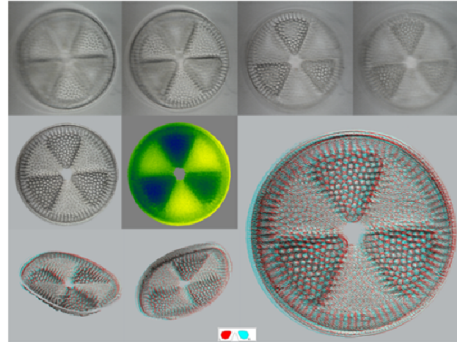www.picolay.de

Three simple methods to generate virtual 3D scanning electron micrographs with PICOLAY

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(A) Focus stacking

- Adjust your scanning electron microscope so that the depth of focus is as low as possible
- Take – using very fine focus steps – a top-down series of images ('focus stack') so that every specimen structure is sharp at least on one image
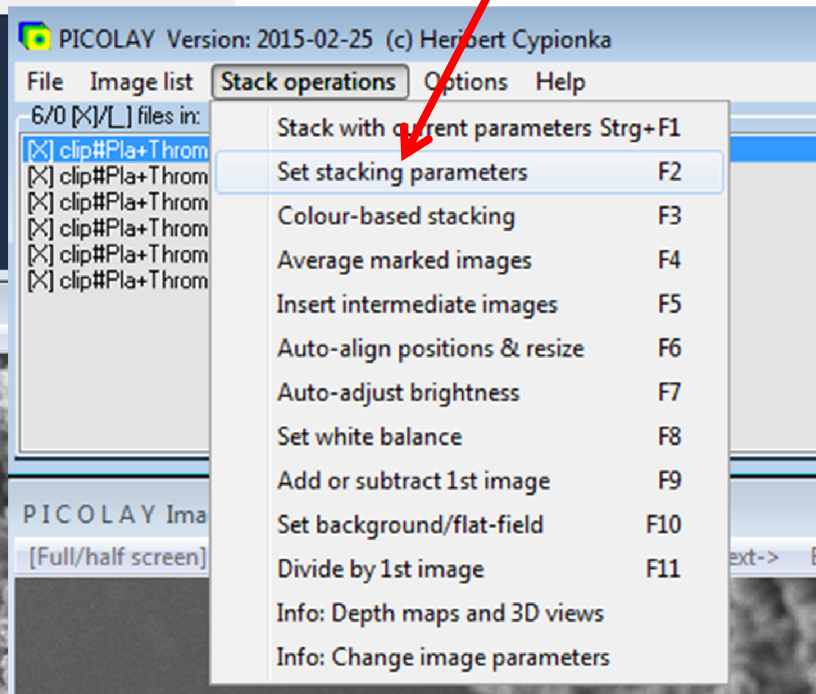- It is not necessary to tilt the stage

