UV Direct-Write Laser System Heidelberg DWL66 FS

Basic step-by-step instructions

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Obsah

1. *Introduction*

The DWL66 FS laser lithography system is a high resolution (up to 1 μm) pattern generator for low volume mask making and direct writing. It utilizes a blue diode laser with the wavelength of 405 nm for direct exposure on photoresist coated substrates ranging from 1 to 8 inch in diameter. The available write head has a focal length of 4 mm and it uses air gauge to measure air pressure change for focusing. Precise positioning of the substrate is done by high resolution interferometric stage. With this equipment it is possible to write down the structures min. 1 μm in size, with an address grid of 100 nm. It is supporting GDSII, CIF, DXF, GERBER. layout formats. Two CCD cameras are used for the top side alignment and the metrology purposes. The alignment accuracy is 250 nm. The whole instrument is located in a special temperature-controlled laminar flow box to ensure stable environment in terms of temperature and clean air flow during the process of the exposure.

2. *Basic knowledge required for DWL:*

- Vector graphic software
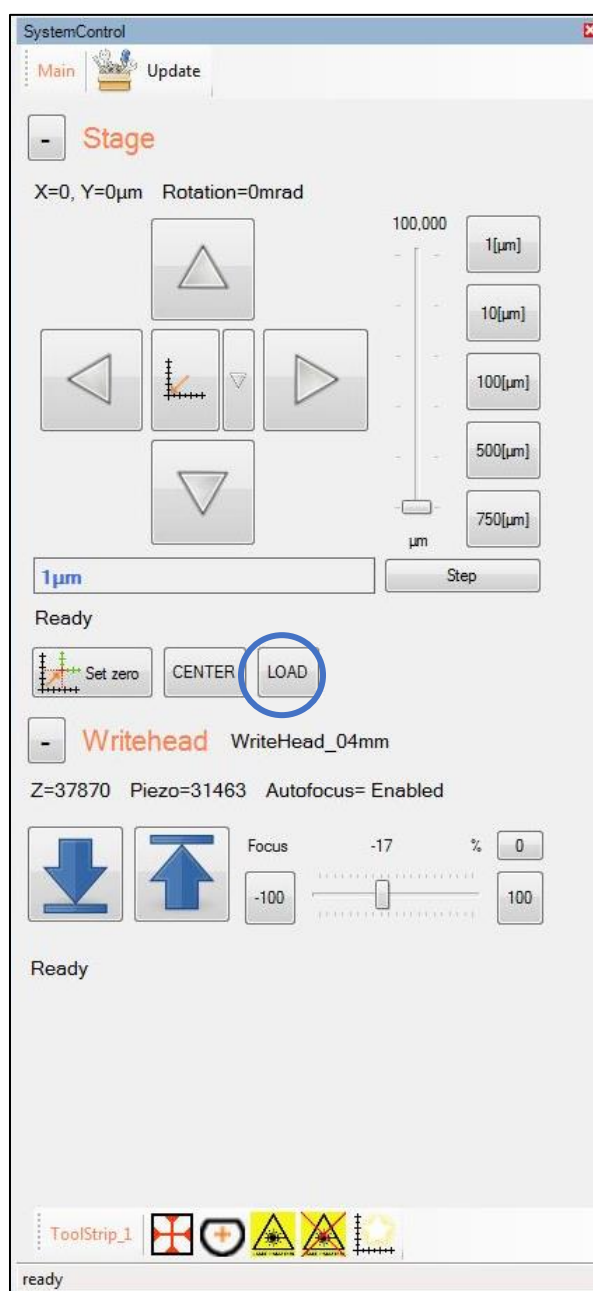- Lithographic processes and systems for lithography

3. *Brief operation summary*

1) Start the *HI SW* (use your personal login and password) on User PC and Conversion SW on Conversion PC.
2) Convert (and transfer) your layout file into instrument compatible LIC-file using Conversion SW on Conversion PC.
3) Set up exposure job on User PC.
4) Place substrate onto interferometric stage, roughly center it and turn on the vacuum.
5) Focus the write head, then start the substrate centering procedure.
6) Turn on laser and start the pattern exposure.
7) After the job is done, turn off the laser, remove the substrate and close the cover lid.
8) Turn off the *HI SW*.

## 4. Basic operation

4.1. Manual loading of the substrate

- Before loading the substrate into the machine, make sure it is clean and free from the dust particles. If not, use CDA (compressed dry air) gun located in the lab to remove the dust particles. You may use vacuum tweezers to holding the substrate during cleaning.
- In the right part of the HI SW window, click on the **Load** button. The interferometric table will move into the substrate loading position.

