Technical note: LiveTrack
TN214(EN)-01-A August 2018

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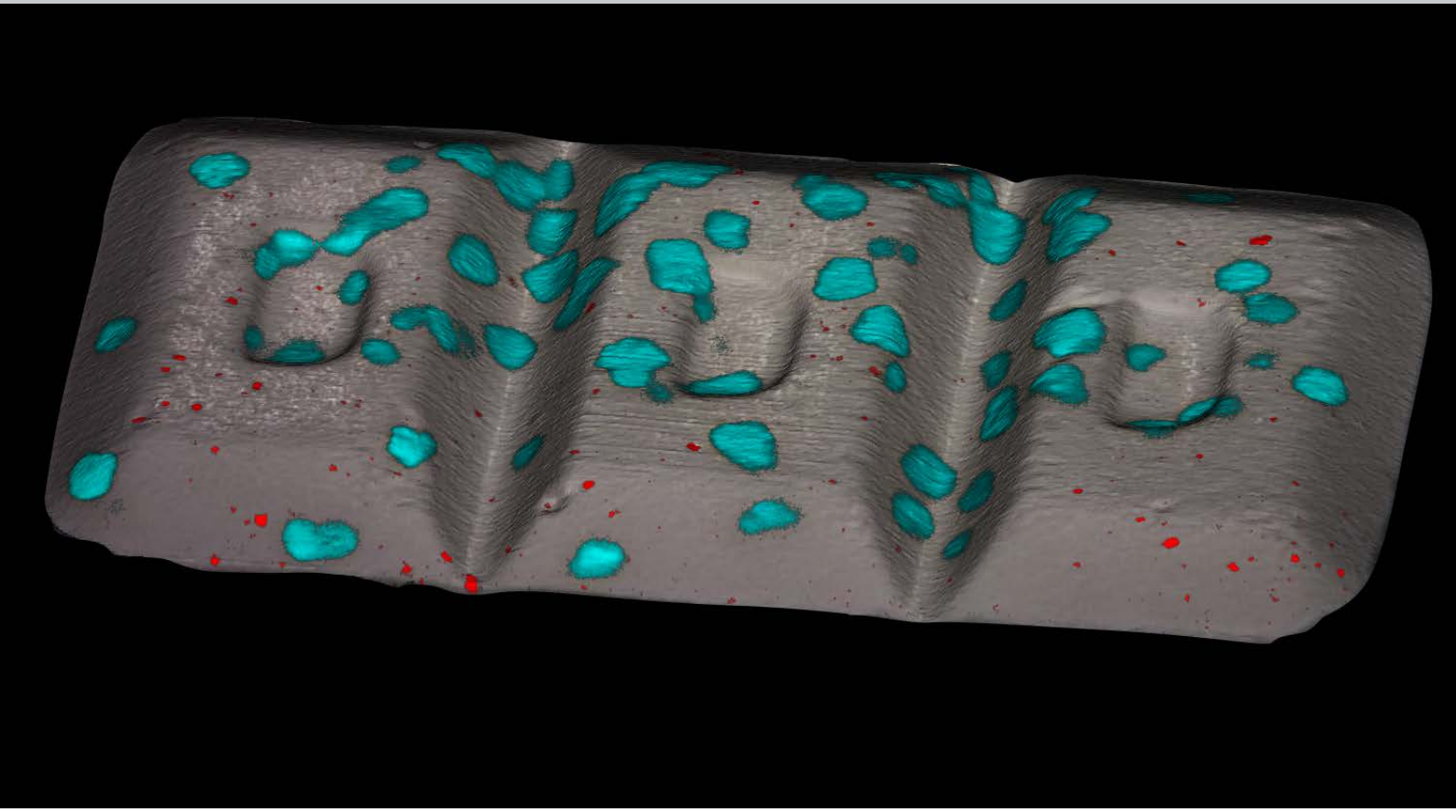
LiveTrack™ focus-tracking technology



3D LiveTrack technology image of a pharmaceutical tablet with the API overlaid in blue.

LiveTrack focus-tracking technology maintains optimum focus for both white light and Raman imaging to give stunning 3D images. It is used in Renishaw's inVia™ Qontor® confocal Raman microscope, and RA802 and RA816 analysers.