The six original pictures:
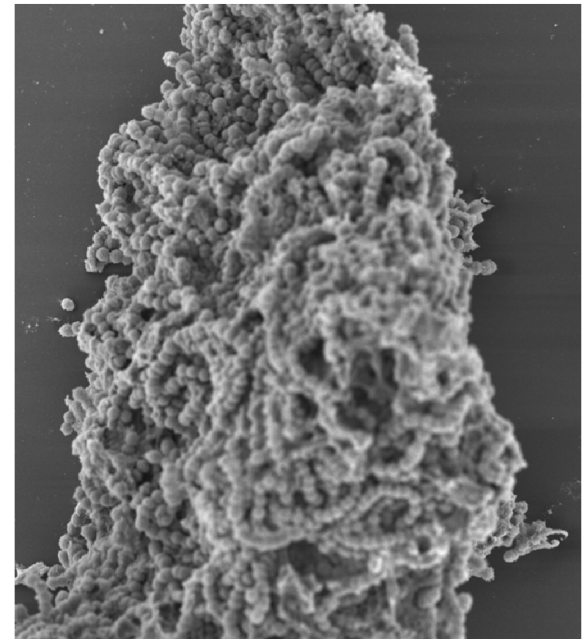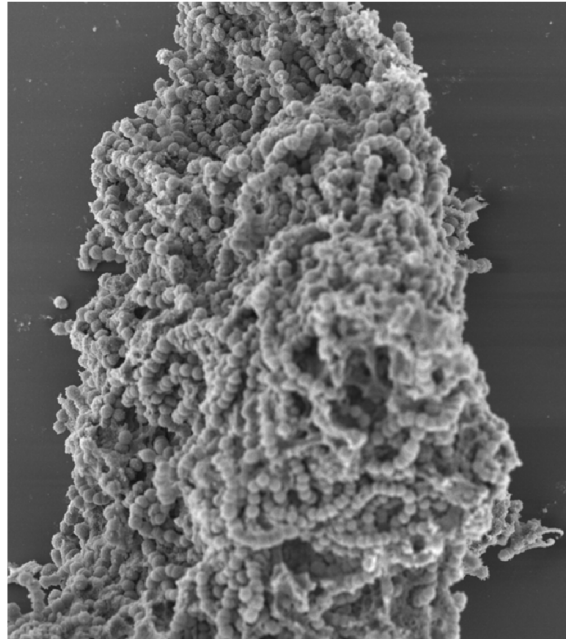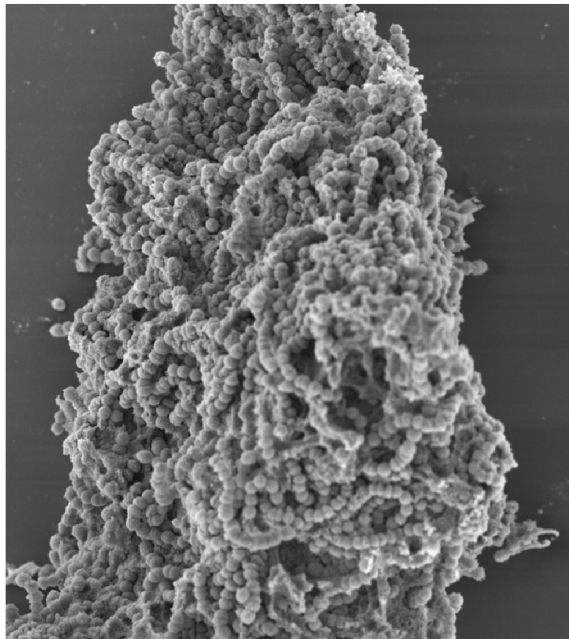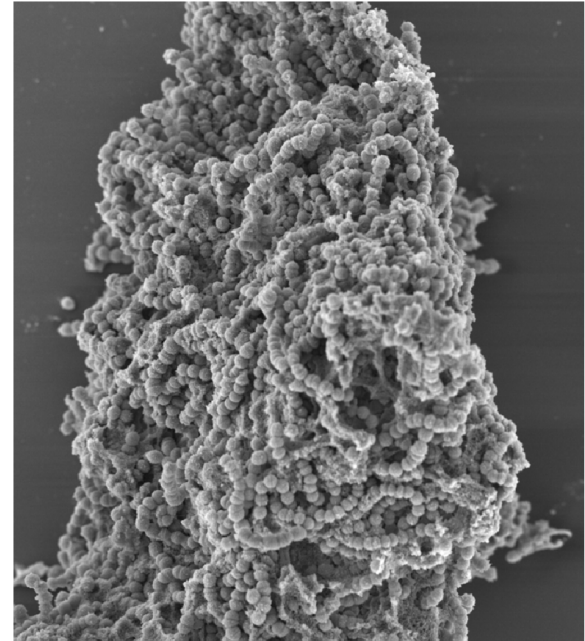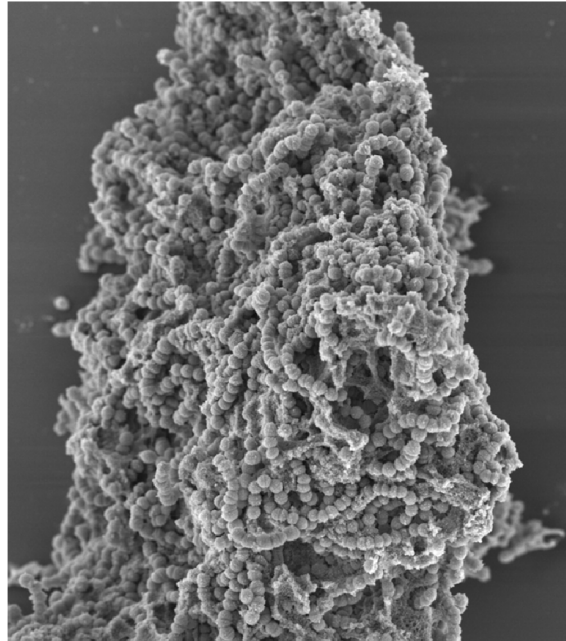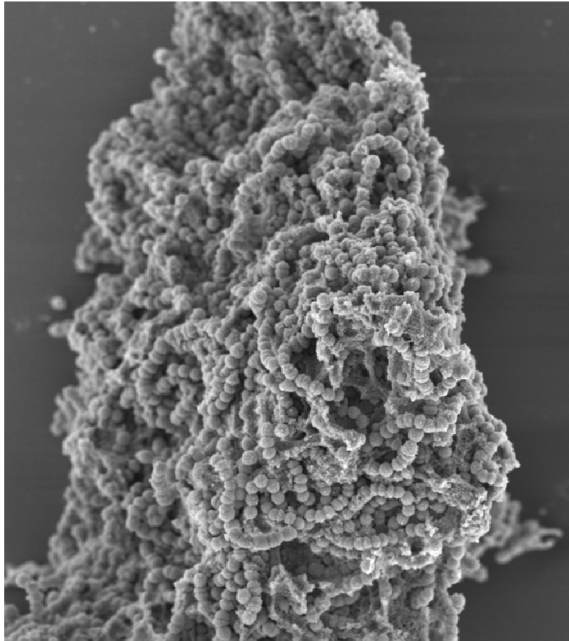
1. Open the images with PICOLAY
   => File => Add images
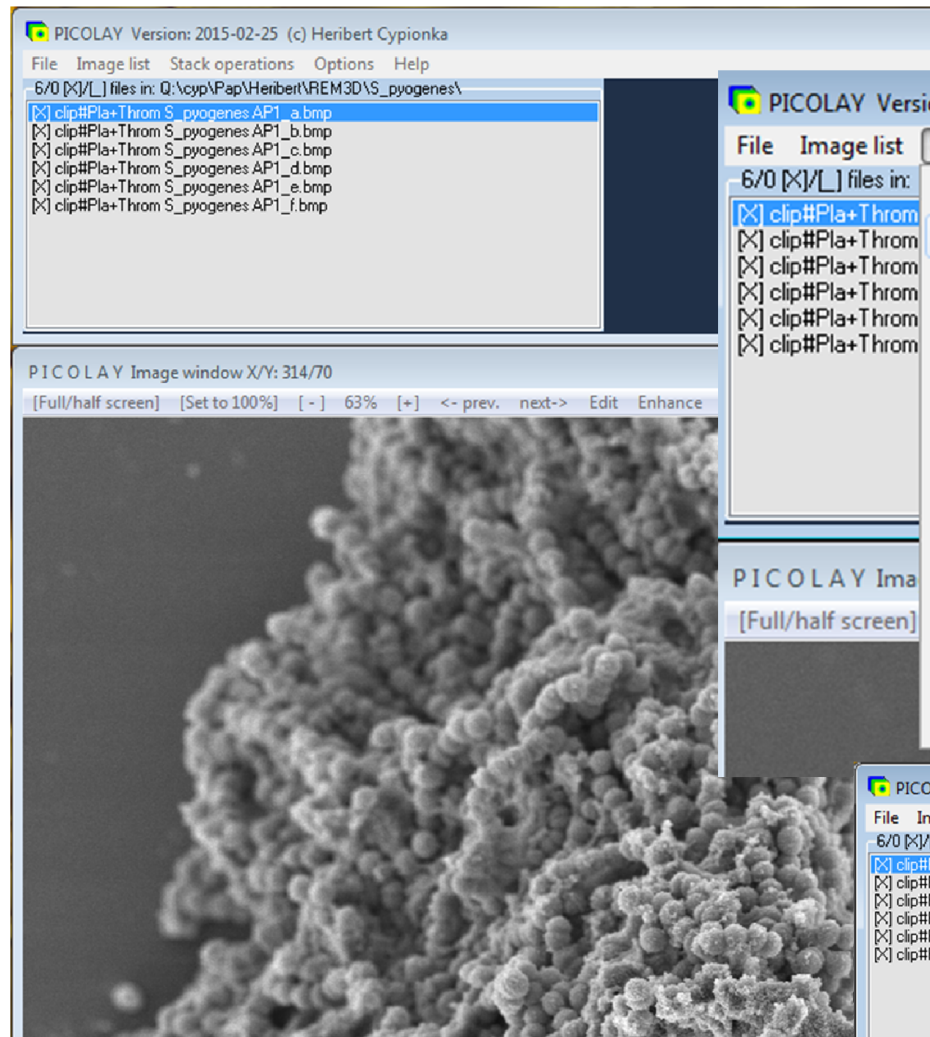
2. Select the stacking routine
   => Stack operations
      => Set stacking parameters

