09/12/2014

| KLOE SA | **HOW TO IMPORT A DXF FILE IN KLOE DESIGN** |

TUTORIAL 2

Import DXF files

The purpose of this tutorial is to describe the typical recommended way to import DXF files in KLOE DESIGN and the way to generate the corresponding files ".lwo" workable with Dilase equipment.

Here is the list of actions which will be managed in a typical conversion.

Loading the DXF

The file we'll take for example throughout this tutorial is a microfluidic chip presented on Fig1 This pattern is included in the example file called "Tuto-dxf.dxf" associated with this tutorial.
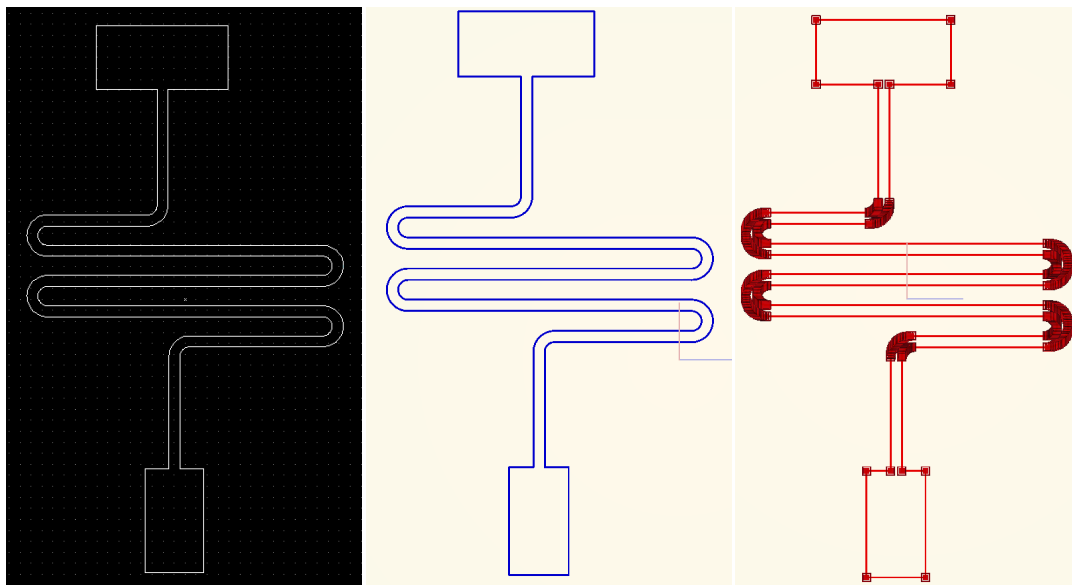

| Fig 1a | Fig1b | Fig1c |

Fig 1a : Overview of the pattern expected (open with a DXF editor).

Fig 1b : Overview of the pattern as it appears in Kloe Design after importation.

Fig 1c : Display of all elements as it appears in Kloe Design when selected.

The pattern shown is a chip designed with a DXF editor. The chip expected to be realized is made of an area entirely exposed and marked out to shape a typical microfluidic channel. When opening in a DXF editor (Fig 1a), it makes appear that the pattern is composed of many lines and arcs.

When the DXF file is imported in KLOEDESIGN, all of these lines are imported (Fig 1b & Fig 1c) and all of them are loaded with their position and their length.

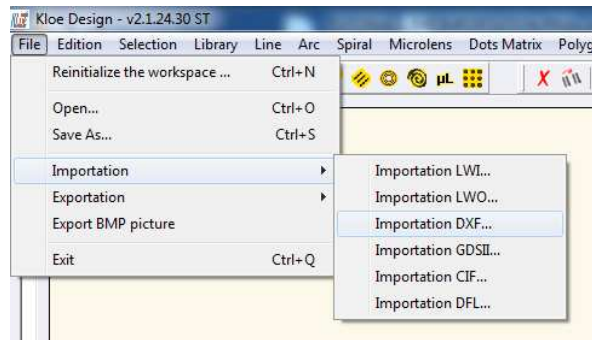- To import a DXF file in KloeDesign, click on **"File > Importation > Importation DXF"**

Fig 2 : Importation DXF

- Select the DXF file to import, and then click "Open".
- KloeDesign will display "Are you sure you want to reinitialize the workspace?", asking if the actual graphic workspace has to be reseted before displaying the new dxf pattern, or if the precedent patterns included in the workspace have to be kept. Click "Yes" or "No". "Yes" will require Kloe Design to delete all the elements in the workspace before displaying the pattern imported.