Now you can easily study samples with uneven, curved, or rough surfaces.

- Keep your sample in focus while you survey it under manual control.
- Raman-map rough, uneven, and curved surfaces.
- Track focus over the entire range of stage travel.
- Obtain surface profile information.
- Avoid time-consuming sample preparation (cutting and polishing).
- View Raman chemical images in 2D or 3D and see both the chemistry and the topography.
- Operated real-time. Does not need a time-consuming surface pre-scan.
- Maintain focus during dynamic measurements, such as sample heating/cooling and during very long measurements when the environmental conditions are varying.
- Benefit from having the advantages of 3D optical and Raman microscopy in the same instrument.

LiveTrack technology

To maintain focus, LiveTrack technology combines precise vertical motion control of the sample stage with new optical technology.

It works in both white-light video viewing and Raman acquisition modes, offering significant advantages over alternative techniques (see ‘Focus tracking techniques’, on final page).

Maintain focus

Focus is maintained in real-time as the sample:

- is scanned during Raman data collection;
- is moved under user command;
- expands or contracts (for example because of temperature or humidity changes).

LiveTrack technology can be offset vertically, enabling Raman data collection to occur at a fixed height below or above the interface being tracked.

Save time during white-light video viewing

Put your sample on the microscope stage, manually focus using the video viewer, activate LiveTrack technology, and you are done. The technology will maintain focus as you move the stage around to survey the sample.

This saves you considerable time as manual ‘move-focus-move’ operations are replaced with just ‘move’. You can concentrate on the features on your sample, rather than continual refocusing.

Raman-map rough, uneven, and curved surfaces

With LiveTrack technology you can acquire Raman data from rough surfaces. This not only saves time (you no longer need to section samples such as minerals and pharmaceutical tablets) but also enables you to study the physical and chemical state at the surface, rather than in the bulk.

As a Raman map progresses, LiveTrack technology continuously adjusts the sample height to keep the sample in focus. The resulting data can be displayed as 2D (‘top-down’) images or as 3D rotatable surfaces which convey not only the chemical structure of your material, but also its topography.

This capability goes beyond rough surfaces; it is also useful for angled or uneven surfaces, such as some semiconductor wafers, which can be slightly bowed. Although the bowing may be very slight, without LiveTrack technology it can be enough to compromise high magnification Raman analysis.

The technology can be used on any interface across which there is an appreciable difference in refractive index. Normally this will be the surface interface between a solid sample and the air, but it could also be the interface between two dissimilar layers. You can also specify an offset between the Raman focus and the LiveTrack focus, so you can take the Raman measurements a fixed distance below or above a surface.

Use with dynamic samples

LiveTrack technology will keep the sample in focus even if the sample height is changing because of humidity and temperature changes or creep. It can work though optical windows so you can, for example, use it to keep focus on a sample in a hot-cold stage during a series of measurements, made as the temperature is changed.

Using LiveTrack to maintain focus on the surface of a sample in a high temperature cell.

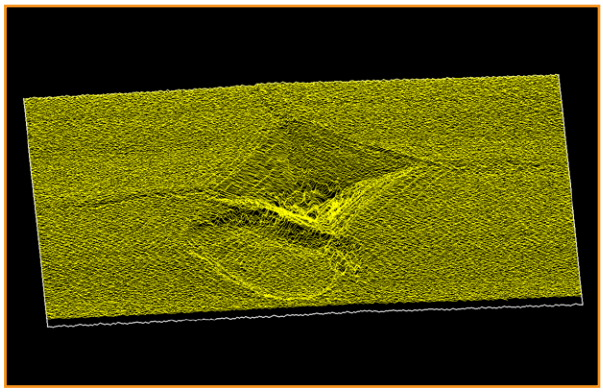
Displaying the results

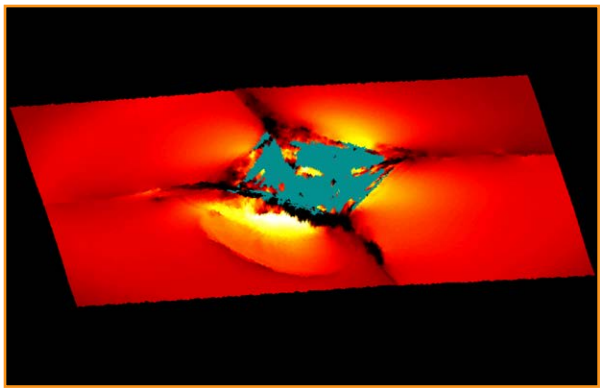
If LiveTrack technology is active during a Raman measurement, surface height data are recorded. Renishaw’s WiRE™ (Windows-based Raman Environment) software can then generate stunning 3D surface plots of the Raman data. The user can rotate and zoom these images and change the colour tables and illumination to get the view that best shows the important information.

