

User guide

Thixis (θίξις) - touch
metrisi (μέτρηση) - measure
"One touch measurement"



Thixomet

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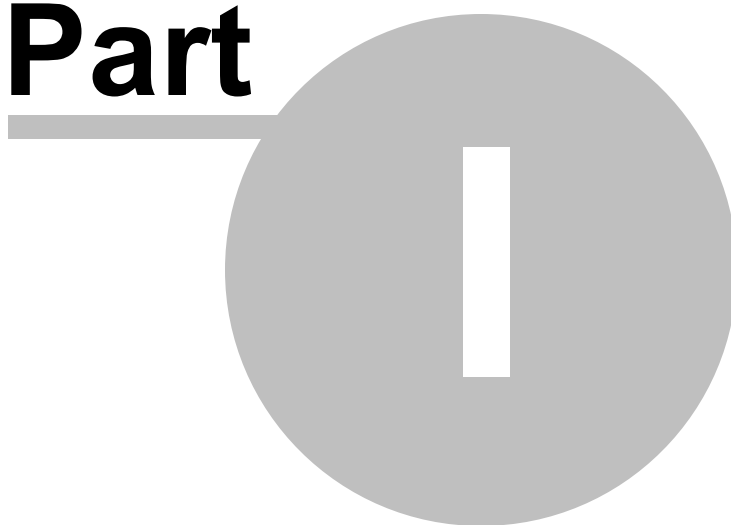
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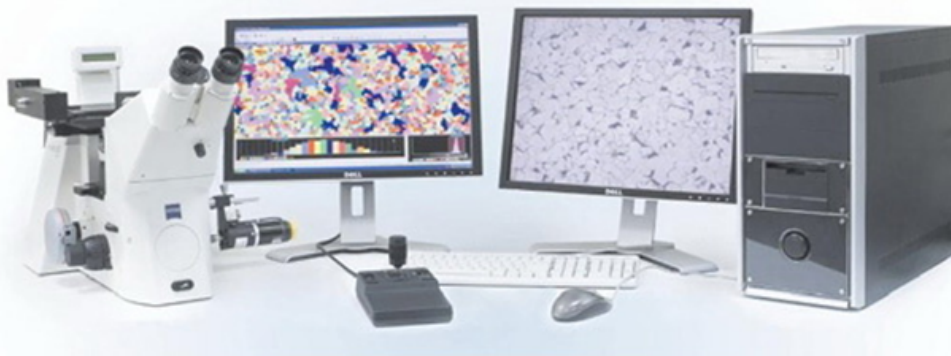
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Work with base functions

Part



1 Work with base functions







This part will help you to work with basic functions of the Thixomet image analyzer

This Manual is a complicated system of cross references; therefore some actions may be repeated while turning over from one page to another. If an action has already been performed, there is no need to repeat it.

To start the work, select the standard, you are interested in ([More](#)^[46]), or use the algorithm for routine work with Thixomet Standard base module ([More](#)^[40]).

1.1 Microscope calibration

- 1) In the **Thixomet** main window select the menu item **Options > Calibration**
- 2) In the bottom part of the opened window in the **Microscopes** group box click the **Create New** button and enter the microscope name, then click **OK** and close the **Calibration** window
- 3) Place the object-micrometer on the microscope stage and focus on the ruler
- 4) In the window **Translation from the camera**  click the **Calibrate** button 
- 5) In the window shown up select the **Object-micrometer** mode
- 6) In the **Microscope** dropdown list select the name of the microscope created in step 2
- 7) Set the minimum magnification of the microscope and enter its value in the **Magnification** field
- 8) In the window **Translation from the camera**  select the **Linear Dimension** tool .
- 9) Place the tool on the ruler of the object-micrometer by the LMB (move the mouse, keeping the button pressed) so that integral number of the scale divisions are selected
- 10) Enter the selected distance in the **Distance** field and click **Save**
- 11) Repeat this procedure for all magnifications of the microscope

1.2 Calibration change

To change the calibration in the **Translation from the camera** window:

- 1) Click the right mouse button (RMB) on any part of the translated image, a popup menu shows up
- 2) In the **Calibration** submenu select the calibration value


- 3) If the microscope has a connection to PC, the item **Automatic definition of calibration** will be accessible. With this item selected, the value of calibration will be automatically read out at the change of objective
- 4) At the image capture the current calibration from the window **Translation from the camera** will be transferred into the **Thixomet** main window

To change the calibration on the the already constructed panorama:


- 1) In the **Thixomet** main window select the menu item **Options > Calibration**
- 2) In the bottom part of the opened window in the **Microscopes** group select the microscope name in the dropdown list
- 3) Select the required calibration in the chart, then press **Install** and close the **Calibration** window
- 4) The selected calibration will be set and in the **Thixomet** main window and in the **Translation from the camera** window

1.3 Work with projects

1.3.1 Create a new project

- 1) Press **CTRL+N**  to open the dialogue window
- 2) Select the microscope name in the **Microscope** dropdown list
- 3) In the **Microscope Magnification** dropdown list select the current magnification
- 4) In the **Project Name** field enter the desired project name
- 5) Press **OK**


1.4 Construction of a panorama

Before construction, please, make sure that the button **Convert to grayscale**  don't pushed.

Select an alternative to construct the panorama:

[Manual construction](#)  ¹⁰

[Panorama construction on the microscope equipped with the motorized microscope stage](#)  ⁶

[Automatic panorama construction by a template on the microscope equipped with the motorized microscope stage](#)  ⁹



[Shading correction](#)  ¹³

[Panorama resizing](#)  ¹⁶

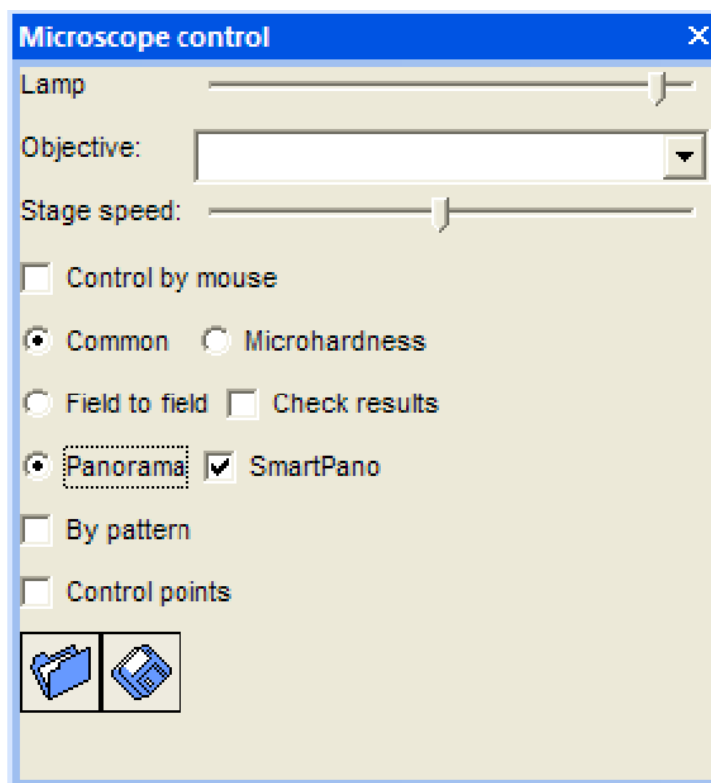
[Trimming according to greylevel](#)  ¹⁷

[Search for fragments sensitivity](#)  ¹⁸

1.4.1 Panorama construction on the microscope equipped with the motorized microscope stage

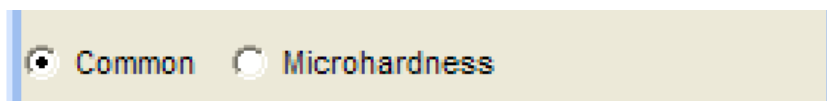
- 1) Create a new project **CTRL+N**  ([More](#)  ⁶)
- 2) Open the window **Microscope Control** , select the **Panorama** mode, the **SmartPano**


option should be enabled and other settings should be disabled

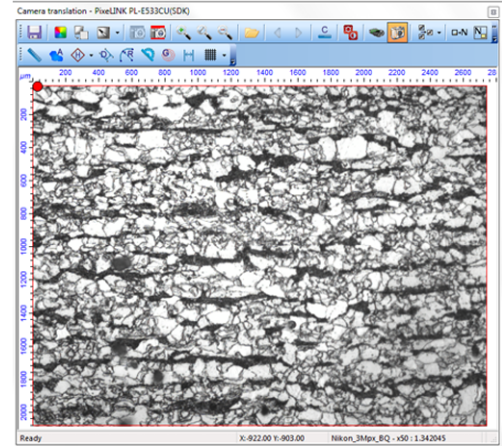
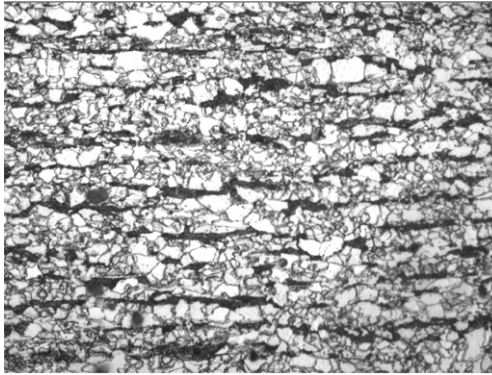


The **SmartPano** option is used for precision stitching of the fields of view. If it is disabled, the fields will be stitched to each other according to coordinates (with the positioning accuracy of the motorized microscope stage).

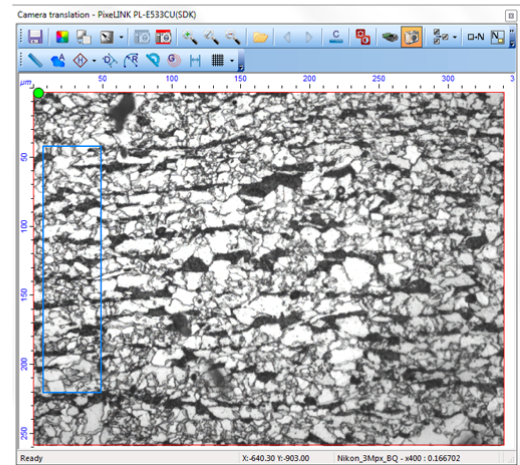
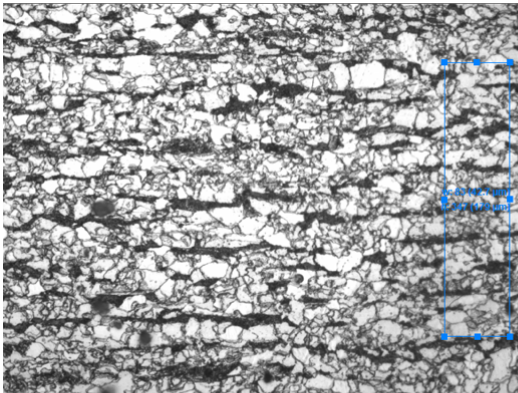
If the panorama is being constructed using the motorized microhardness tester, it is necessary to select the **General Functions** mode




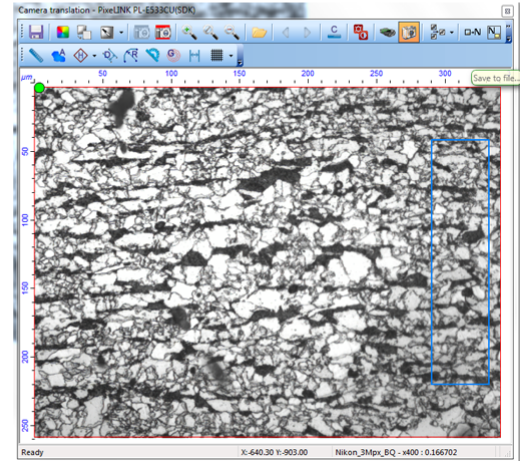
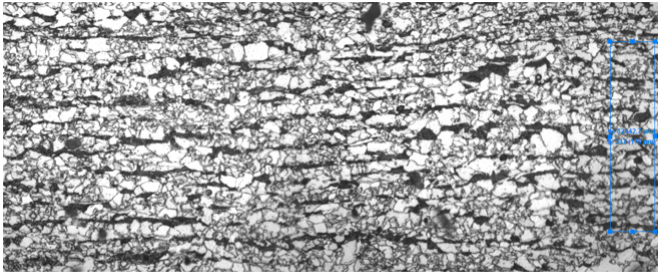
- 3) Press the **Space** key, and the image from the **Translation from the camera**  window will be captured into the main window



- 4) Select a moving direction on the sample by pressing of one of the directional < > ^ v





- 5) Press the **Space** key, and the image from the window **Translation from the camera**  will be captured and stitched with the image in the main window

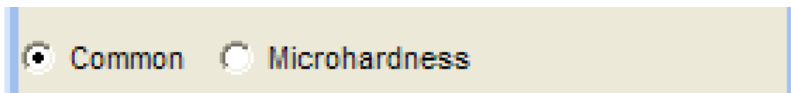


- 6) If an illumination drop is visible, select the background ([More](#)¹³⁾) and begin panorama construction from beginning
- 7) Repeat steps 4-5 until you constructed the panorama of the desired area
- 8) In case of insufficient memory for panorama construction, use [Panorama Resizing](#)¹⁶⁾

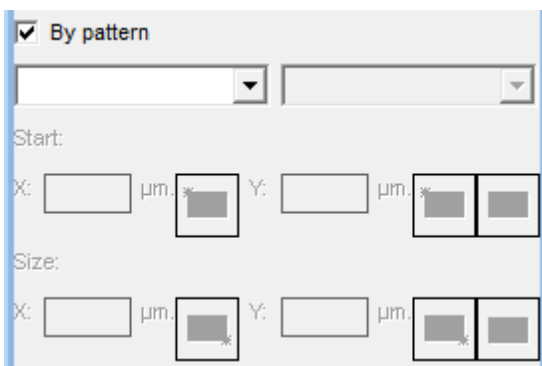
1.4.2 Automatic panorama construction on the microscope equipped with the motorized microscope stage






- 1) Create a new project **CTRL+N**  ([More](#)⁶⁾)
- 2) Open the **Microscope Control** window , select the **Panorama** mode, the **SmartPano** and **By Template** options should be enabled, and other settings should be disabled

If the panorama is being constructed using the motorized microhardness tester, it is necessary to select the **General Functions** mode





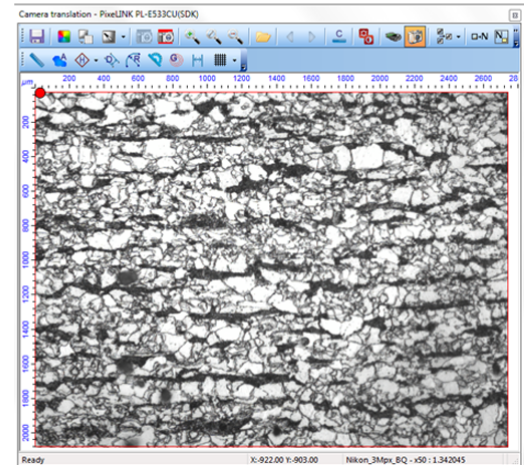
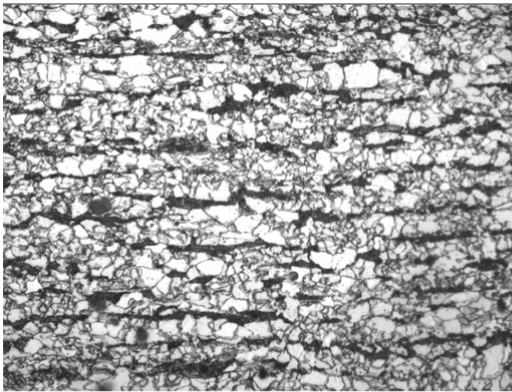
- 3) In the left dropdown list select **Add** item and enter the name of a new template and the area; or select the already created template.





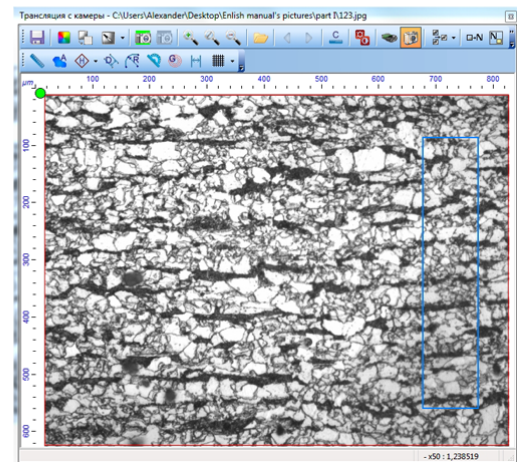
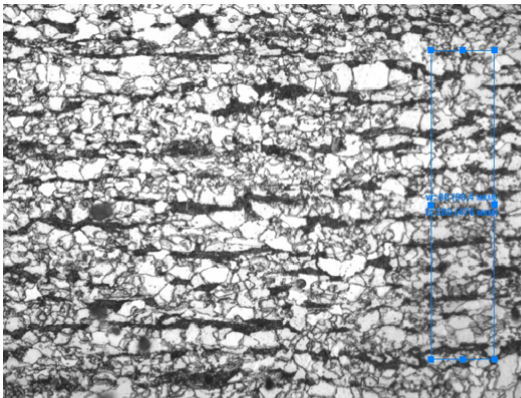
- 4) Choose a spot on the sample where the panorama construction shall begin, then click the **Set the beginning on X**  and **Set the beginning on Y**  buttons.
- 5) In the **Dimension** field: enter the desired dimensions of the panorama by X axis and Y axis, or choose a spot on the sample where the panorama should end, and click the **Set the end on X**  and **Set the end on Y**  buttons.
- 6) If it's necessary to adjust the focus during panorama construction, enable **Focusing** ([More](#)²³⁾)
- 7) If necessary, it is possible to create several areas for one template. To create a new area in the right dropdown list select item **Add**; then enter the area name. Repeat items 4 and 5 for each created area.
- 8) Click the **Begin new construction**  button, thus all the set areas will be constructed in the separate images of the current project.
- 9) If an illumination drop is visible, select the background ([More](#)¹³⁾) and begin panorama construction from beginning
- 10) In case of insufficient memory for panorama construction, use [Panorama Resizing](#)¹⁶⁾


1.4.3 Manual construction

- 1) Create a new project **CTRL+N**  ([More](#)⁶⁾)
- 2) Press the **Space** key, and the image from the window **Translation from the camera**  will be captured into the main window

