

DialInspect.OSM 2010

**Automated particle analysis for superabrasives and
surface analysis**



**Operation guide
Version 1.2.8**

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Main components:

The Automated image analysis system consists of the following components:

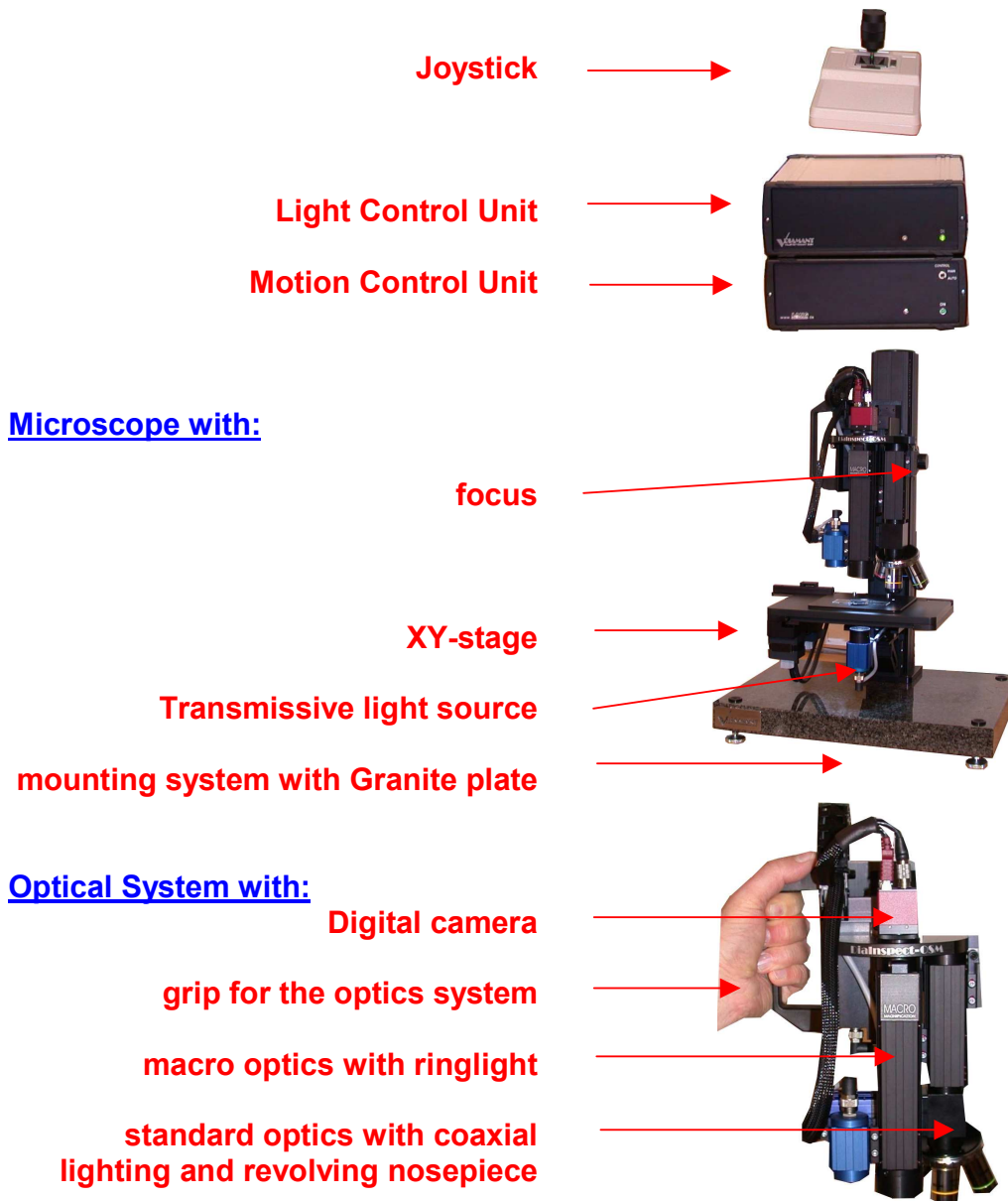


Fig. 1: Main components

Precautions

CAUTION This microscope is a high precision instrument. Please handle it gently. Strong shocks and forcible operation will damage the instrument. Move and locate this microscope with caution. This microscope weighs approximately 25kg.

- When carrying the microscope , hold it at his granite plate.
- When carrying the Optic System, hold it at his grip (Fig 1).
- Do not use cabel as grip to shift the optics (Fig 4).

