

Product Note M128-02/11

Automatic beamsplitter exchange unit for VERTEX 80v FT-IR

Bruker Optics is very proud to offer a new and unique automatic beamsplitter exchange unit BMS-c (fig.1) for its VERTEX 80v top-of the line bench-top vacuum FT-IR spectrometer. Its outstanding functionality enables the

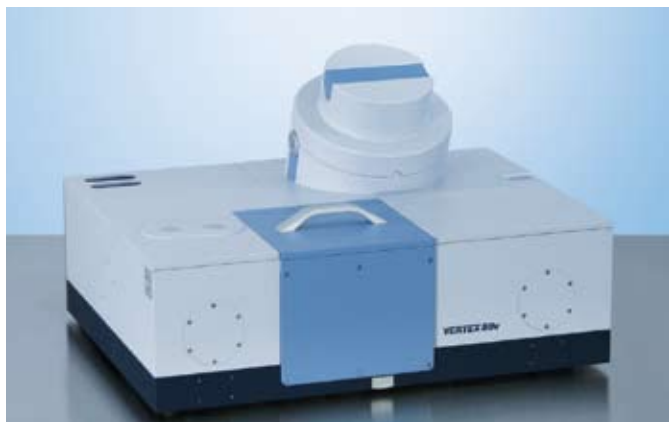


Fig.1: VERTEX 80v vacuum spectrometer equipped with the automatic beamsplitter exchange unit (BMS-c) exchange of up to four different types of beamsplitter under vacuum conditions. The beamsplitter exchange is remotely controlled by the OPUS FT-IR operating software. With this new option for the high end research and development VERTEX 80v spectrometer, Bruker Optics now offers the



real successor to the very famous IFS 113v FT-IR spectrometer which started the Bruker FT-IR product line in 1974 and also incorporated an automatic beamsplitter changer. All the experience in instrumentation and vacuum technology pioneered and developed in over 35 years guarantees the reliability and functionality of such a demanding optical device.

Additional value of an automatic beamsplitter exchange unit

Since the introduction of FT-IR spectroscopy, it is very well accepted by the research community that a spectrometer based on a vacuum optics bench provides IR spectra which are free of residual H₂O- and CO₂- absorption bands, which may mask very weak spectral features of the measured sample. Such residual absorptions of the laboratory room air are typically visible under purge conditions (for more details see the "Vacuum" product note T18-02/08).

But measurements of a sample in the complete IR or THz spectral range require different types of beamsplitter which makes it necessary to vent and re-evacuate the spectrometer optics bench for exchange of the beamsplitter. The BMS-c is particularly useful for more demanding applications such as working with liquid helium cooled cryostats or investigating samples which may change over time. This

is because of the shortened measurement time. A further benefit is the stable measurement condition and hence optimum spectral quality resulting from leaving the optics alone. It should be mentioned also that even for purge systems and not just vacuum, the BMS-c provides significant advantages with respect to experiment time and instrument stability.

Upgrade possibility

All already installed VERTEX 80v instruments can be upgraded with this new option. For spectrometers supplied later than May 2008 it will be possible to upgrade on-site in the customer laboratory. The beamsplitters already supplied with the spectrometer can be used and will fit into the BMS-c unit. Easy exchange as well as the addition of new beamsplitters are possible without difficulty (fig. 2). For earlier installed VERTEX 80v spectrometers the customer has to contact the local Bruker Optics office for the upgrade procedure.



Fig. 2: The open cover shows the inserted four beamsplitters mounted in the BMS-slots of the exchange unit BMS-c

Measurement examples

In order to demonstrate the excellent spectral matching of the different measurement ranges a piece of red plastic with ca. 1mm thickness has been measured in Transmittance from the short wavelength visible down to the far IR or THz spectral range (fig. 3a). For the wideband merged spectrum ranging from 10cm⁻¹ up to 25,000cm⁻¹ the internal IR source and visible tungsten lamp as well as the externally connected water cooled FIR/THz Mercury arc source were used. All three sources are permanently mounted and selectable under the OPUS spectrometer software. Both internal DTGS detectors have been used in the far, mid and NIR spectral ranges. For the visible spectrum the Si-diode detector was inserted.