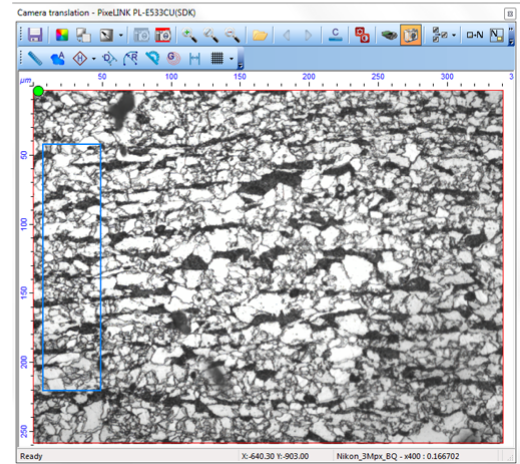
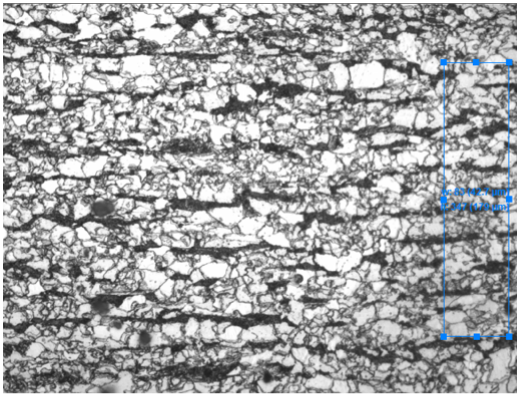



- 3) Select the moving direction of the microscope stage by pressing one of the keys < > ^ v on the numpad, thus the tool **Area Selection** , will automatically appear on the image; its position is traced in the window **Translation from the camera** 

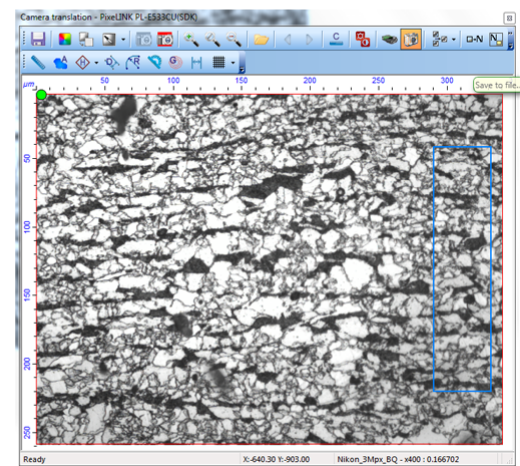
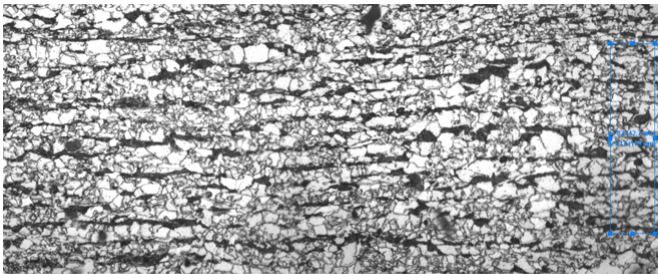


- 4) Move the microscope stage so that the selected fragment in the **Translation from the camera**  window would move to the opposite edge. While the circle in the left top corner of the window

Translation from the camera  is green - stitching of images is possible



5) Press **Space** key, and the image from the **Translation from the camera**  window will be captured and stitched with the image in the main window






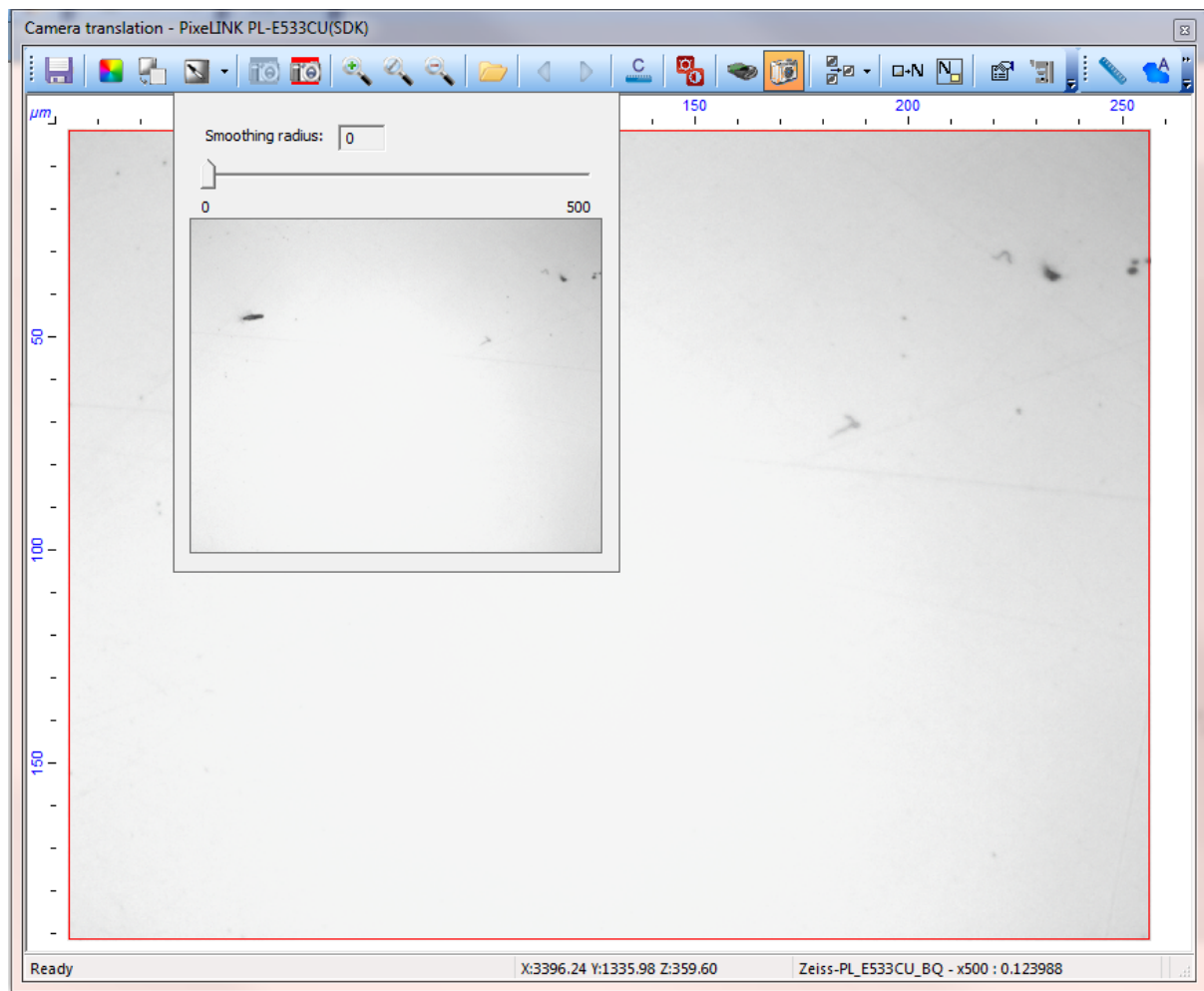
- 6) If an illumination drop is visible, select the background ([More](#) ¹³) and begin panorama construction from beginning
- 7) Repeat steps 3 to 5 unless the panorama of the required area is constructed

1.4.4 Shading correction

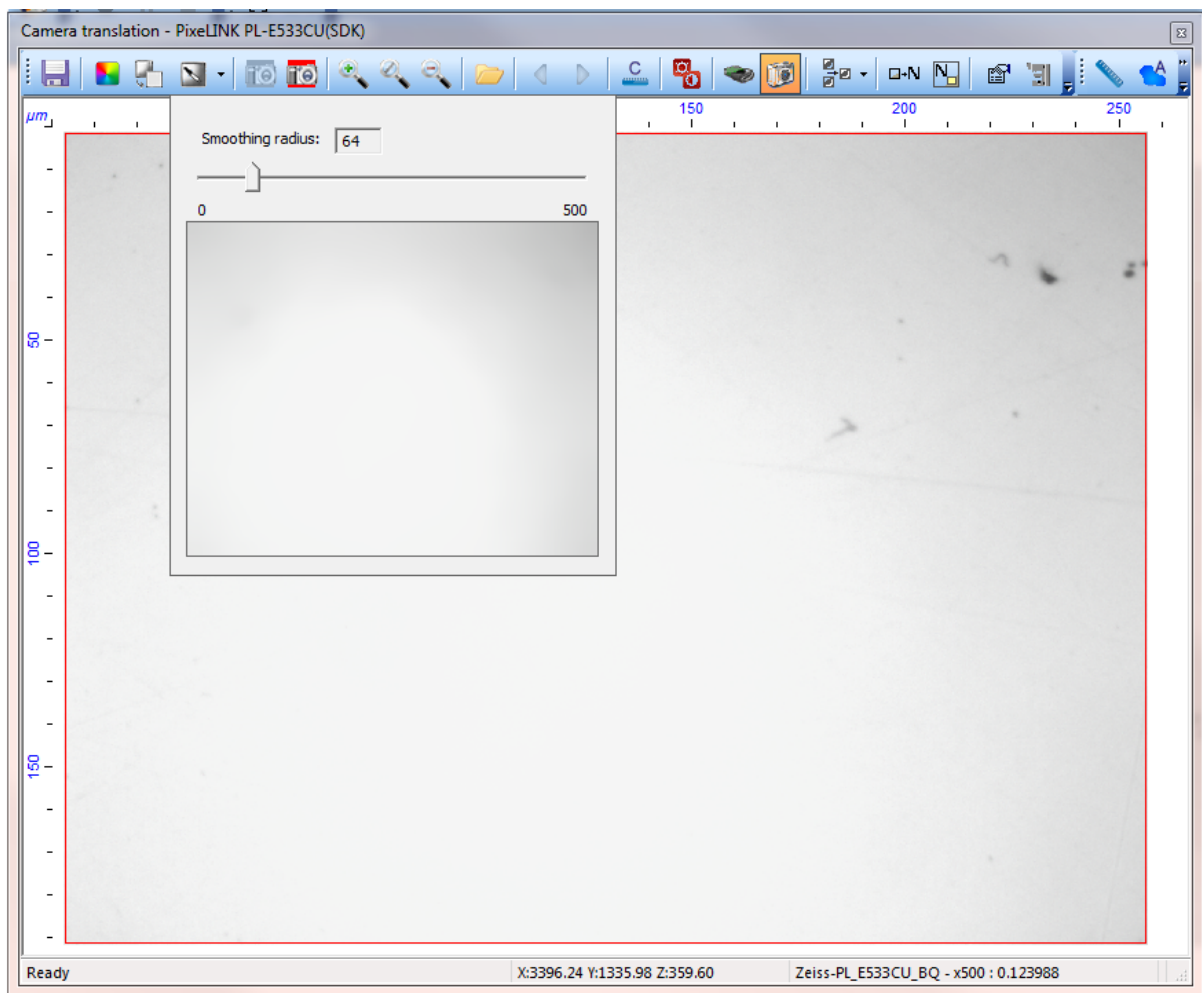
- 1) If an illumination drop is visible while constructing the panorama, use the **Shading correction** function




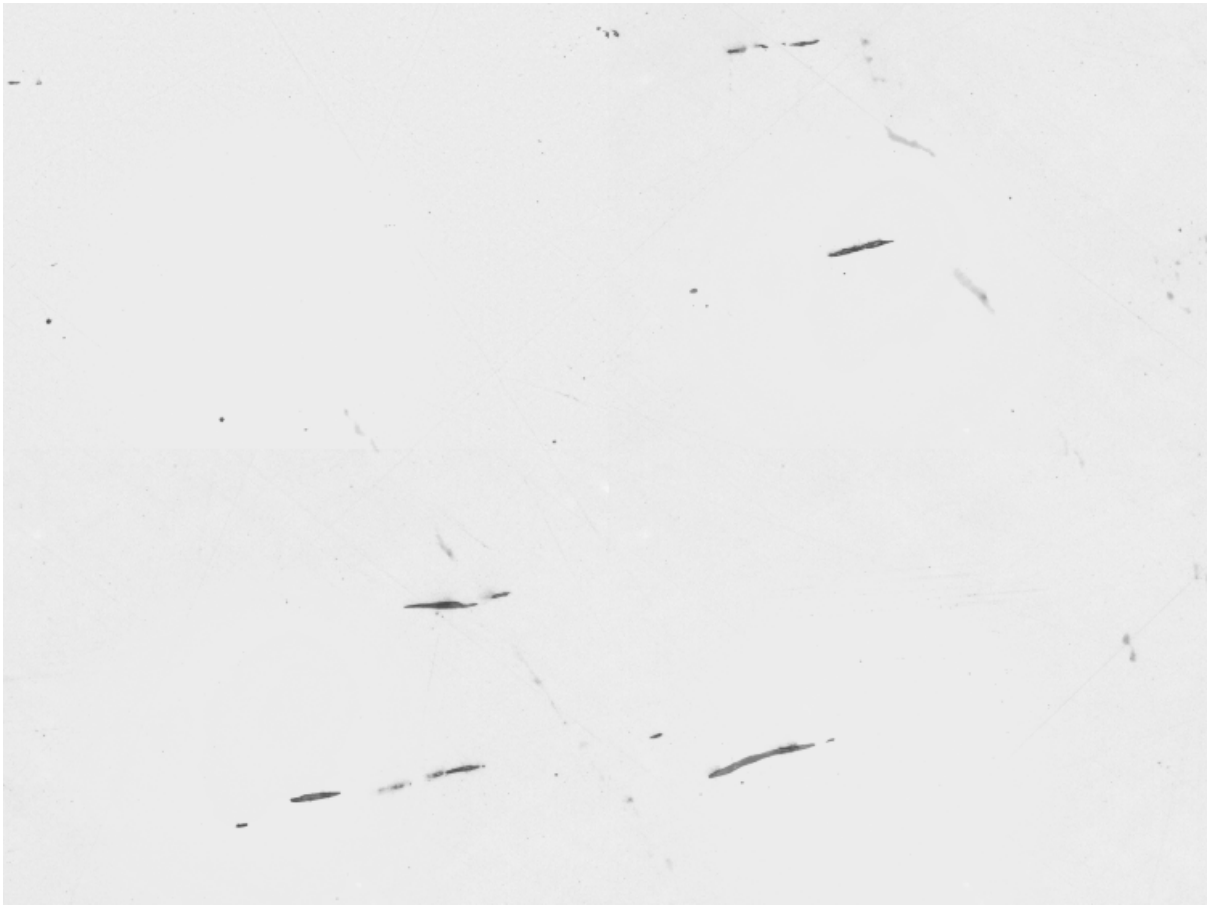
- 2) Find a place on the sample with an even background, i.e. without large scratches, pores, etc.
- 3) In the window **Translation from the camera**  press the button  near the button **Set the background** , and the dropdown window with the structure mini image will open



- 4) Select the minimum value of the parameter **Blur Radius** when all the structure elements are blurred

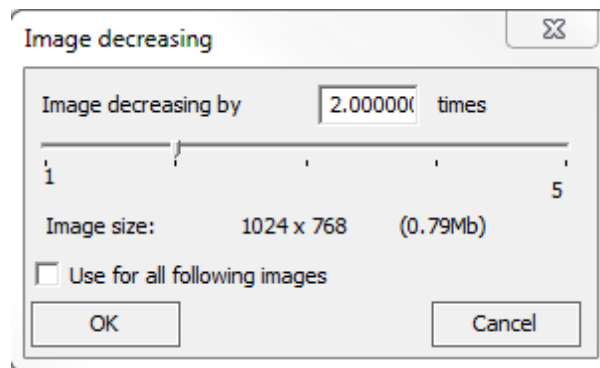


- 5) To subtract the selected background during the panorama construction, the button **Shading correction**  should be pressed
- 6) The background should be selected individually for different adjustments of illumination, different magnifications and different samples
- 7) After of the background the illumination drop on the panorama will be compensated




1.4.5 Panorama resizing

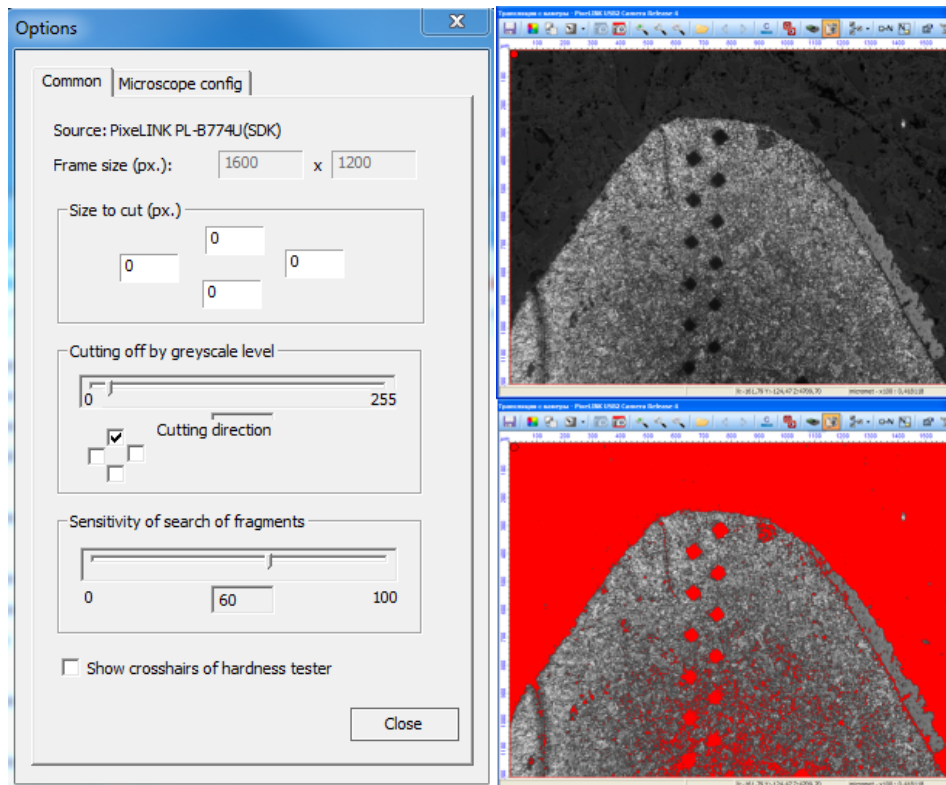
1) In the **Thixomet** main window select the menu item **Options** -> **Panorama resizing**



