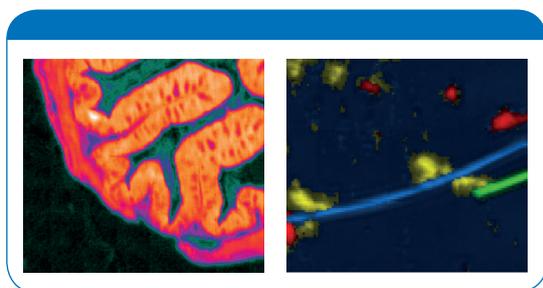




• **LUMOS II** Fully motorized FTIR imaging microscope

Specifications

Bruker is working hard to make advanced techniques more accessible to users of any skill level. The LUMOS II FTIR microscope keeps following that creed. Its hardware, software and user interface were built around the idea, that even beginners should obtain exceptional results in a minimum amount of time.



These FTIR images of a tissue section (left) and a filter loaded with microplastic particles (right) were recorded with **>550 spectra per second at 4 cm⁻¹** spectral resolution.

LUMOS II Highlights

- Superb FPA imaging performance
- High-definition spectroscopic and visual data
- Ultrafast data acquisition in imaging mode
- FTIR imaging in ATR, transmission and reflection mode
- Fully automated measurements in all modes
- High-sensitivity TE-MCT detector as standard
- Software guided measurements support all users
- Conveniently handle samples of up to 40 mm thickness
- Large field of view and brilliant visual quality
- All hardware is motorized and software controlled
- Complies with cGMP, pharmacopoeias and FDA 21 CFR p11
- Automated OQ/PQ/pharmacopeia tests
- Always reliable performance with PermaSure+

Automation	Specification	Annotation
<ul style="list-style-type: none"> Visual Mode 	<ul style="list-style-type: none"> Motorized change between IR and Vis Single-click autofocus included Automatically used during mapping experiments Motorized switch of illumination mode (transmission, reflection, darkfield) Motorized Vis polarizer and analyzer with high positioning accuracy (option) Motorized change of numerical aperture (NA) between IR and Vis mode 	<ul style="list-style-type: none"> All hardware parameters are controlled with a simple mouse click from the OPUS software. Fully concentrate on your analytical tasks, the LUMOS II's extensive automation will do the rest. The motorized ATR crystal lets you perform background and sample measurements fully automated.
<ul style="list-style-type: none"> Attenuated Total Reflectance (ATR) 	<ul style="list-style-type: none"> Piezo driven and encoded Germanium ATR crystal ($n_{Ge} = 4$); ATR crystal tip size: 100 μm Motorized ATR crystal with built-in pressure sensor and three, software-selectable pressure steps 	<ul style="list-style-type: none"> The Piezo motor ensures accuracy and makes ATR microscopy practical and efficient. The integrated pressure sensor optimizes contact between crystal and sample (hard and soft).
<ul style="list-style-type: none"> Transmission and Reflection 	<ul style="list-style-type: none"> Motorized measurement mode switch (ATR, Reflection, Transmission) 	<ul style="list-style-type: none"> Precise switching between ATR/transmission/reflection with the click of a button.
<ul style="list-style-type: none"> Sample Stage 	<ul style="list-style-type: none"> Motorized X,Y,Z-stage (only Z-drive for LUMOS-M) Adjustment range: 75 mm x 50 mm Adjustment accuracy: 0.1 μm (=smallest step size) Maximum sample height: 40 mm Repeatability: < 1 μm Automatic calibration Open access to sample stage 	<ul style="list-style-type: none"> Open access to the sample stage from all sides and generous working distance allow microscopic analysis even of large samples. Therefore, in many cases even larger samples can be analyzed without prior preparation. Analyze large sample up to 40 mm in height.
<ul style="list-style-type: none"> Detectors 	<ul style="list-style-type: none"> Motorized switch between up to 3 detectors 	<ul style="list-style-type: none"> Conveniently switch between single-element and FPA detectors at the click of the mouse.
<ul style="list-style-type: none"> Apertures 	<ul style="list-style-type: none"> Motorized illuminated transparent knife-edge aperture; very precise positioning down to 5 x 5 μm^2 (optional) Automatic aperture wheel with 8 positions (5 μm, 10 μm, 20 μm, 35 μm, 50 μm, 100 μm, 200 μm, open) 	<ul style="list-style-type: none"> All movable parts are motorized, making your life a lot easier. This includes the apertures. For flexible aperture adjustments optional LED illuminated knife-edge apertures can be equipped.
Sample View	Specification	Annotation
<ul style="list-style-type: none"> Visual Inspection 	<ul style="list-style-type: none"> Full view of sample area during IR data acquisition even with positioned aperture (transparent knife-edge apertures only) 	<ul style="list-style-type: none"> Discover smallest regions of interest with an unrestricted sample view. LUMOS II even allows sample live view during data acquisition.
<ul style="list-style-type: none"> Illumination 	<ul style="list-style-type: none"> White light LED illumination in transmission and reflection; white balance and wide range brightness, color and contrast control 	<ul style="list-style-type: none"> Assures homogenous illumination of your sample in transmission and reflection mode.
<ul style="list-style-type: none"> Video Image 	<ul style="list-style-type: none"> Large field of view: 1490 x 1118 μm^2 High lateral resolution: 0.6 $\mu\text{m}/\text{pixel}$ Live stream of full-resolution image @ 1/2 FOV Fast CMOS camera, 5 MegaPixel, USB3, QSXGA Supports dual monitor use 	<ul style="list-style-type: none"> High definition visual images of an exceptionally large sample area. Zooming allows further magnification. LUMOS II has sub-micron visual resolution, matched by high spatial resolution in IR imaging. View the live sample image fully resolved on a second monitor.
<ul style="list-style-type: none"> Objective 	<ul style="list-style-type: none"> 8x objective for automated measurements in transmission, reflection and ATR NA= 0.4 for visual inspection of samples with high depth of field. NA= 0.6 for IR data collection 30 mm working distance for transmission, reflection and ATR 	<ul style="list-style-type: none"> Automatic change of numerical aperture (NA) between IR and vis mode results in highest performance in both modes. Large working distance enables smart analysis of very thick or structured samples especially in ATR (e.g. large workpieces).