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- Open the cover lid and place the substrate carefully onto the stage and center it with the help of **pins**. Then turn on **vacuum switch** and rotate the **white screws** next to it to check if there are no leaks. When everything is OK, <u>remove the pins</u> and close the cover lid.
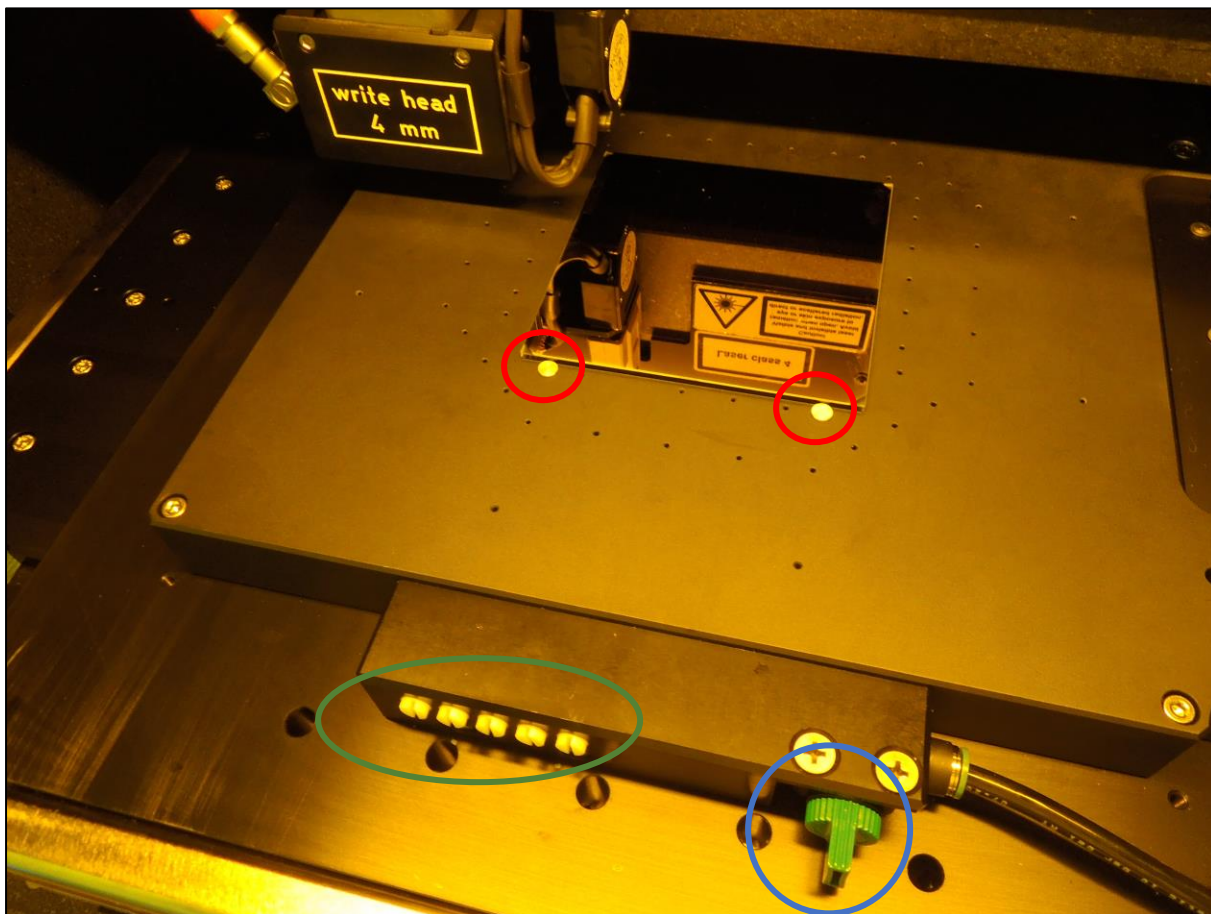
- Click **Center** button to move the table under the head. Then click **DownArrow** symbol to focus the head on the substrate.
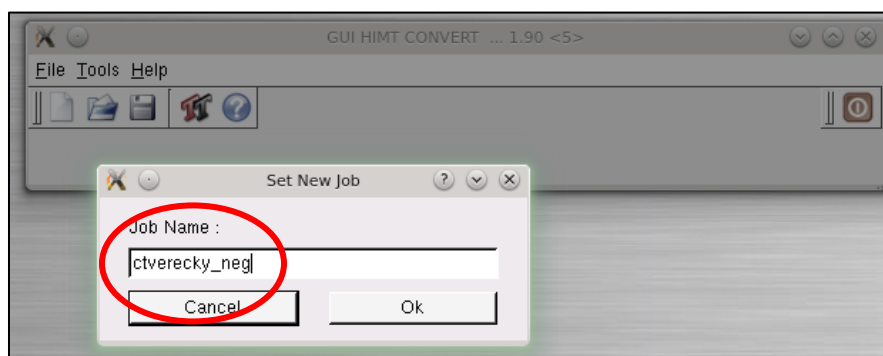
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- Start centering procedure by clicking **PlateCenter** or **WaferCenter** buttons in the toolstrip at the bottom of the system control panel. The progress of the procedure is highlighted by icon
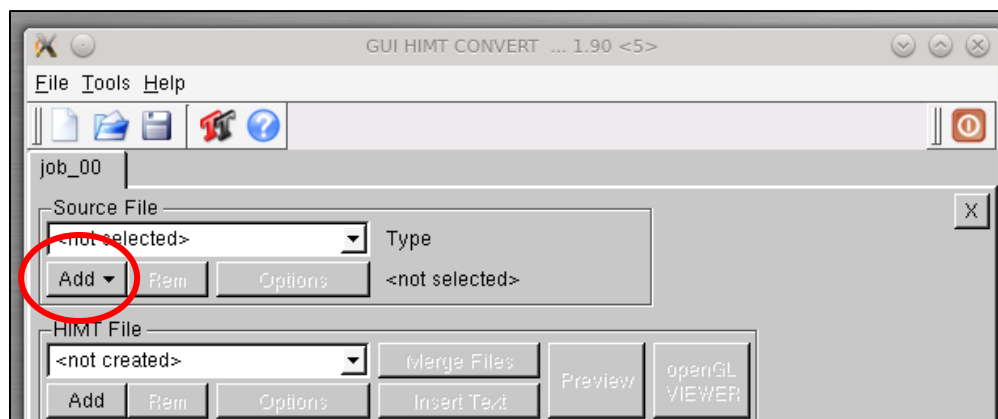

- After loading the substrate, wait approximately 15 mins to keep the flow box environment stable. Then you can start the exposure.

## 4.2. *Conversion of layout file to LIC files using Conversion PC (Linux)*

- Copy your file with structure layout from USB memory stick into appropriate subfolder (GDSII, DXF etc.) in Root folder on Conversion PC. **GDSII** format of the file is highly preferred because it works most well for the conversion. If you have any other format, please, try to convert it into GDSII format first. The name of the file must be short and must not contain spaces, dashes, or other special characters, to prevent any problem.

- Click only once on the icon (Linux feature) to open **Conversion SW**, then click **File/New** to create new conversion job (File/Load to load previously converted job for editing). Enter **job name**.

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- Click **Add**, select source GDSII, then click **Open**.