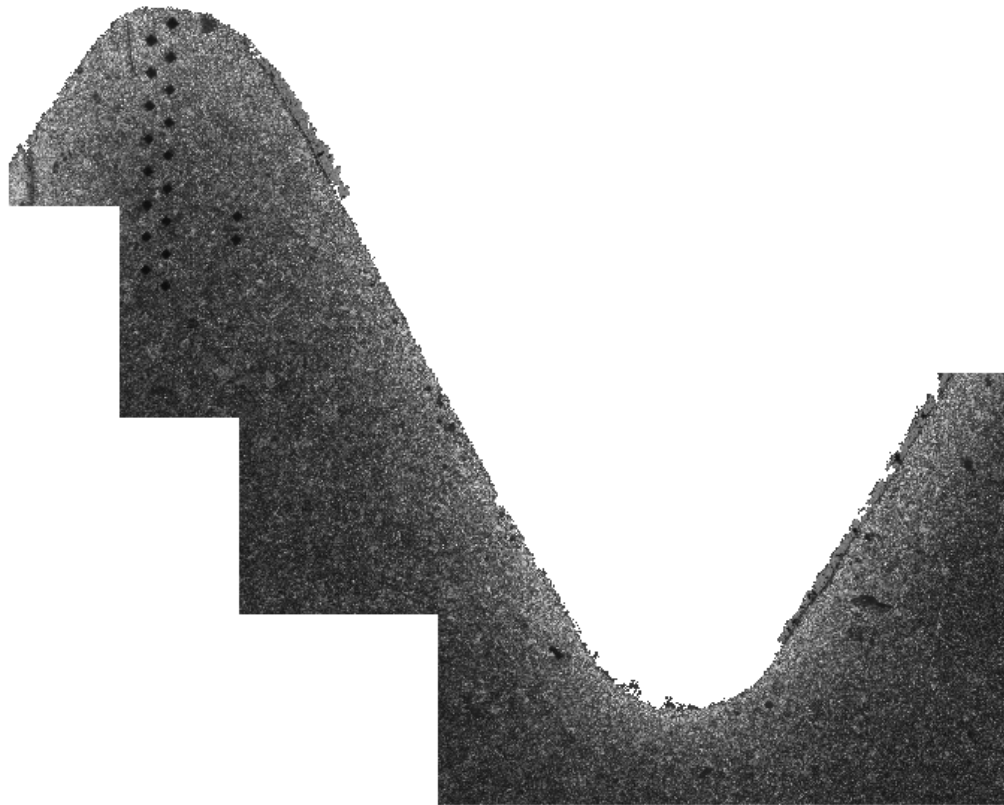
- 2) In the opened window select the degree of reduction
- 3) Set the **Use for all subsequent panoramas** flag if you want to use the selected degree as default value
- 4) When a panorama is resized it is possible to continue its construction

1.4.6 Trimming according to greyscale

- 1) Press the **Options**  button in the **Translation from the camera** window, the **Options** window will open
- 2) Select the direction of trimming and the grey level for the space behind the edge of the sample

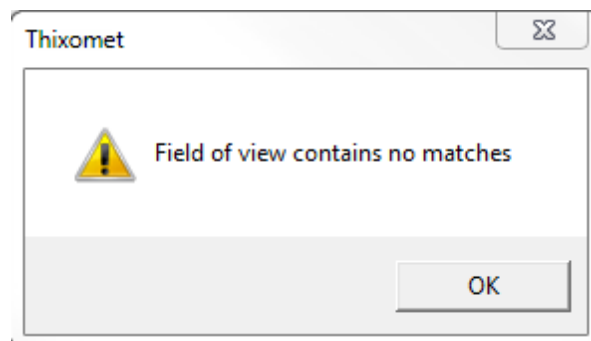


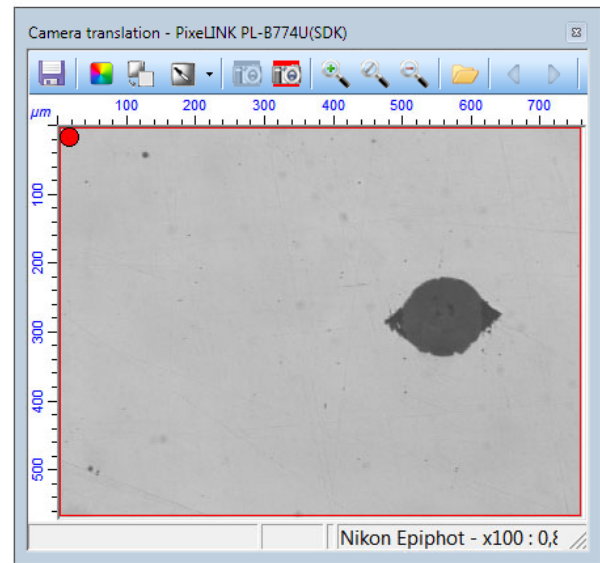
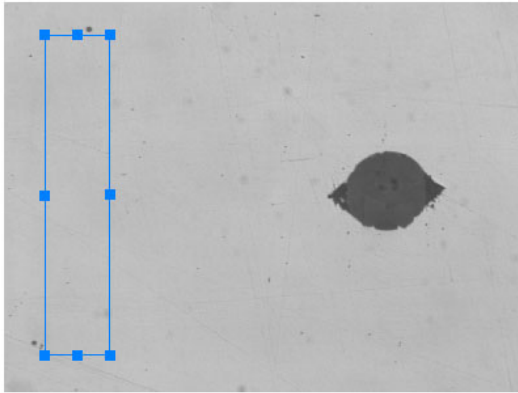
- 3) Now, the highlighted area will be cut off at the panorama construction




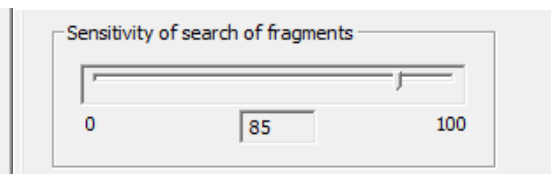
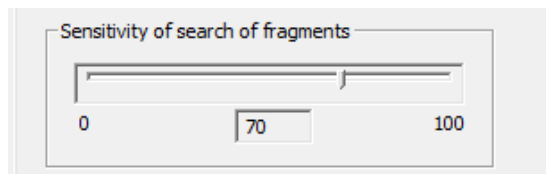
1.4.7 Search for fragments sensitivity

- 1) If the fragment selected in the **Main Window** is cannot be found in the **Translation from the camera** window during panorama construction a message “**Correspondence not found**” will pop up, In this case it’s necessary to adjust **Search for fragments sensitivity**.

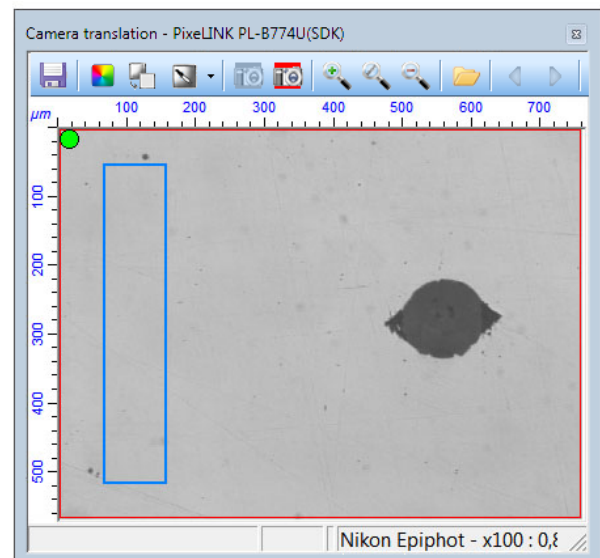
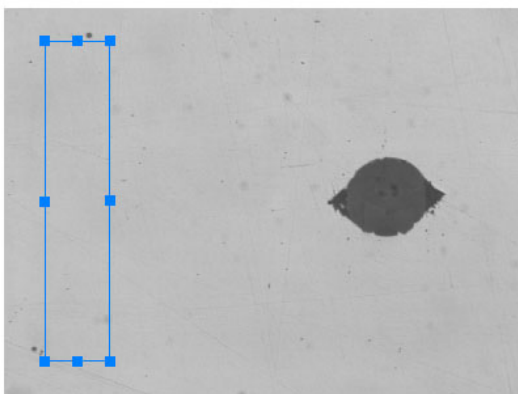









- 2) In the window **Translation from the camera** click Options  and on the tab **General** increase the **Search for fragments sensitivity** parameter

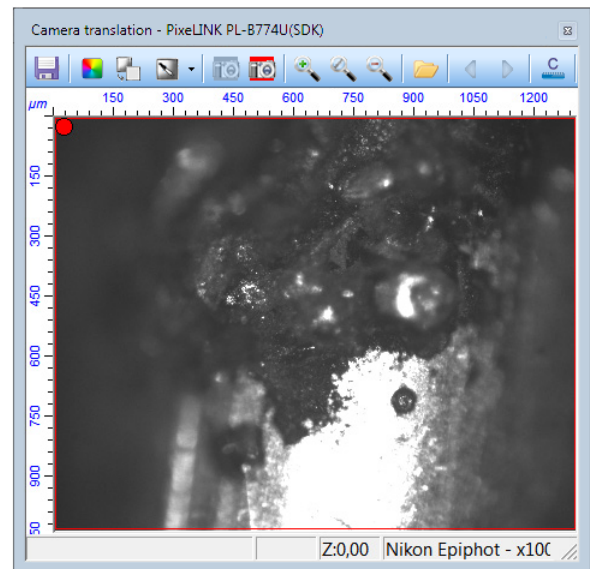
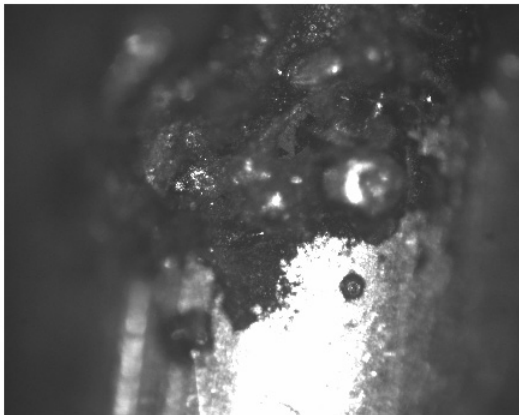


Thus, the fragment selected in the **Main Window** and a green circle in the top left corner will appear in the window **Translation from the camera**, showing that it is possible to continue with the panorama construction.

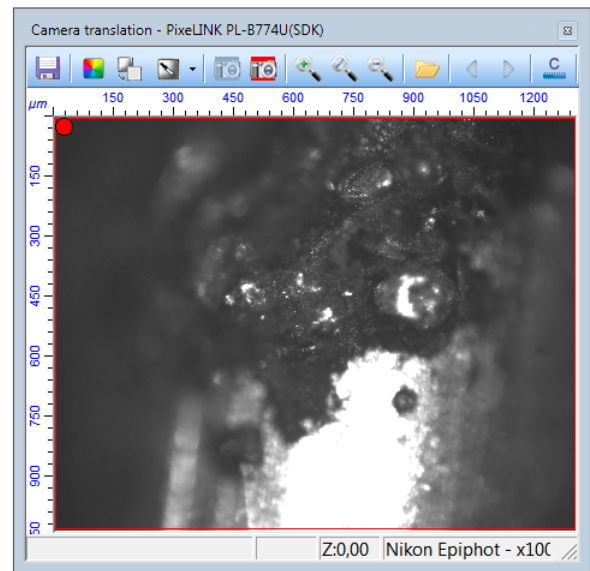
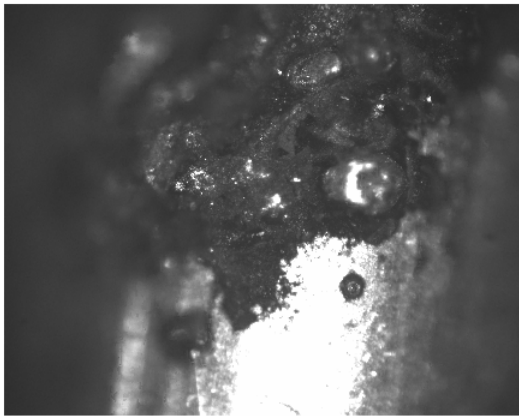


1.5 Extended Focus

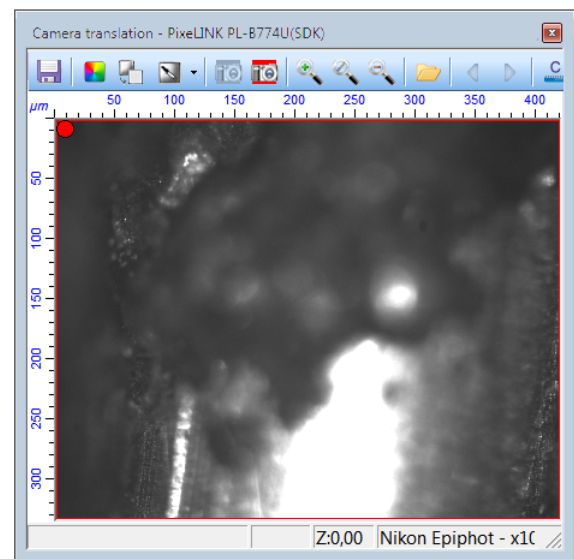
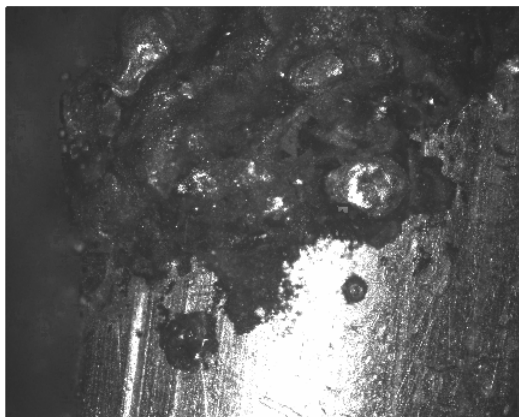
- 1) Create a new project **CTRL+N**  ([More](#) )
- 2) Adjust the focus in extreme top or extreme bottom position
- 3) Press the button **Extended Focus**  in the window **Translation from the camera** 
- 4) Press **Space** key, thus the image from the window **Translation from the camera**  will be captured in the main window



- 5) Adjust the focus onto the other spot and press **Space** key again, thus the image from the working window will be mixed with the image from the **Translation from the camera** window. The areas with sharp details from both images will be preserved.



6) Repeat step 4 until the whole object will be pictured in focus






Extended focus feature can be combined with the panorama construction ([More](#)^[10])

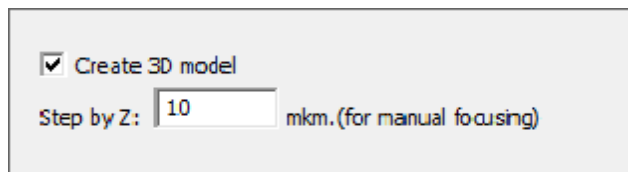
During the use of extended focus it's also possible to build 3D model of inspected object ([More](#)^[21])

1.6 3D modeling

For 3D modeling it is necessary to calibrate the microscope on Z-axis.

1) Select a step on Z-axis (a turning angle of the fine focus knob)

- 2) Press the button , located near the button **Extended focus**  in the window **Translation from the camera**  and set the **Create 3D model** flag in the dropdown window and specify a step on Z-axis



- 3) Adjust the focus on the lowermost fragment of the sample and press the button PgUp (or the uppermost and press the button PgDn). By doing so you specify a moving direction on Z-axis during 3D model construction.
- 4) Restore the field in the extended focus ([More](#)²⁰⁾), and set the **Create 3D model** flag in the dropdown window and specify a step on Z-axis
- 5) To view 3D model press the button **Show 3D model** in the **Main window**
- 6) For better quality of 3D model use smoothing tool which is located on: **Process> 3D> Smooth**



1.7 Motorized microscope control

[Manual control of the microscope, equipped with the motorized stage](#)²³⁾

[Panorama construction on the microscope equipped with the motorized stage](#)⁶⁾

[Automatic panorama construction by template on the microscope equipped with the motorized stage](#)⁹⁾

[Focusing on the microscope equipped with automated focus](#)²³⁾


[Use of the Navigator mode on the microscope equipped with the motorized stage](#)²³⁾

1.7.1 Manual control a microscope, equipped with the motorized stage

- 1) Keys < > ^ v move the object stage onto by one field of view step
- 2) Keys < > ^ v on the numpad: the stage smoothly moves to the specified direction
- 3) Keys 1,3,7,9 on numpad smoothly move the stage on the diagonal directoin
- 4) By pressing key 5 on the side-mounted digital keyboard automatic focus is controlled
- 5) By pressing keys PageUp and PageDown manual focus is controlled

1.7.2 Focusing on the microscope equipped with automated focus


During the *Automatic construction of panorama by template* ([More](#)⁹⁾) or the *Automatic analysis from field to field by template* the focus may be controlled manually and automatically.

- 1) Set the tag **Focusing** in the window **Microscope Control** 
- 2) Select the mode **Manual** for manual or **Intellectual** or **By three dots** for automatic focusing **Control of the**
- 3) Set the required quantity of the vision fields in the field **Frequency of Adjustment** through which the focus will be adjusted
- 4) If the microscope is not equipped with the automated focus you can access only the field **Frequency of Adjustment**.


1.7.3 Use of the Navigator mode on the microscope equipped with the motorized stage

The **Navigator** is used to display the position of the current vision field on the panorama or on the separate field of vision taken under the smaller magnification.


Use of the **Navigator** on a separate field of vision:


- 1) To send the current vision field into the **Navigator** window press the button **Assign the image by the navigator field**  in the window **Translation from the camera**, thus the **Navigator** window will open, and the current position of the vision field will be shown by the yellow rectangle
- 2) Set the bigger magnification and set a new calibration ([More](#)⁵⁾), thus in the **Navigator** window the yellow rectangle will display position of the current vision field. This display will remain intact while moving the object stage of the microscope until the current field of vision does not overstep the bounds of the field in the **Navigator** window.

Use of the **Navigator** on the panorama:

- 1) To send constructed panorama ([More](#)⁶⁾), into the window **Navigator** press the button **Send the image to the navigator**  in the Thixomet main window, thus the **Navigator** window with the panoramic image will open, and the yellow rectangle will display the current position of the vision field

- 2) During the movement of the object stage of the microscope within the panorama area in the **Navigator** window the yellow rectangle will display the current position of the vision field. The display is also possible with the bigger magnifications

To call the **Navigator** window without sending of the new image to it (to keep the previous one) press the button  in the window **Translation from the camera**.

Before using the Navigator mode it is necessary to correct its position. If there was a calibration of durometer crosshair position , the correction is not required.

