

ICAN Notes

Focus Track – How to minimize and compensate z-Axis drift using the Renishaw InVia Raman microscope

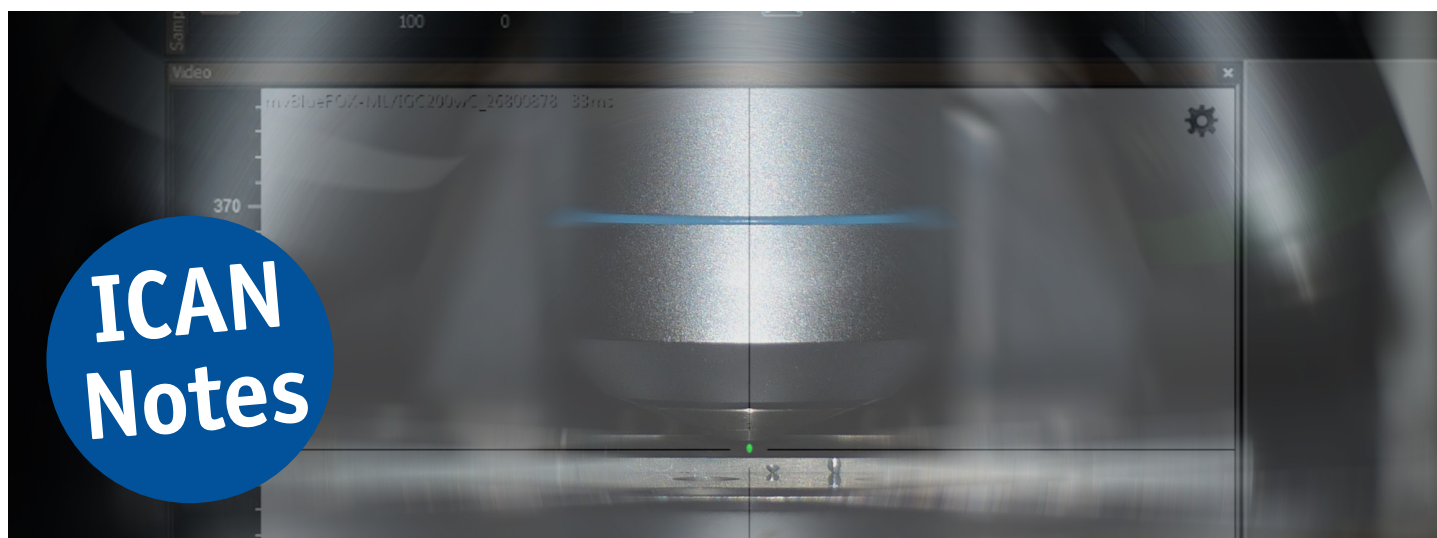
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Focus Track – How to minimize and compensate z-Axis drift using the Renishaw InVia Raman microscope

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The z-position of an optical microscope is prone to drift in the few μm -range due to a variety of factors: temperature instability, air movement in the lab, warming of the electronics or lasers, and others. When doing long-term Raman measurements, this can reduce the spatial resolution and the detected Raman signal by defocussing the laser spot. The same can happen, if the sample has a height structured topography or is tilted towards the objective.

However, these effects can be minimized, and a procedure of how to correct for the stage drift is presented in this note. The biggest effect can of course be seen, when using the 100 \times objective on the optical microscope. If objective lenses with lower magnification are used the z-Axis drift is less noticeable due to their smaller depth of focus. If only the 5 \times or 20 \times objectives are used drift compensation is usually not necessary.