- **GDSII options** window will show up. Here, select suitable **Layer** which should be converted, and set **scaling for the X and Y axes**, if it needs to be used. Then click **Create Default**.
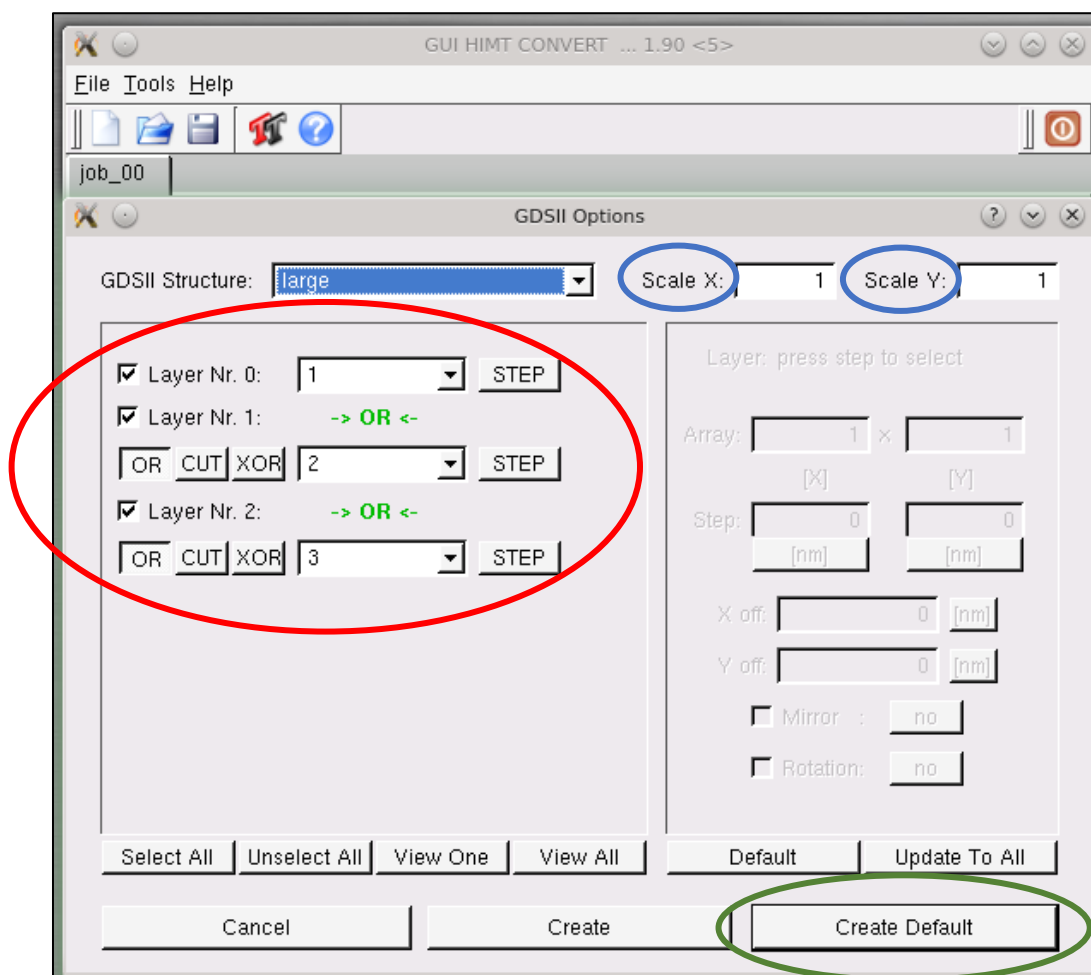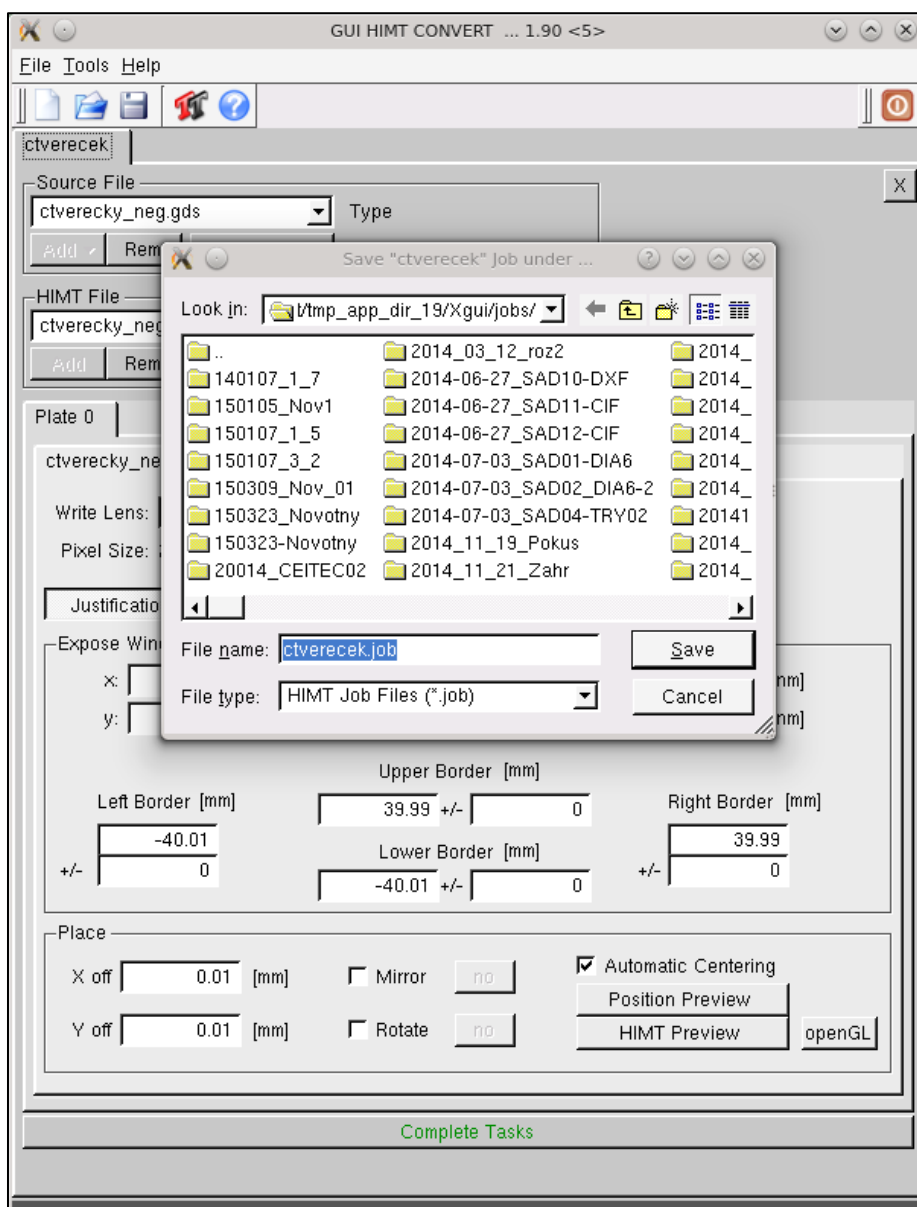
- Click tab **Expose Options**, and **double click** on **XOR Mode & non invert** buttons (non invert means that hatched objects will be exposed) to prevent conversion problems.
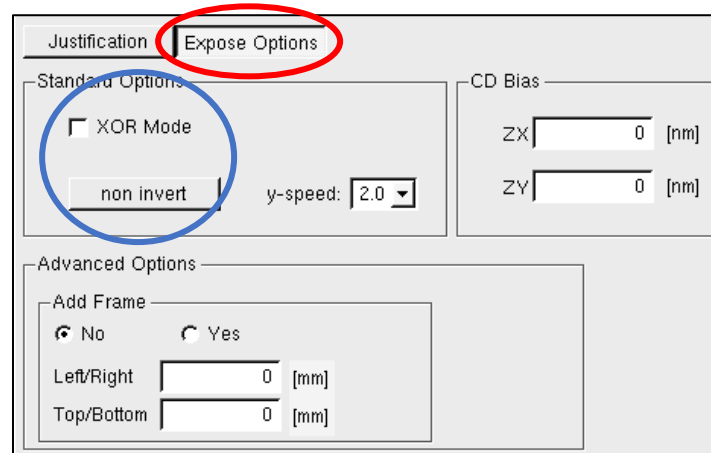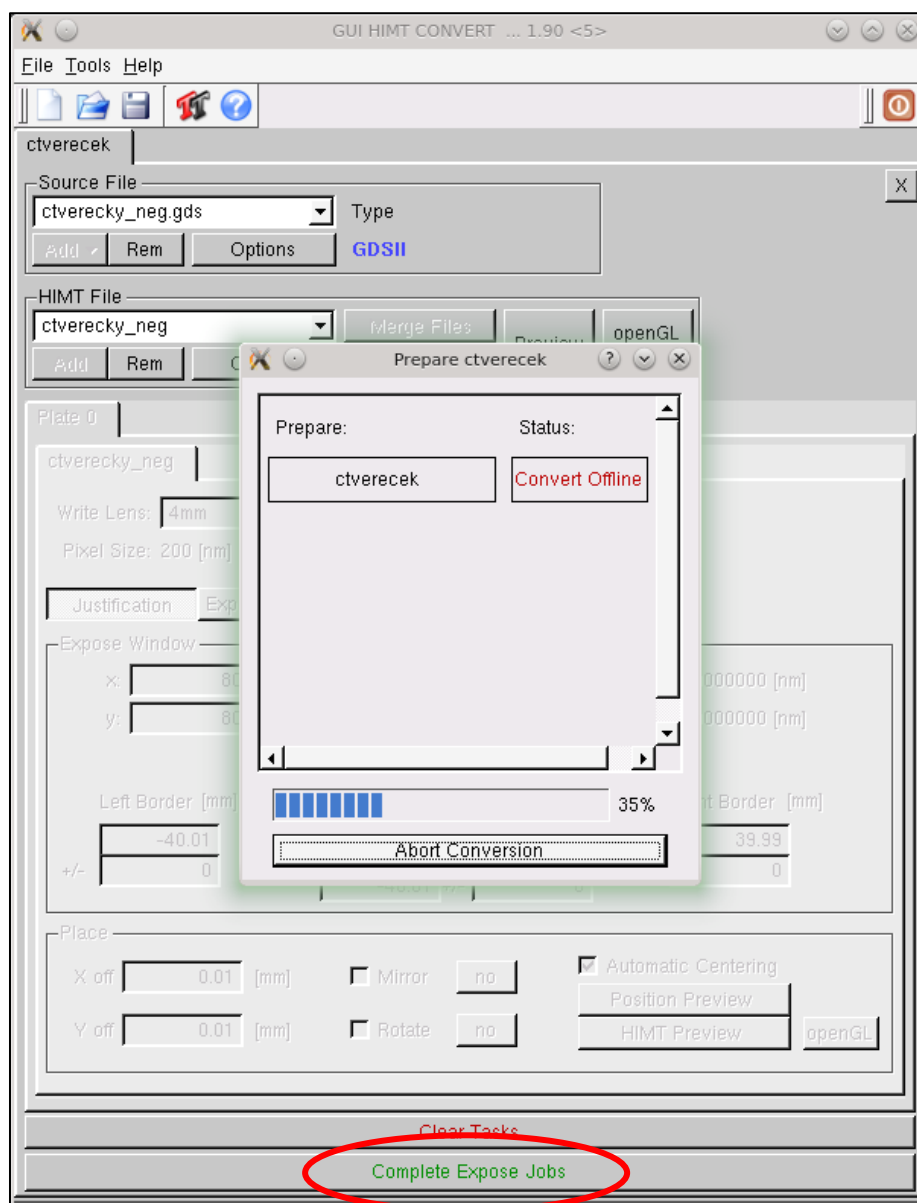