You can also obtain cross-sections of the samples in x- and y-planes, giving dimensional information, and can export values to a text file for further analysis.

More power, more samples

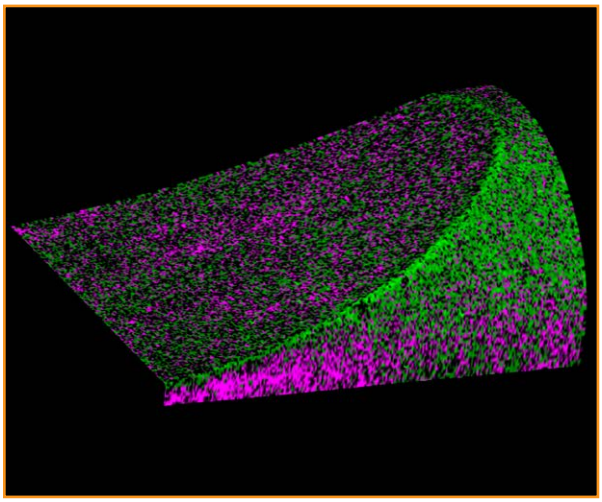
With inVia Qontor and LiveTrack technology you can not only study your existing samples in more detail, more efficiently, but you can also analyse a whole new range of uneven, rough, and curved samples.





Indentation of a silicon wafer by a diamond Vickers indenter, using 500 g load. Confocal StreamHR Raman data collected at 532 nm excitation with LiveTrack technology (100× objective). The analysed surface is 78 µm wide, 58 µm deep, and 4.6 µm high. The topography image (left) shows median and lateral cracking, and material removal by chipping. The image also reveals the raised area surrounding the indent, caused by the plastic deformation.
The Raman image (right) reveals stresses around the indent (compressive regions white/yellow, tensile regions black/dark red). The blue-green region within the indent is silicon that has been very highly plastically deformed, with a highly amorphous structure.

3D surface profile image of a metal coin demonstrating LiveTrack technology's 3D optical microscopy ability. The coin's dimensions were 18.0 mm diameter × 1.7 mm thick.



Analysis of a coated flat-head screwdriver bit. StreamHR confocal Raman data were collected at 532 nm excitation, with LiveTrack technology (20× objective). The image reveals the distributions of TiN (green) and TiO_2 (magenta). The imaged surfaces is 8.1 mm wide, 5.1 mm deep and 3.6 mm high.

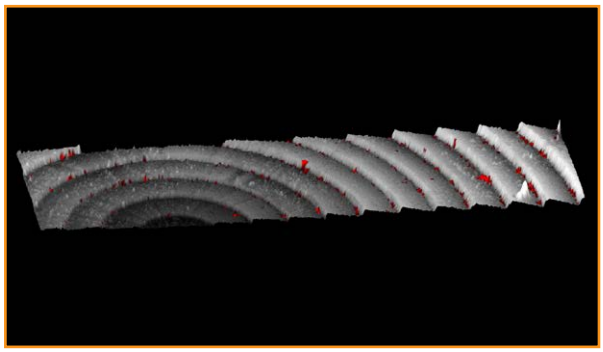
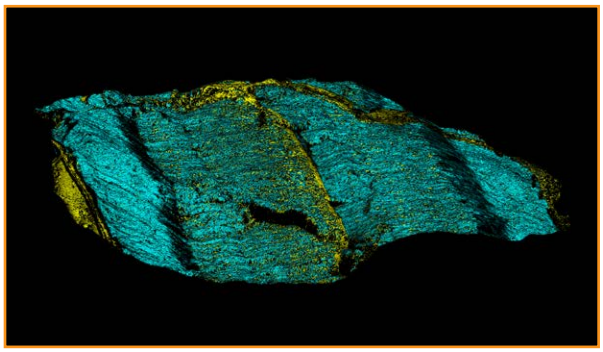


Image of a Fresnel lens showing the concentric ring lens topography and, from Raman analysis, contamination (red), which is preferentially located in the grooves of the rings. Data were collected using 532 nm excitation and a 50× objective. The analysed surface is 4.5 mm wide, 1.3 mm deep, and 24 µm high.