- 1) Use the **Navigator** mode on the separate field of vision
- 2) After change of magnification make active the **Navigator** window
- 3) Save Ctrl pressed and by the buttons < > ^ v bring the position of the yellow rectangle into accord with position of the current field of vision
- 4) Correct all magnifications except the smallest

1.8 Export of images and data

[Export of report to MS WORD](#) ²⁴

[Export of images to file](#) ²⁶



[Export of data from the histogram according to the properties](#) ²⁹

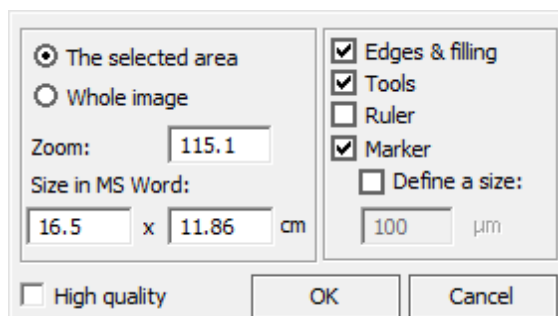
[Export of data from the window Properties of Object](#) ³⁰

[Export of image from the window Translation from the camera](#) ³⁰

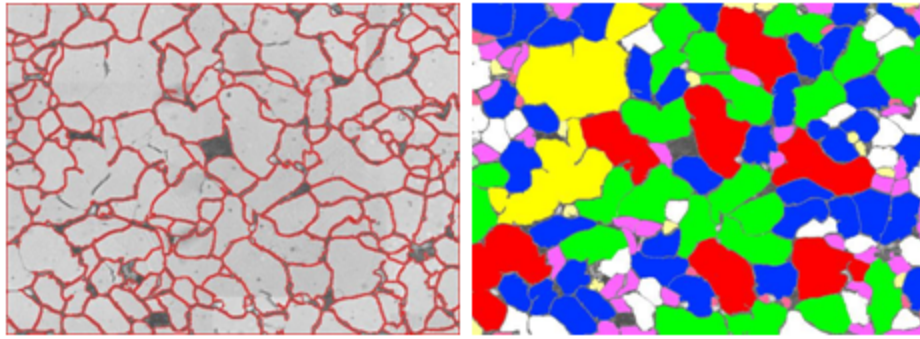
[Export of report to MS WORD](#) ³¹

1.8.1 Export of images to MS WORD

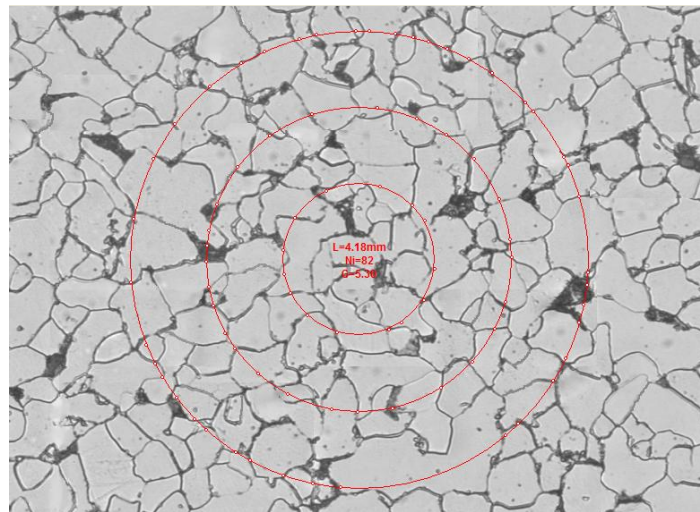
- 1) If it is necessary to export an image fragment, use the tool **Area Selection**  to highlight this fragment (the tool is used by the RBM). If this step is missed, the image will be exported as a whole
- 2) To export the image to MS Word press the button **Export to Microsoft Word** , thus the export dialogue will open



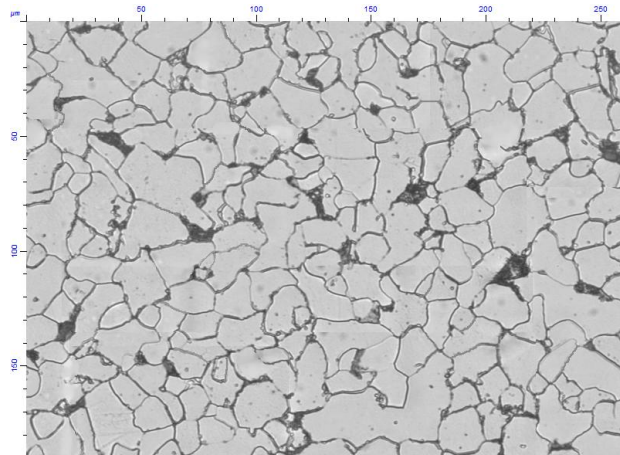
- 3) In the left part enter the desirable magnification, or dimensions of the image
- 4) Set the tag **Borders and Pouring** if you wish to see the results of recognition on the exported image



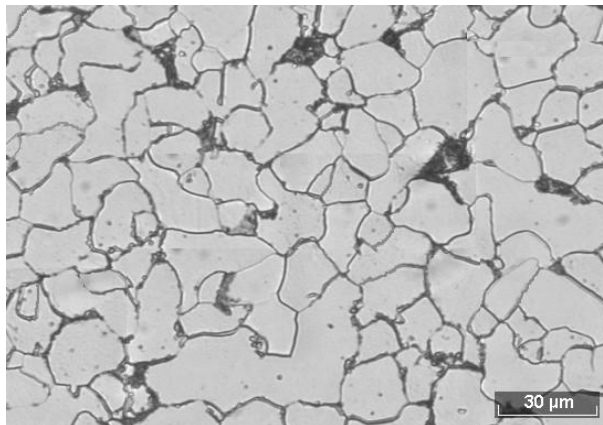
5) Set the tag **Tools** if you wish to see the tools and signatures on the exported image



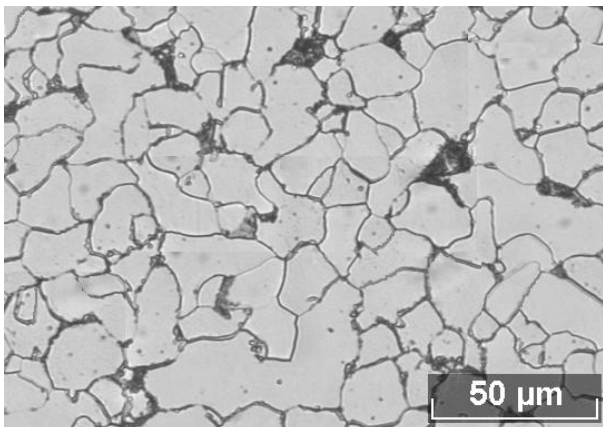
6) Set the tag **Ruler** if you wish to see the ruler in the microns, located on the top and left edges of the image




7) Set the tag **Marker** if you wish to see the marker on the exported image

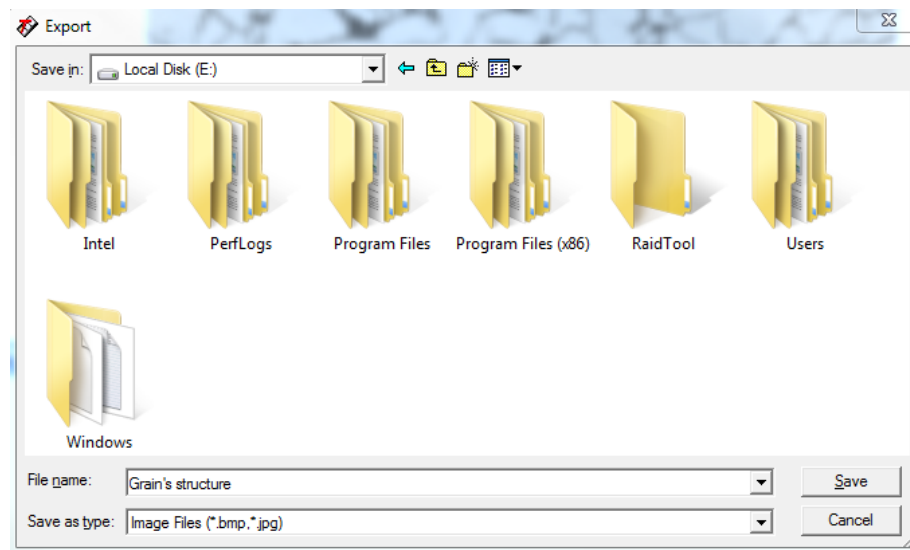


- 8) Set the tag **Set Dimension** if you wish to set the dimension of the marker manually

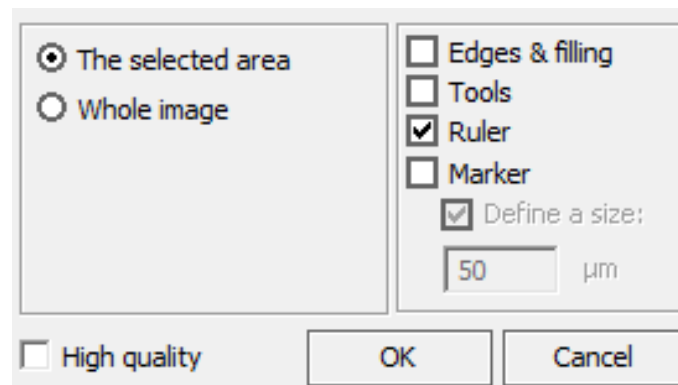


1.8.2 Export of images to file

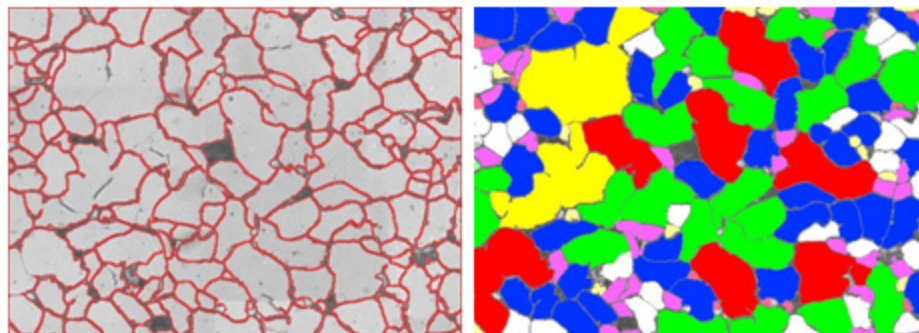
- 1) If it is necessary to export an image fragment, use the tool **Area Selection**  to highlight this fragment (the tool is used by the RBM). If this step is missed, the image will be exported as a whole
- 2) To export the image to the file open the menu **Image > Export**, thus there will appear a window where it is necessary to specify the way of saving and the name, and then press the button **Save**



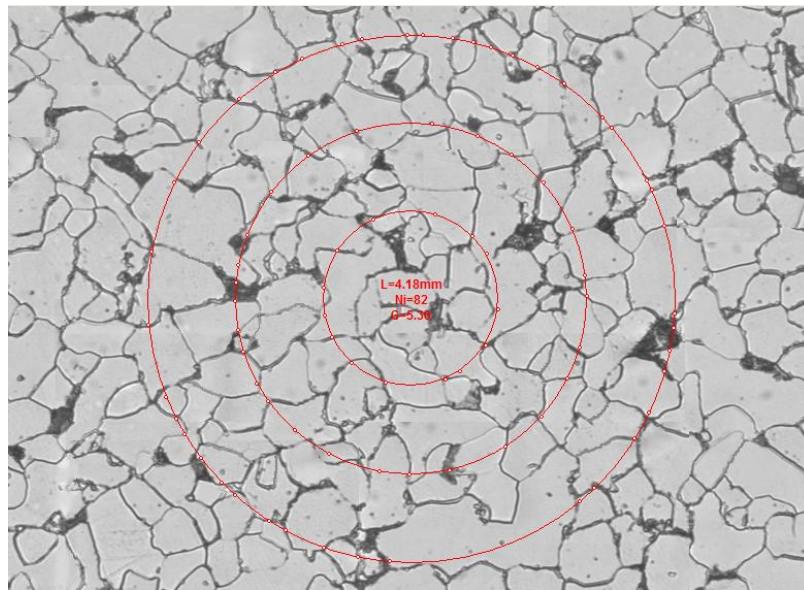
3) Export dialogue will open



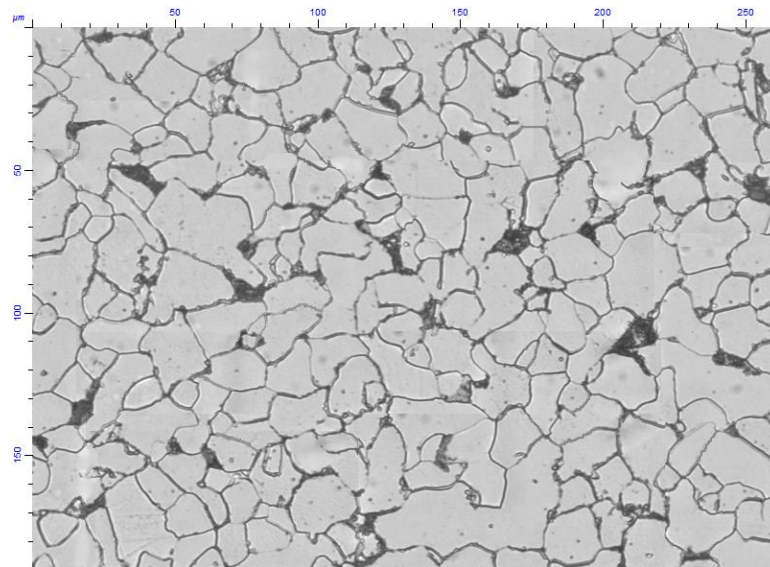
4) Set the tag **Borders and Pouring** if you wish to see the results of recognition on the exported image



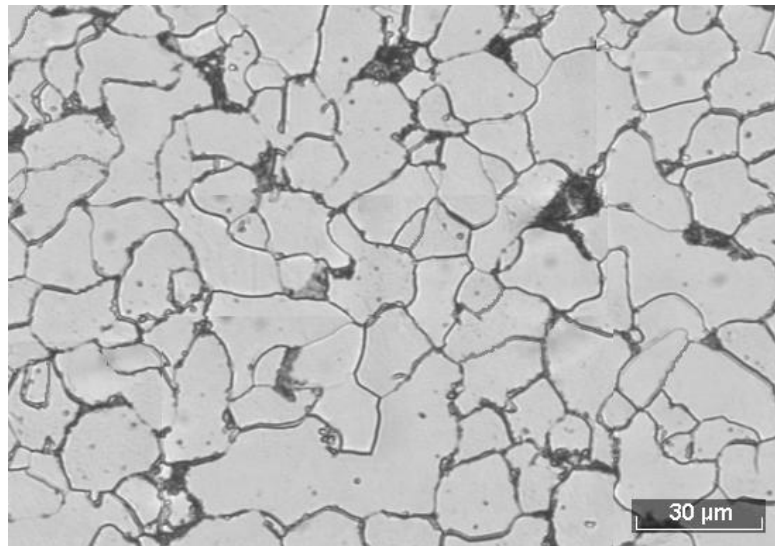
5) Set the tag **Tools** if you wish to see the tools and signatures on the exported image



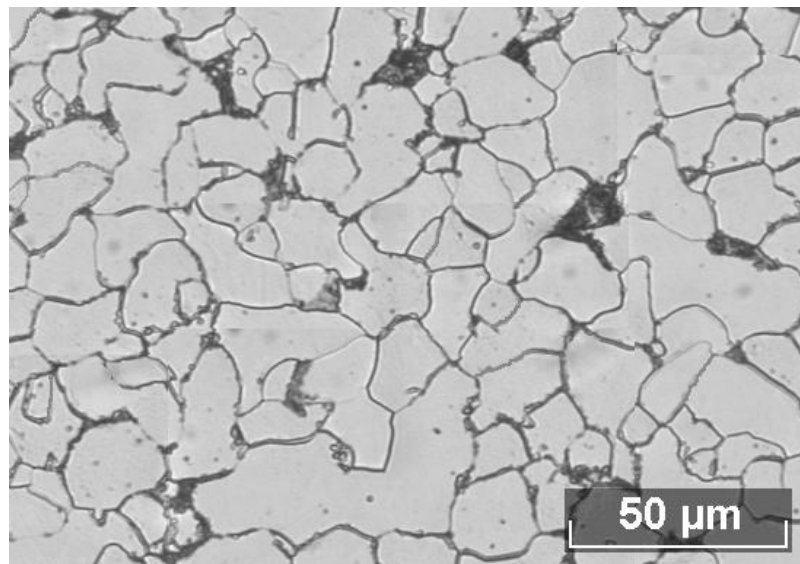
- 6) Set the tag **Ruler** if you wish to see the ruler in the microns, located on the top and left edges of the image



- 7) Set the tag **Marker** if you wish to see the marker on the exported image

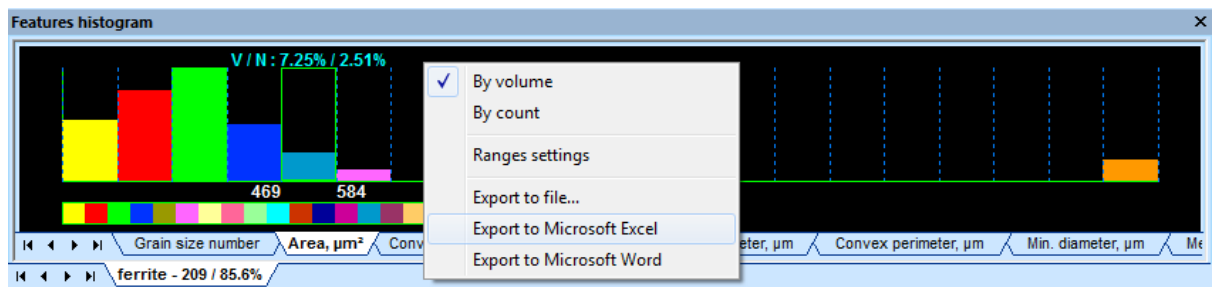


8) Set the tag **Set Dimension** if you wish to set the dimension of the marker manually



1.8.3 Export of data from the histogram according to the properties

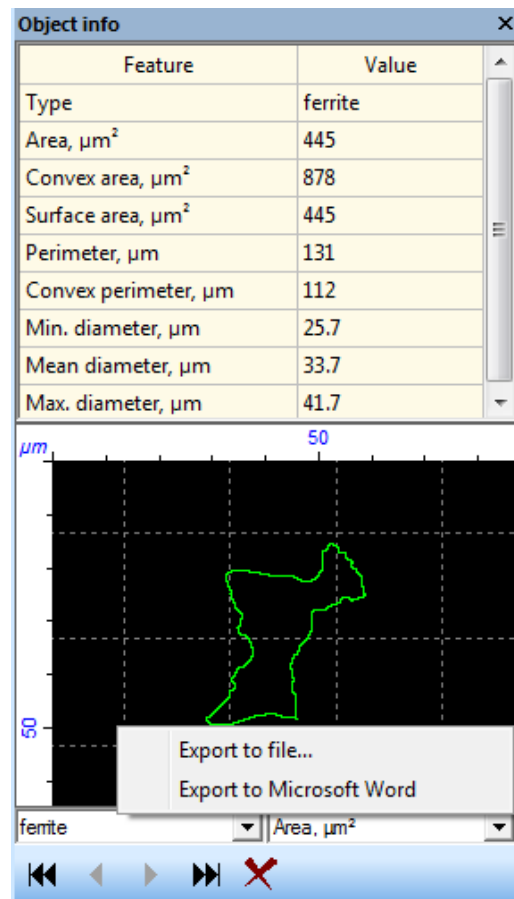
1) Press the RBM, having guided the cursor in histogram area