Infrared Optics	Specification	Annotation
<ul style="list-style-type: none"> ■ Interferometer 	<ul style="list-style-type: none"> ■ Permanently aligned cube corner interferometer ■ Insensitive against mirror tilts, mechanical vibrations and thermal effects ■ 10 years warranty 	<ul style="list-style-type: none"> ■ RockSolid™ is more than just a name. It is a statement for highest stability and performance. ■ The wavenumber precision and accuracy by Bruker's patented interferometer design remain unsurpassed.
<ul style="list-style-type: none"> ■ Mirrors 	<ul style="list-style-type: none"> ■ Gold coated mirrors for highest efficiency in MIR 	<ul style="list-style-type: none"> ■ LUMOS II uses carefully selected mirror materials to provide high-definition visual data and peak sensitivity in MIR single-point measurements and FPA imaging.
<ul style="list-style-type: none"> ■ Windows and Beamsplitter 	<ul style="list-style-type: none"> ■ ZnSe windows and beamsplitter (standard) ■ KBr windows and beamsplitter (optional) 	<ul style="list-style-type: none"> ■ Standard ZnSe optics enable high MIR performance while making the LUMOS II's optics inert to high humidity. KBr windows and beamsplitter can be equipped for an extended spectral range.
<ul style="list-style-type: none"> ■ Infrared Source 	<ul style="list-style-type: none"> ■ High performance IR light source ■ 5 years warranty 	<ul style="list-style-type: none"> ■ Bright and robust light source to deliver continuous performance throughout its lifetime.
<ul style="list-style-type: none"> ■ Calibration Laser 	<ul style="list-style-type: none"> ■ Robust diode laser with long lifetime and low power consumption ■ 10 years warranty 	<ul style="list-style-type: none"> ■ Energy efficient, state-of-the-art diode laser with very long service life and continuously high performance.
<ul style="list-style-type: none"> ■ Purge and Sealing 	<ul style="list-style-type: none"> ■ Sealed and desiccated interferometer and detector chamber (standard) ■ Dry-air or nitrogen purge (optional) 	<ul style="list-style-type: none"> ■ All optomechanics are tightly sealed. Dry-air purge not required but optionally available. ■ ZnSe optics is inert against humidity.
<ul style="list-style-type: none"> ■ General 	<ul style="list-style-type: none"> ■ Fully automatic calibration of optics 	<ul style="list-style-type: none"> ■ Never worry about the instrument and focus only on your analytical task.