The sample was mounted on the sample holder of the A510/Q-T automated 11° Reflectance / Transmittance unit. This accessory provides OPUS-controlled switch over from Transmittance to Reflectance measurement mode and vice versa without the need to move or to replace the sample

manually or to vent the sample compartment. Figure 3b shows the mid and far IR Reflectance spectrum in which the red plastic piece is totally absorbing in Transmittance. By applying the OPUS function “Kramers-Kronig-Transformation (KKT)” it was possible to calculate the sample absorption coefficient, complex refractive index and the complex dielectric function. A spectral library search using the imaginary part of the refractive index (which corresponds to the absorption coefficient of the sample spectrum) allowed identification of the sample as a PMMA thermoplastic material.

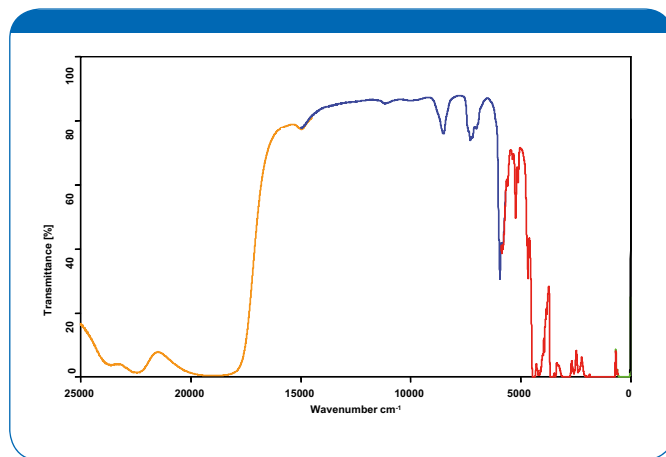


Fig. 3a By using the automatic beamsplitter exchange unit BMS-c a red piece of plastic was measured in Transmittance from the short wavelength visible down to the far IR or THz spectral range (fig 3a).

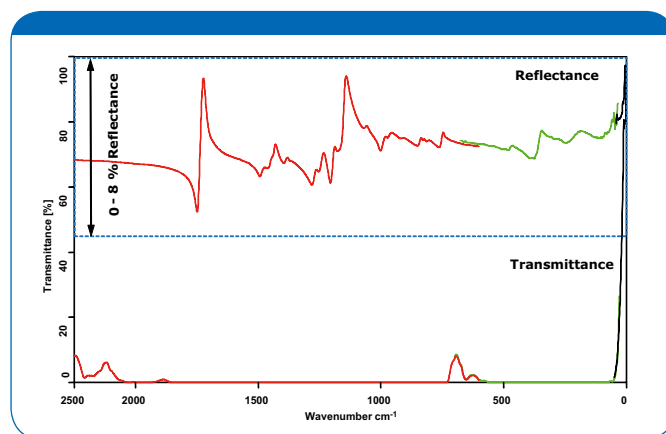


Fig. 3b In the non-transparent mid and far IR spectral range the specular Reflectance spectrum was measured using the automated Reflectance / Transmittance unit A510/Q-T.

Due to the fact that measurements in the THz spectral range (1 THz = ca 33 cm⁻¹) are becoming increasingly important for polymorph characterisation in the pharma industry, the pharmaceutical filler material lactose monohydrate has been measured in the spectral range from 4000cm⁻¹ to 10cm⁻¹. Instead of using traditional pressed KBr and Polyethylene pellet techniques, the Diamond micro ATR unit Platinum A225/Q was applied which avoided the need for time consuming sample preparation. Fig. 4a shows the

complete measurement result which was acquired with three different setups of the optical components (sources, detectors and beamsplitters). The expanded spectrum below 1600cm^{-1} of fig. 4b demonstrates the excellent instrument performance by the very good matching of the three measurement configurations.