- 2) Select **Export to file** to export the histogram in the form of image in the jpg format
- 3) Select **Export to Microsoft Word** to export the histogram and data according to the selected parameter to MS Word. During the export the white color on the histogram will be changed into black
- 4) Select **Export to Microsoft Excel** to export the data on each recognized object to MS Excel

1.8.4 Export of data from the window Properties of Object

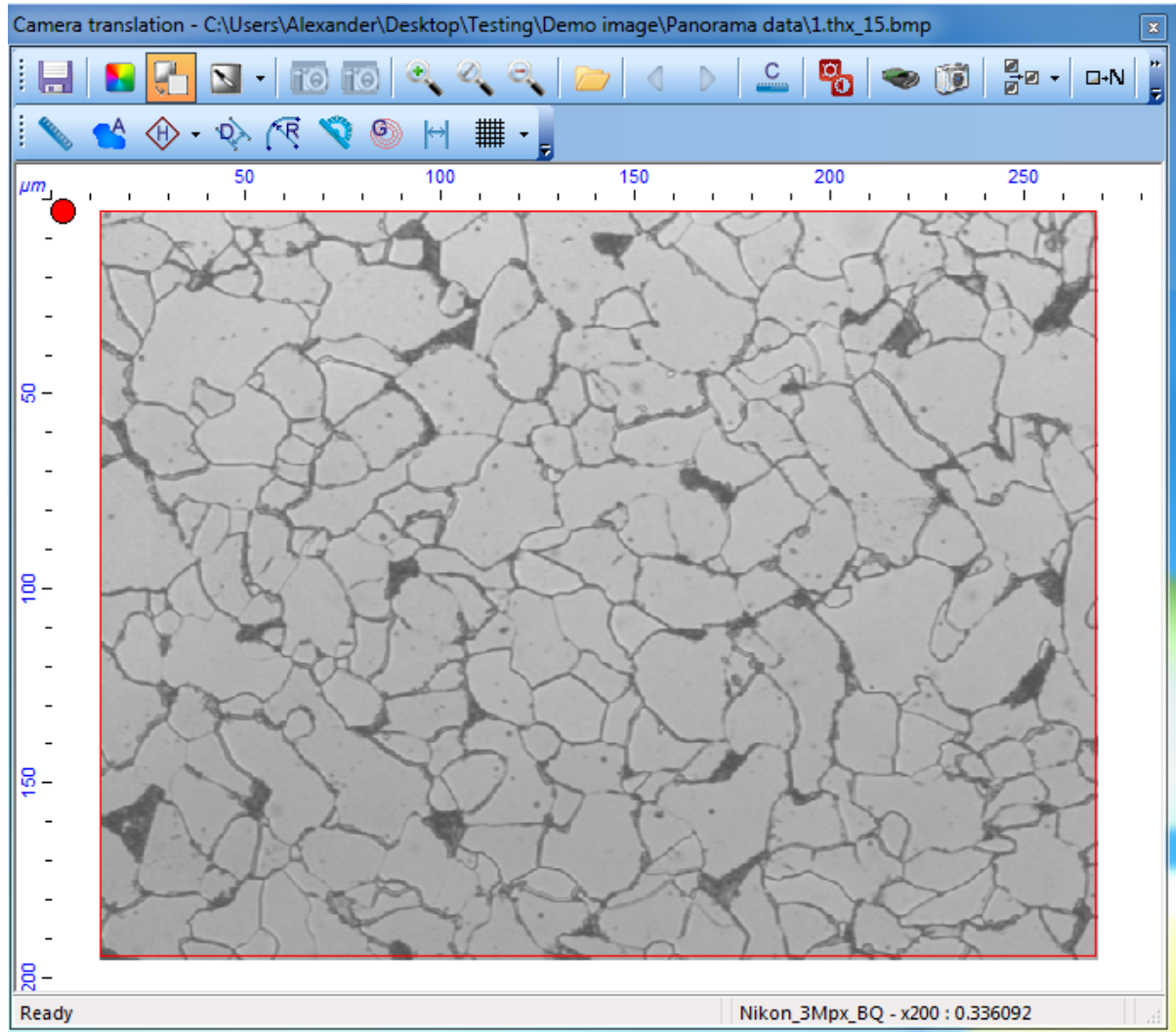
- 1) Press the RBM, having guided the cursor in the area with the image of the object contours




- 2) Select **Export to File** to export the object contours with dimension grid in the form of the image in the jpg format
- 3) Select **Export to Microsoft Word** to export of the object contours with dimension grid and data on the object to MS Word

1.8.5 Export of image from the window Translation from the camera

- 1) Press the button **Save to file**  and select the way and the file name

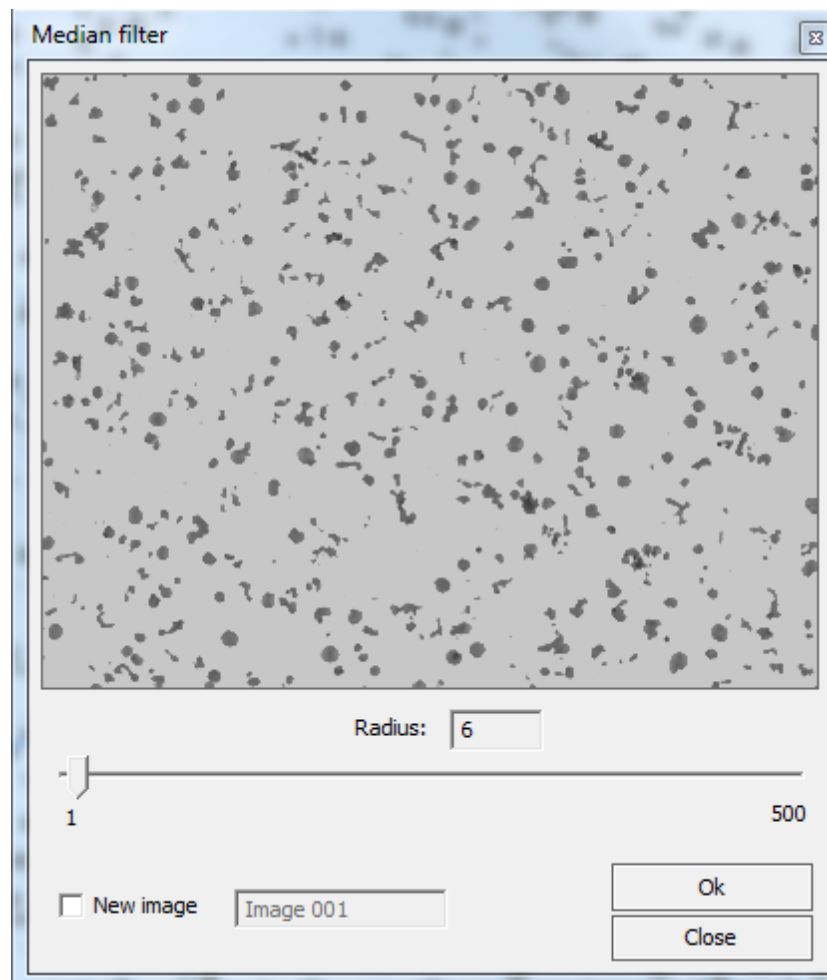


1.8.6 Export of report to MS WORD

1) Call the report and press the button 

1.9 Processing of images

The access to the functions to process the images is provided through the menu [**Processing**]. The work with the functions from the given menu is organized as follows. After selection of certain function there appears a dialogue which includes the following elements: the window of preliminary viewing and the settings of processing function. In the window of preliminary viewing the result of processing of the image fragment selected by the tool [**Area Selection**] is displayed. If the area is not selected, the tool is set automatically. Figure 6.11 shows the type of the function dialogue [**Median Filter**].



Adjustment of the processing function of the median filter consists of one parameter: the radius. It is also possible to select an option **[New Image]**, in this case the result of processing will not be placed in the current panorama, it will be in the newly created image with the set name.

For arithmetic and logic operations there is an option of the second image

1.9.1 Correction

As one of the image pretreatment stages it is often necessary to remove some small objects and noise or to eliminate ruptures in lines and details. For these purposes it is possible to use one of the functions: **[Smoothing]**, **[Averaging]** or **[Median Filter]**. **[Smoothing]** function realizes Gaussian filter, which provides for the fact that the value of brightness of each pixel is calculated as a linear combination of brightness values of the pixels from its vicinity. The factors of the linear combination are calculated according to the two-dimensional normal distribution law. As adjustment of the given function the root-mean-square deviation $[\sigma]$ of normal distribution is used. **[Averaging]** function calculates the value of each pixel as an average arithmetic value of pixels from its vicinity; the vicinity radius is defined by the filter adjustment. **[Median Filter]** function realizes nonlinear filtering of the image, which provides for the fact that the value of brightness of a pixel is replaced with the median of brightness values of all the pixels of the vicinity; the vicinity radius is set by the filter adjustment.

Application of the median filter allows achieving smaller defocusing of the image in comparison with the linear Gaussian and averaging filters.

[**Sharpening**] function is intended for sharpening of the image, and realizes a method of diffuse masking. The given method provides the following. Gaussian filter is applied to the initial image. Then, the brightness of each pixel of the initial image rises by certain percent of the difference of brightness of the pixels of the initial and diffuse images. The given function has two adjustments. The root-mean-square deviation [σ] of the Gaussian filter defines the dimension of the zone where the tone changes will be shown. The smaller radius is used to underline small details. [**Degree**] defines how strong the sites of the image on the contours borders will be shaded or brightened.

[**Edge Enhancement**] function is used to select the objects borders of the image; it realizes convolution of the image by Sobel or Laplace operators. Selection of the operator is made in the corresponding dialogue.

[**Gamma correction**] function may be used to increase the image contrast; it provides nonlinear transformation of the pixels brightness of the image. Correction degree is defined by adjustment [γ].

[**Shading Correction**] function can be used for correction of non-uniformity of the image illumination if it had not been done when the picture was taken. Background calculation is carried out with the help of median filter with its radius set in the dialogue. It is necessary to set the minimum radius so that the objects of the image remain untouched. The larger the objects - the bigger the radius.

1.9.2 Binarization

For manual selection of objects on the image it is possible to use [**Binarization on the set range**] function. Binarization in this case is made on the active range in the window [**Color histograms**]. The following functions can be used only for binarization of images in gradation of grey.

[**Automatic Binarization**] function calculates a threshold of binarization on the basis of the histogram according to the level of grey. The best thing is to use it for binarization of images with bimodal histogram.

[**Adaptive Binarization**] function defines a threshold of binarization for each pixel of the image on the basis of the analysis of its vicinity. Sensitivity of binarization can be regulated in the dialogue. This function should be applied, when it is not possible to select a single threshold of binarization for the whole image.

[**Watershed**] function is used for controllable segmentation of images. It provides the following. In Geodesy the watershed is understood as the line of the surface dividing basins of two rivers. It is possible to present the image as a topological surface, where the height of a dot is defined by the pixel brightness.

Immersion modelling technique is used for construction of the watersheds, which consists in iterative immersing of the surface into water. At immersing basins are formed and watersheds are constructed at their confluence. To control the degree of segmentation the threshold of the basins depth is used. If the depth of one of the merging basin is less than the set threshold, a watershed shall

not be constructed.

After binarization the objects may be analyzed in the Thixomet PRO base module.

1.9.3 Morphology

Morphological operations are applied to binary images. Base morphological operations are [**Erosion**] and [**Dilatation**]. Erosion operation substitutes the values of the objects pixels for the values of background if there is a background pixel in the structural element. Dilatation operation on the contrary substitutes the values of background pixels for the values of the objects if there is an objects pixel in the structural element. An eight-coherent pixel area is used as a structural element. Thus during erosion the image objects are narrowed, and during dilatation - extend.

Operation [**Opening**] is a consecutive repetition of operations of erosion and dilatation, operation [**Closing**] - on the contrary, first comes dilatation, then erosion. By means of closing operation it is possible to delete small objects on the binary image. Closing operation allows to delete small pores in the objects and to smooth their borders.

In the corresponding dialogues it is possible to set the iterations quantity of the operations described above.

Operation [**EDM**] calculates Euclidean map of the image distances. The given operation results in the image being in gradation of grey with the value of each pixel to be defined by the distance to the nearest object pixel on the initial binary image.

Operation [**Skeletonization**] builds a skeleton of the binary image, specifying the objects up to the lines of 1 pixel thick.

Operation [**Filling**] fills in the pores in the image objects



1.9.4 Arithmetic and logic operations

[**Arithmetic operations**] are used for pixel by pixel processing of two images (color images or in grey gradation). Selection of operation and the second operand is made in the corresponding dialogue. The image used as the second operand, should be in the current project and coincide in the dimensions with the first one.

During the operations [**Addition**] and [**Subtraction**] if the result turns out to be less than 0, it is substituted for 0, if it is more than 254 - it is substituted for 254. During the operations [**Multiplication**] and [**Division**] the resulted range of values for all the image is reduced to the range from 0 to 254.

[**Logic Operations**] are used for pixel by pixel processing of two binary images. The image used as the second operand, should be in the current project and coincide in the dimensions with the first one.

1.10 Toolbar

[Annotations](#)  36
[Actions](#)  38

[Measuring tools](#) ³⁵
[Panorama](#) ³⁸

1.10.1 Measuring tools

- 1) Select one of manual measurements in the toolbar in the Thixomet main window:



Linear dimension

It is used for measurement of distances between two dots, or for measurement of distances on broken lines. To select a tool press the RBM in the beginning and release in the end of the measured section



Area measurement

To select a tool press the RBM, and without releasing it, lead round the measured area





Measurement of micro and macrohardness

To select a tool specify prints angles of indenter (or three dots on the circles) by pressing the RBM



Measurement of the layer depth

The Linear dimension is used for distance measurement between two selected tools  **Linear**

dimension. To select a tool select in turn two selected tools  **Linear dimension** by pressing the RBM.



Curvature radius


To select a tool specify three dots on the measured curve by pressing the RBM




Angle measurement


To select a tool specify by pressing the RBM a dot on the part of the first straight line forming the angle, then the vertex of the angle, then a dot on the part of the second straight line forming the angle. The angle is measured counter-clockwise.


- 2) Apply the selected tool by the *RBM*. In the centre of the applied tool there will be a label specifying the value of the measured dimension
- 3) If necessary - edit the applied tool by the *LBM*. When pointing the mouse tool is being changed. For editing of tools point the cursor at the border or the tool fixed point (thus the cursor is being changed); press the button of the mouse and without releasing it, lead the mouse. To move the tool without its editing, do the same operation with the area limited to the tool or its label.
- 4) To delete the tool press the *RBM* in the area limited to the tool or on its label.


The information on all applied measuring tools is displayed in the window of **Statistics of manual measurements** .


Statistics of manual measurements


Linear


Area



Micro- and macro-hardness

Layer depth


Radius of curvature

Angle measurements

Grain size

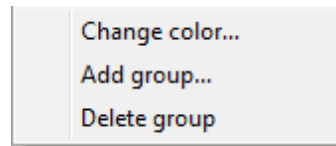


OK

Color	Group 	Number of...	Total lengt...	Mean leng...	Standard d...	Confidenc...	Relative ac...
	Group 1	20	415	20.8	4.36	1.95	9.38
	Group 2	20	257	12.8	3.5	1.57	12.2

The type of measuring tools is selected in the left part of the window, and the information about tools is displayed in the right part.

By pressing the RBM the menu opens in the left part of the window and it is possible to change color of tools of the current group box, to add or remove the group box.



To export the data of the table to MS Excel press the button **Export**

The button **Data on all project** displays the data on the applied measuring tools from all images of the current project, this button is switched by pressing the LBM in position **Data on the current image**, in this case only the tools applied on the current image will be displayed.

1.10.2 Annotations

- 1) Select one of the tools on the toolbar in the Thixomet main window:

Field of vision

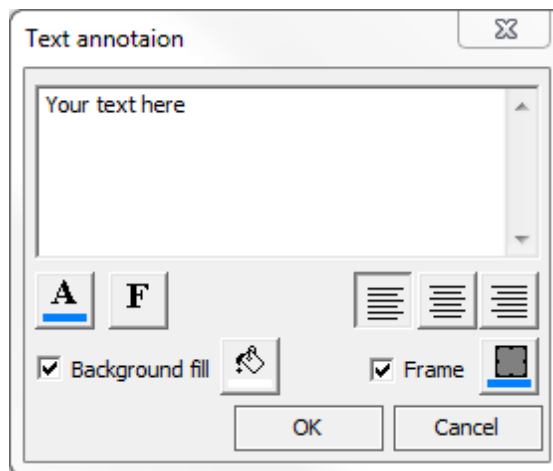
It is used for comparison of the dimensions of the constructed panorama with the dimensions of the field of vision provided by the standard. The button calls the menu to select the dimensions of the vision field. In order to select a tool, click by the RBM on the image.

Marker

It is used to superimpose the marker on the image. In order to select a tool, click by the RBM on the image.

T Text annotation

It is used to superimpose the marker on the image. In order to select a tool, click by the RBM on the image.



➤ To select color of the text press



➤ To select font press



➤ To select alignment use buttons



➤ To fill the area of the text annotation set the tag **Fill**, to select the fill color use the button



➤ To display the borders of the text annotation area set the tag in the field **Frame**, to select the color of borders use the button



↖ Arrow

It is used to apply arrows on the image. To select a tool press the RBM in the beginning and release in the end of the arrow.

- 2) Apply the selected tool by the *RBM*. In the centre of the applied tool there will be a label specifying the value of the measured dimension.
- 3) If necessary - edit the applied tool by the *LBM*. When pointing the mouse tool is being changed. For editing of tools point the cursor at the border or the tool fixed point (thus the cursor is being changed); press the button of the mouse and without releasing it, lead the mouse. To move the tool without its editing, do the same operation with the area limited to the tool or its label.
- 4) To delete the tool press the *RBM* in the area limited to the tool or on its label.

1.10.3 Actions

The tools of the window **Action** and work with them is described in the [Recording of actions](#)⁴².

1.10.4 Panorama



Initial image



Blinking mode



Show 3D model



Scrolling mode



Objects selection mode



Clear background



To convert in grayscale



Area highlight



Area highlight by ellipse



Area delete



Color selection for filling and pencil



Sponge



Pencil



Filling of selected area



Filling of one-color area



Zoom in



Initial dimension



Zoom out



Zoom in of selected area



Delete all



Cancel

1.11 Selection of standard for analysis

The standard selection is carried out in the project already created.