=> 3. GO
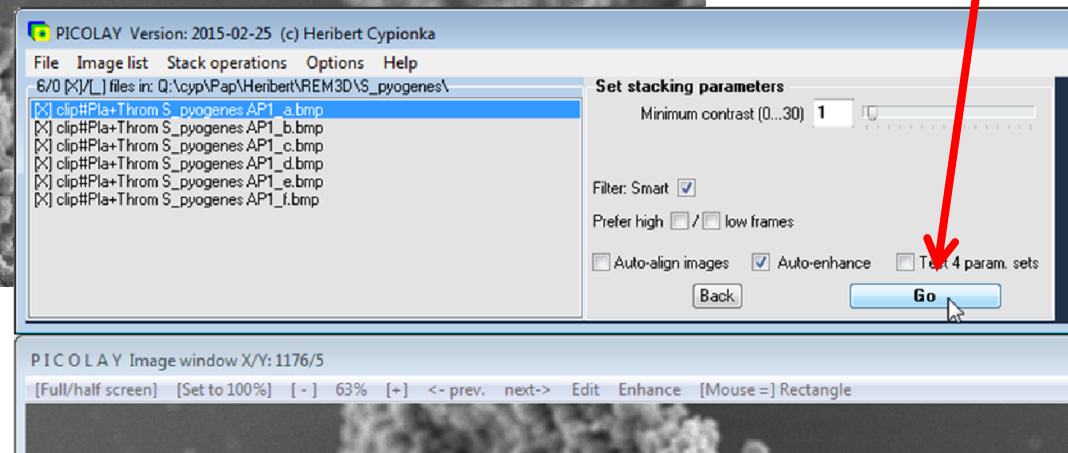
… a few seconds later you'll get

- Two new files in your image list:

  "p#sharp_min1_en.bmp" = the **sharp stacked image** and

  "p#mapsharp_min1_en.bmp" = the **depth map**

- The left window shows an overlay of sharp image and depth map
- The right window shows the stacked sharp image