- Go back to the **Justification tab**, make sure everything is OK and **Automatic Centering** is selected (it will shift layout origin to the plate/wafer center). You can check your layout by selecting **openGL VIEWER** to make sure the instrument will work with the same pattern as you intended. Then click **Complete Tasks**.
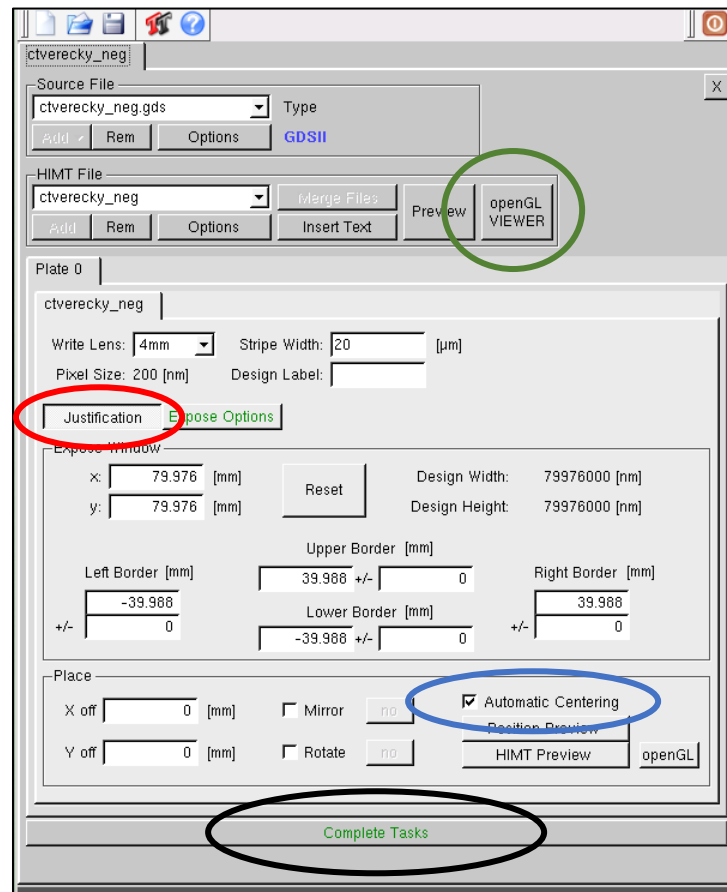
- The program will save the conversion job into **predefined folder (…Xgui/jobs/)**. Give name to your exposure job.