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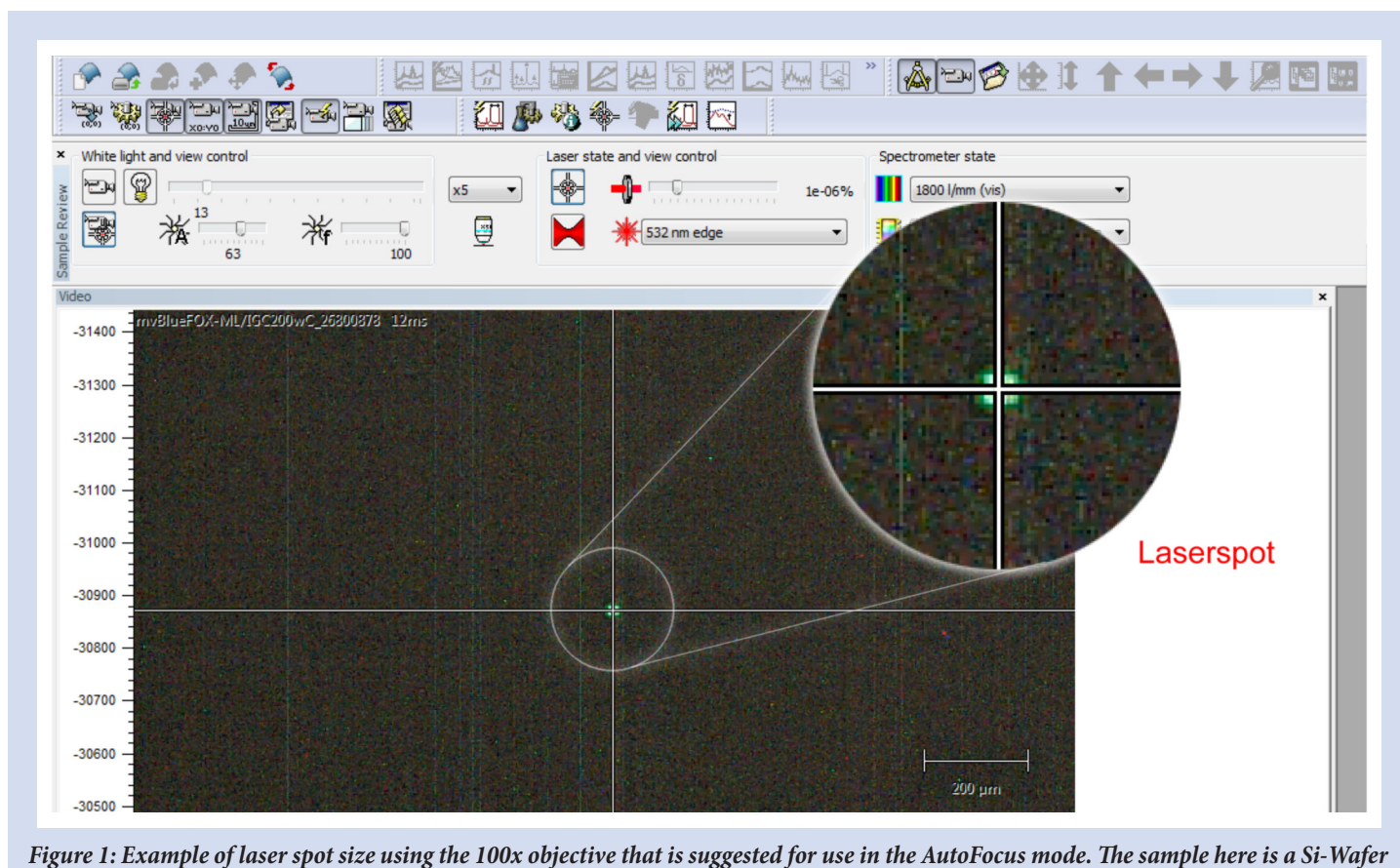


Figure 1: Example of laser spot size using the 100x objective that is suggested for use in the AutoFocus mode. The sample here is a Si-Wafer