Detectors	Specification	Annotation
<ul style="list-style-type: none"> ■ TE-MCT (standard) 	<ul style="list-style-type: none"> ■ Thermo-electrically cooled MCT single-element detector 	<ul style="list-style-type: none"> ■ Perform IR microscopy with high spatial resolution, and sensitivity without the need for liquid nitrogen.
<ul style="list-style-type: none"> ■ LN₂-MCT (mid-band, option) 	<ul style="list-style-type: none"> ■ Liquid nitrogen cooled MCT single-element detector 	<ul style="list-style-type: none"> ■ Peak performance for demanding applications that require highest sensitivity.
<ul style="list-style-type: none"> ■ LN₂-MCT (broad-band, option) 	<ul style="list-style-type: none"> ■ Liquid nitrogen cooled MCT single-element detector 	<ul style="list-style-type: none"> ■ Recommended for applications that require an extended spectral range.
<ul style="list-style-type: none"> ■ Focal-Plane Array (FPA, option) 	<ul style="list-style-type: none"> ■ 32 x 32 pixel detector element ■ Pixel resolution 5 μm (ATR: 1.25 μm) ■ PermaSure+ pixel by pixel calibration ■ Liquid nitrogen cooled 	<ul style="list-style-type: none"> ■ Applicable in transmission, reflection and ATR mode. Delivers chemical images in stunning detail with a resolution of one spectrum per 5 μm (1.25 μm in ATR). ■ To achieve maximum pixel-to-pixel wavenumber accuracy and highest signal to noise, all pixels of the FPA detector are calibrated individually (patent pending).
<ul style="list-style-type: none"> ■ DLaTGS (optional) 	<ul style="list-style-type: none"> ■ DLaTGS single-element detector 	<ul style="list-style-type: none"> ■ Both DTGS and TE-MCT do not require liquid nitrogen cooling. In comparison, DTGS detectors offer a significantly reduced sensitivity, which limits the spatial resolution to >50 μm.