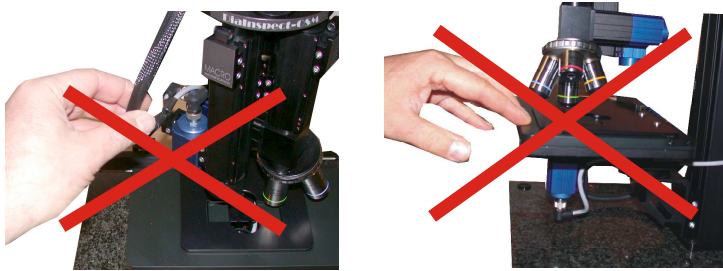


Fig 4: Forbidden

Cleaning instructions

CAUTION: Please pay attention at the surface of the XY-stage. It must be free of diamonds at the working time. Use an air-brush for cleaning the XY-stage and all optical systems! Never use fluids for cleaning the optics!

Use alcohol or air-brush for cleaning of the metallic surfaces. Never use water!

Safety instructions

Protect yourself and your environment against danger of accidents by suitable precautions and follow the following hints in your own interest.

- This device must be operated and maintained only by instructed persons.
- The operator has to ensure appropriate operation.
- At all maintenance- and repair works: before starting to work always pull out the power

plug.

- Danger of hands being hurt. When the tray is moving, do not put your hands between the fixed frames and moving parts. Although we have set the power to the motors to very low values it might be painful when a finger is squeezed between a glass plate and a part of the moving stage.

Operating the hardware and the electronic controls

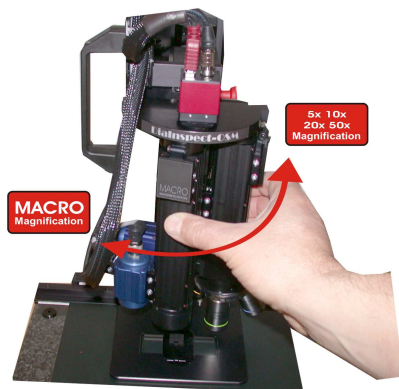
There are some parts of the microscope which need manual handling:

The lens system is swivel-mounted and can be swivelled from macro-optics to standard microscope optics and back. The microscope lenses are mounted on a revolving nosepiece, which is manually operated as well.

Optics swivel changer

Manually you can switch between macro and microscope resolution (see Fig.5)

CAUTION: Please never use the cable as a handle to change the optics!



Lens	Image width	Pixel width	Object distance
MACRO	11.9	9.3 μm	35 mm
5x	2.2 mm	1.7 μm	20 mm
10x	1.1 mm	0.85 μm	10 mm
20x	0.55 mm	0.41 μm	1 mm
50x	0.22 mm	0.17 μm	< 1 mm

Fig. 5

It should be mentioned that a magnification value of 50x as given on the lens corresponds with a system magnification of roughly 2160x when using a 22" monitor with 1680x1050 resolution.