- **Note :** Some warning messages may appear to alert the user that some elements could not be inserted. Kloedesign does not import the following kinds of elements HATCH, MTEXT, TEXT, SPLINE and IMAGE.
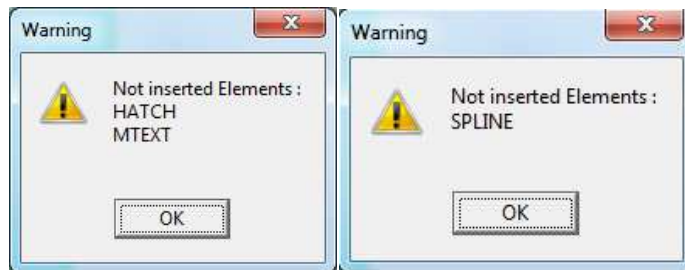

Fig 3 : Warning message

You need to converted before loading theses elements in lines or arcs.

- Then the dxf pattern appears, exactly as the file has been designed, with all the lines created in this pattern (Fig 4).

- **Note :** Dependant on the numbers of lines, the loading time may vary and may take a few seconds or up to a couple of minutes.
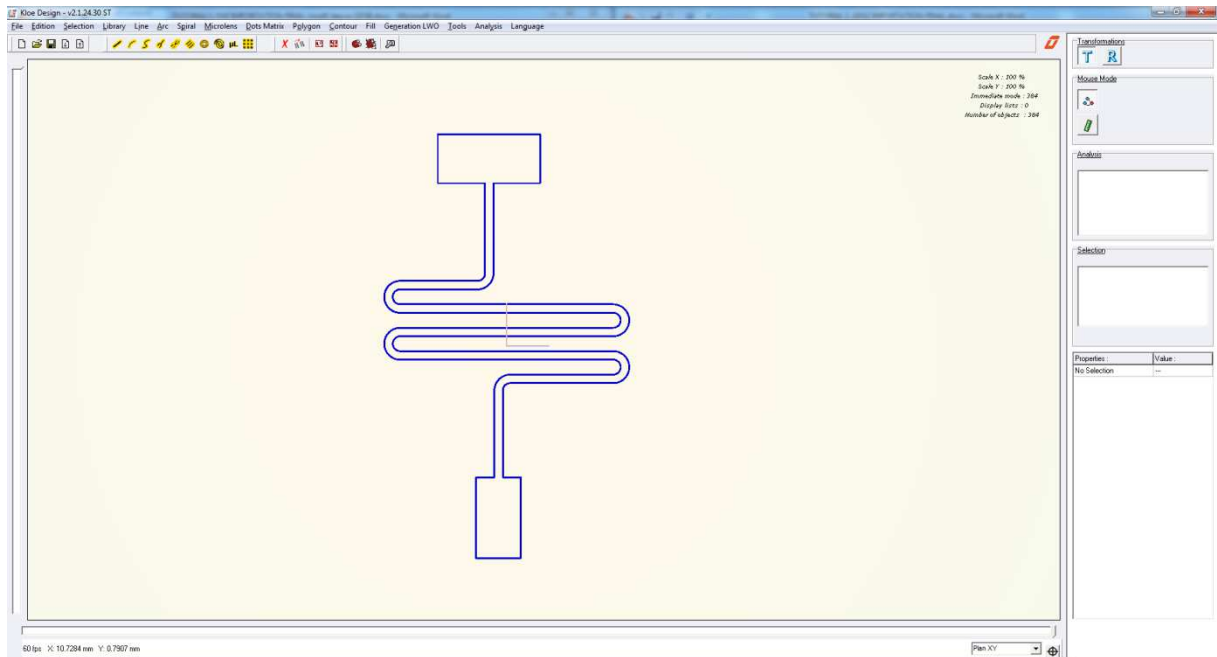
Fig 4 : Dxf pattern displayed after importation.