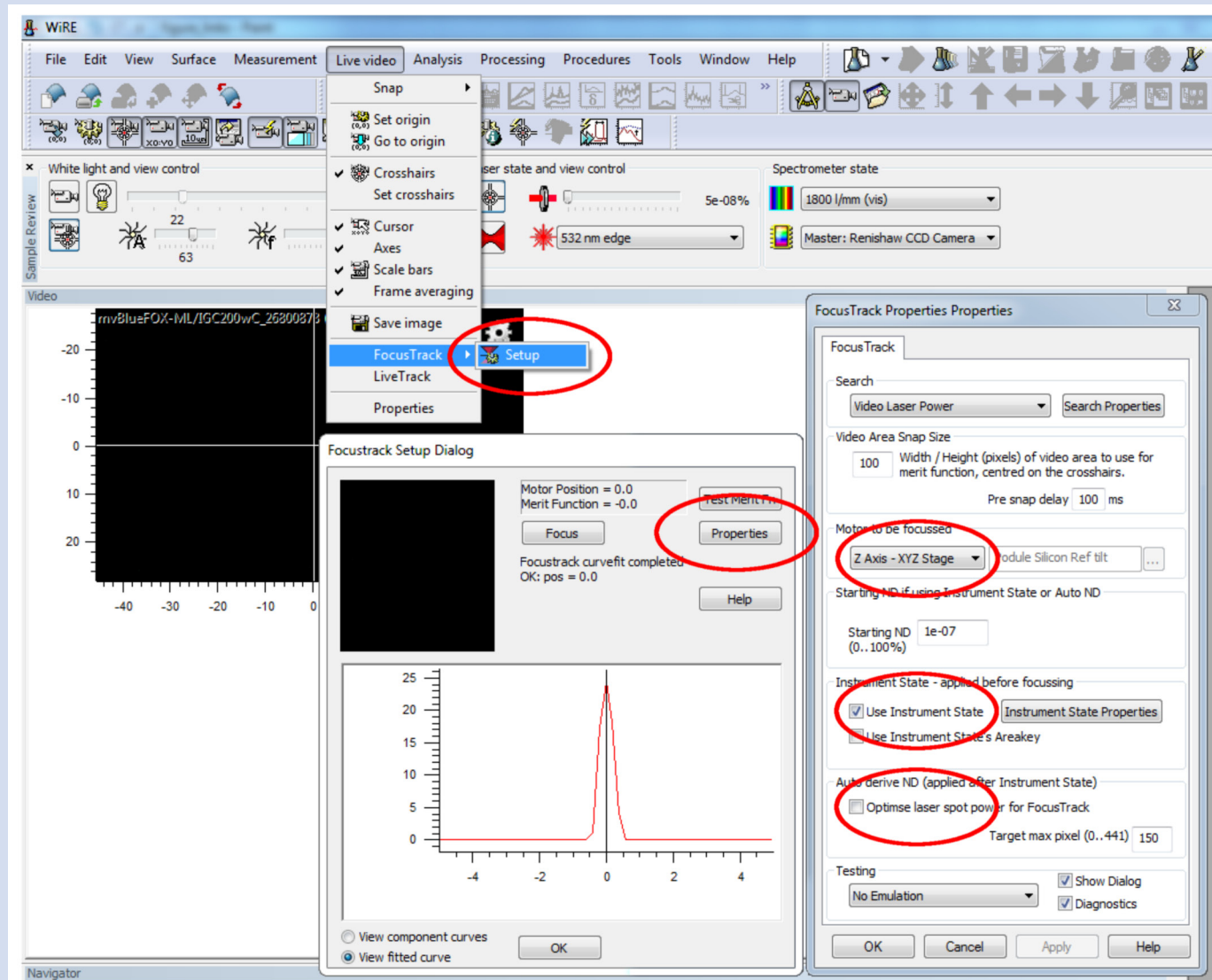


Figure 2: top: select FocusTrack Setup; center: FocusTrack Setup dialog; right: FocusTrack Properties window.

The following steps and rules must be applied before starting a long-term measurement in order to perform z-Axis focus correction.

1. The Raman microscope and the lasers should be running at least 30 minutes prior to the start of a long-term measurement. To optimize thermal stability the lab doors should be closed. The adjustable gears of the optical microscope are not to be used. Ever. They are locked in place and handling them can damage the microscope.
2. The sample should be in focus of your chosen objective and the chamber door should be closed for at least 15 minutes before starting the measurement. In these 15 minutes a possible defocusing due to z-Axis drift should be corrected by adjusting the z-height using only the Trackball in the correct speed setting. Write down the drift per minute for the setup of your final measurement. The drift is typically lower than 2 to 5 microns within these 15 minutes. The chamber door should not be opened. If no large drift is visible set origin to 0,0,0.

The WiRE software by Renishaw that is used at the ICAN does offer a focus track option. This feature automatically detects the correct z-value for the optimal focus using the USB-Camera, which

also records the video image of the sample. For this the z-value of the stage position is varied around the current $z=0$ height and the program determines the maximum laser spot intensity in the video signal of the USB-Camera. However, for this to work properly the following procedure should be followed for setting up the focus track for a mapping or similar longterm measurements:

3. The laser power for the drift correction should be chosen to be so low, that no Pixel of the camera is saturated. To find this value on a given surface turn off the illumination lamp while the sample is in focus, start at around „ $1e-07\%$ “ laser power (see **Starting ND** in the **FocusTrack Properties** window in Figure 2 right), and increase it stepwise until you see a small laser spot in the video image, as shown in Figure 1.
4. Select **Live video** > **FocusTrack** > **Setup**, see Figure 2 top.
5. Click on **Properties** in the newly opened window, see Figure 2 center.
6. A new dialog window will open. Adjust the setting to match the ones shown on the right of Figure 2 and then click on **Search Properties**.