motor driven Z-axis and focus knobs

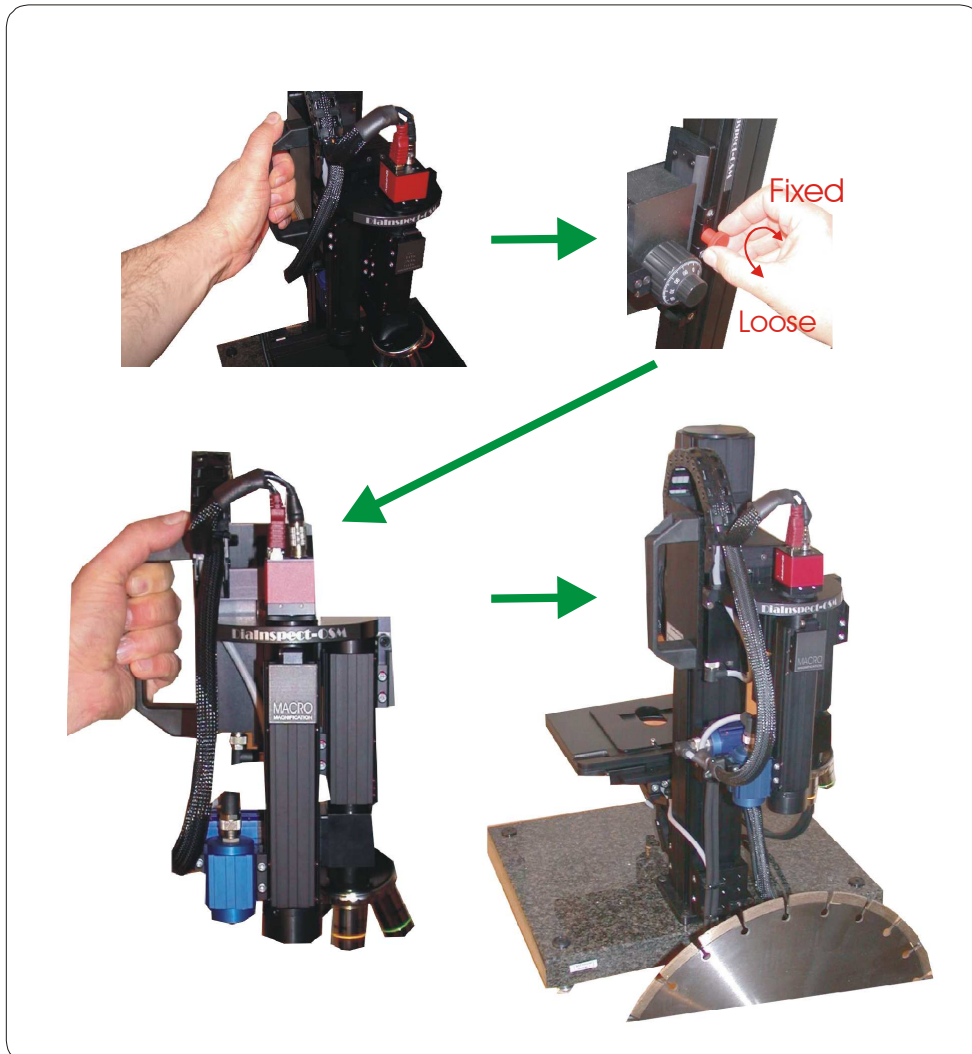
CAUTION: When using focus knobs by hand please have a look at the object distance.

CAUTION: short-working-distance objectives such as 20x or 50x



Changing the optical setup

The new design with increased depth of field for the macro optics and longer working distances provides more flexibility than before. The new optics head with integrated focus drive can be mounted on the front side of the microscope mounting bar for working together with the XY-stage or at the back side for the observation of bulky objects.



All other operations of the microscope are controlled by the PC, there is one additional “CONTROL” switch at the motor control unit. Position “MAN” means you can use the motion control unit by joystick without PC. In position “AUTO” the motor controller is fully controlled by the program.



CONTROL SWITCH

POWER ON LED

The light sources have no manual adjustment, the program will set the light intensity along with the camera shutter and gain automatically. The program remembers the setting for every combination of lens and lightsource and restores the values when the user notifies the program about a lens change.

This makes the handling of the microscope easy, no need to adjust the brightness of the light sources or the cameras exposure time everytime when the lens has been changed.

The rough height adjustment of the optics unit must be done with care. Please have in mind that the stage where the sample is mounted will immediately move to its zero position everytime the microscope control panel is opened. Please make sure there's enough space between the lenses and the sample!

Sample preparation

For carrying the particles we use microscope slides 76x26x1 mm (3"x1"). They are intended for one way use, once you have sputtered abrasive powder onto the plate don't try to remove it. Throw the used plate away.

It requires some training to obtain a good particle distribution on the plate.

Preparation of Coarse grit (>150µm):

Coarse grit is best carried on the special glass plate equipped with a metallic border. Coarse material can be removed easily from there by means of a soft brush.



Therefore the plate can be used many times.

Preparation of powders (20...150µm):

When investigating powder in the size range from ~20 µm up to ~150 µm it works fine when you take a very small amount of powder onto the tip of a knife and sprinkle it from a certain height (10.. 20 cm) onto the plate. During the free fall most of the particles will separate.



Preparation of micron powders(< 20 µm):

When working on micron powder wet application is recommended. The reason is the formation of agglomerates due to the influence of small grains of < 1µm.

Prepare a solution of 1% $K_4P_2O_7$ in distilled water. Shake the solution well till the powder is dissolved.

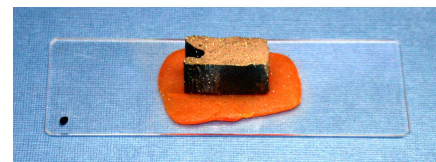
Take a small amount of this solution (about 5 - ml) into a separate dish with closure. Put a small amount of the micron powder (depending on the grain size - the smaller the grain size the smaller the amount) to the solution and shake it well.