- Once imported and displayed, the design can be entirely processed by Kloe Design.
- From now, the user can create the "lwo" file which will be loaded and executed by the Dilase equipment (Dilase250, Dilase650, Dilase750).
- The "Generation LWO" menu is dedicated to the creation of lwo files. Click on **"Generation Lwo" > Generate the current pattern**" (Fig 5).

  - o **Note :** The "**Generate the current pattern"** function is used to generate <u>ALL</u> the patterns displayed in the workspace. If there is some other patterns in addition to the one treated by the user, they will be generated in the same lwo file.
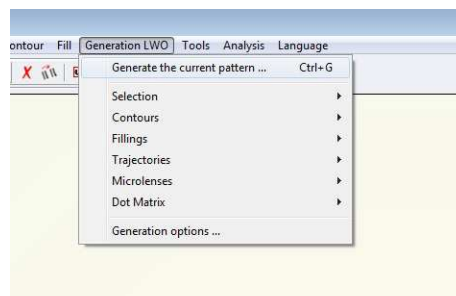

Fig 5 : Generation of the current pattern

- First, Kloe Design will ask for a file name and a file location and, after computing the operation, it will display the summary of the elements generated (Fig 6), meaning that the generation is complete.
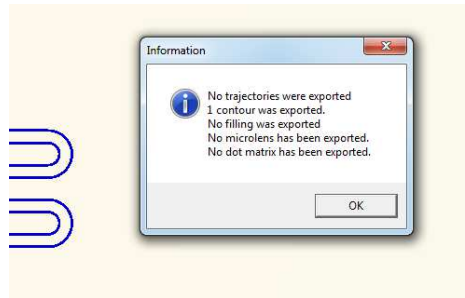
Fig 6 : Generation summary

- Now, the lwo file is ready to be used by the Dilase equipment. The user can load it in the software "Dilasesoft" embedded in the equipment and dedicated to manage the lithographic operations.
- A process simulation is available in KloeDesign in order to have an overview of the execution of this file by the equipment. Click on **"File > Importation > Importation LWO"**.
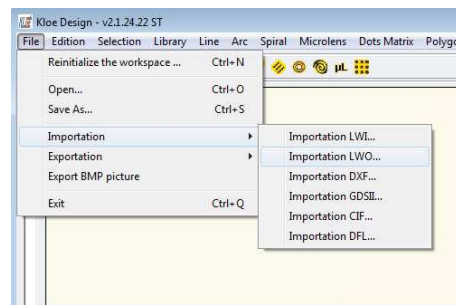

