

multi focus imaging in macro and micro photography

Macro and especially micro photographers have the big problem a very thin focus layer. This problem can be solved by producing more pictures of the same object with slightly different focus point and combining these afterwards with software like Helicon Focus from HeliconSoft.

Here I will show how I use this software in macro and micro photography and also give some basics mainly on microscopy and micro photography.

1 definition

Macro and micro photography is defined by the reproduction scale. That is given by the ratio between object size in reality and the image size on the film or sensor of the camera. Macro starts at around 1:2, so when the image is half the size of the original object. Ratios of 1:2 are often realized in standard and tele zoom optics for SLR cameras and also in some compact digital cameras.

Special macro optics can get up to ratios of 1:1. Higher ratios can be realized with bellows or spacer rings. With these helpers ratios of 3:1 or even a little bit higher are possible. 3:1 means that the image is three times larger than the object itself. So when using a normal digital SLR camera (crop 1.5) you can get an image of an object with 8mm using the whole sensor.

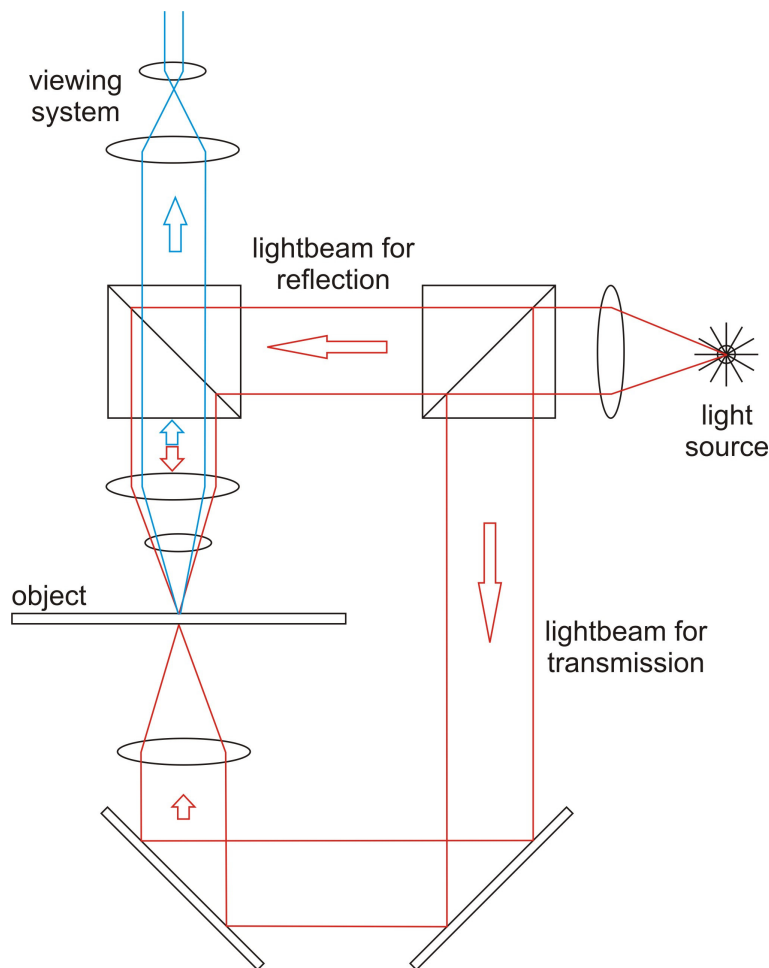
Ratios higher than 3:1 are commonly named as micro photography. These ratios are done by special micro optics for SLR cameras or by using a microscope with attached camera.

2 microscope

In this report I will focus on the usage of an optical microscope for photography. First I will give a short introduction in the microscope itself.

A microscope is – simply – a very good magnification glass. It is a combination of an object and an eyepiece lens (viewing system), most times combined with an integrated light source. Due to changeable object lenses the magnification factor can be varied.

Focusing is done by adjusting the distance between object lens and the surface. This is done by driving the z-axis of the sample holder. This is quite a good system for multi focus imaging because you can change the focused layer very accurate and in small steps. These small step size is important as the thickness of the focused layer can be very thin when using high magnifications. This thickness can be as small as less than 10µm (0.01mm).



The light, coming from a high intensity lamp, can be routed to the surface for reflection imaging or to the objects backside for transmission imaging of transparent samples.