- 1) In the Thixomet main window select the menu item **Analysis > Selection of standard**, the window with the list of accessible standards will open
- 2) Select the standard you are interested in by double clicking the LBM, and its name it will be displayed in heading of the window containing the image

1.12 Report call





- 1) In the Thixomet main window select the menu item **Analysis > Selection of standard**, the window with the list of accessible standards will open
- 2) Under the name of the current standard click the LBM on the word **Report**, and the window containing the report will open

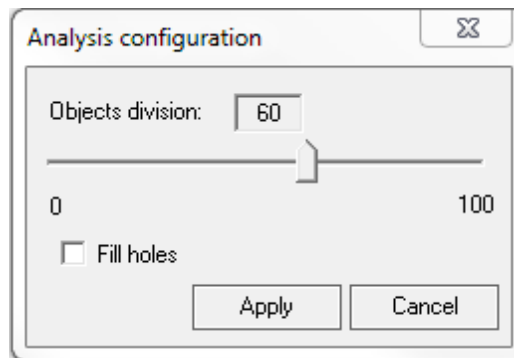
1.13 Selection of objects by color

Selection of objects by color is made on the image already available.

- 1) Call the window **Color histograms (CTRL+G)**
- 2) Press key Ctrl and click the interesting object twice
- 3) In the appeared window enter the name for the range, press the button **Apply**, the range will be automatically created in the window **Color histograms**
- 4) Switch on the **Blinking Mode**  estimate compliance of the filling with the real dimensions of the object. The blinking mode will work until of the button  is pressed again
- 5) If necessary, edit the range, for this purpose it is necessary to lead the mouse cursor onto the range border in the window **Color histograms** (thus the border will turn red), and having pressed the mouse key, move the border to the required place. Range editing to be carried out on the panorama, for this purpose press the key Ctrl and click once by the left button of mouse (LBM) on the object to add its color to the range, and RBM - to subtract.

1.14 Thixomet Standard base module algorithm

- 1) Create new project **Ctrl+N**  ([More](#)^[67])
- 2) Create the image for analysis ([More](#)^[67])
- 3) Create necessary ranges according to grey level ([More](#)^[39]) .
- 4) Start the analysis  (**CTRL+A**), borders of objects will be recognized
- 5) Switch on the **Blinking Mode**  , estimate compliance of the filling with the real dimensions of the object. The blinking mode will work until of the button  is pressed again
- 6) If the recognized borders do not coincide with real ones, it is necessary to apply to the **Setting**

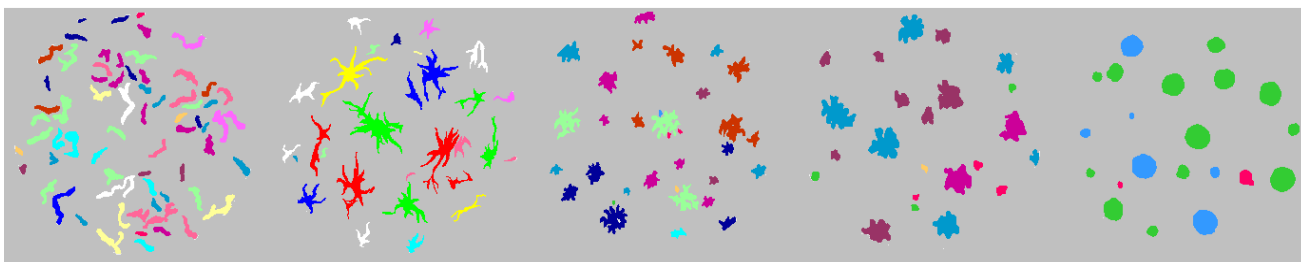


- 7) Parameter **Partitioning of the objects stuck together** allows separating of the objects which are close to each other. The more the parameter value, the stronger the objects will divide
- 8) Set the tag **Filling of objects** to take into account unfilled areas inside the investigated objects as their parts

1.15 Partitioning of the objects by metric parameters

- 1) During Partitioning of the objects by metric parameters it is possible to use [Actions record](#)^[42]
- 2) Partitioning is exercised on the recognized image ([More](#)^[40]) .

Let's examine in detail the process of partitioning the objects on the following example. The drawing has the recognized image with various forms of graphite inclusions. The Roman figures correspond to the designations of forms of graphite inclusions according to ISO 945.

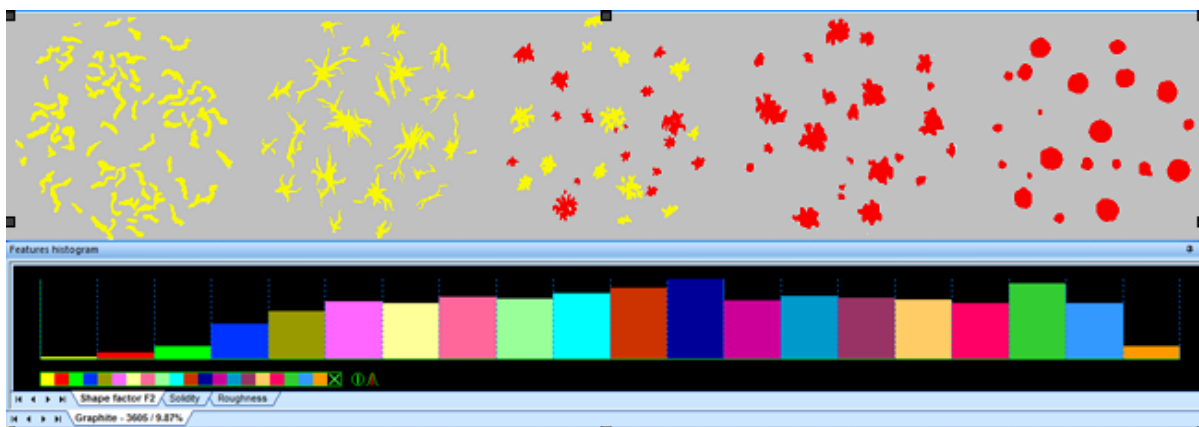


3) Select the parameter to divide the investigated objects.

It is visible, that with increase in number from II to VI (from the left to the right) the form of graphite inclusions is increasingly aspiring to the circle form, and this is the tendency to be used for their primary partitioning. The factor of F2form is calculated as the relation of the object area to the area of the described circle, that is, this parameter is the best to accomplish the task.

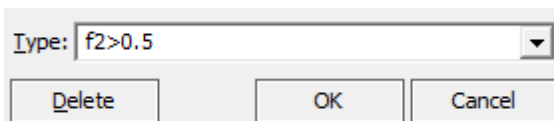
4) Divide the investigated objects according to the selected parameter.

Let's separate VI, V and a part of IV form from other graphite inclusions. For this purpose on the histogram of distribution by properties (opens by pressing Ctrl+F) it is necessary to jump to insert "Factor of F2form" and to create two ranges: from 0 to 0,5 and from 0,5 to the largest F2 values.

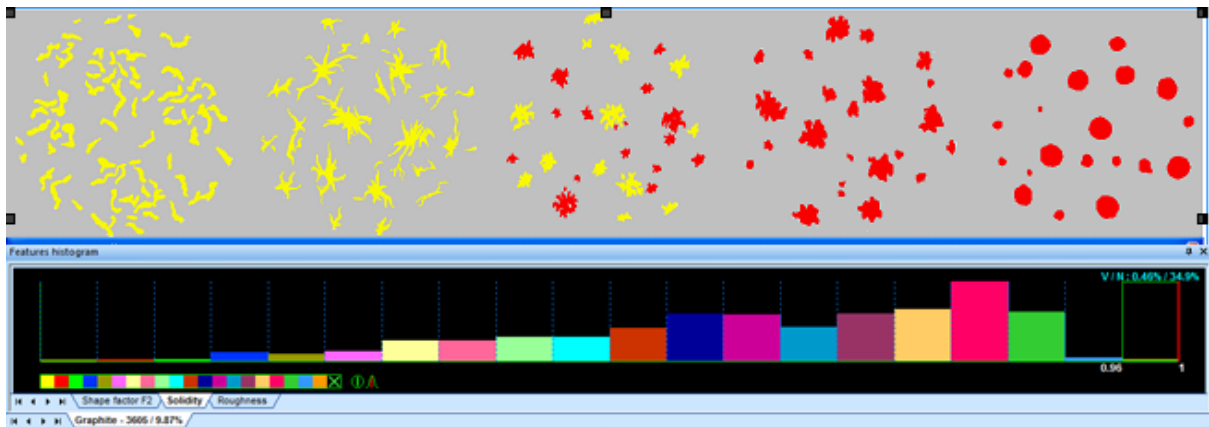


5) Give names to the created ranges.

For this purpose it is necessary to click twice by the LBM on the range, for which the type of objects is reassigned, and to enter the new name in the open window and to press the button **Apply**. In this specific case the range will be named "F2 > 0,5".



For convenience of the further work, we reassign "F2 < 0,5" to the remained inclusions of the "Graphite" type, such reassignment can help to avoid mess in the realization of complicated multistage algorithms. After the new type is created, there will appear a new insert in the bottom line of the window [**Histogram according properties**].






- 6) Continue to execute items 2-4 if the further partitioning is necessary

Further, from the group box of objects with the name “F2> 0,5” we separate graphite inclusions of form VI. It is visible, that inclusions of this group box are the most compact; therefore for their partitioning it is necessary to use “Solidity” parameter. On the histogram of distribution of objects by properties it is necessary to jump to the corresponding insert and to create a range of values from 0,87 and more, then the graphite inclusions of form VI will be painted in the color identical to the color of the range just created. Now we assign type VI to all the objects with solidity of more than 0,87.

The above action has allowed to separate unequivocally graphite inclusions of form VI, using parameters “Factor of F2form” and “Solidity”. Thus, it is possible to allocate absolutely any objects under the combination of several parameters that allows to create the techniques of the images analysis or to realize the standards already existing.

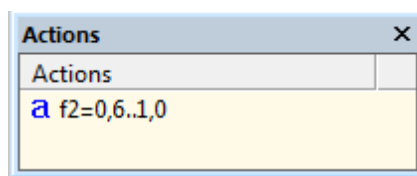
1.16 Actions record

- 1) Record of actions is used for preservation of the operations with recognized objects by means of the window **Histogram by properties (Ctrl+F)**
- 2) To start the actions record press the button **Start action record**  in the **Thixomet** main window
- 3) To pause the record press the button **Pause action record**  in the **Thixomet** main window
- 4) To stop the record press the button **Stop action record**  in the **Thixomet** main window, thus there will appear the window:
- 5)

- 6) Enter the action name and press the button **Save**

To use the action written down earlier:


- 1) Open the **Action** window (Mode> Operating windows> Actions)

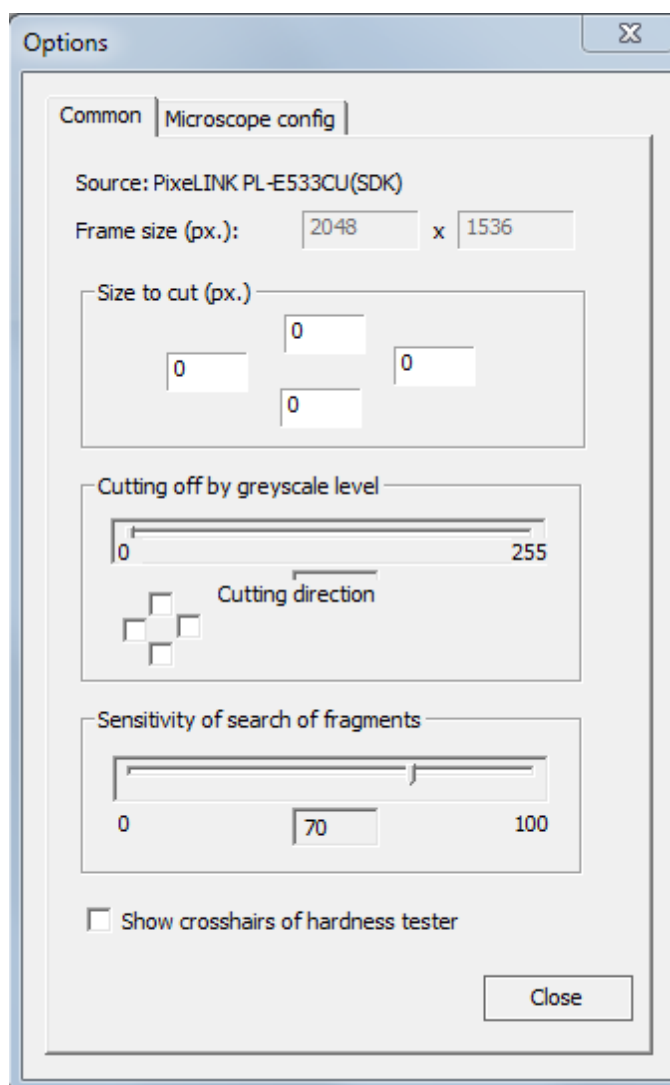


2) Select the required action by double click of the LBM

It is necessary to note, that the action can be applied only to the color range, with the same name under which it was created.

1.17 Settings of the window Translation from the camera

It is called by pressing the button  in the window **Translation from the camera**



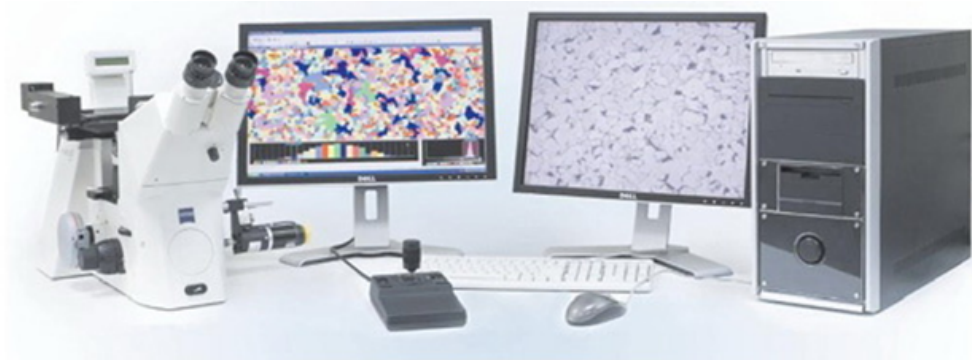
- In the field **Source** image source is deduced - name of the camera or the “file system” if the image is open from the disk
- In the field **Dimension of the vision field** the image dimension in pixels is deduced in the window **Translation from the camera**
- In the group box **Scissoring in pixels** the number of pixels is shown which will be cut off from the image at its capture in the main window.
- Group box [Scissoring according to the grey level](#)¹⁷
- Group box [Sensitivity of the fragments search](#)¹⁸
- If there is a tag **Display hardness tester crosshair**, there will be red cross on the image used for planning of prints indenter on the hardness tester

Work with standards

Part



2 Work with standards



In this part you will get trained in the work with the standards in the environment of the Thixomet images analyzer.

List of standards:

[ASTM 1382, ASTM E112](#) ⁴⁷

[DIN 50601](#) ⁴⁷

[ASTM 1245](#) ⁴⁹

[ASTM E45](#) ⁵³

[DIN 50602](#) ⁵⁶

[ISO 4967](#) ⁵⁷

[Bar charts](#) ⁶⁰

2.1 Dimension of grain

[Algorithm of work](#) ⁴⁷

[Technique](#) ⁴⁷






[Standard settings](#) ⁴⁷

[Manual measurement](#) ⁴⁸

2.1.1 Technique

- There should be not less than 500 grains on the analyzed image
- Small grains (differing from the average dimension by 5-6 points) should not be taken into account


2.1.2 Algorithm of work

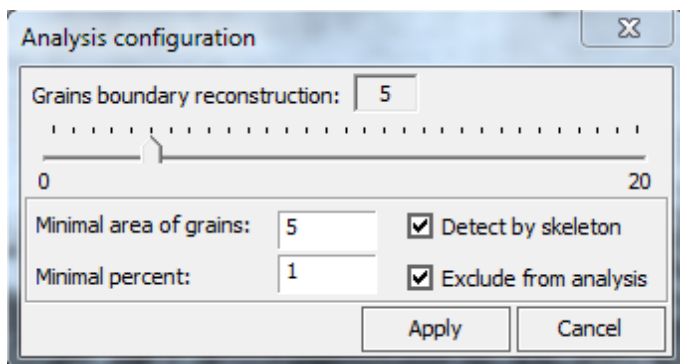
- 1) Create new project **Ctrl+N**  ([More](#) ⁶⁴)
- 2) Select one of the standards according to the dimension of grain ([More](#) ³⁹).
- 3) If necessary, familiarize with the standard requirements ([More](#) ⁴⁷).
- 4) Create the image for analysis ([More](#) ⁶⁴)
- 5) Create a range according to the grey level for grain ([More](#) ³⁹).
- 6) Start the analysis  (**CTRL+A**)
- 7) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 8) If the recognition results do not satisfy you, address the standard setting  ([More](#) ⁴⁷)
- 9) Call the report ([More](#) ³⁹)

If automatic recognition of grains' borders is impossible, it is necessary to use the tool [Dimension of grain](#) ⁴⁸

2.1.3 Standard settings

This section specifies the settings of the following standards: GOST 5639, DIN 50601 and ASTM 1382, ASTM E112



Let's examine the standard settings .

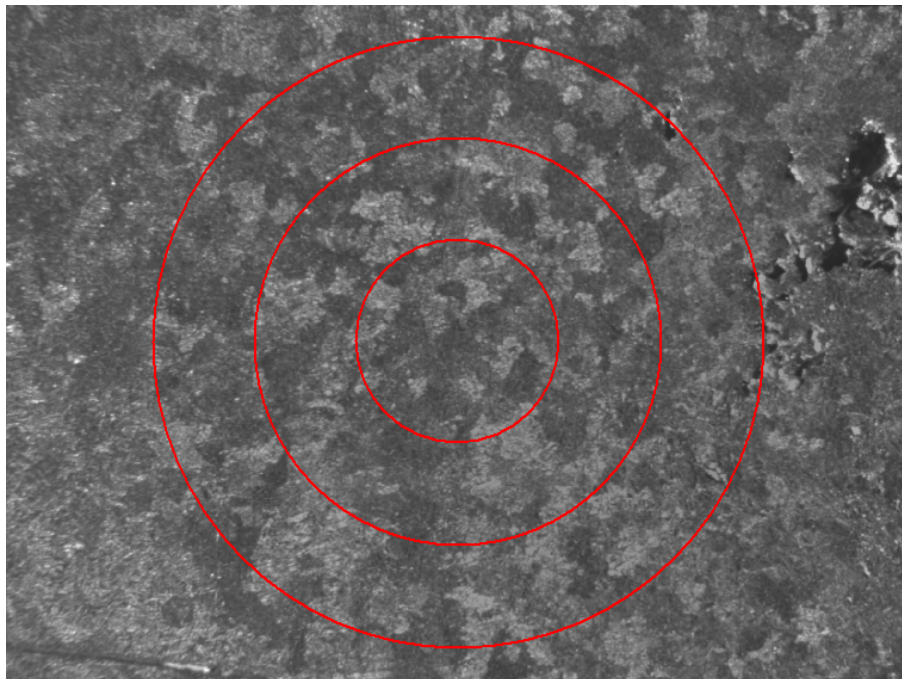


After whatever changes of parameters in the window **Standard setting** it is necessary to press the button **Apply**.