Fig 7 : Importation LWO

- The software will ask for a writing velocity and a repositioning velocity. Click on "Ok" to accept the default values. A green cross will move all over the graphic panel, drawing the pattern generated. This cross represents the way that the trajectories of the pattern will be written by the equipment (Fig 7). The red lines represent the trajectories during which the laser is on, the green lines (if present) the ones executed by the stages but with the laser off.
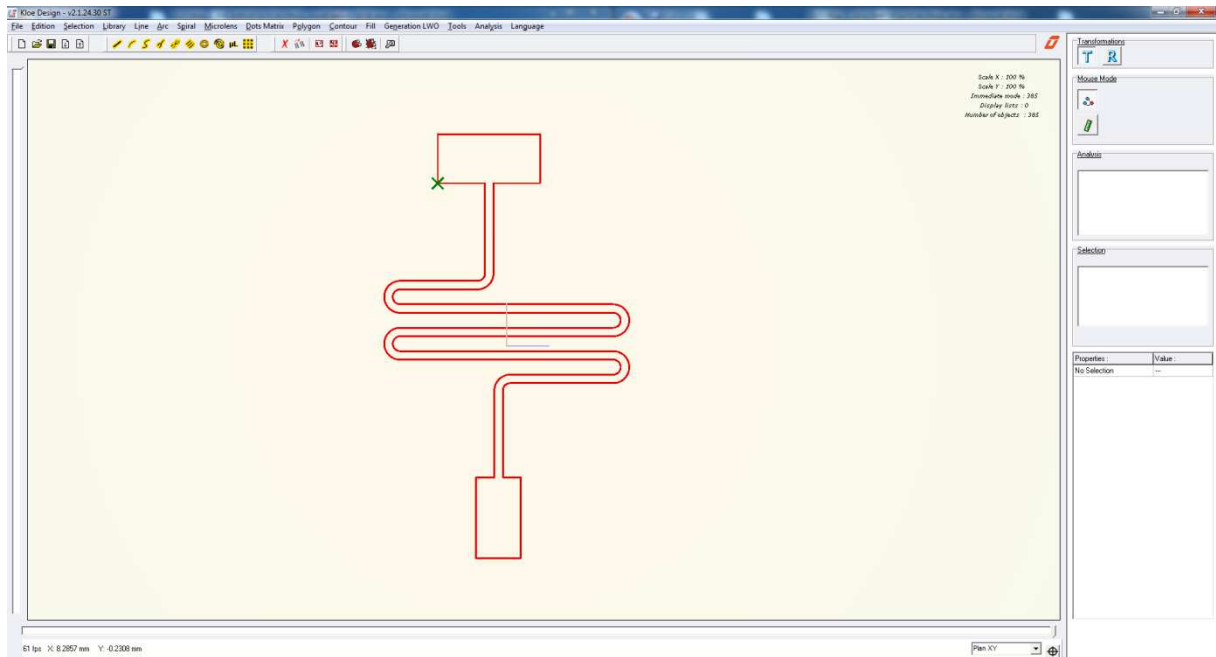
Fig 8 : Simulation LWO

- The lwo file is drawing exactly the pattern described by the dxf file. The immediate importation doesn't require more steps to convert a dxf file to a lwo file.
- The lwo file can be found in the windows explorer, cut or copy/pasted in a USB key, and copy/pasted again in the Dilase computer. See the DilaseSoft manual to know more about how to program a Dilase equipment with lwo file to schedule a lithographic process.

- Make roll the scroll wheel of the mouse to zoom in the pattern.
- Click on the red lines of the simulation pattern.
- On the right side of the interface, if the simulation pattern is correctly selected, the properties tab appears (Fig 9). Click on "RAZ" to start again the simulation from the beginning, and after a few seconds of simulation, click on "Pause" to stop the simulation. The simulation will continue to go ahead by clicking on "Resume" instead of "Pause".

Properties :	Value :
Name	test generation com
Color	Red
Position x (mm)	0.0000
Position y (mm)	0.0000
Stabilisation color	Green
Detection unit (ms)	0.0000
Current Index	6035
Time	0h 0m 22s
Velocity write	5
Velocity replacement	10
State	Resume
Reloading	RAZ

Fig 9 : Simulation properties tab

- The user can see the proceedings of the simulation trajectories.

Dilase writing strategy

Each realization made with the Dilase technology meets a writing strategy in order to optimize the quality and the writing time.

The typical and most used writing strategy is given by the generation of a "contour pattern", added of a "filling pattern". The contour pattern will only include the borders of the pattern. The filling pattern will include the areas filled inside the pattern. A filling pattern can ONLY be created when associated to a contour pattern.

- **Note :** When a dxf file is imported, the "filling pattern" is not included ! As a consequence, it is not possible to generate it without using the "Filling" menu available in Kloe Design and. The filling pattern has to be created by the user.

Creating the contour file

The generation of the contour file will be made exactly by the same way than explained before.