The object can be moved to find the right spot. The magnification is changed by changing the object lens. Normally there is a tray with about six different lenses for fast changing.

Focus is done by adjusting the height position of the object, and by that, the lens – surface distance. This can be done in very small steps.

fig. 1: optical system of a microscope

3 first steps in micro photography

The first and simplest method is to place the lens of an compact camera to the eyepiece of the microscope. As this method is not very promising for reproducable good quality pictures, I will skip it here.

A second method is to put a SLR camera to the microscope using a standard lens. This type of adaption is quite useful but you have quite a lot of glass (microscope optics AND the camera lens) in your viewfield.

I used the third method (which I think is the best) and adapted my DSLR camera without any additional optics. You need just an adaptor from your cameras bayonet to the connection at your microscope. Here is another problem to be considered: The focus distance of your microscope optics has to match the combination of your camera plus adaption.

See fig. 2 how I did this adaption. I had an adaptor from our microscopes system to M42 so I just needed an M42-P/K adapter for my Pentax K10D I use for my photos.

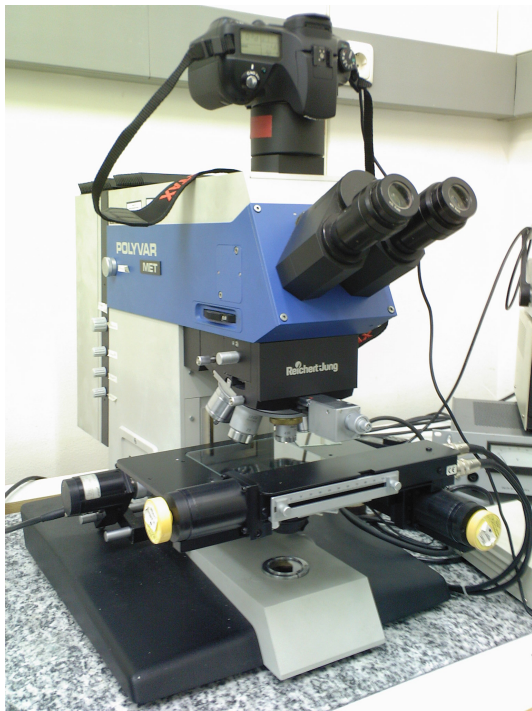


fig. 2: Mounting of my camera on the used microscope

I also had the problem that the focus distance for the eyepieces and the camera had been slightly different so I had to adjust the focus through the cameras viewfinder.

4 Examples

I took some photos of crystalline surface, which are quite rough (for such high magnifications). Without focus bracketing and combination by software like HeliconFocus you would not be able to get a picture which is sharp over the whole area.

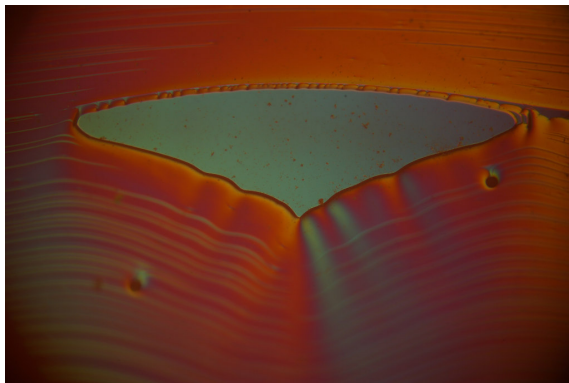


fig. 3: high focus level

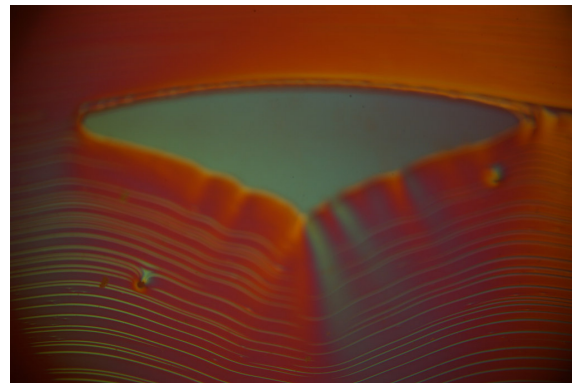


fig. 4: low focus level

At all I took 16 pictures of this area with steps at the focus level of around 2 micrometers which were combined by HeliconFocus afterwards. Concerning the colours: These pictures had been taken with Nomarski Interferential Contrast. With this optical system the different surface orientations results not only in grey level contrast but also colour differences. The resulting pictures get an interesting three

dimensional touch. But these colours do not represent the original surface, it's only an interference that causes these colourful images.