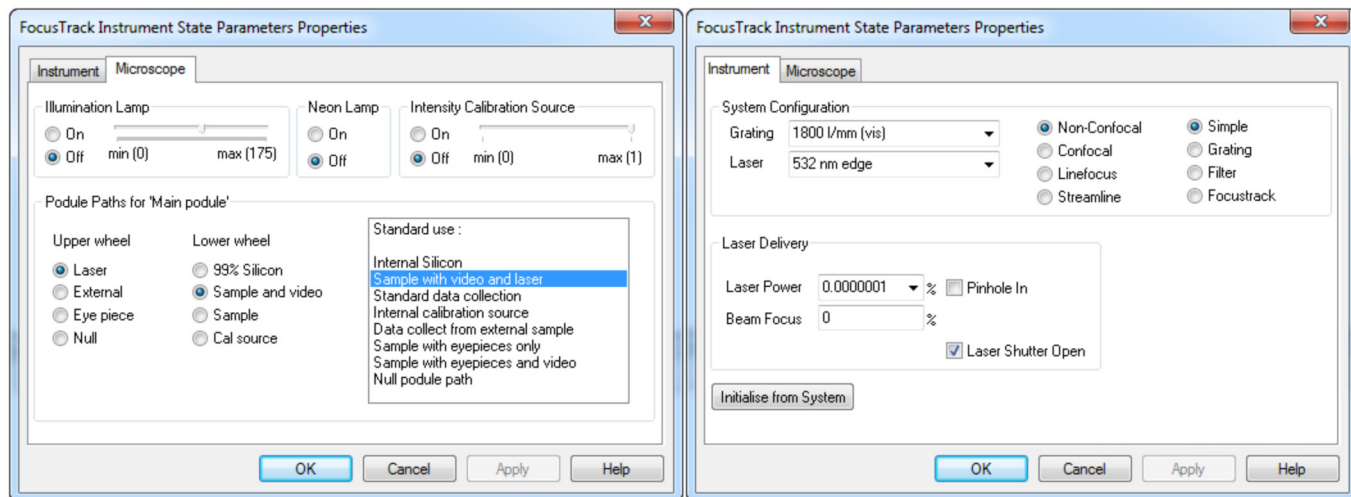


Figure 3: FocusTrack Instrument State Parameters Properties window.

7. In the newly opened window you can select the total global z-Axis limit range the stage is allowed to move during the AutoFocus measurement. It must be verified by the user that the stage can move freely within the range without crashing into the sample, holder, or the like. Do not put anything on the stage except the sample that you want to measure. The range determines how many microns around the current z-Axis zero level will be measured by the software to determine the correct focus height. For instance, a range of 10 μm at a stage position of $z = 0$ leads to a stepwise increase of z from $-5 \mu\text{m}$ to $5 \mu\text{m}$. Use the values for the drift that you measured in step 2 for an estimate of total possible drift. The stepsize should be around 0.1 or 0.2, when using the 100 \times objective. Close the dialog window and open the Instrument State Properties.

8. Select the desired **Laser** and **Laser Power** in the instrument tab

of the newly opened window, Figure 3 right. The laser power should be the same value that was determined in step 3 of these instructions. Make sure the **Illumination lamp** is checked off in the microscope tab, the **Lower wheel** and **Upper wheel** positions are selected as depicted in Figure 3 (left), and that **Sample with video and laser** is chosen as standard use.

9. Close the FocusTrack Instrument State Parameters Properties windows and start a test run by clicking on **Focus**, see Figure 2 center.

Figure 4 gives two examples of resulting intensity curves depending on the laser power chosen. If everything has been set up correctly a peak shape like the one on the right panel should be seen.

The FocusTrack is now properly set up.