Performance	Specification	Annotation
<ul style="list-style-type: none"> Spectral Ranges 	<ul style="list-style-type: none"> 6000 – 670 cm⁻¹ (TE-MCT, ZnSe optics) 6000 - 600 cm⁻¹ (mid-band MCT, ZnSe optics) 7800 – 450 cm⁻¹ (broad-band MCT, KBr optics) 5000 – 750 cm⁻¹ (FPA, ZnSe optics, typical) 	<ul style="list-style-type: none"> Accessible spectral range depends on detector, measurement mode, and optics. ZnSe optics are strongly recommended as they are inert to degradation by water vapour.
<ul style="list-style-type: none"> Spectral Resolution 	<ul style="list-style-type: none"> 2 cm⁻¹ resolution (standard) 0.8 cm⁻¹ resolution (optional) 	<ul style="list-style-type: none"> High spectral resolution option to even resolve IR bands of gases (typically macroscopic).
<ul style="list-style-type: none"> Signal to Noise Ratio 4 cm⁻¹ resolution, 2200-2100 cm⁻¹, 1 min. measurement time, typical 	<ul style="list-style-type: none"> TE-MCT >1800 : 1 (100 μm aperture) >600 : 1 (50 μm aperture) >150 : 1 (25 μm aperture) LN-MCT >35000 : 1 (100 μm aperture) >5000 : 1 (25 μm aperture) >2000 : 1 (10 μm aperture) FPA >1000 : 1 (no aperture, 5 μm pixel resolution) DLaTGS >650 : 1 (100 μm aperture) >40 : 1 (50 μm aperture) 	<ul style="list-style-type: none"> TE-MCT detectors do not require liquid nitrogen and still offer a clear sensitivity advantage compared to DLaTGS measurements. LN-MCT detectors require liquid nitrogen and provide peak sensitivity. Given value applies to the mid-band MCT detector. FPA detectors are the ultimate choice in chemical imaging, yielding a spatial/pixel resolution of 5 μm (ATR 1.25 μm) and peak signal to noise ratio. DLaTGS detectors provide flexibility without cooling time for quick routine measurements with low demand on spatial resolution (>50 μm).
<ul style="list-style-type: none"> Wavenumber Accuracy 	<ul style="list-style-type: none"> ≤ 0.05 cm⁻¹ @ 1576 cm⁻¹ for all types of single element detectors; ≤ 0.08 cm⁻¹ @1576 cm⁻¹ for each individual pixel of the FPA detector 	<ul style="list-style-type: none"> Wavelength accuracy describes how well the wavelength axis of an instrument matches a reference wavelength axis.
<ul style="list-style-type: none"> Wavenumber Precision 	<ul style="list-style-type: none"> <0.0005 cm⁻¹ @ 1576 cm⁻¹ Repeatability from 10 measurements 	<ul style="list-style-type: none"> Wavelength precision describes how well an instrument repeats its own wavelength axis.
<ul style="list-style-type: none"> Mapping (LUMOS II) 	<ul style="list-style-type: none"> 5 spectra per second @ 4 cm⁻¹ 	<ul style="list-style-type: none"> Parallel data collection and processing enable rapid single point measurements.
<ul style="list-style-type: none"> Imaging (LUMOS II-IMG) 	<ul style="list-style-type: none"> 1024 spectra per 2.2 seconds @ 4 cm⁻¹ 1 mm x 1 mm, single scan, scan time 75 sec., 5 μm per pixel, corresponds to >550 spectra/sec 1024 spectra per 1.2 seconds @ 16 cm⁻¹ 1 mm x 1 mm, single scan, scan time 40 sec. 5 μm per pixel, corresponds to >900 spectra/sec 	<ul style="list-style-type: none"> Collect over 50.000 spectra in less than a minute with this fast-paced measurement mode. The excellent pixel resolution of 5 μm (ATR: 1.25 μm) indicates how many spectra you obtain in a defined area (e.g. per micrometer).
<ul style="list-style-type: none"> Macroscopic Sample Measurement 	<ul style="list-style-type: none"> Left side; compatible with QuickSnap™ modules Dedicated DLaTGS with automated OQ/PQ and electronic sampling module recognition 	<ul style="list-style-type: none"> The Macro Unit expands the capabilities of LUMOS II to perform macroscopic analysis in ATR/transmission/reflection (just like ALPHA II).
Validation	Specification	Annotation
<ul style="list-style-type: none"> cGMP/GLP 	<ul style="list-style-type: none"> Automated OQ and PQ tests for FPA and single element detectors Permanent system monitoring 	<ul style="list-style-type: none"> Automatic test routines according to recent pharmaceutical regulations. Software warns about OQ and PQ expiration dates.
<ul style="list-style-type: none"> Pharmacopoeias 	<ul style="list-style-type: none"> USP, JP, ChP, IP, Ph.Eur compliance 	<ul style="list-style-type: none"> LUMOS II complies with all major pharmacopoeias.
<ul style="list-style-type: none"> Data Integrity 	<ul style="list-style-type: none"> Fully complies to FDA 21 CFR part 11 Globally unique object identifier User & signature management All data is stored in its original form Original data cannot be deleted (OPUS/VALIDATION required) 	<ul style="list-style-type: none"> OPUS is used for measurements, evaluation, audit trailing and data integrity features. OPUS is based on the ALCOA+ principle, yielding data that is: Atributable Legible Contemporaneous Original Accurate +Complete +Consistent +Enduring.
<ul style="list-style-type: none"> Reference Standards 	<ul style="list-style-type: none"> NIST traceable polystyrene standard integrated in Internal Validation Unit (IVU) External polystyrene standard for instrument qualification with ATR according to Ph.Eur. 	<ul style="list-style-type: none"> Certified standards are available to qualify LUMOS II according to all major pharmacopoeias.