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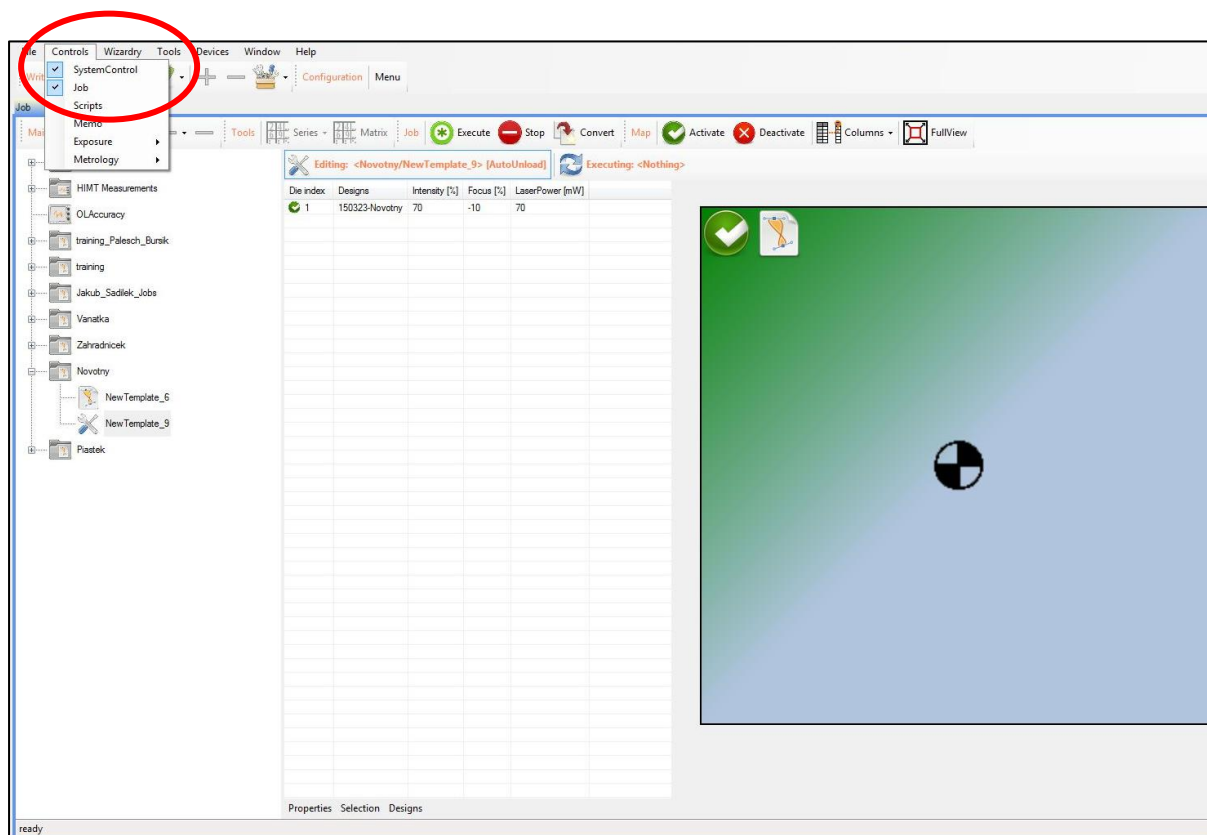Approved: 25.5.2020 by Jiří Zita Jiri.Zita@ceitec.vutbr.cz

- Click **Complete Expose Jobs** to start the conversion. The program will show progress of the conversion process. After that click **Finish**.
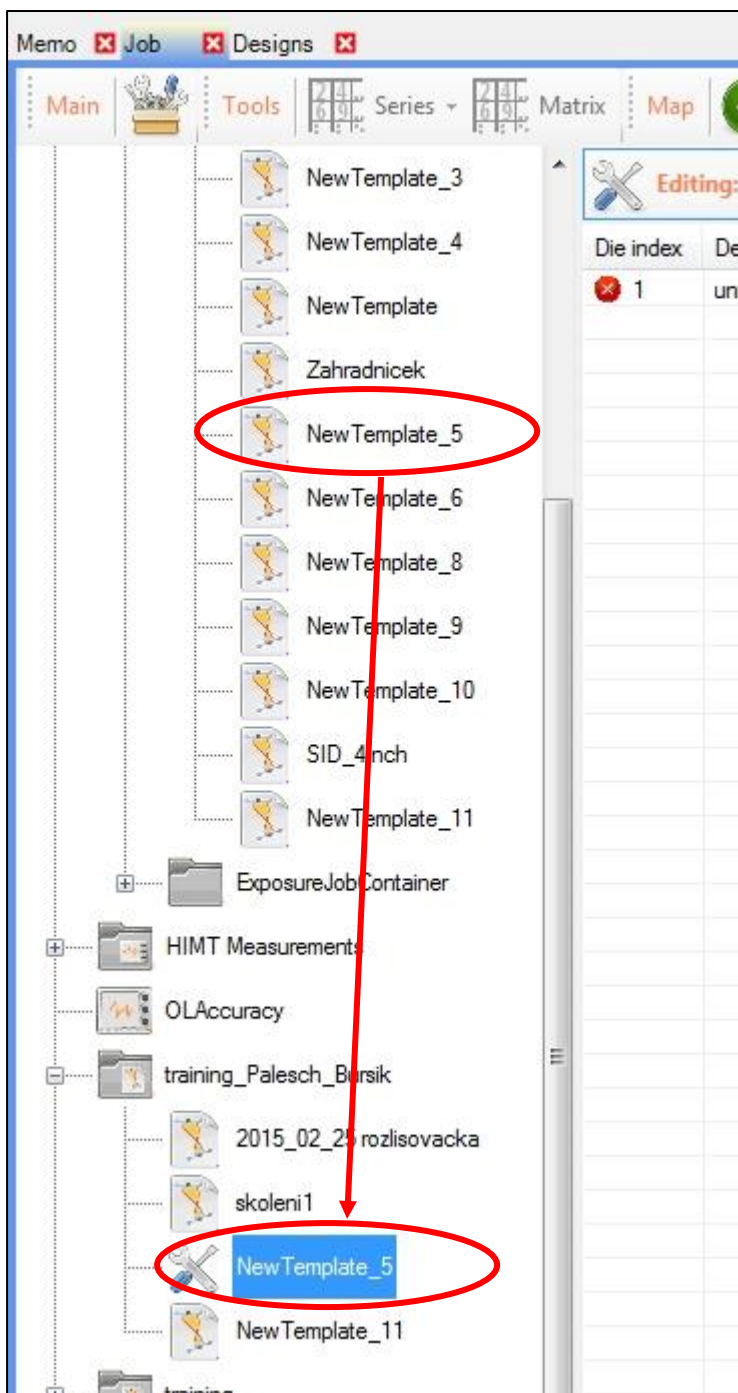
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4.3.   *Setup of the simple one-field exposure job using User PC (Win)*
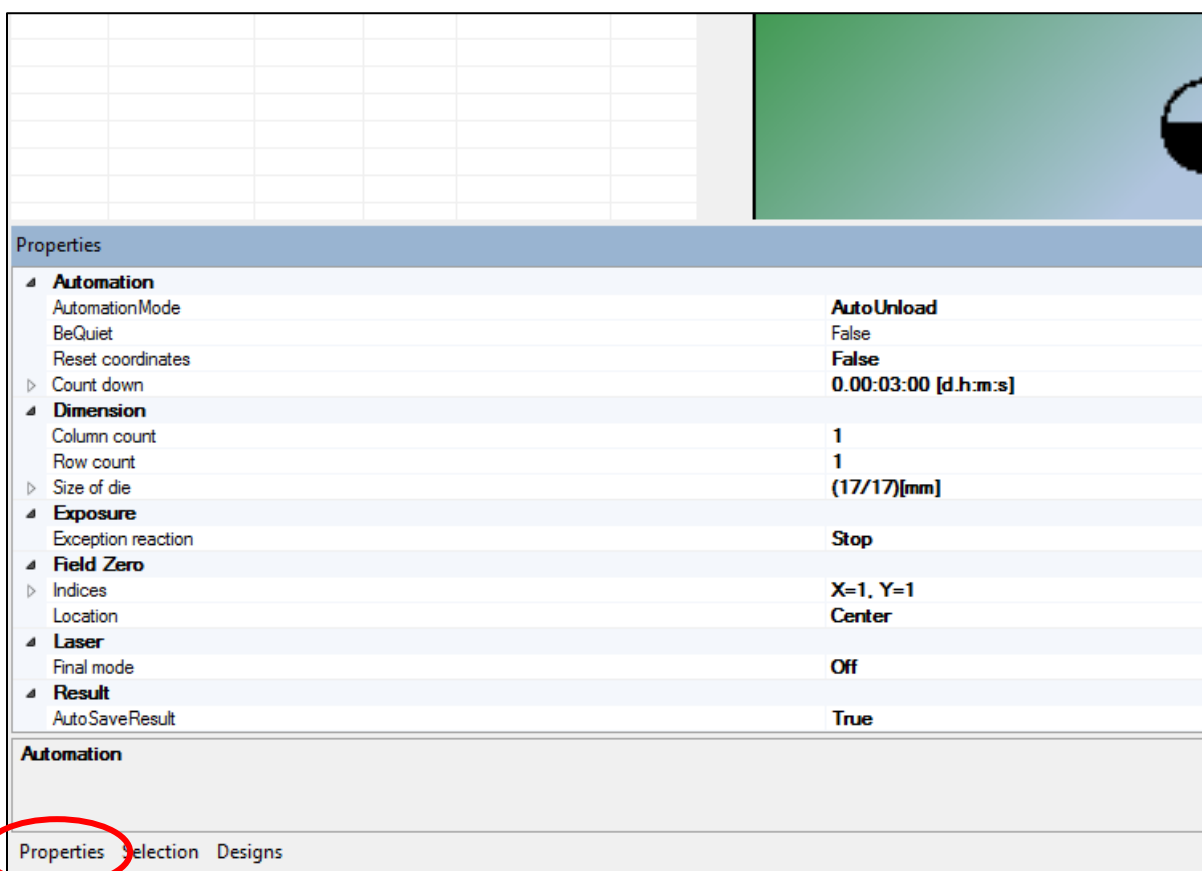
- Open the **Job Control panel** by selecting **Controls → Job** in the main menu bar **(should be opened on the right side)**. The panel should contain executable exposure jobs divided into folders in the left part, spreadsheet of the jobs in the middle, and exposure map in the right part.