Depending on the grain size, the dish solution has to be set into an ultrasonic bath. For grain sizes smaller than 5 µm this step is necessary, for larger grains it is not necessary, but does not disturb. About max. 60 minutes of ultrasonic treatment for the smallest grain sizes should be enough in most cases.

Put a drop of the solution onto the plate and distribute it a bit.

Preparation of segments:

The sample holder (76x26 mm) with the mounted segment is loaded in the same way as the microscope slide.



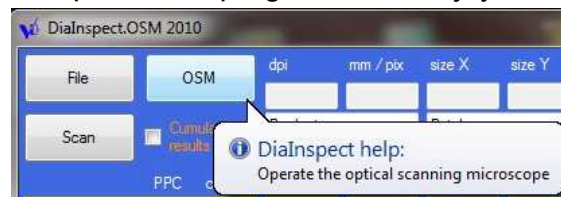
Operating the microscope

The operator has to switch on the Light Control Unit and the Motion Control Unit (at the rear side of each control block).

All the next steps were done by means of the DialInspect.OSM program and the joystick attached to the Motion Controller.

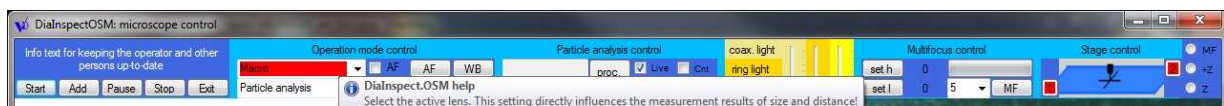
Please launch the DialInspect.OSM program.

On the main panel push the button OSM, this leads you to the microscope control panel.



We will come back to the main panel later in the manual.

The microscope control panel shows up while the stage is initialized. The stage will travel to the zero position of the scan area, after having finished this it will wait in start position, waiting for your input. The drop down list for the microscope magnification is blinking red, showing that input is required. The three light sources are flashing. You have to set the magnification selector according to the value written on the lens. All other computation and scaling is done internally in the program, no need to worry about.



The operation panel shows 6 sections with controls aligned on top, the area below is used for displaying the camera picture.

For the next few steps we need to use the joystick. Please try to move the stage by joystick control in X and Y direction. Turning the knob left and right will operate the focus drive. If the stage doesn't move check the joystick symbol in the section "Stage control", it must appear in black, not grey. You can toggle the state (active/inactive) by clicking the symbol.

Adjusting light source and camera

At first we should have a look at the result of preparation.

Insert the slide into holder on the stage.

Swivel the macro optics in the active position.

Set the drop down selector for the optics to “Macro”.

Set the drop down selector for the scanmode to “Particle analysis”.

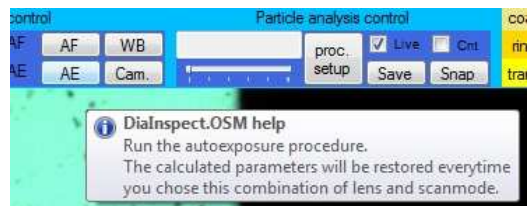
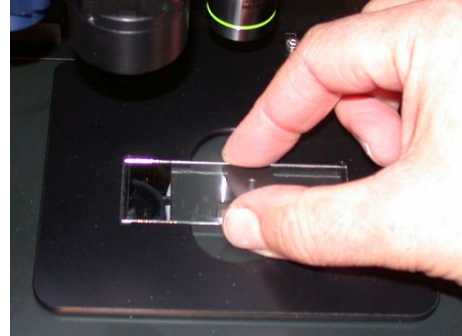
Use the joystick and move the stage to a position, where the camera image shows the illuminated sample holder.

Click the button “AE” (auto exposure), this starts the adjustment of light source brightness, camera shutter time and camera brightness.

After this procedure has finished you can adjust the color response of the imaging system by clicking “WB” (white balance).

It is the right moment to doublecheck the magnification level. If the particles appear very large (1/10 .. 1/20 of the picture area) scanning will take a long time. If possible choose the magnification that makes the pictures look similar to the samples in the following chapters. Don't forget to set the magnification dropdown list according the value you have choosen!