To generate a 3D image click on
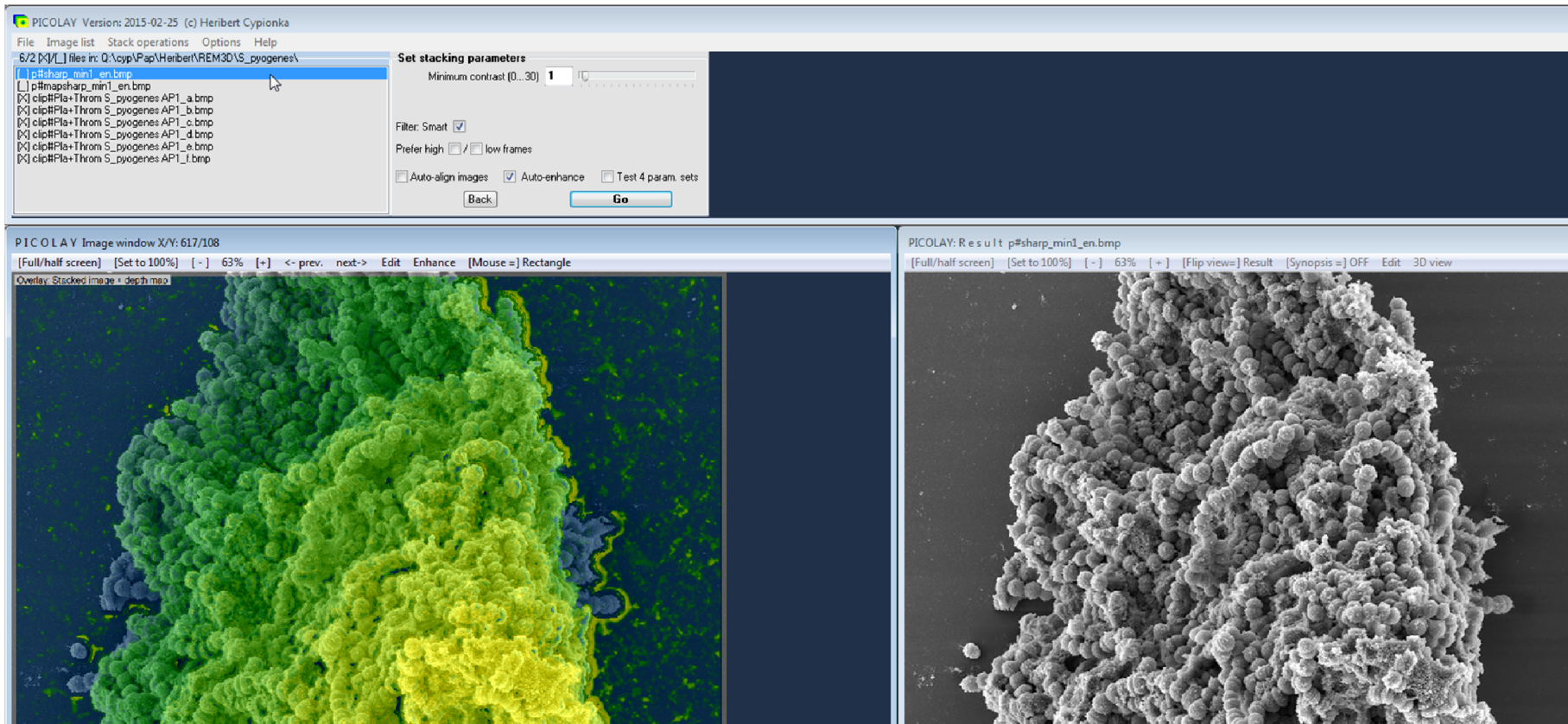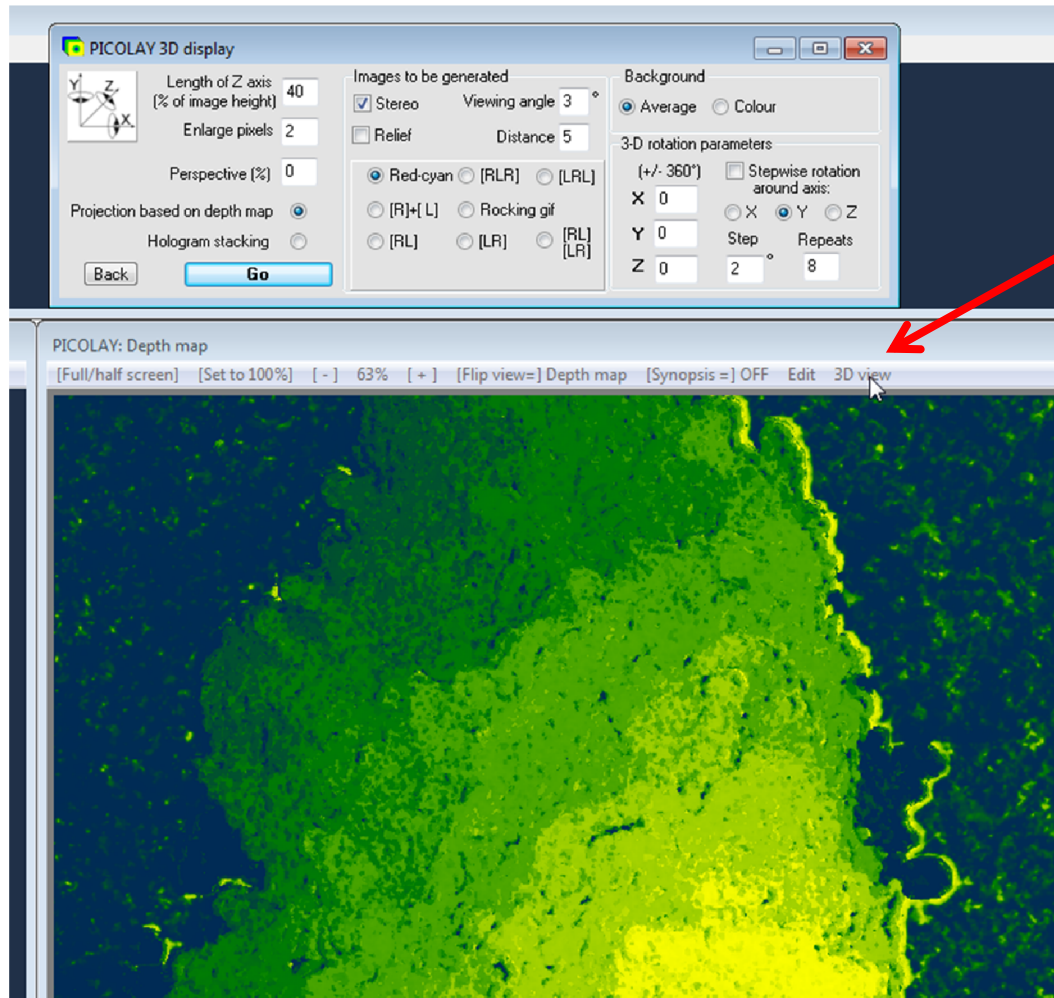4. **3D view** on the right window

- A new panel **PICOLAY 3D display** will open, and the depth map will be displayed in the right window.
- If necessary, change some parameters as
  - Length of Z axis (= specimen depth)
  - Viewing angle (e.g., 3° for monitor viewing, 2° for video presenter)
- Select the type of 3D image you want (e.g., red-cyan anaglyph image)
- 5. Press **Go** to get your result…