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- In the **Job list on the left**, open the folder **Templates** by clicking on the plus **(+)** sign. **Select job template and drag-and-drop it** to the chosen folder below the Templates folder. Give the job a characteristic name.

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- Select the newly formed exposure job in the spreadsheet and click **Properties** at the bottom of the job control panel.

- Here, find *section Dimension*. At both **Column Count** and **Row Count**, enter **1**, if you want to have one layout in one field (die). You can create more dies, if you want to have different layouts in each, or create array of dies to repeat exposed pattern (e.g. creation of resolution pattern). Accordingly, the spreadsheet shows the number of rows, which is the same as the number of dies you created.

- In case you have more dies in your exposure job, set both Width and Height in the parameter **Size of die** which also determines distances between single patterns (in case of 1 x 1 this parameter is not to be considered). When you have one field exposure, the parameters **Indices** in the *section Field Zero* should be **X, Y = 1**. Parameter **Location** is set to **Center** as default. This means the die is centered at the coordinate system set after loading and plate/wafer center. Also, select *Automation Mode* in the *Automation section* of the Properties list. Select **AutoUnload** to move the table to the substrate loading position after the exposure is finished if you wish to do so.

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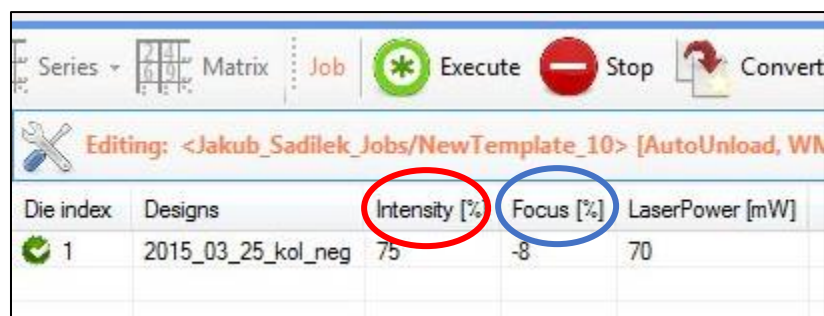Approved: 25.5.2020 by Jiří Zita Jiri.Zita@ceitec.vutbr.cz

- Select layout(s) required for the exposure by clicking **Designs** at the bottom of the spreadsheet in the control panel. Always click **Update**. Find design in the folder structure. **Drag & drop the layout** into appropriate column in the spreadsheet, or directly into the die.
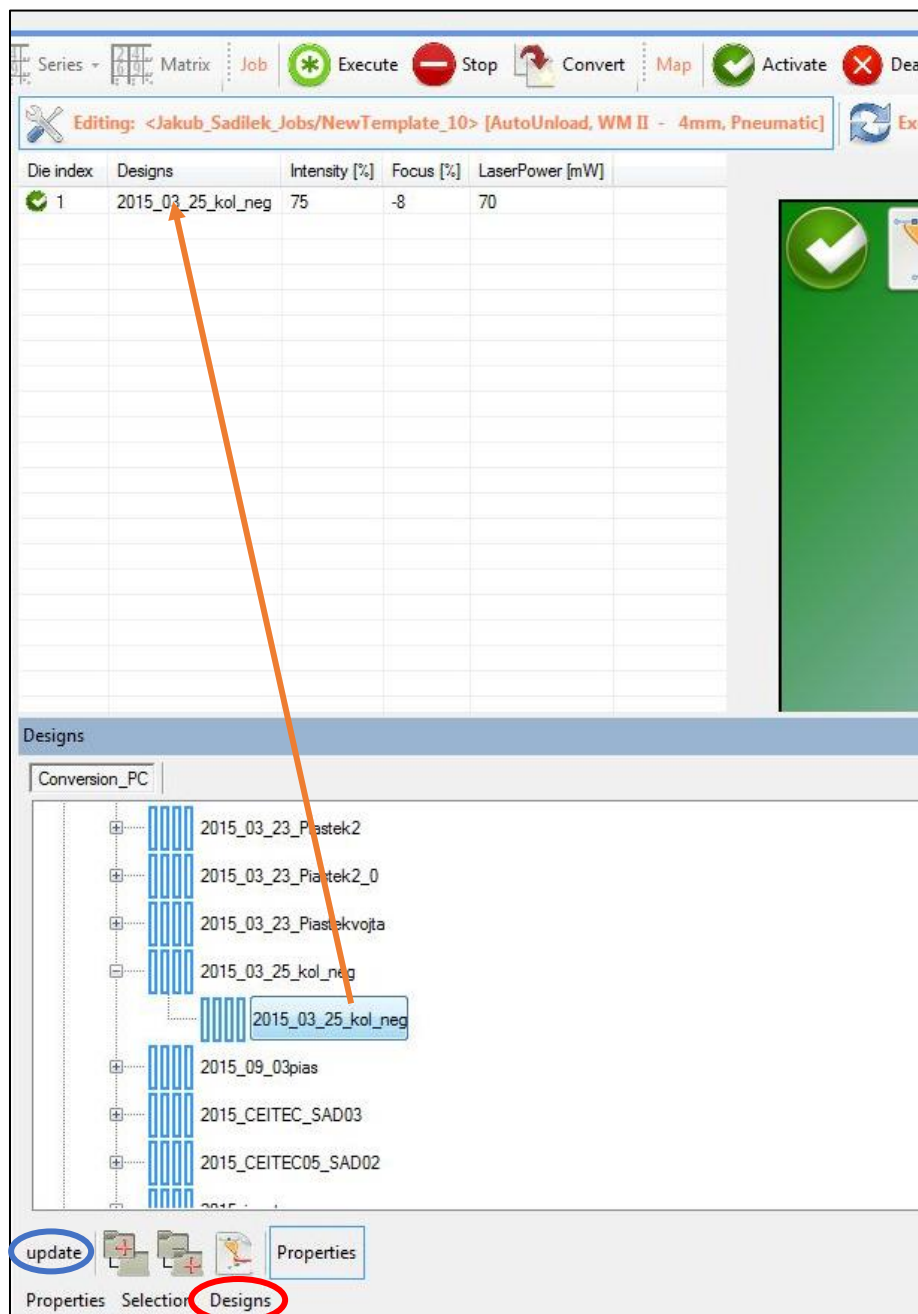
- For exposing the same layout to multiple dies, select design in the first row of the spreadsheet and move the mouse cursor while holding it over all other dies.