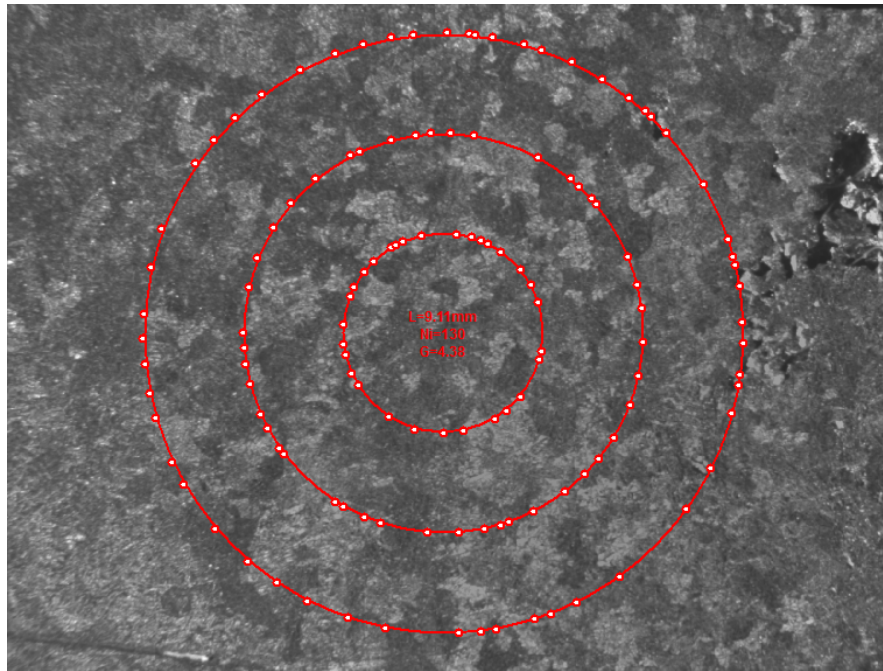
- 1) The slider **Reconstruction of the grains' borders** allows to restore poorly treated borders, the more is value of parameter, the more borders are recognized
- 2) Parameter **Minimum area** allows to set the area where from the grains will not be taken into consideration during the analysis
- 3) If there is the tag **Calculation by skeleton** the borders between grains will be specified to 1 pixel
- 4) Parameters **Minimum percent** and to **Exclude from analysis** are accessible only in standards GOST 5639 and DIN 50601. If the tag is set **Exclude from analysis** the report will not detail the grain numbers which volume percent will be less than the value entered in the field **Minimum percent**. If the tag is not set, in the histogram in the grain numbers report which volume percent is less than the value entered in the field; the **Minimum percent** will be marked in red color.

2.1.4 Manual measurement

- 1) Create new project **Ctrl+N**  ([More](#)⁶⁴)
- 2) Select one of the standards according to the dimension of grain ([More](#)³⁹)
- 3) Create the image for the analysis ([More](#)⁶⁴)
- 4) Select in the **Thixomet** main window the tool **Dimension of grain**  and by pressing the RBM set it on the panorama.



- 5) By the LBM specify the places of crossing the borders of grains and secants of circles



6) Call the report ([More](#)³⁹)

2.2 Nonmetallic inclusions

List of standards:

[ASTM 1245](#)⁴⁹

[ASTM E45](#)⁵³

[DIN 50602](#)⁵⁶

[ISO 4967](#)⁵⁷

2.2.1 ASTM E 1245

Select the analysis version:

[Analysis of the panoramic image](#)⁵⁰

[Analysis from field to field](#)⁵⁰ (analysis of separate fields without panorama construction)

[Technique](#)⁵⁰






[Standard settings](#)⁵¹

[Monitoring of measurements](#)⁵²










2.2.1.1 Technique

- During the evaluation of separate vision fields the fields should be selected by means of “joint to joint”, it is impossible to miss the fields or to select them with “tipping over”
- The evaluation can be made on the panorama of the representative area

2.2.1.2 Analysis of the panoramic image

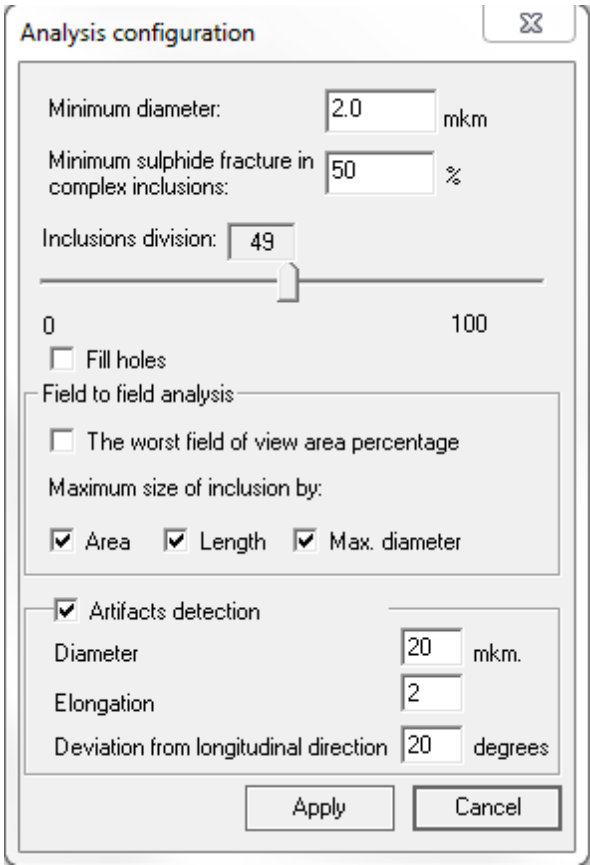
- 1) Create new project **Ctrl+N**  ([More](#)^[6])
- 2) Select standard **ASTM E 1245** ([More](#)^[39]).
- 3) If necessary, familiarize with the standard requirements ([More](#)^[50]).
- 4) Create the image for analysis ([More](#)^[6])
- 5) Select by color all investigated types of inclusions (for example, sulphides and oxides). ([More](#)^[39]).
- 6) Start the analysis  (**CTRL+A**)
- 7) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 8) If the recognition results do not satisfy you, address the standard setting  ([More](#)^[51])
- 9) Call the report ([More](#)^[39])

2.2.1.3 Analysis from field to field

- 1) Create new project **Ctrl+N**  ([More](#)^[6])
- 2) Select standard **ASTM E 1245** ([More](#)^[39]).
- 3) If necessary, familiarize with the standard requirements ([More](#)^[50]).
- 4) Create the image for analysis ([More](#)^[6])
- 5) Select by color all investigated types of inclusions (for example sulphides and oxides) ([More](#)^[39]).
- 6) Start the analysis  (**CTRL+A**)
- 7) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 8) If the recognition results do not satisfy you, address the standard setting  ([More](#)^[51])
- 9) In the **Thixomet** main window press the button **Send analysis data to the report**   (A), the window with an interim report will open
- 10) Without closing the window with the interim report, begin construction of the new image in the same project.
- 11) After construction of the new image the grey level ranges and standard settings will be automatically transferred. Carry out the analysis  (**CTRL+A**) and press the button **Send analysis data to the report**  (A).
- 12) Carry out actions 10-11 until the sufficient area of the sample is not yet estimated. To trace the measurement results open the window **Monitoring of measurements** (**CTRL+M**) ([More](#)^[52]), there will be an information in it after the departure of three vision fields to the report.
- 13) Call the report ([More](#)^[39])

2.2.1.4 Standard settings

Let's examine the **Standard settings** .



Analysis configuration

Minimum diameter: 2.0 mkm

Minimum sulphide fracture in complex inclusions: 50 %

Inclusions division: 49

0 100

☐ Fill holes

Field to field analysis

☐ The worst field of view area percentage

Maximum size of inclusion by:

☒ Area ☒ Length ☒ Max. diameter

☒ Artifacts detection

Diameter: 20 mkm.

Elongation: 2

Deviation from longitudinal direction: 20 degrees

Apply Cancel

After changing any parameters in the window **Analysis configuration** of the standard it is necessary to press the button **Apply**.

- 1) In the field **Minimum diameter** enter the diameter, with which the inclusion will be taken into consideration at the analysis.
- 2) In the presence of complex inclusions (oxy sulfides) in the field Minimum share of sulphide in the **complex inclusions** enter the sulphide percent in the inclusion from which the inclusion will be recognized as oxy sulfide. If the sulphide share in the inclusion is less than the specified value, it will be recognized as oxide.
- 3) Parameter **Division of bound together inclusions** allows to separate the inclusions which are close to each other. The more the value of the parameter is, the stronger the inclusions will be divisible.
- 4) Option **Filling of objects** allows to take into account unfilled areas inside the investigated objects as their parts
- 5) In the group box **Field-to-Field analysis** set the tag **Field with the maximum impurity** if you want to have information on the most polluted field in the report.
- 6) In the group box **Field-to-Field analysis** set the tags at those parameters, the information about

which you want to see in the report

2.2.1.5 Monitoring of measurements

The window **Monitoring of measurements** is called by pressing a combination of keys **CTRL+M**.

The monitoring window has two rows of bookmarks, the lower row allows to select an object of structure for which the statistical parameter is selected in the upper row, which change should be visualized as a function of the quantity of investigated fields.

Fig. 1 shows an example of the diagram reflecting the change of relative error for HB volume fraction. Parameter RA reflects uniformity of distribution of inclusions, the less its value is, the higher the reliability of the received data is.

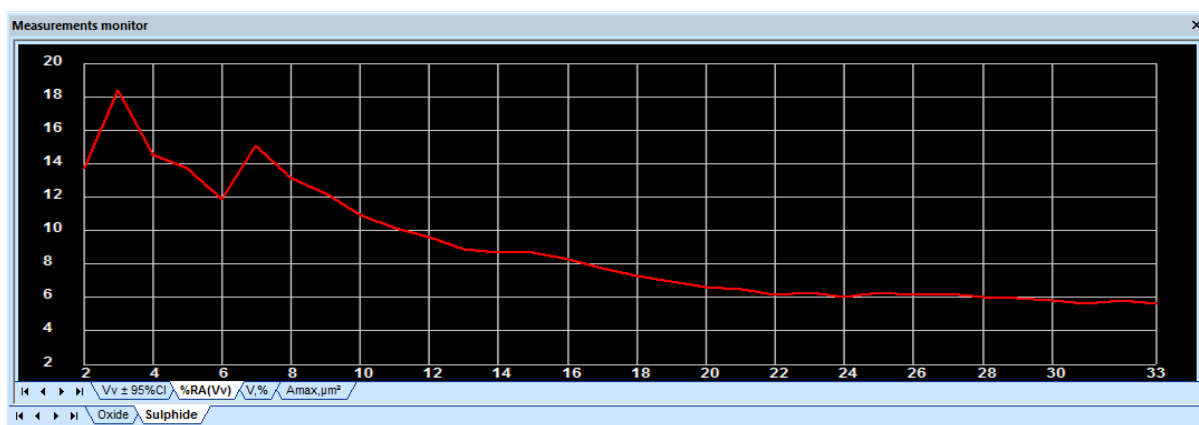


Fig. 1

Fig. 2 shows the diagram reflecting change of the average value of the volume fraction (red), the confidence interval is shown in blue color. When the authentic result is achieved the average value of the volume fraction should become a constant.

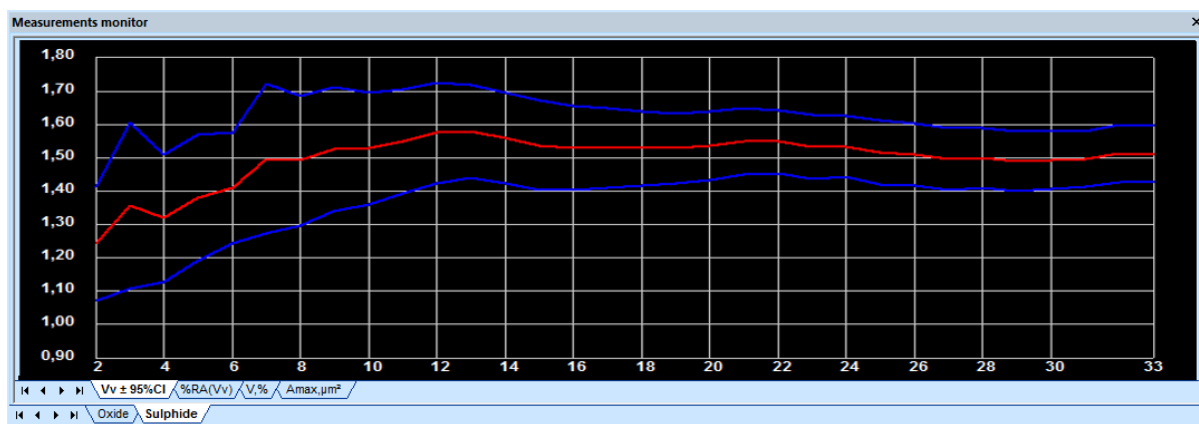



Fig. 2

2.2.2 ASTM E 45

Select the method:

[Method A](#)  - evaluation of the most polluted fields

[Method D](#)  - evaluation of each field















[Technique](#) 

[Standard settings](#) 


2.2.2.1 Technique

- It is necessary to evaluate 6 samples from one melting
- On each sample the area 200 mm^2 is subject to evaluation
- The size of panorama for the analysis should be not less than $0,5 \text{ mm}^2$
- If the panorama of the polluted place does not exceed the dimension of the estimated scale, the missing area will be taken into consideration as an open field (only for the analysis by method A)

2.2.2.2 Method A










- 1) Create new project **Ctrl+N**  ([More](#) )
- 2) Select standard **ASTM E 45** ([More](#) )
- 3) If necessary, familiarize with the standard requirements ([More](#) )
- 4) Select the place polluted by nonmetallic inclusions on the slice
- 5) Create an image for analysis ([More](#) )
- 6) Open the standard settings  and set the tag **Field with the maximum impurity**
- 7) Select by color all investigated types of inclusions (for example sulphides and oxides). ([More](#) )
- 8) Start the analysis  (**CTRL+A**)
- 9) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 10) If the recognition results do not satisfy you, address the standard setting  ([More](#) )
- 11) In the **Thixomet** main window press the button **Send analysis data to the report**  (A), the window with an interim report will open
- 12) Select the following place polluted by nonmetallic inclusions on the slice. If all inclusions for analysis you are interest in have already been estimated, pass to item 16.
- 13) Without closing the window with the interim report, begin construction of the new image in the same project.
- 14) After construction of the new image the grey level ranges and standard settings will be automatically transferred. Carry out the analysis  (**CTRL+A**) and press the button **Send**


analysis data to the report (A).

- 15) Carry out actions 12-14 until all the places polluted by nonmetallic inclusions on the slice are evaluated.
- 16) After evaluation of all places polluted by nonmetallic inclusions on the current sample, locate the next sample on the microscope stage and, without closing the window with the interim report, begin construction of the new image in the same project.
- 17) Enter the standard setting  and specify the number of the current sample ([More](#)^[55])
- 18) Carry out action 8-17 until all 6 melting samples are evaluated
- 19) Call the report ([More](#)^[39])

There is a possibility of evaluation of panoramic images of all the area required by the standard, in this case the analysis is carried out similarly to method D ([More](#)^[54]), but in item 5 it is necessary to set the tag **Field with the maximum impurity**.

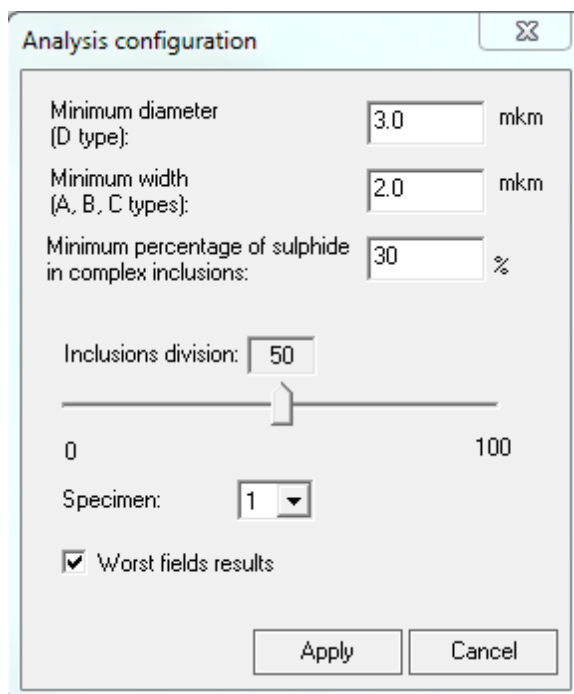
2.2.2.3 Method D

- 1) Create new project **Ctrl+N**  ([More](#)^[6])
- 2) Select standard **ASTM E 45** ([More](#)^[39]).
- 3) If necessary, familiarize with the standard requirements ([More](#)^[53])
- 4) Create an image for analysis ([More](#)^[6])
- 5) Open the standard settings  and make sure the tag **Field with the maximum impurity** isn't set
- 6) Select by color all investigated types of inclusions (for example sulphides and oxides). ([More](#)^[39])
- 7) Start the analysis  (**CTRL+A**)
- 8) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 9) If the recognition results do not satisfy you, address the standard setting  ([More](#)^[55])
- 10) In the **Thixomet** main window press the button **Send analysis data to the report**  (A), the window with an interim report will open
- 11) Without closing the window with the interim report, begin construction of the new image in the same project.
- 12) After construction of the new image the grey level ranges and standard settings will be automatically transferred. Carry out the analysis  (**CTRL+A**) and press the button **Send analysis data to the report**  (A).
- 13) Carry out actions 11-12 until all the places polluted by nonmetallic inclusions on the slice are evaluated.
- 14) After evaluation of 200 mm² on the current sample, locate the next sample on the microscope stage and, without closing the window with the interim report, begin construction of the new image in the same project.

- 15) Enter the standard setting  and specify the number of the current sample ([More](#)⁵⁵)
- 16) Carry out action 7-15 until all 6 melting samples are evaluated
- 17) Call the report ([More](#)³⁹)

2.2.2.4 Standard settings

Let's examine the standard settings .