You should repeat the autoexposure procedure for every newly used lens once. The brightness of the light source is set to approx. 80% of the maximum possible value, then shutter and gain of the camera are adjusted for an optimal image. The type of light source is dependend on the combination of lens and scanmode, see table below:

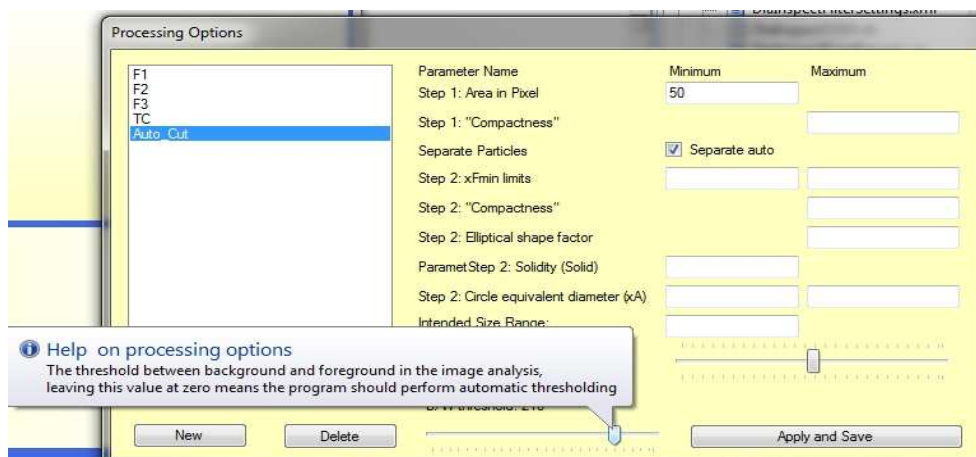


Scanmode / Lens	Macro	5x	10x	20x	50x
Particle analysis	Transmissive	Transmissive	Transmissive	Transmissive	Transmissive
Porosity analysis	Ring light	Coaxial light	Coaxial light	Coaxial light	Coaxial light

You are free to use any mix of light source intensities which are suitable for the selected lens, for example for the 5x lens 80% transmissive light + 20% coaxial light. The program will remember these settings and will apply them the next time you chose the 5x lens.

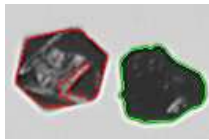
Image processing options

As easy as it is for the human eye to locate the abrasive particles on the display, as difficult it is for the computer program. We have to describe what part of the image should be treated as single particle. The button “Proc setup” brings up the setup panel for the image processing and analysis options.

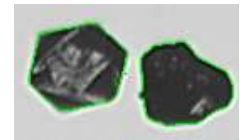


At first it is obviously that in the microscope the particle appears darker than the background. The threshold between dark particle and bright background is defined by

the BW–slider. The setting of this slider should be approximately 210 units. If necessary you can let the program compute the threshold level automatically by setting the slider to zero.



The left picture was processed with a b/w threshold too low, parts of the red marked particle were counted as background. The picture on the right side show



processing with a properly adjusted threshold slider. You can try out this behaviour easily, because everytime you operate the Snap button an image is acquired and processed with the current settings.

Now the program is able to find parts of the image which maybe represent single particles, maybe two or more particles touching each other or maybe particles of dust or a hair of the brush. Some more filtering is necessary in order to remove all things from being counted and analysed, which are not single, clearly painted members of the batch we want to analyse.