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4.4. *Exposing the pattern & finishing procedures*

- In the spreadsheet, select required **Intensity** and **Focus** for the exposure. Intensity is the percentage of the maximum intensity available (pre-set value in the column LaserPower, considering the filters installed). Focus is the deviation of the best exposure focus from default lens position, in percentage of the full range. For given resist and the corresponding thickness, first *look into the DWL66 Exposurelog.xls file on the desktop of User PC*, to see, which values should be used. If the values are unknown, it is very recommended to expose the test pattern to decide which intensity and focus appear to be the most suitable (after development and optical microscopy inspection).

- If the substrate is properly loaded, click on the **laser icon** in the toolstrip at the bottom of the system control panel to launch it. By clicking on **activate/deactivate** buttons (see next page) for each die you will select rather if die should be exposed or not. Click **Execute** in the job control panel to run the exposure. A window will appear which shows the exposure progress.

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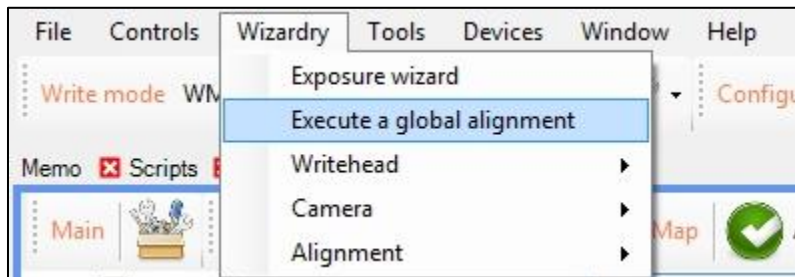
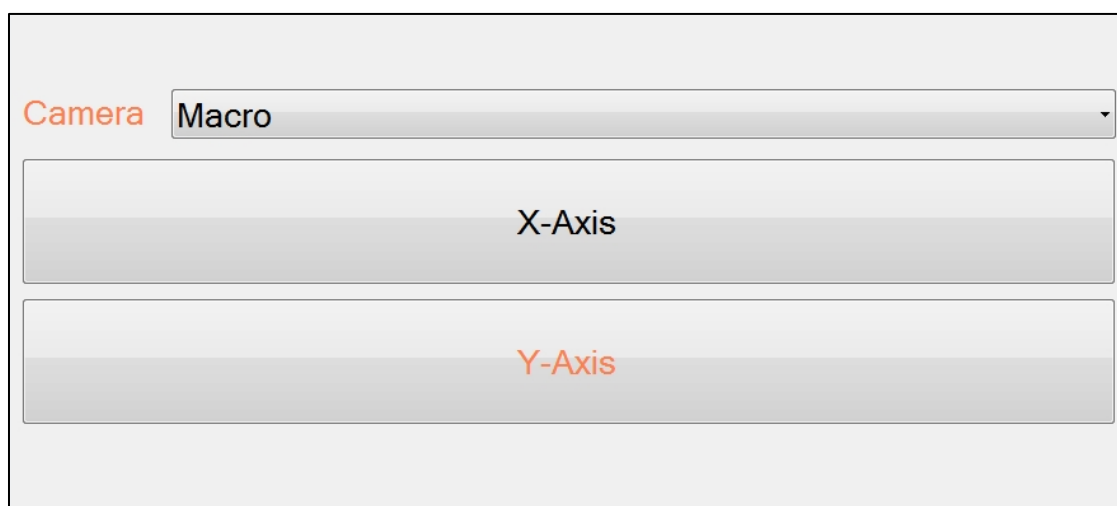- After the exposure is finished, **switch off the laser** (via toolstrip).

- Open the cover lid, turn off the vacuum and remove your substrate. Then close the cover lid again.

Basic alignment procedure

- Click **Wizardry** in the main menu bar and select **Execute a global alignment**. This will open the alignment wizard.


- **Choose the camera** which will be used during point acquisition process and select whether the alignment should be done **along X or Y axis**.

