Application Note AN R531

Mineral analysis with the handheld Raman spectrometer BRAVO

Minerals are very important natural components of rock and soil being of high value for various industries and applications. Modifications are studied to deduce their formation and origin. Furthermore, mineral and soil analysis is at the core of most exploration as well as routine studies in the mining and petroleum industry. Of course, the value of gem stones for jewelry industry is clearly evident.

Raman spectroscopy is, next to XRD and XRF [1], one of the most commonly employed techniques for mineral analysis. Advances in technology have led to the development of handheld Raman instrumentation that can be field deployed with the highest degree of flexibility. Bruker's analyzer BRAVO incorporates a high performance laboratory grade Raman spectrometer, in conjunction with intuitive software for on-board data evaluation, and the active fluorescence mitigation SSE™ [2], in a handheld format.

SSE™ - fluorescence mitigation and high sensitivity

Many minerals emit a strong fluorescence signal as result of the laser excitation. This fluorescence signal can mask the Raman signature as illustrated in Figure 1 (red spectrum). Applying the SSE™ technique Raman signals are successfully extracted from intense fluorescence contributions, thereby maintaining a high level of sensitivity and selectivity. In the given example, the resulting spectrum from kaolinite (blue) matches the Raman signature obtained at a benchtop FT-Raman system (1064 nm excitation) very well.

Keywords	Instrumentation and Software
Raman	BRAVO
Minerals	OPUS Spectroscopic Software
Fluorescence	Spectral Databases

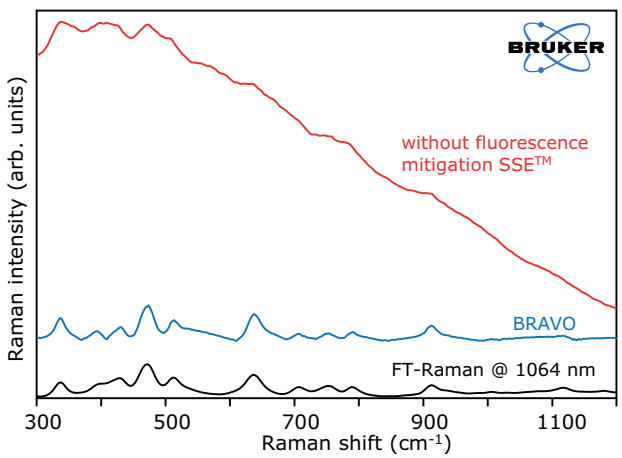

Figure 1: Raman spectrum of kaolinite with and without fluorescence mitigation SSE™ in comparison to FT-Raman data.

Material identification

BRAVO is a dedicated Raman analyzer for material identification and verification. A measured Raman spectrum serves as a fingerprint which is compared to on-board library data and the result is immediately presented on the touch screen display. Subsequently, the data can be transferred to a computer for reporting or further post data evaluation.

Databases

For identification purposes, the use of comprehensive databases is essential. It is possible to generate libraries based on any existing Raman data, such as open source Raman spectra, your own data from benchtop instruments or the BRAVO itself.

Unmatched accuracy

BRAVO's spectrometer offers unrivaled wavenumber accuracy for a handheld instrument which is of importance for differentiating similar minerals and unambiguous identifications (see Figure 2). Based on performance tests with certified reference samples, the BRAVO achieves accuracy values in the range of +/- 1 cm^{-1} [3].

Mineral classes

The BRAVO can be applied for the identification of various mineral classes including gems, carbonates, sulfates, oxides, phosphates, etc. as well as organic minerals, as recently evaluated by Jehlička et al. [4]. As an example Figure 3 shows various Raman spectra obtained with BRAVO from different minerals. Each spectrum shows a distinct signature which is used like a fingerprint for library matching.

Benefits

- High performance spectrometer with active fluorescence mitigation SSE™
- Comprehensive mineral spectrum libraries can be generated
- Unmatched wavenumber accuracy for unambiguous material identification [3]
- Various adapters for optimal measurement conditions available
- Advanced acquisition mode via WiFi/ Ethernet using the software suite OPUS [5]

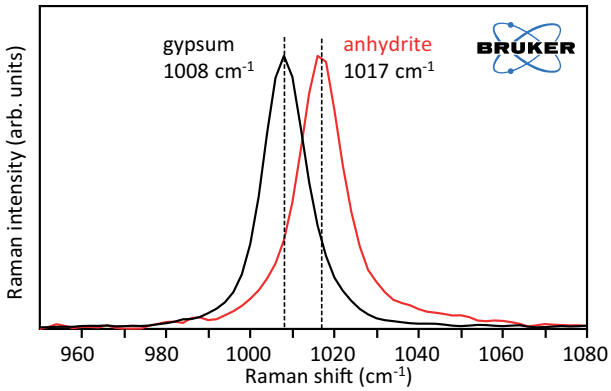

Figure 2: Exact band positions are often important for distinguishing slight differences in minerals.

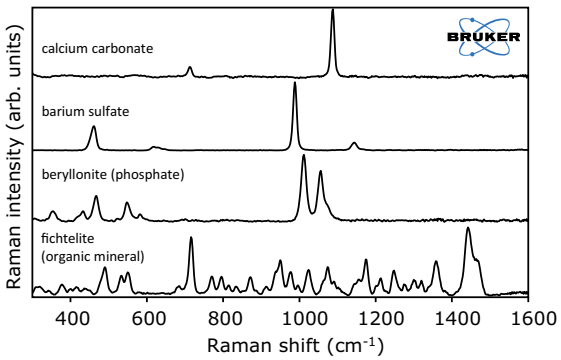

Figure 3: Raman spectra of different minerals.

References

[1] https://www.bruker.com/applications/material-science/mining-minerals.html

[2] Bruker Product Note T29 12/15, Efficient mitigation of fluorescence in Raman spectroscopy using SSE™

[3] Bruker Product Note T30 03/16, Accuracy is crucial: The starting point for a robust transfer of methods

[4] Jehlička et al, J. Raman Spectrosc.(2017), doi: 10.1002/jrs.5105

[5] Bruker Product Note R34 05/16, Advanced Data Acquisition and Evaluation in Handheld Raman Spectroscopy

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