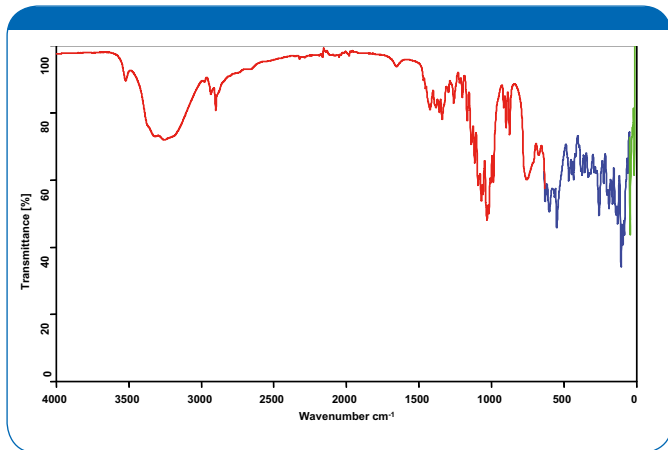


Fig.4a Using the Platinum Diamond Micro-ATR unit (A225/Q) the pharmaceutical filler material lactose monohydrate was measured in the mid and far IR spectral ranges.

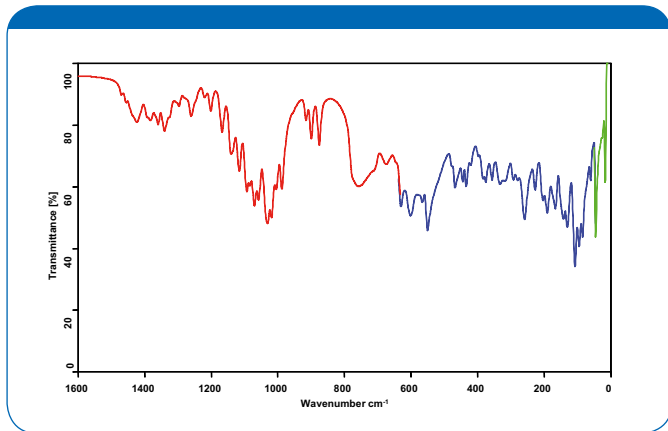


Fig.4b The expanded spectrum below 1600cm^{-1} demonstrates the excellent matching of the three different measurement configurations.

Operation of the BMS-c unit

Via the OPUS interface for measurement parameter settings, the desired type of beamsplitter can be selected. The setup in fig. 5 shows the list of four installed beamsplitters which are the far IR / THz Mylar-BMS with $50\mu\text{m}$ thickness (T205/8) and the far IR multilayer Mylar BMS (T222/8) as well as the standard mid IR KBr beamsplitter (T304/8) and the wide band UV-VIS-NIR beamsplitter (T602/8). These four beamsplitters have been used to acquire the spectra in the very wide spectral range from 10cm^{-1} (0.3THz) up to $25,000\text{cm}^{-1}$ (400nm) for the above shown measurement examples without the need of venting and re-evacuation the spectrometer optics bench for BMS exchange. The instrument operator will be able to remove, add and/or exchange the VERTEX 80 series beamsplitters without the need for service call out. Especially for this purpose a dedicated “lift” function is available which provides easy access to the beamsplitter mounting slots (fig.2).

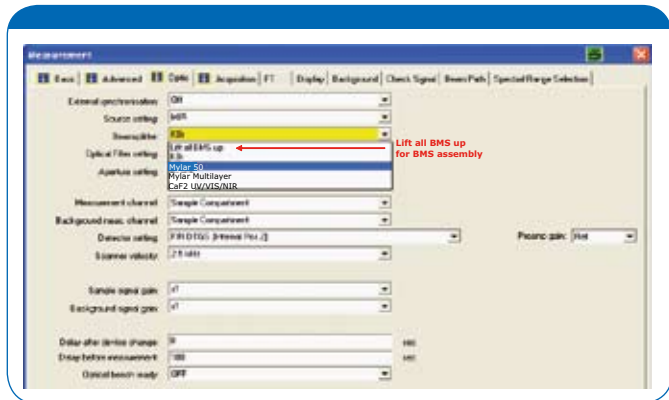


Fig.5: Via the OPUS interface for the measurement parameter settings, the requested beamsplitter can be selected. In the shown setup four different type of beamsplitters have been installed.