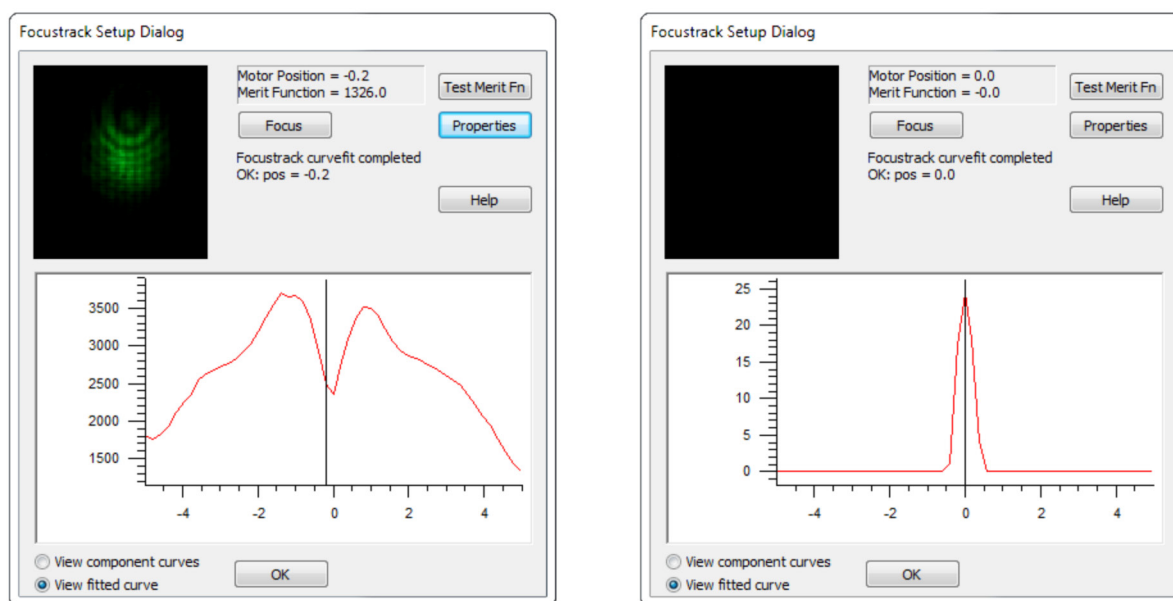


Figure 4: left: laser power too high, right: laser power sufficient and well-adjusted.

Including FocusTrack in a mapping measurement

To include the FocusTrack in a mapping, the **Use Legacy FocusTrack** in the FocusTrack tab of the map measurement setup has to be checked, see Figure 5. Next, select after how many scans (or steps) the FocusTrack should be performed. Use the written down drift from step 2 to estimate the time between two drift corrections. The observed drift and the topography of the sample determines the time one should choose between drift corrections.

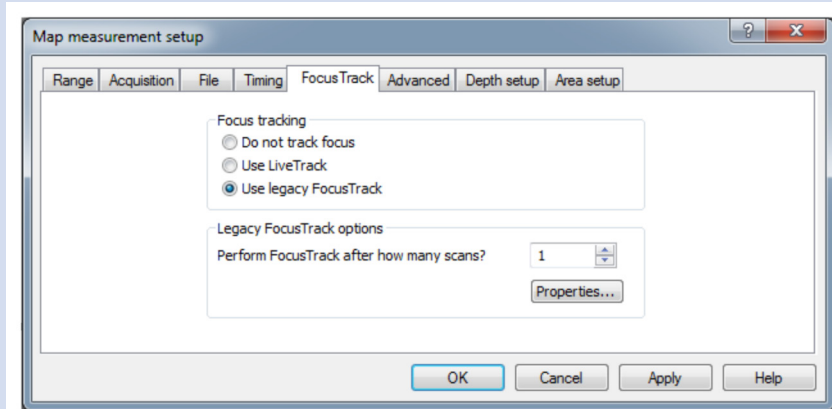


Figure 5: Map measurement setup window.

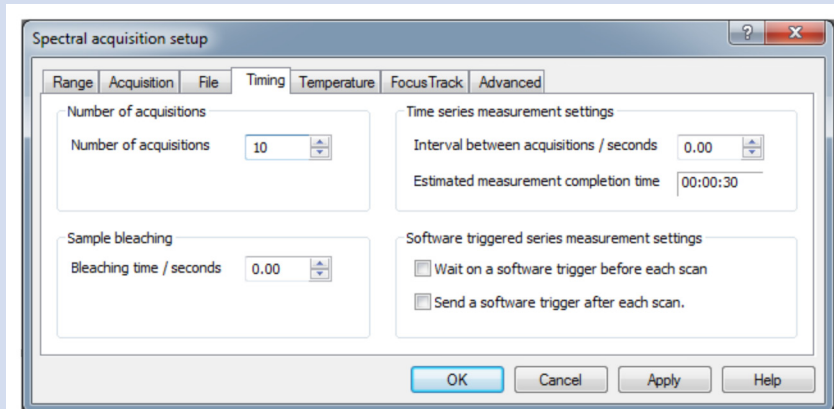


Figure 6: Spectral acquisition setup window.

Including FocusTrack in a spectral measurement

To include the FocusTrack in a single spectral acquisition, the timing option in the timing tab of the spectral acquisition setup has to be used, see Figure 6. The **Number of acquisitions** is the number how often the acquisitions defined in the acquisition tab is repeated. Thus, if one sets acquisitions to 10 both in the timing and acquisition tabs a total of 100 acquisitions is performed. The number of scans after which FocusTrack should be done refers to the number of acquisitions in the timing tab.

References

- [1] see also WiRE Online Help:
Help / Contents and search for *FocusTrack set-up*

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