Depth map: The six colours from yellow to blue indicate the layers where sharp structures were detected in the six pictures.
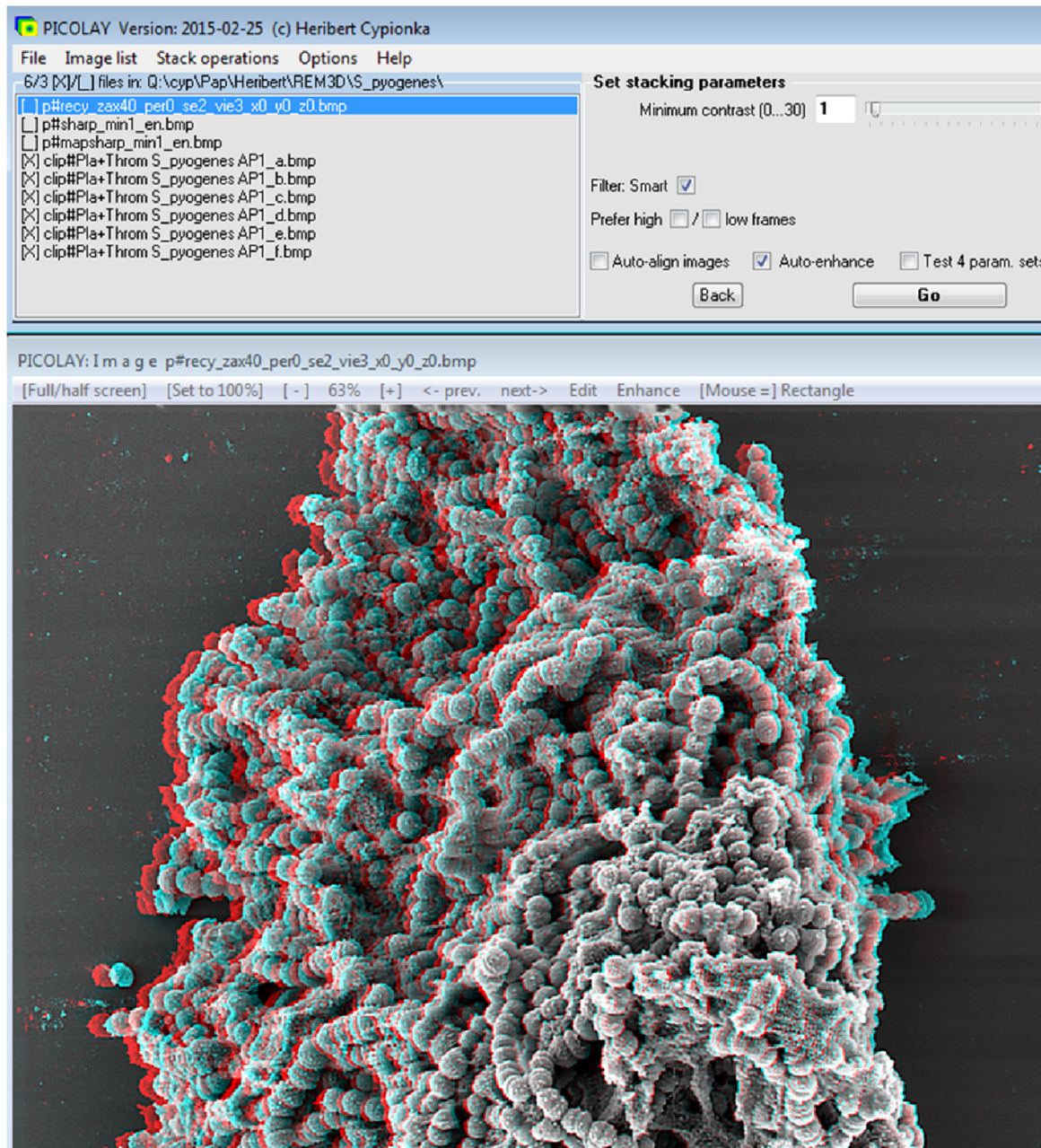
© Manfred Rohde, HZI, Braunschweig

A new image is shown and a file is added to your image list: "p#recy ... .bmp", which has some of the parameters used in its file name.

Look at it through your anaglyph glasses…
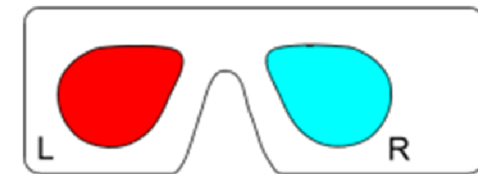
# (B) Interpret a single scanning electron micrograph directly as depth map

If the electron detector is arranged around the optical axis of the column of a SEM (in-lens detector), a single SEM photograph can be used to generate a 3D image. The trick is based on the fact that upper specimen structures normally give a brighter signal than those in the depth. As long as brightness of a specimen structure is correlated to its z-position, a correct depth map will be generated. Images with the same brightness at different depth levels might give misleading results.