Procedure

- Ensure that the contour is closed.
    - Click on a single element of the pattern.
    - Click on **"Selection > Identify the closed contour from the selection".** If the selected element is a part of a contour, each element of this contour will be selected.
- Once the contour pattern is selected, it is possible to generate the lwo file corresponding to this pattern.
- Click on **"Generation lwo" menu > Generate the current pattern…".**
    - Note : The "**Generate the current pattern**" function is used to generate ALL the patterns displayed in the workspace. If there is some other patterns in addition to the one treated by the user, they will be generated in the same lwo file.

- First, Kloe Design will ask for a file name and a file location and, after computing the operation, it will display the summary of the elements generated (see Fig 6 of this document), meaning that the generation is complete.

- Now, the lwo file is ready to be used by the Dilase equipment. The user can load it in the software "Dilasesoft" embedded in the equipment and dedicated to manage the lithographic operations.

Taking into account the spot size

Dilase equipment will execute the trajectories computed in the lwo file, meaning that the stages will start from a point A and will go to a point B. The lwo file gives some informations to the equipment to synchronize the laser with the points A and B and eventually with other intermediate points. As the user created a lwo file based on the dxf file, the border lines of the dxf pattern have been directly converted in lwo trajectories at the same location. But,

when the pattern will be executed by the equipment, the laser will light on the resist at this same location, converting a "software line" in a "microstructure line", giving it a "line width" according to the spot size embedded in the Dilase.

- o **Note :** <u>Lwo file doesn't carry any informations about the spot size used by the equipment.</u>

In order to keep the area dimensions initially given by the dxf file, KloeDesign proposing some tools to the user to allow him to take into account the spot size, and then executing a lwo file in agreement with the dimensions required by the dxf pattern.

- Taking into account the spot size of the beam to create <u>an internal contour</u> of the pattern requires to select the polygon before and to realize a homothety at 50% of the spot size.
- Click on a single element of the pattern.
- Click on **"Selection > Identify the closed contour from the selection".** If the selected element is a part of a contour, each element of this contour will be selected.
- Click on **"Contour > Freeze the selected contours"**. The shape remains red colored, and now all the lines are linked together.
- Click on **"Contour > Convert selection in polygons".** The contour element becomes a polygon element.
- Click on "**Fill > Filling of the polygons..."**. A window "Polygon Filing options" appears.
- Enter the spot size selected in the Dilase equipment in the textbox **"Spot size considered"** and then valid with "Enter" key (Fig 10). Enter **"50%"** in the textbox **"Overlap rate"** and then valid with "Enter" key (Fig 10).
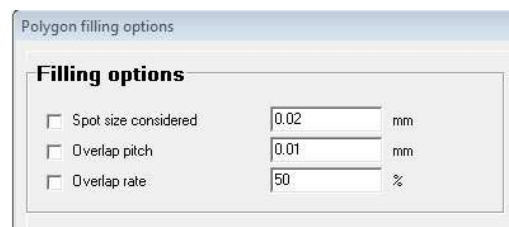

Fig 10 : Filling options

- In the area **"Reproduce the contour by homothety"** , click on "Reduce" with the number "1" in the textbox. (Fig 11).
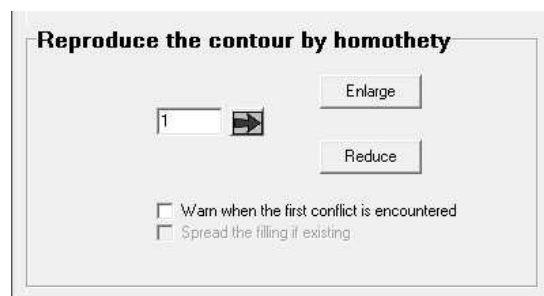