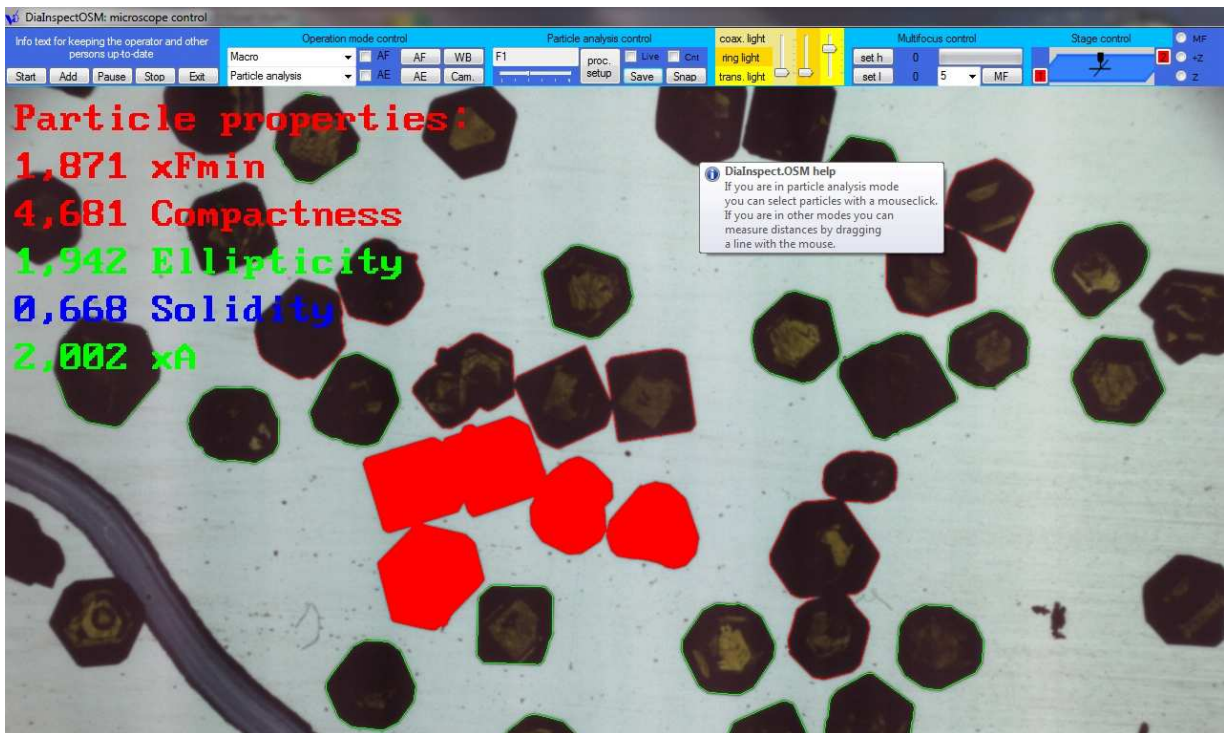
DialInspect.OSM comes with a some predefined combinations of filter parameters, these are listed in the left field of the “Processing options” panel. You can define new filters, delete unnecessary filter or modify existing filters. Just enter the desired values and click on “Apply and save”. At the end of this manual you find a more detailed explanation of what the used parameters describe and how the calculation is performed.

The workflow inside the image processing and analysis can be roughly described as follows:

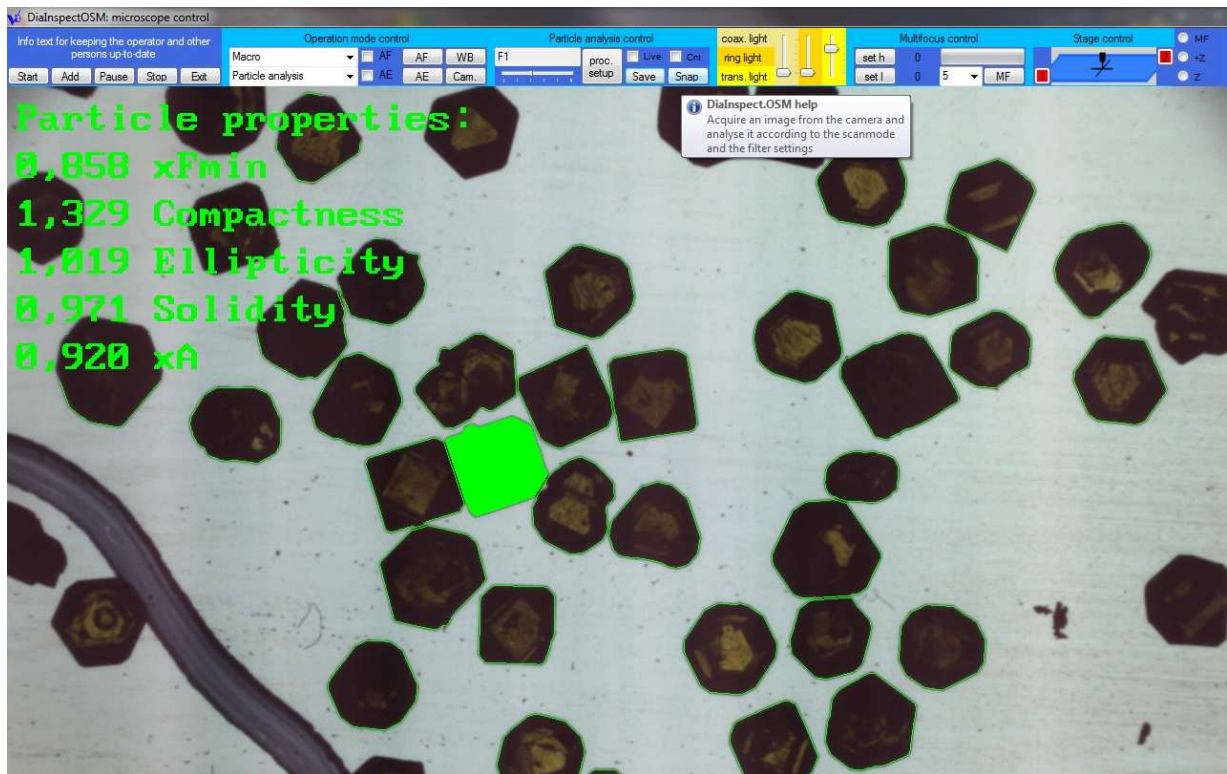
- Separate foreground (what is maybe particle) from background
- Calculate the parameters used in “first step options” and exclude all parts of the foreground that do not pass through the first step options.
- Compute and apply separation lines between touching particles, if desired
- Compute the whole parameter set for all remaining parts of the image that pass through the “second step options”