1. Open a SEM picture with PICOLAY
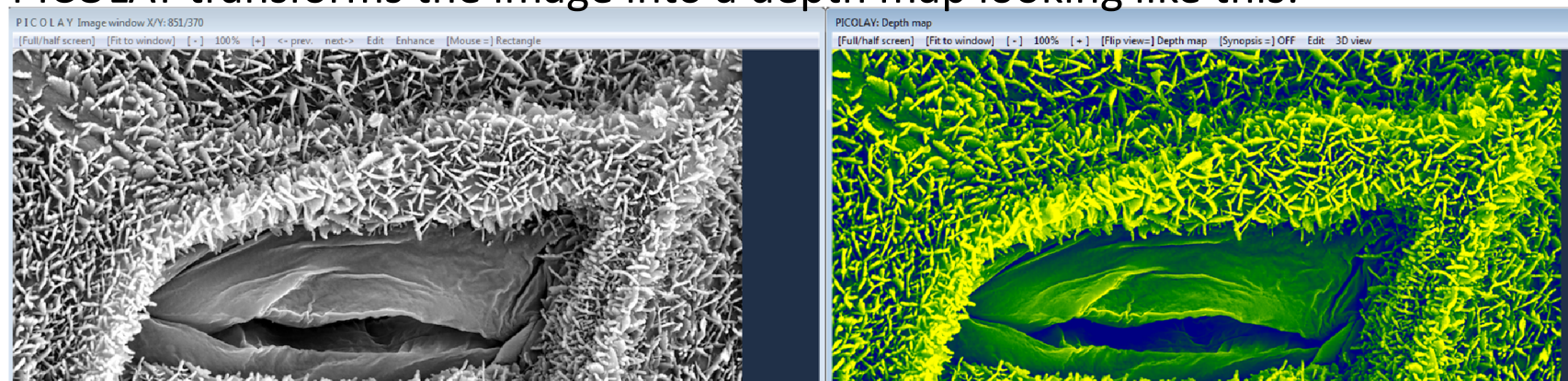File => Add image

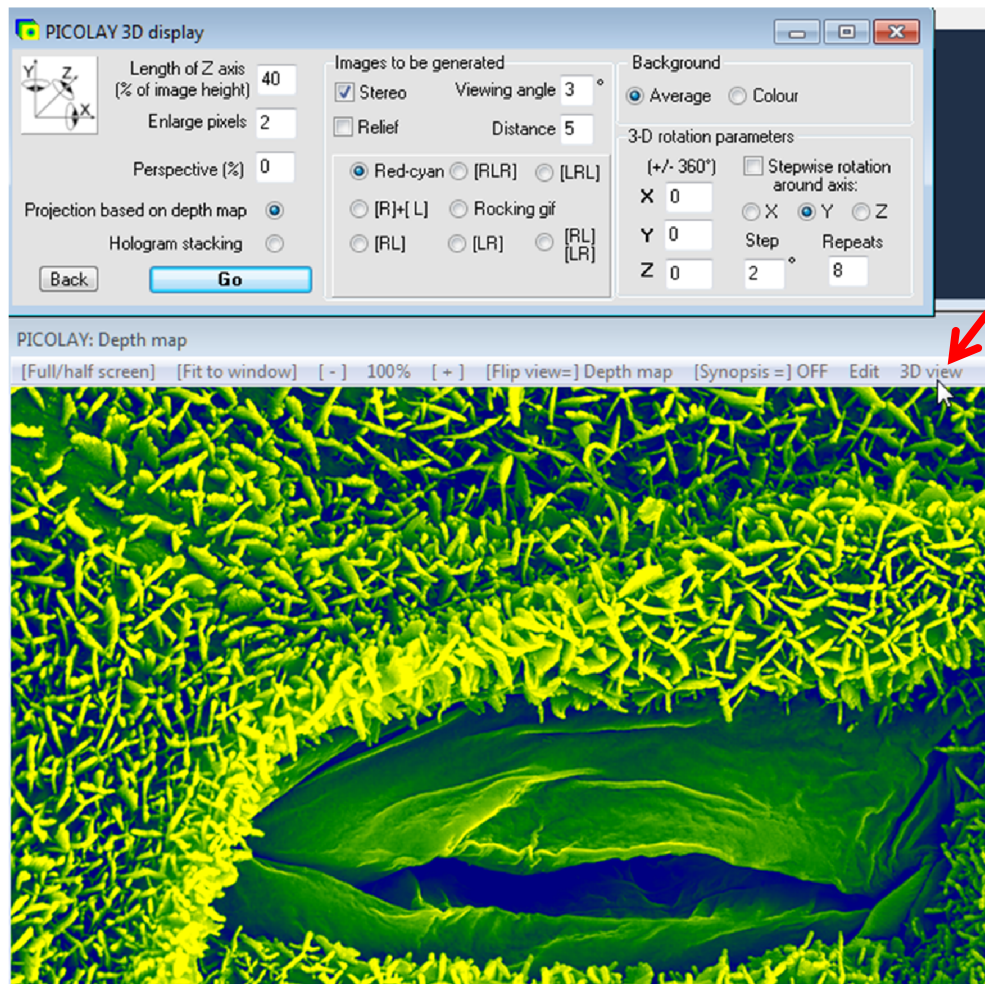## 2. Edit => Copy to result image
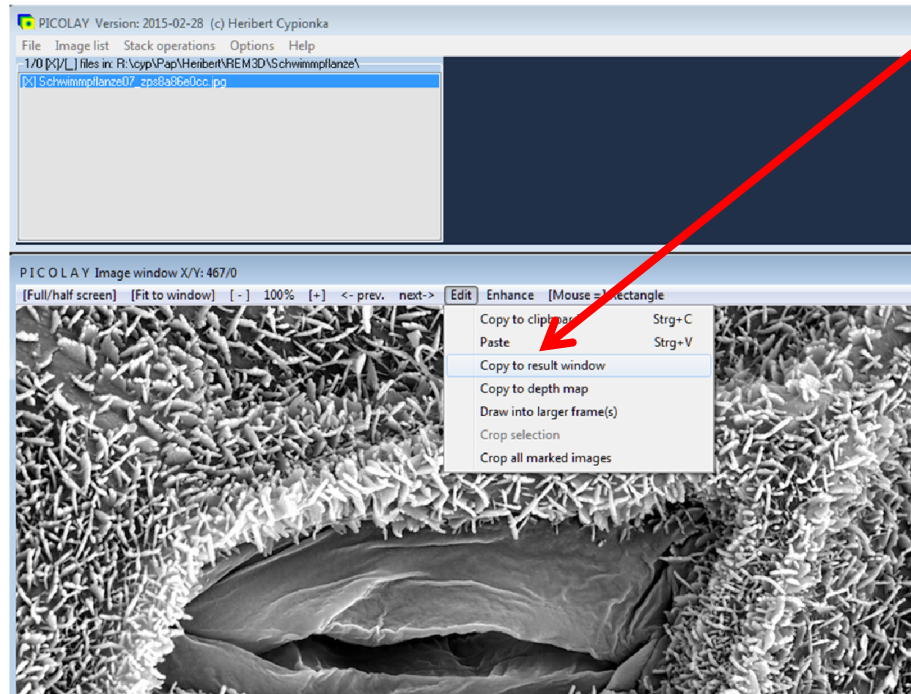
3. With the same image do:
Edit => Copy to depth map
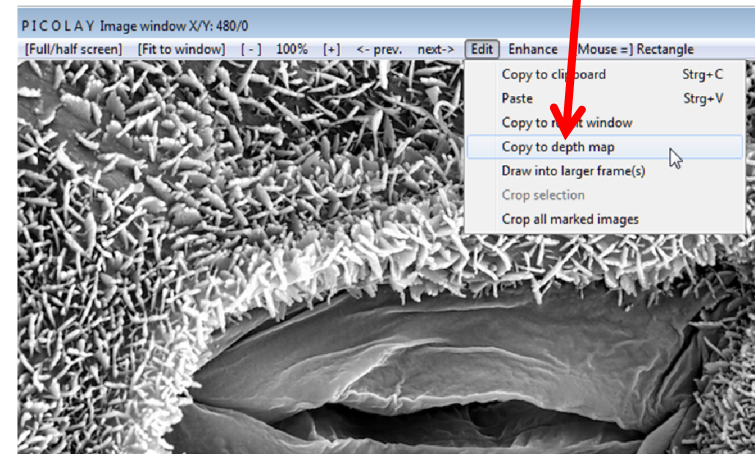
PICOLAY transforms the image into a depth map looking like this:

To generate a 3D image click on
4. **3D view** on the right window

- A new panel **PICOLAY 3D display** will open, and the depth map will be displayed in the right window.
- If necessary, change some parameters as
  - Length of Z axis (= specimen depth)
  - Viewing angle (e.g., 3° for monitor viewing, 2° for video presenter)
- Select the type of 3D image you want (e.g., red-cyan anaglyph image)
- 5. Press **Go** to get your result…
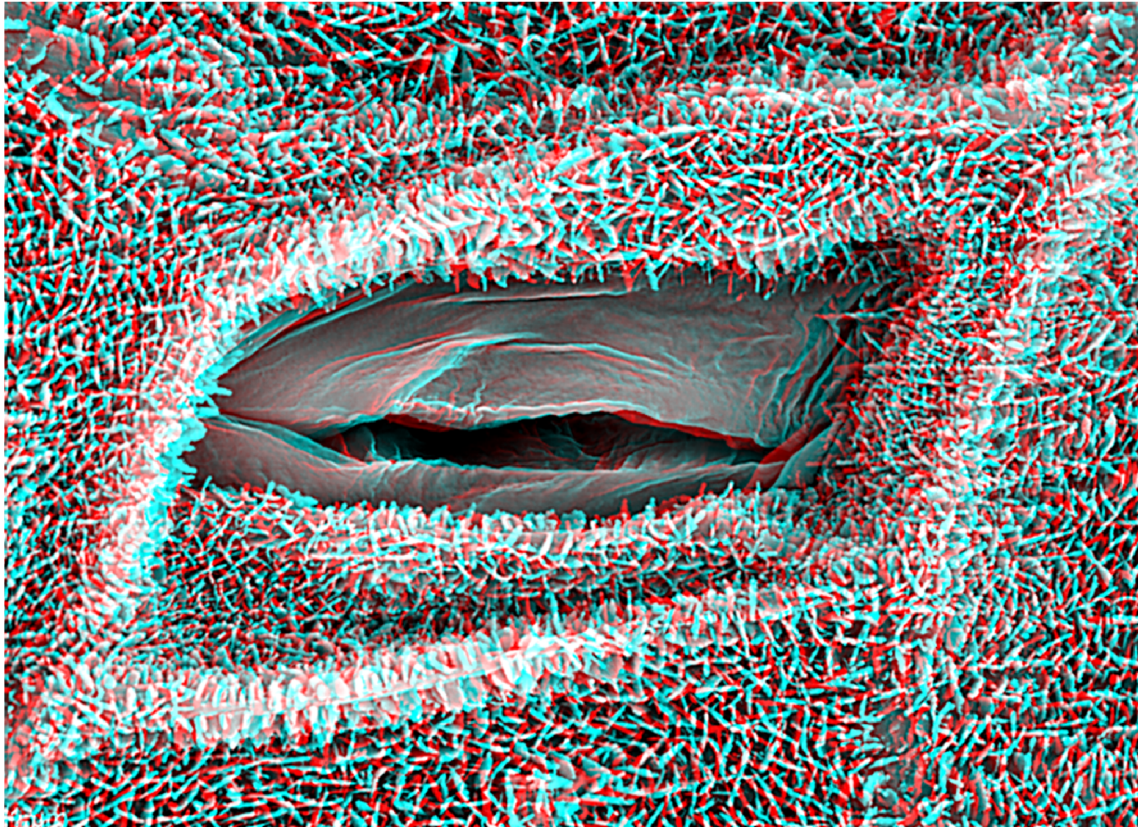
© Eckhard Voelcker, Berlin

A new image is shown and a file is added to your image list: "p#recy … .bmp", which has some of the parameters used in its file name.

Look at it through your anaglyph glasses…
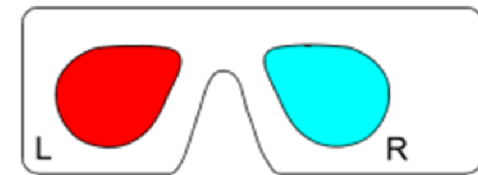
(C) Combine two SEM pictures taken after horizontal displacement of the specimen