Fig 11 : Homothety options

- One new polygon (because "1" entered) is then created, located <u>inside</u> the one selected (because "Reduce" clicked) and the distance between the two polygons is equal to "spot size considered" multiplied by "50%", meaning that the distance is the half the spot size. The new polygon created is selected and red colored. The first one can be deleted if considered useless, or colored to differentiate it.
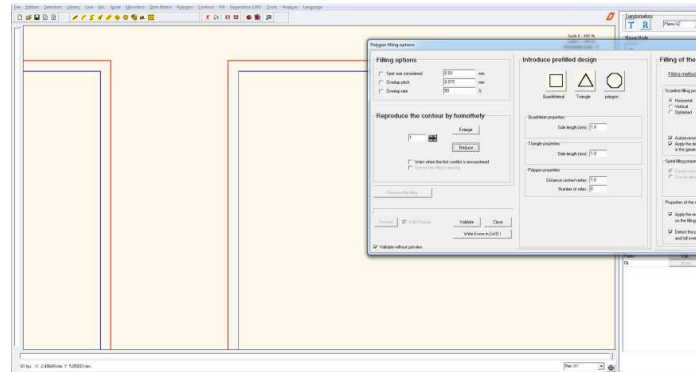

Fig 12 : Creation of an internal contour

- For now the pattern is ready to be generated in lwo file.
- Please see "Procedure" see on the preview chapter to generate the lwo file.
- The homothetic polygon created can be generated alone by selecting it, then click on **"Generation lwo > Selection > Selected patterns**…". It will only generate the selected elements.

Creating the filling file

Step 1 : Creation of the filling

To generate the filling of a contour pattern, it is necessary to indicate to KloeDesign the way and the settings to use.

- o **Note ;** it is absolutely necessary to associate a filling pattern to a contour pattern. The contour pattern will inform about the boundaries of the filling pattern.

- Click on the contour polygon to fill.
- Click on **"Fill > Filling of the polygons"**
- Check or enter the following settings, and valid by pressing "Enter" (see Fig 13) :
    - o Spot size considered = the spot size used to write the filling pattern
    - o Overlap rate = 50% is default value
    - o Filling method = Scanline
    - o Vertical
    - o Autoreverse mode
    - o Apply the multiple trigger on the fillings
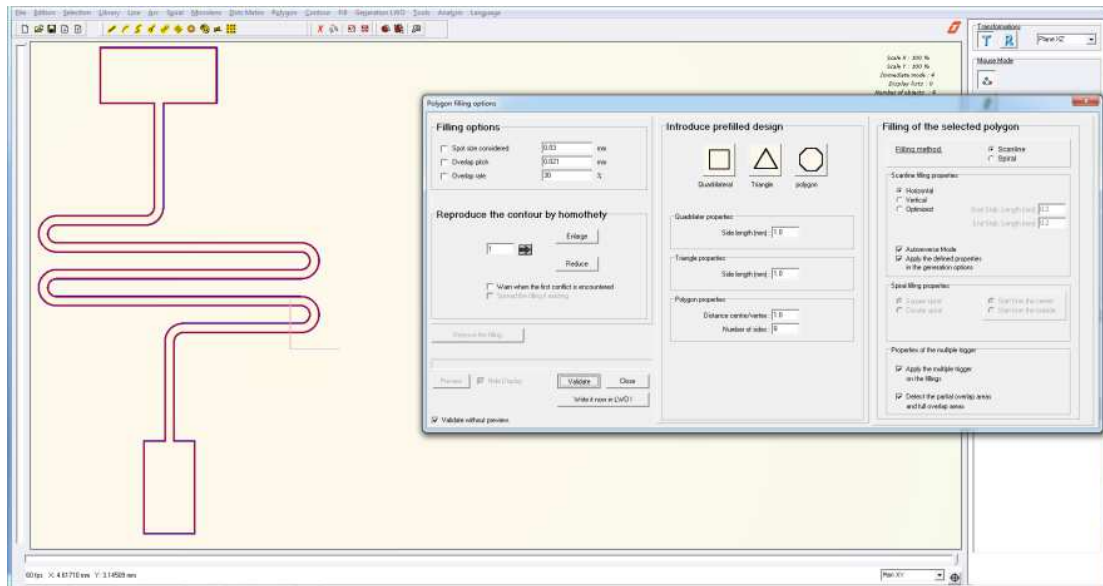   - o Detect the partial overlap areas and full overlap areas.