- Draw a green line around particles which passed through the options
- Draw a red line around particles which did not pass through the second step options

The graphical result is immediately visible on the computers screen, when you click inside a particle also the properties appear on the screen. Red parameter values indicate that the value is higher than the limit in the filter, blue indicates too low values. The sample image above was analysed without the automatic separation feature enabled. Please compare below the results with automatic separation enabled.



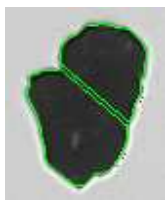
Interactive evaluation of the particle analysis filters (no automatic separation)



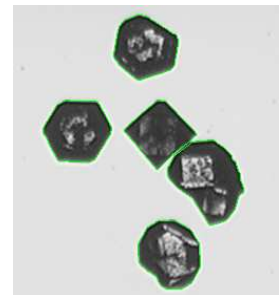
Interactive evaluation of the particle analysis filters (automatic separation active)

It is easy to fine tune the filter settings. Once you have finished a filter store it using “Apply and save” into the filter database for future application.

Attention: Automatic separation works fine on well shaped convex particles, but please be careful when applying this method on other ones.



Left picture: Separation mismatch!



You can set the program into a continuous analysis mode and move the slide with the particles on it with the joystick forth and back. The image will be acquired and analysed continuously until you uncheck the box “Cnt”.



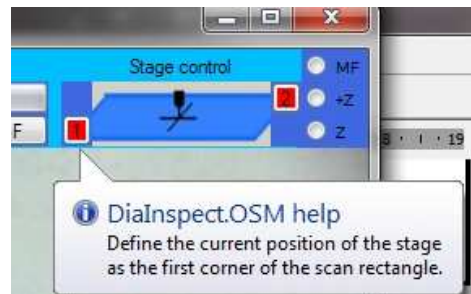
Scanning a slide with particles

After setting the processing options it takes only a few seconds to start the scan of the sample.

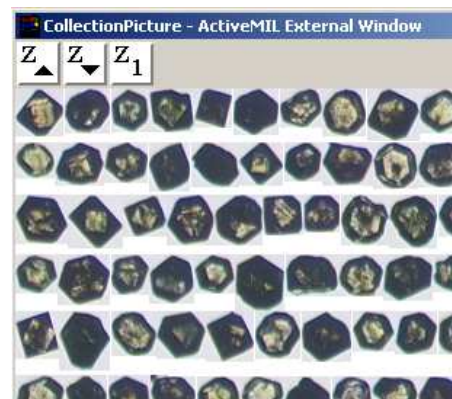
At first we have to define the scan range. By means of the joystick we can navigate to the start point of an rectangle where the particles density is good.

We fix this startpoint by clicking 1.

Then we navigate to the opposite corner of the range we want to have scanned and fix this endpoint by clicking 2.



Now the automated scan process will begin when push Start. The program will move the stage step by step through the viewing range of the camera. Image acquisition and image processing is done automatically, you can watch the process on the microscope control panel. You get information about the number of processed and stored particles, the live display show the camera view and in the overlay the result of the computation. In addition a large collection picture hold copies of the pictures from every single particle that passed the filter (collecting pictures stops when collection picture is full). During the scan process it is possible to pause the scan. During pause you can operate the joystick.