Software	Specification	Annotation
<ul style="list-style-type: none"> ■ User Interface 	<ul style="list-style-type: none"> ■ OPUS software with guided measurements and step-by-step measurement assistant 	<ul style="list-style-type: none"> ■ OPUS is Bruker's all-in-one software for vibrational spectroscopy products, offering an easy to navigate and intuitive interface.
<ul style="list-style-type: none"> ■ Data Storage 	<ul style="list-style-type: none"> ■ All results are stored in a single file; includes information about sample and experiment as well as visual and spectral data 	<ul style="list-style-type: none"> ■ Storing all information in a single file makes your visual and spectral data more secure. Access all relevant information directly from OPUS.
<ul style="list-style-type: none"> ■ Data Acquisition 	<ul style="list-style-type: none"> ■ Completely automated in all measurement modes 	<ul style="list-style-type: none"> ■ Select the measurement points and OPUS will do the rest.
<ul style="list-style-type: none"> ■ Spectra Preview 	<ul style="list-style-type: none"> ■ Real time spectra preview and live trace during mapping and imaging measurements 	<ul style="list-style-type: none"> ■ Live Trace during data acquisition allows on-the-fly analysis of your sample.
<ul style="list-style-type: none"> ■ Sample View 	<ul style="list-style-type: none"> ■ Real time sample view (only with knife-edge apertures) 	<ul style="list-style-type: none"> ■ Sample live view can be displayed in a separate window and exported to other screens.
<ul style="list-style-type: none"> ■ Data Export 	<ul style="list-style-type: none"> ■ CSV, MatLab, ENVI, JCAMP-DX and more. ■ BMP, JPG, PNG and EMF. 	<ul style="list-style-type: none"> ■ Spectral data export into multiple data formats. Export visual and chemical images in high quality.
<ul style="list-style-type: none"> ■ Data Evaluation 	<ul style="list-style-type: none"> ■ Spectra identification by searching commercial and customer made libraries, mixture analysis, qualitative and quantitative spectral analysis using various uni- and multivariate methods ■ Display of IR images as 2D and 3D plots, overlaid or blended with visual data ■ Selection and view of one or many spectra in chemical images 	<ul style="list-style-type: none"> ■ OPUS goes beyond measuring data. It's also a powerful spectral evaluation software suite to obtain great results. ■ Superimpose spectral data on top of visual images to analyze samples in great detail.

Other	Specification	Annotation
<ul style="list-style-type: none"> ■ Dimensions 	<ul style="list-style-type: none"> ■ Width x height x depth: 300 x 670 x 520 mm (LUMOS II) 300 x 790 x 650 mm (LUMOS II-IMG) 	<ul style="list-style-type: none"> ■ Compact formfactor to setup the instrument on crowded laboratory benches or any other workplace environment where you need your IR microscope.
<ul style="list-style-type: none"> ■ Weight 	<ul style="list-style-type: none"> ■ ~ 60 kg (LUMOS II, LUMOS II-M) ■ ~ 66 kg (LUMOS II-IMG) 	<ul style="list-style-type: none"> ■ As a standalone FTIR microscope, no additional spectrometer is necessary.
<ul style="list-style-type: none"> ■ Power Consumption 	<ul style="list-style-type: none"> ■ 100 - 240 VAC, 50 - 60 Hz, 60 W, max. 90 W (LUMOS II) ■ 100 - 240 VAC, 50 - 60 Hz, 90 W, max. 140 W (LUMOS II-IMG) 	<ul style="list-style-type: none"> ■ Low power consumption saves a lot of money in the long run.
<ul style="list-style-type: none"> ■ Operating System 	<ul style="list-style-type: none"> ■ Windows 10 ■ Windows 7 	<ul style="list-style-type: none"> ■ Utilize Windows'64-bit capabilities for peak imaging performance and data analysis.
<ul style="list-style-type: none"> ■ Computer Interface 	<ul style="list-style-type: none"> ■ Ethernet ■ USB 3.0 ■ CamLink (only for imaging) 	<ul style="list-style-type: none"> ■ Ethernet cable for spectrometer controls. ■ USB 3.0 for visual camera signal. ■ CamLink for high-speed imaging data.

Technologies used are protected by one or more of the following patents:
DE 102004025448; DE 19940981; DE 102012200851; US 8873140
Additional patents pending

**Bruker Optics is ISO 9001
and ISO 13485 certified.**

Laser class 1

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