Fig 13 : Polygon filling options

- Then Click on "Validate" button. The filling trajectories are calculated by the software.

  o **Note :** Dependant on the spot size considered and the surface to fill, it may take several minutes to compute.

- The graphic panel displays the computed trajectories (Fig 14). The red lines represent the trajectories during which the laser is on, the green lines the ones executed by the stages but with the laser off.
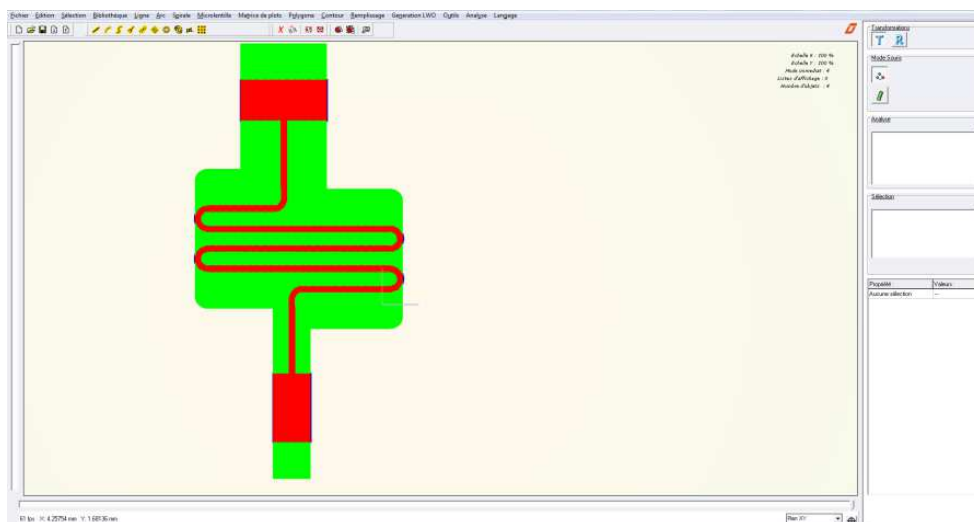

Fig 14 : Displaying of the calculated filing

- Click on **"Fill > Hide all the calculated fillings"** to make disappear the filling trajectories. When hidden, a background color is applied to the contour pattern to remind that a filling has been computed for this contour.

- Click on "**Fill > View all the calculated fillings"** to make them appear**.**

Step 2 : Generation of the filling

To generate the calculated filling as a lwo file :

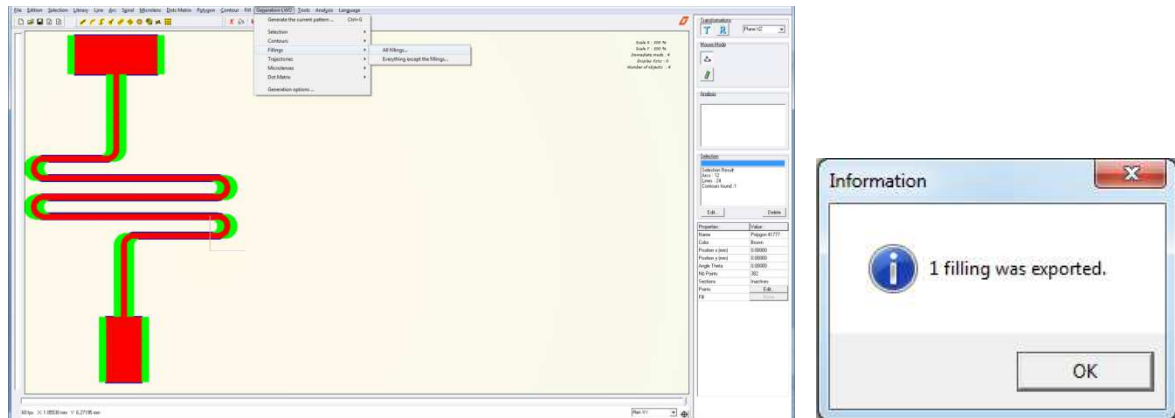- Click on **"Generation LWO > Fillings > All the fillings..."** (Fig 15).

