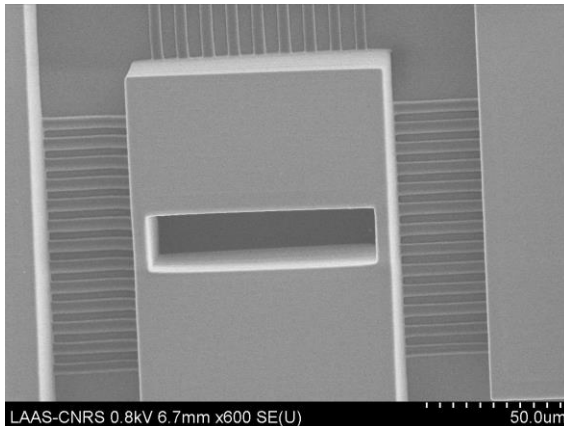
1 % File generated by DeScribe 2.7
2
3 % System initialization
4 InvertZAxis 1
5
6 % Writing configuration
7 GalvoScanMode
8 ContinuousMode
9 PiezoSettlingTime 10
10 GalvoAcceleration 10
11 StageVelocity 200
12
13 % Scan field offsets
14 XOffset 0
15 YOffset 0
16 ZOffset 0
17
18 % Writing parameters
19 PowerScaling 1.0
20
21 % Shell writing parameters
22 var $shellLaserPower = 80
23 var $shellScanSpeed = 40000
24
25 % Scaffold writing parameters
26 var $scaffoldLaserPower = 80
27 var $scaffoldScanSpeed = 40000
28
29 % Base writing parameters
30 var $baseLaserPower = $shellLaserPower
31 var $baseScanSpeed = 20000
32
33 var $interfacePos = 0.5
34
35 % Include slicer output
36 include Moule-ej_data.gwl
37
38
  
```



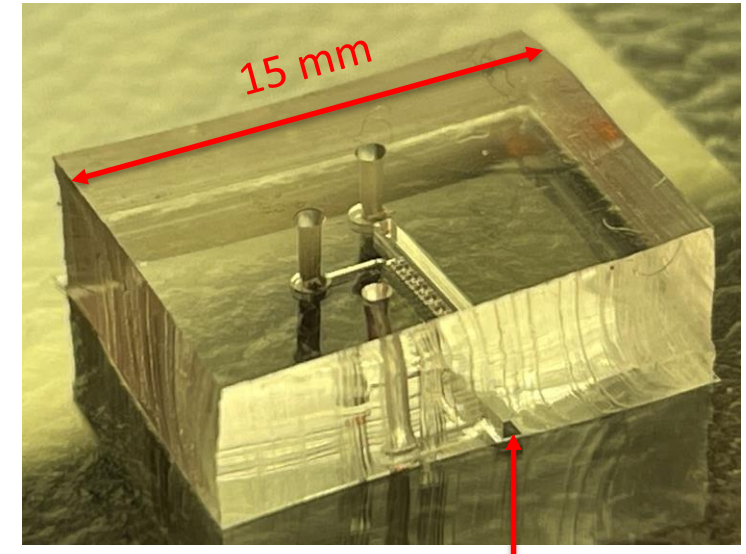
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> Avantages

- Alignement des couches
- Répétabilité des dimensions ($h=530 \mu\text{m} \pm 3 \mu\text{m}$)
- Changement des dimensions
- Réplication de contre-moules en PDMS



Puce micro-fluidique en PDMS



Ouverture section carrée

> Inconvénients

- Perte fabrication collective sur wafer
- Durée d'écriture de 10h

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Merci pour votre attention

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