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- As next, navigate the stage with the help of **arrow buttons,** so that the alignment mark is visible in the camera window (*keep in mind the orientation of the stage: X is orthogonal to the cover lid, Y is paralell to it*).
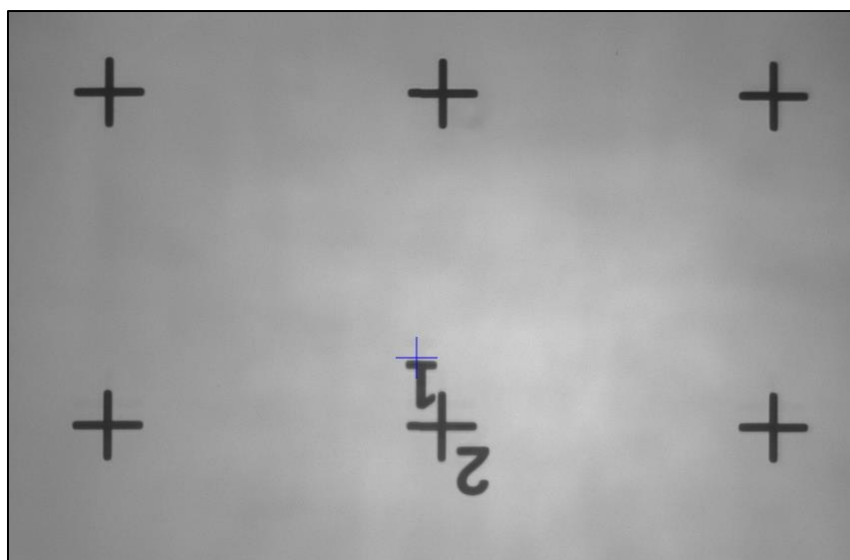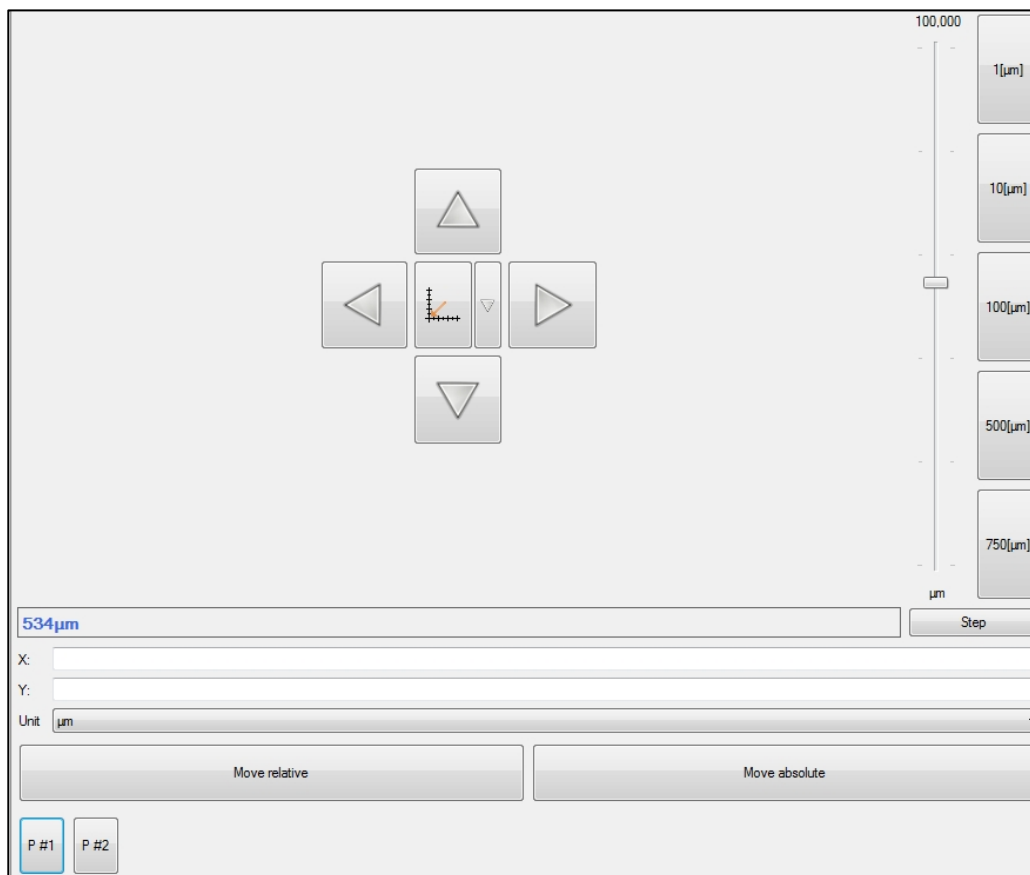
- Proceed to the next step: In the freezed camera image, **move the crosshair** to the desirable point of the alignment mark (*recommended shapes: edges (!) of crosses, squares or L-shapes*), then **click middle-mouse button** to confirm. You may use macro (left) or micro camera (right) image for this purpose.
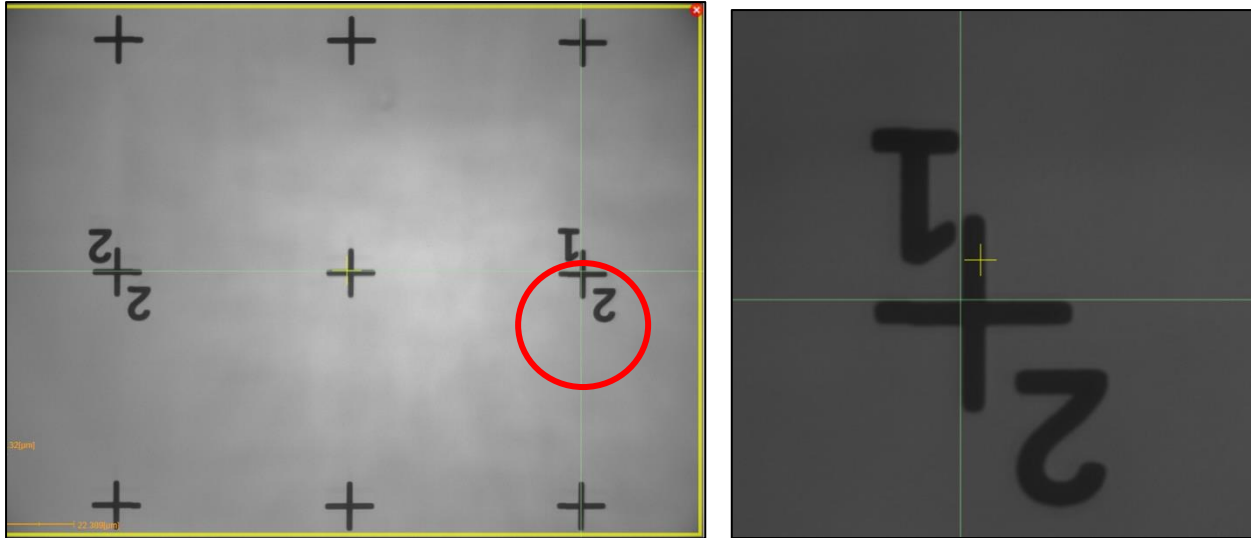
- Repeat last two steps with another alignment mark to acquire the second point.

- After the second point is acquired, the wizard displays the positions of both points and angle between virtual connecting line and chosen axis. You can submit the measured angle which is then used for all other movements of the stage (and also subsequent measurements) **(Save and go to x=0 y=0)**. When choosing option **Submit and start next iteration**, wizard will loop back to the step of acquiring first point on the first alignment mark. The purpose of this is to refine the alignment and make it more precise. You can reach previous points by clicking now activated **P1** and **P2** buttons in the stage navigation panel or define new points (e.g. for longer baseline).