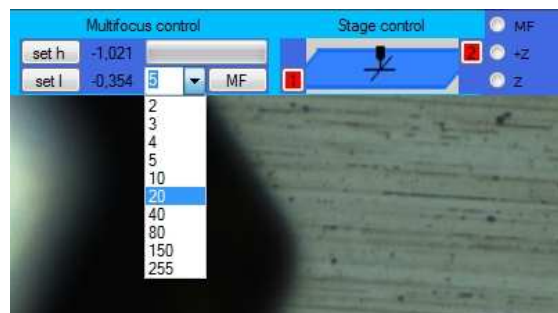
The scan stops when the rectangle is completely scanned, when then collection image is filled completely or when you push Stop. If the collection picture holds not enough particles you should prepare another slide with particles from the batch, place it on the sample holder and push “Add”. This slide will be scanned and analysed applying the same settings as for the previous slide. The particles will be added to the collection. You can check now the content of the collection picture. If you are convinced that the measured particles represent the batch quite good, you can press Exit for leaving the microscope control.

Please note:

It is recommended to set the restrictions (the processing filters) not too narrow during the scan. It is no problem if the collection picture contains some touching groups of particles or some parts which don't belong to the batch. You can easily run a new analysis of the collection picture later on at any time. On the other hand: every particle which was not collected into the collection picture due to tight restrictions is not available forever in future calculations!

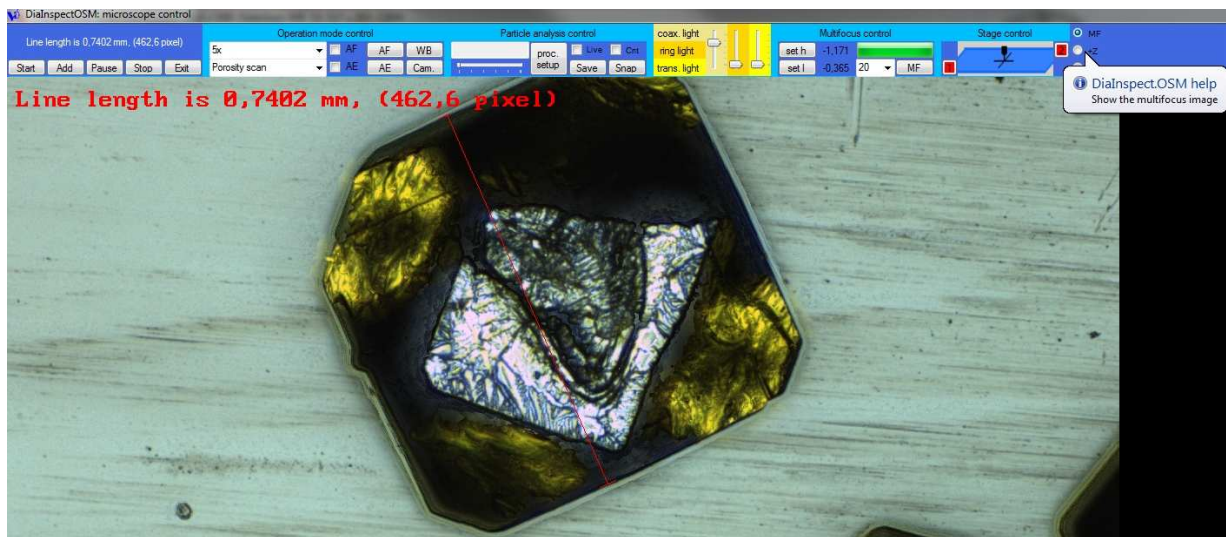
Multifocus operation

The microscope lenses have a short depth of field. Threedimensional objects may appear only partially sharp and clear. Dialinspect.OSM provides an easy way to overcome this limitation. In the so called “multifocus mode” the program acquires a series of images at different distances between lens and object and generates a sharp picture of the object. As useful side-effect a height map of the object is produced



as well. The operation quite simple: use the focus to focus on the topmost part of the object, click “set h” to store this value of the focus height. Then focus on the lowest part of the object, click “set l”. The dropdown list allows to chose the number of pictures to take and process. The button “MF” starts the multifocus procedure. The focus drive

moves to start position and then travels in one smooth move to the target position. The program acquires the requested number of images at exactly defined focus levels. The multifocus image is available immediately after the scan has finished. The radiobuttons “MF”, “+Z” and “Z” select the display of the pure multifocus picture (MF), the multifocus picture together with color coded height information (+Z) or the pure height information (Z). Please note that the height resolution depends on the number of images, i.e. the number of discrete height levels where information was acquired. It also depends on the image content. Regions with no contrast will produce no useful information.



Dragging a line with the mouse on the display will produce a length marker, whose length is displayed.

At this point the explanation of the microscope control closes. The further inspection of results is the same as in DialInspect. The only exception is that we return to a main panel which is no longer empty, but filled with all the data we have measured using the microscope.