A third simple method for generation of 3D SEM images is the overlay of two pictures taken after horizontal displacement of the specimen. This technique is easy to apply. However, one has to find out the proper positions, as the results depend on the localisation of the detectors inside the SEM.
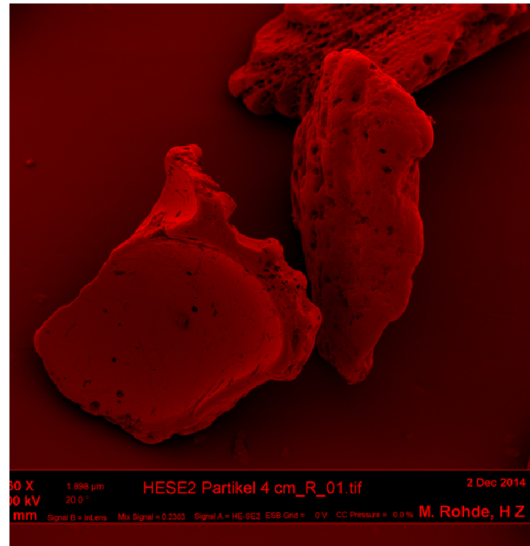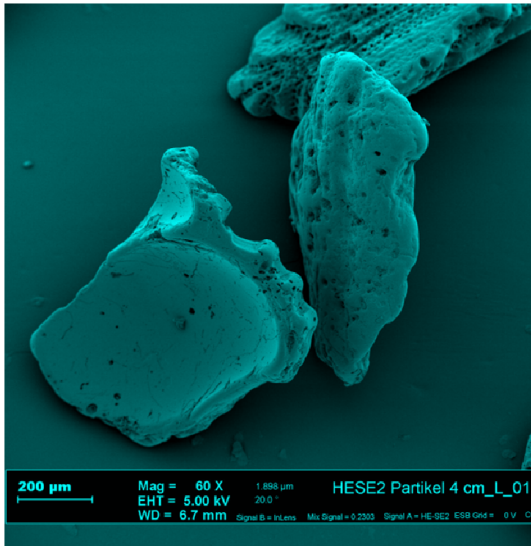
1. Take a SEM picture
2. Move the specimen to the side
3. Take a second picture
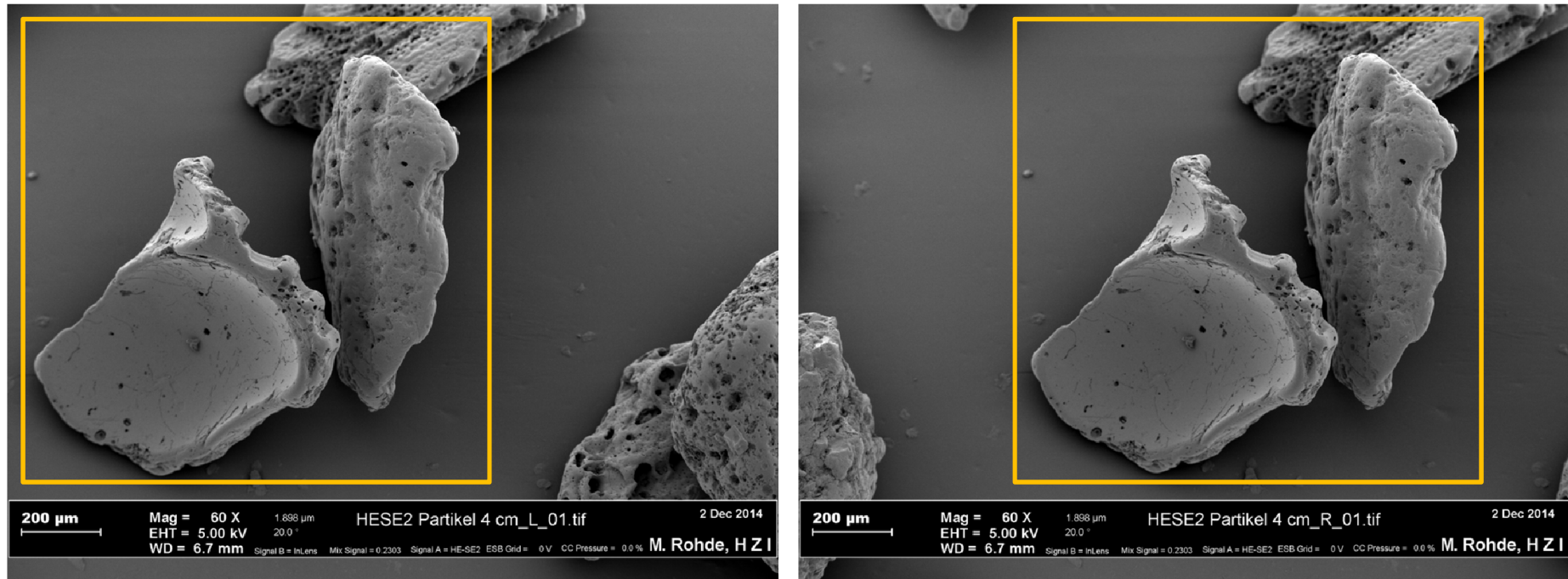


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4. Cut out congruent areas of the two pictures (using freeware like PICOLAY or StereoPhotoMaker)

=> The pictures will differ in a way that allows to generate a 3D image without using a depth map.
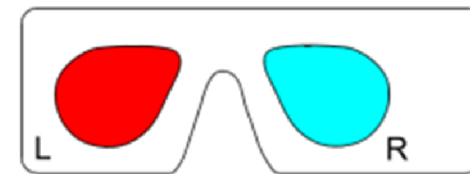
5. Set the red (left pict.) or the blue and green RGB channels (right pict.) of the pictures to zero, and

6. make an overlay of the resulting images (using freeware like PICOLAY or StereoPhotoMaker).
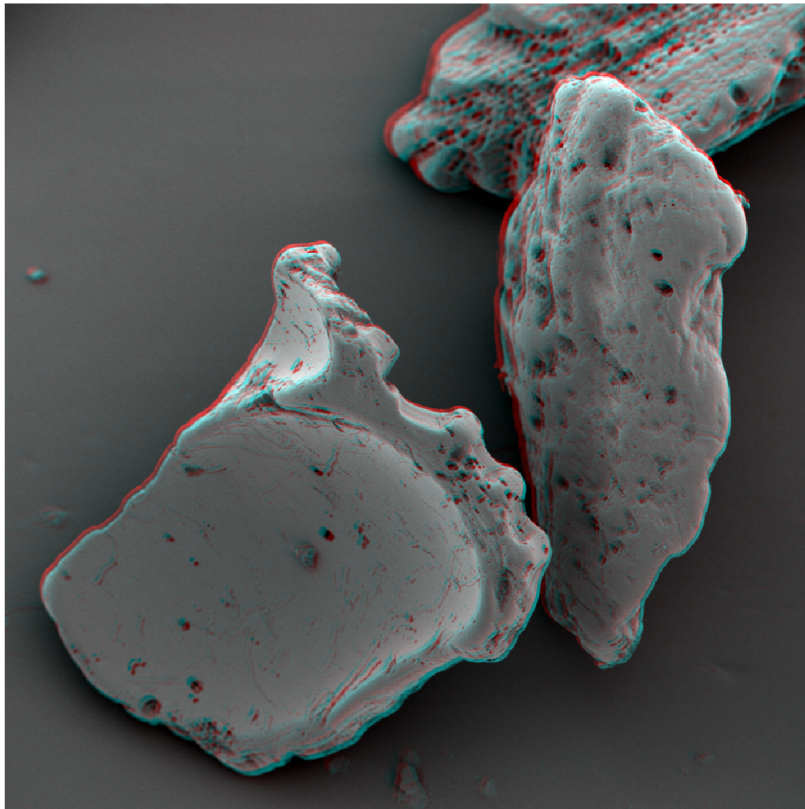
Look at the result through your anaglyph glasses…

www.picolay.de

It's that easy.

(Once you do it right it'll work.)