Quartz-dominated rock (Tiger's Eye) examined using 532 nm excitation and a 20× objective lens. The Raman image shows quartz (cyan) and inorganic carbonates (yellow). The imaged surface is 47 mm wide, 26 mm deep, and 3.0 mm high.

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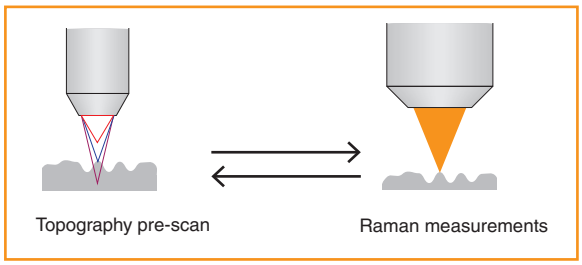
Focus-tracking techniques

A variety of focus-tracking techniques can be used to scan uneven surfaces.

Independent prescan

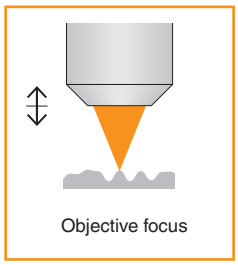
An independent focusing system prescans the sample prior to Raman data acquisition. This is often performed using a chromatic sensor or relies on optical contrast in the image.



Independent prescan

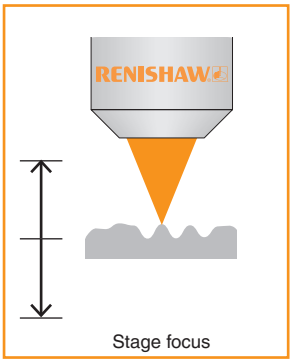
Focusing microscope objective

The microscope objective lens, rather than the sample stage, moves vertically to keep the sample in focus during scans. This movement is normally of limited range.



Focusing microscope objective

LiveTrack technology



Renishaw's LiveTrack technology

In contrast, Renishaw's LiveTrack technology continually adjusts the height of the motorised microscope stage to maintain focus during viewing and scanning.

This has many advantages.

- It gives a continuous closed-loop feedback of focus, both in white-light and Raman operation.
- It does not use a pre-scan, which can be time consuming and is unsuitable for samples whose heights are dynamically changing (from mechanical creep, temperature variation, drying, etc).
- It does not require optical contrast in the image.
- It offers a large range of focus travel unlike most pre-scan or objective lens focusing systems which are limited in sensor or mechanical range.
- It supports the whole horizontal travel of the microscope stage.

Specifications

Parameter	Value
Tracking of focus	Better than objective depth of field
Maximum overall height range	Only limited by the travel of the microscope stage
Maximum lateral range	Only limited by the travel of the sample stage. For Renishaw's MS20 stage this is 112 mm × 76 mm
Supported objective lenses	Standard Renishaw objective lenses from 20× to 100×
Supported lasers	Visible and near-infrared, from 450 nm to 830 nm inclusive
EN 60825-1:2014 classification	Class 3B Laser product*

*Class 4 or Class 1 for certain configurations.

Renishaw. The Raman innovators

Renishaw manufactures a wide range of high performance optical spectroscopy products, including confocal Raman microscopes with high speed chemical imaging technology, dedicated Raman analysers, interfaces for scanning electron and atomic force microscopes, solid state lasers for spectroscopy and state-of-the-art cooled CCD detectors.

Offering the highest levels of performance, sensitivity and reliability across a diverse range of fields and applications, the instruments are designed to meet your needs, so you can tackle even the most challenging analytical problems with confidence.

A worldwide network of subsidiary companies and distributors provides exceptional service and support for its customers.

Please visit www.renishaw.com/qontor for more information.