Fig 15 : Generation of the filling

- o **Note :** Dependant on the number of filling trajectories computed, it may take several minutes to generate.

- If the filling computed filling is not satisfying, it is possible to remove it from the contour to compute another with different settings.
- Click on the contour pattern associated to the filling wanted to be removed.
- Click on **"Fill > Filling of the polygons...".**
- Click on the "Remove the filling" button, under the "Reproduce the contour by homothety" section.

- o **Note :** If the "Remove the filling" button is not clickable, it means that there is no polygon contour selected, or the polygon contour selected has not any filling associated.

Simulation files

Once the lwo files are generated , they are available to be used by the Dilase equipment, meaning that the user can load them in the software "Dilasesoft" embedded in the equipment and dedicated to manage the lithographic operations.

A process simulation is available in KloeDesign in order to have an overview of the execution of these files by the equipment.

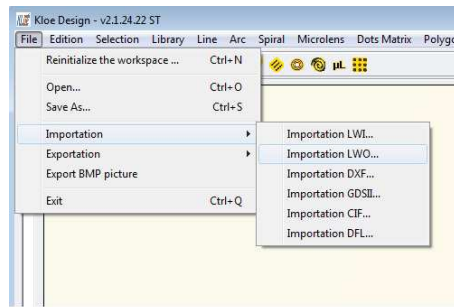- Click on **"File > Importation > Importation LWO"**.

Fig 16 : Importation LWO

- Select the lwo file wanted to be displayed in KloeDesign.
- The software will ask for a writing velocity and a repositioning velocity. Click on "Ok" to accept the default values. A green cross will move all over the graphic panel, drawing the pattern generated. This cross represents the way that the trajectories of the pattern will be written by the equipment. The red lines represent the trajectories during which the laser is on, the green lines (if present) the ones executed by the stages but with the laser off.

The simulation starts immediately. The user can then obtain the estimated writing time of the realization made by the equipment, based on the default speed entered or set by the user.

The estimated writing time can be found by clicking on the simulation pattern, and then the properties tab at the bottom left of the interface fills with the lwo file information. The row **"Time"** indicates the estimated writing time, based on the values in the rows **"Velocity write"** and **"Velocity replacement"** (Fig 17).

Fig 17 : LWO Simulation

The time entered on the text box "Time" will be function of the writing speed and the replacement speed entered on the text box "Velocity write".

It is possible to explore different configurations by changing the **"Velocity write"** to obtain different estimations of writing time.

- o **Note:** It is possible to load several times the same file into the KloeDesign interface and chose the best configuration.

The Fig 18 shows the pattern created corrected on the left, the contour pattern simulation on the middle, and the filling pattern simulation on the right.
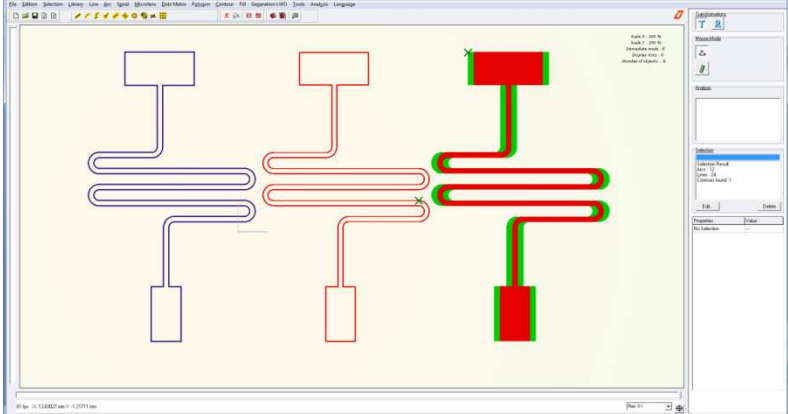

Fig 18 Overview of the pattern, simulation pattern and filling pattern

To match with the estimated time, the speed parameters in the Lwo simulation should be entered in the DilaseSoft interface when the lwo file will be executed.