The image shows a software window titled "Analysis configuration". It contains several input fields and a slider. The "Minimum diameter (D type):" field is set to 3.0 mk.m. The "Minimum width (A, B, C types):" field is set to 2.0 mk.m. The "Minimum percentage of sulphide in complex inclusions:" field is set to 30 %. The "Inclusions division:" is a slider set to 50, with a range from 0 to 100. The "Specimen:" dropdown menu is set to 1. There is a checked checkbox for "Worst fields results". At the bottom are "Apply" and "Cancel" buttons.

Minimum diameter (D type):	3.0	mk.m
Minimum width (A, B, C types):	2.0	mk.m
Minimum percentage of sulphide in complex inclusions:	30	%
Inclusions division:	50	
Specimen:	1	
<input checked="" type="checkbox"/> Worst fields results		

After whatever changes of parameters in the window **Standard setting** it is necessary to press the button **Apply**.

- 1) In the field **Minimum diameter** (for inclusions of type D) enter the diameter, with which the globular inclusions will be taken into consideration at the analysis.
- 2) In the field **Minimum thickness** (for inclusions of types A, B and C) enter the dimension, with which the inclusions will be taken into consideration at the analysis.
- 3) In the presence of complex inclusions (oxy sulfides) in the field Minimum share of sulphide in the **complex inclusions** enter the sulphide percent in the inclusion from which the inclusion will be recognized as oxy sulfide. If the sulphide share in the inclusion is less than the specified value, it will be recognized as oxide.
- 4) Parameter **Division of bound together inclusions** allows to separate the inclusions which are close to each other. The more the value of the parameter is, the stronger the inclusions will be divisible.
- 5) In the dropdown list **Sample number** select the sample number. The sample number should be changed with transition to the analysis of the next sample.
- 6) If the tag **Field with the maximum impurity** is set, the analysis will be carried out by method A (evaluation of the most polluted fields), otherwise by method D (evaluation of each field).

2.2.3 DIN 50602

[Algorithm of work](#)  ⁵⁶



















[Technique](#)  ⁵⁶

[Standard settings](#)  ⁵⁶

2.2.3.1 Technique

- It is necessary to evaluate 6 samples from one melting
- On every sample the area of 160 mm² is subject to evaluation

2.2.3.2 Algorithm of work

- 1) Create new project **Ctrl+N**  ([More](#)  ⁵⁶)
- 2) Select standard **DIN 50602** ([More](#)  ³⁹).
- 3) If necessary, familiarize with the standard requirements ([More](#)  ⁵⁶)
- 4) Create an image for analysis ([More](#)  ⁶)
- 5) Open the standard settings  and select method K for analysis
- 6) Create a range by level for all investigated types of inclusions (for example sulphides and oxides). ([More](#)  ³⁹)
- 7) Start the analysis  (**CTRL+A**)
- 8) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 9) If the recognition results do not satisfy you, address the standard setting  ([More](#)  ⁵⁶)
- 10) In the **Thixomet** main window press the button **Send analysis data to the report**  (A), the window with an interim report will open
- 11) Without closing the window with the interim report, begin construction of the new image in the same project.
- 12) After construction of the new image the grey level ranges and standard settings will be automatically transferred. Carry out the analysis  (**CTRL+A**) и нажмите кнопку **Отправить данные анализа в отчет**  (A).
- 13) Carry out actions 11-12 until all the places polluted by nonmetallic inclusions on the slice are evaluated.
- 14) After evaluation of 100 mm² on the current sample, locate the next sample on the microscope stage and, without closing the window with the interim report, begin construction of the new image in the same project.
- 15) Enter the standard setting  and specify the number of the current sample ([More](#)  ⁵⁶)
- 16) Carry out action 7-15 until all 6 melting samples are evaluated
- 17) Call the report ([More](#)  ³⁹)

2.2.3.3 Standard settings

Let's examine the standard settings :

Analysis configuration

Min. diameter: 0.0 microns

Method K: 4

Specimen: 1

Inclusions division: 40

0 100

Mark out 10 largest inclusions.

Artifacts detection

Diameter: 50 microns

Elongation: 2

Deviation from longitudinal direction: 20 degrees

Apply Cancel

After whatever changes of parameters in the window **Standard setting** it is necessary to press the button **Apply**.

- 1) In the dropdown list **Method K** select the method according to which the evaluation will be carried out
- 2) In the dropdown list **Sample number** select the number of the sample. The sample number should be changed at transition to the analysis of the next sample.
- 1) Parameter **Division of bound together inclusions** allows to divide the inclusions which are close to each other. The more the value of the parameter is, the stronger the inclusions will be divisible.
- 3) In the field **Select by frame ___ the largest inclusions** enter the quantity of inclusions.
- 4) In the group box Recognition of artefacts enter:
 - In the field **Diameter** enter diameter of the slice defect
 - In the field **Elongation** enter elongation of the slice defect
 - In the field the **Deviation from the pass line** enter an angle of an inclination of the slice defect

2.2.4 ISO 4967

Select the method:

[Method A](#)⁵⁸ - evaluation of the most polluted fields

[Method B](#)⁵⁹ - evaluation of each field



















[Technique](#)⁵⁸

[Standard settings](#)

2.2.4.1 Technique

- It is necessary to evaluate 6 samples from one melting
- On each sample the area, 200 mm² is subject to evaluation
- The size of panorama for the analysis should be not less than 0,5 mm²
- If the panorama of the polluted place does not exceed the dimension of the estimated scale, the missing area will be taken into consideration as an open field (only for the analysis by method A)











2.2.4.2 Method A

- 1) Create new project **Ctrl+N**  ([More](#) )
- 2) Select standard **ISO 4967** ([More](#) )
- 3) If necessary, familiarize with the standard requirements ([More](#) )
- 4) Select the place polluted by nonmetallic inclusions on the slice
- 5) Create an image for analysis ([More](#) )
- 6) Open the standard settings  and make sure the tag **Field with the maximum impurity** is set
- 7) Select by color all investigated types of inclusions (for example, sulphides and oxides). ([More](#) )
- 8) Start the analysis  (**CTRL+A**)
- 9) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 10) If the recognition results do not satisfy you, address the standard setting  ([More](#) )
- 11) In the **Thixomet** main window press the button **Send analysis data to the report**  (A), the window with an interim report will open
- 12) Select the next place polluted by nonmetallic inclusions on the slice. If all inclusions for the analysis have already been evaluated, pass to action 16.
- 13) Without closing the window with the interim report, begin construction of the new image in the same project.
- 14) After construction of the new image the grey level ranges and standard settings will be automatically transferred. Carry out the analysis  (**CTRL+A**) and press the button **Send analysis data to the report**  (A).
- 15) Carry out actions 12-14 until all the places polluted by nonmetallic inclusions on the slice are evaluated.
- 16) After evaluation of all the places polluted by nonmetallic inclusions on the current sample, locate the next sample on the microscope stage and, without closing the window with the interim report, begin construction of the new image in the same project.
- 17) Enter the standard setting  and specify the number of the current sample ([More](#) )
- 18) Carry out action 8-17 until all 6 melting samples are evaluated
- 19) Call the report ([More](#) )

The evaluation of panoramic images of the entire area required by the standard is possible, in this case

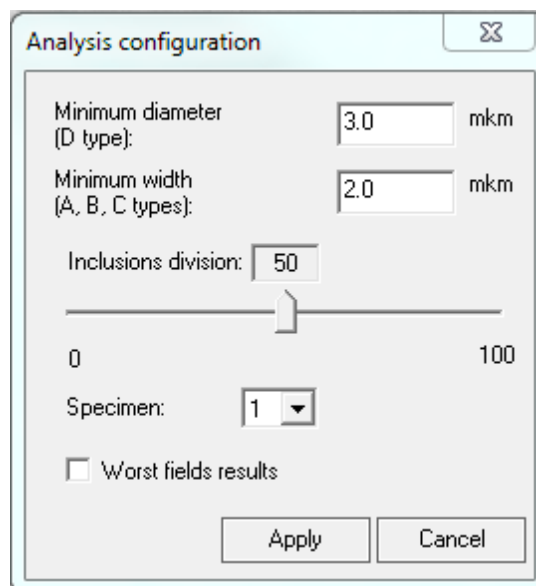
the analysis is carried out similarly to method B ([More](#)^[59]), but in item 5 it is necessary to set the tag **Field with the maximum impurity**.

2.2.4.3 Method B

- 1) Create new project **Ctrl+N**  ([More](#)^[6])
- 2) Select standard **ISO 4967** ([More](#)^[39]).
- 3) If necessary, familiarize with the standard requirements ([More](#)^[58])
- 4) Create an image for analysis ([More](#)^[6])
- 5) Open the standard settings  and make sure the tag **Field with the maximum impurity** is set
- 6) Select by color all investigated types of inclusions (for example sulphides and oxides). ([More](#)^[39])
- 7) Start the analysis  (**CTRL+A**)
- 8) Switch on the **Blinking Mode** , estimate the adequacy of the recognized borders to the real ones of the grains. The **Blinking Mode** will work unless the button  is pressed again
- 9) If the recognition results do not satisfy you, address the standard setting  ([More](#)^[59])
- 10) In the **Thixomet** main window press the button **Send analysis data to the report**  (A), the window with an interim report will open
- 11) Without closing the window with the interim report, begin construction of the new image in the same project.
- 12) After construction of the new image the grey level ranges and standard settings will be automatically transferred. Carry out the analysis  (**CTRL+A**) and press the button **Send analysis data to the report**  (A).
- 13) Carry out actions 11-12 until all the places polluted by nonmetallic inclusions on the slice are evaluated.
- 14) After evaluation of 200 mm² on the current sample, locate the next sample on the microscope stage and, without closing the window with the interim report, begin construction of the new image in the same project.
- 15) Enter the standard setting  and specify the number of the current sample ([More](#)^[59])
- 16) Carry out action 7-15 until all 6 melting samples are evaluated
- 17) Call the report ([More](#)^[39])

2.2.4.4 Standard settings

Let's examine the standard settings .








After whatever changes of parameters in the window **Standard setting** it is necessary to press the button **Apply**.

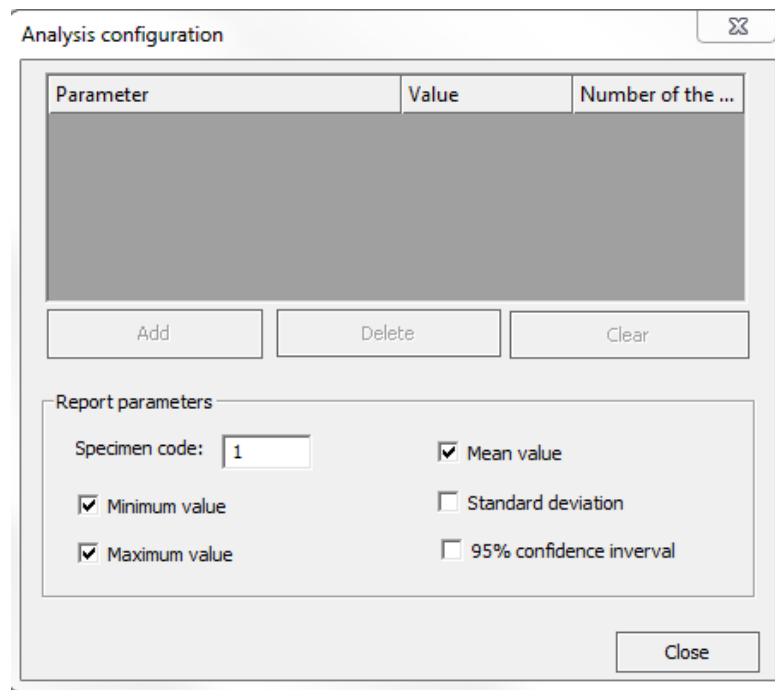
- 1) In the field **Minimum diameter (for inclusions of type D)** enter the diameter with which the globular inclusions will be taken into consideration at the analysis.
- 2) In the field **Minimum thickness (for inclusions of types A, B and C)** enter the dimension, with which the inclusions will be taken into consideration at the analysis.
- 3) Parameter **Division of bound together inclusions** allows to separate the inclusions which are closely to each other. The more the value of the parameter is, the stronger the inclusions will be divisible.
- 1) In the field **Sample number** specify the sample number. The sample number should be changed at transition to the analysis of the next sample.
- 2) If the tag **Field with the maximum impurity** is set, the analysis is carried out according to method A (evaluation of the most polluted fields), otherwise - by method D (evaluation of each field).


2.3 Bar charts

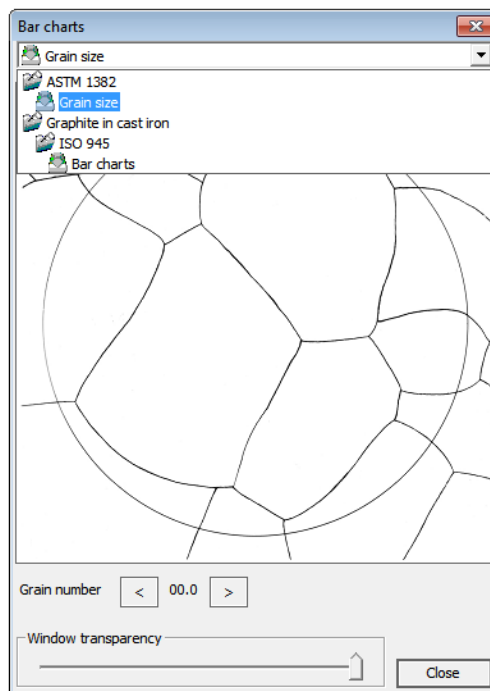
[Algorithm of work](#) 

2.3.1 Algorithm of work

- 1) Create new project **Ctrl+N**  ([More](#) )
- 2) Select the technique **Standard scales** ([More](#) )
- 3) Create an image ([More](#) )
- 4) Open standard settings 

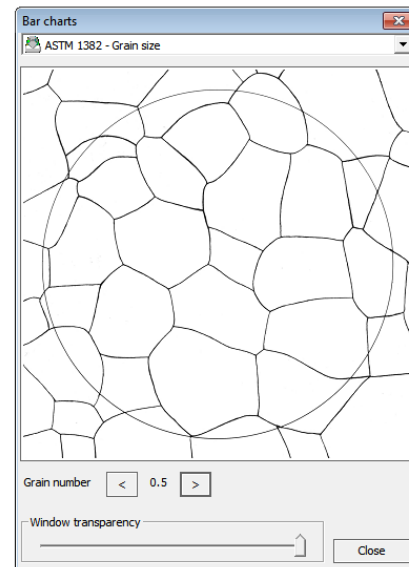
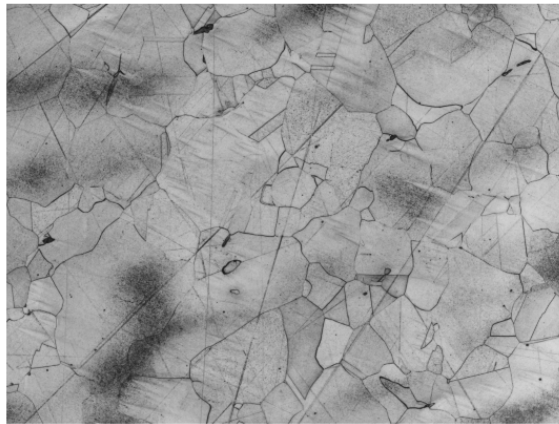


- 5) Open **Standard scales** , in the upper popup menu of the window **Standard scales** and select the standard according to which the evaluation will be carried out (on the example of ISO 945)

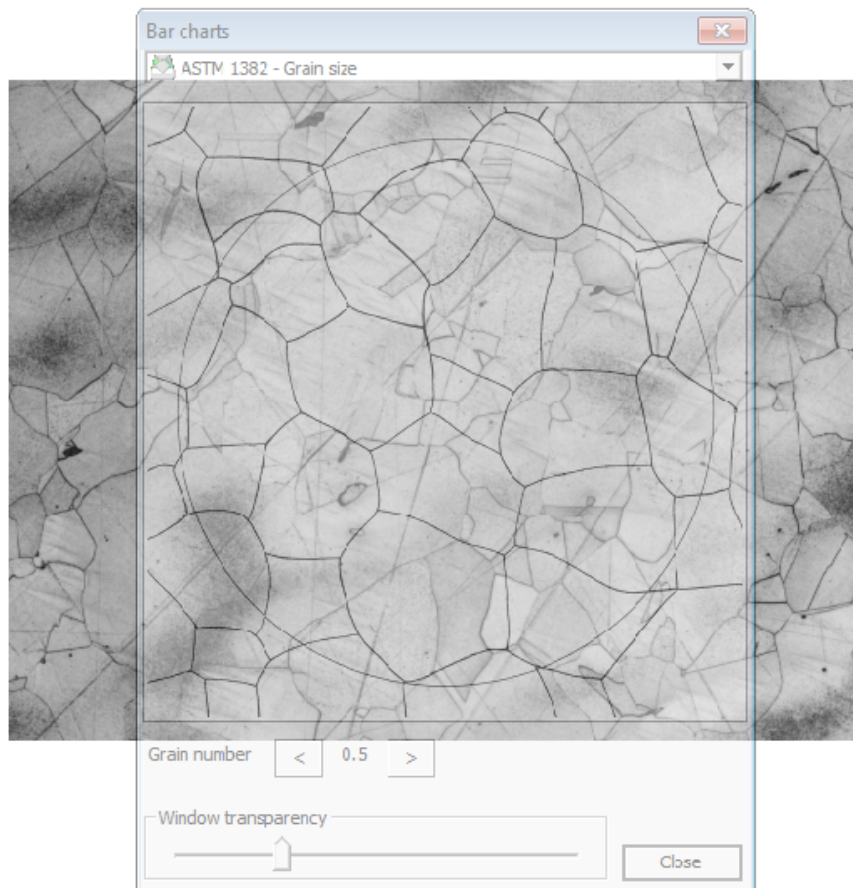


- 6) Select the value of the evaluated parameter with which the image on the reference scales will be the closest to the estimated one. During the evaluation it should be noted that the panorama scale is

equal to the scale on the reference scales.




- 7) For convenience of comparison in the window **Standard scales** it is possible to set transparency of the window by corresponding slider and to superimpose the scale on the image



- 8) In the window **Analysis settings**  press the button **Add**, thus the evaluated parameter

selected in the window **Standard scales** will be displayed in the table. The button **Delete** is used for removal of the selected record from the stage, the button **Clear** is used for removal of all records from the table.

- 9) In the **Thixomet** main window press the button **Send analysis data to the report**  (A), the window with an interim report will open Call the report ([More](#)³⁹)
- 10) Call the report ([More](#)³⁹)