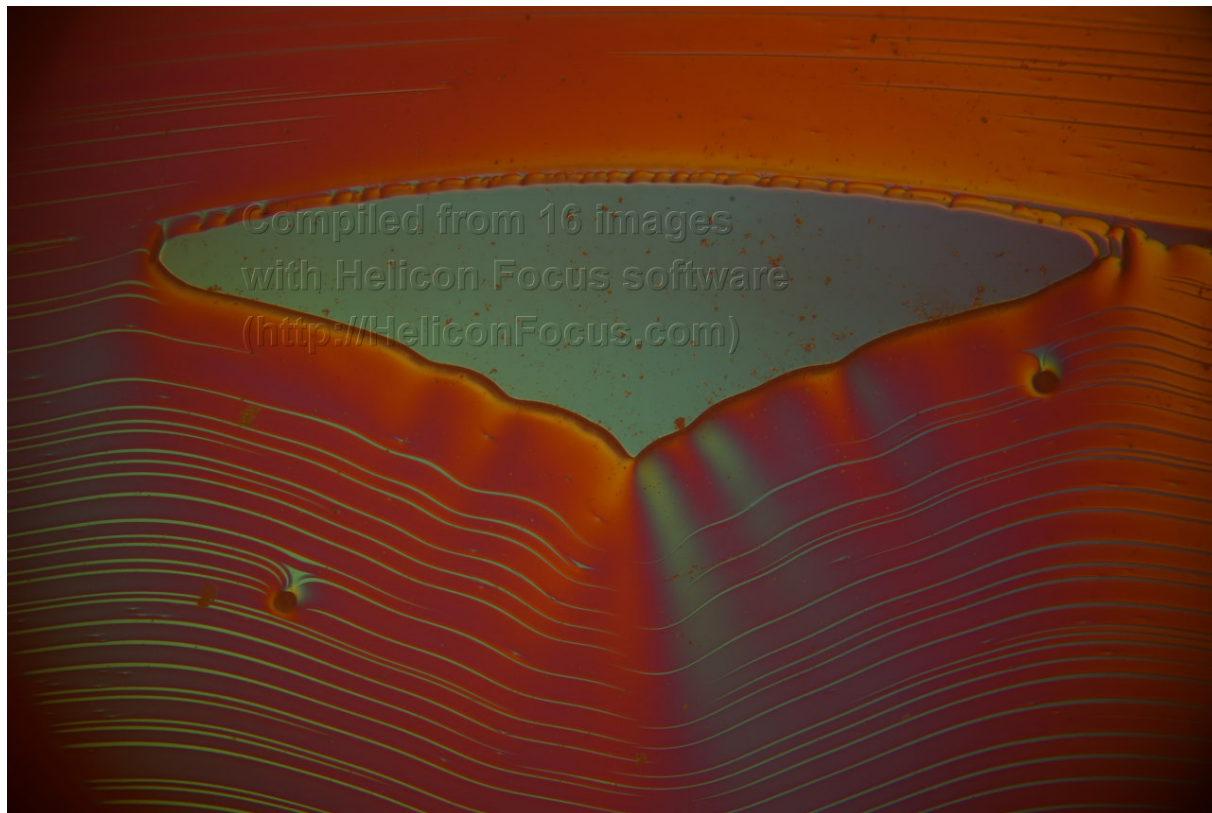


fig. 5: resulting image combined from 16 single pictures

The resulting image has the right focus over the whole area (and over the whole depth). Now we just need to crop the image a little bit. As you can see the edges of our picture are black. This results as microscopes are not built for the large area CCD's used in modern cameras. In special CCD's for microscope imaging you normally find chip sizes smaller than the in DSLR's mostly used standard. But with 10 or even more megapixels in today's cameras this small crop is no big problem.

5 Conclusion

For microscope photography HeliconFocus is a very useful and powerful tool. As the depth of focus is normally very small for such high magnifications, focus bracketing and combination is the best (and often the only way) to get pictures completely in focus.