Lightnovo

TECHNICAL NOTE

Comparison of Lightnovo 785 nm Spectrometers: miniRaman vs RG vs RG PRO

TeN-005

Key words

Raman spectroscopy, spectral range, resolution, sensitivity

Introduction

Lightnovo offers a range of Raman spectrometers operating at 785 nm wavelength: compact handheld miniRaman, portable RG, and portable RG Pro. This technical note compares their basic characteristics such as spectral range and resolution. We use standard reference samples such as acetonitrile, calcite, paracetamol, polystyrene and silicon.

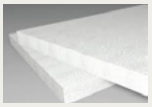
Experimental conditions

Three spectrometers in standard configuration with excitation wavelength of 785 nm were used: miniRaman 785, RG 785 and RG PRO 785. The following standard reference samples were measured: acetonitrile, calcite, paracetamol, polystyrene and silicon.

The excitation power was kept at 50 mW for all the spectrometers. The exposure time was also kept the same: 250 ms, 10 repetitions to be able to directly compare the spectral response of the units.

Figure 1. Lightnovo Raman spectrometers.

Experimental results



Polystyrene

Polystyrene was used as a Raman reference material due to its well-characterized and reproducible vibrational spectrum containing multiple sharp bands distributed across the Raman shift range. Prominent features at approximately 620, 1001, 1031, 1156, 1452, and 1602 cm^{-1} enable verification of wavenumber accuracy, spectral resolution, and relative intensity consistency over a broad spectral window. Polystyrene exhibits negligible fluorescence under common Raman excitation wavelengths and is chemically and mechanically stable, making it well suited for routine instrument performance verification in accordance with established Raman calibration practices.

As it can be seen from the spectra of polystyrene, all the spectrometers are well calibrated, the calibration is consistent, and measured positions of the lines correspond to their tabulated positions. The advantage of RGs Pro spectrometer is that it provides access to low frequency modes of polystyrene which relate to the supramolecular structure of the sample while mRs spectrometer, although its response is limited in low frequency range, at the same time allows to access the CH stretch region of polystyrene.

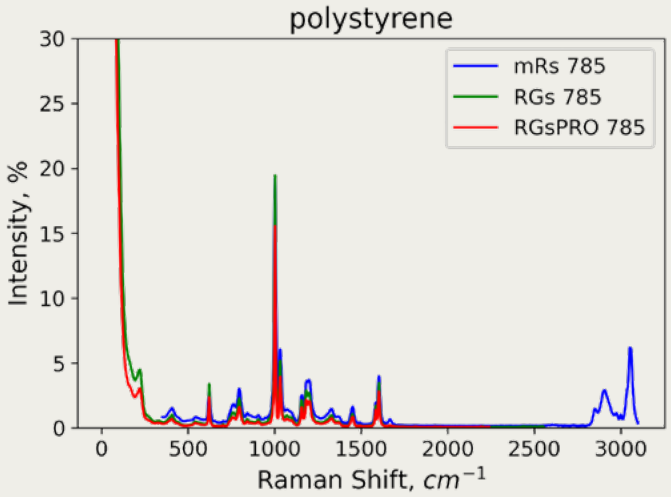


Figure 2. Raman spectrum of polystyrene.

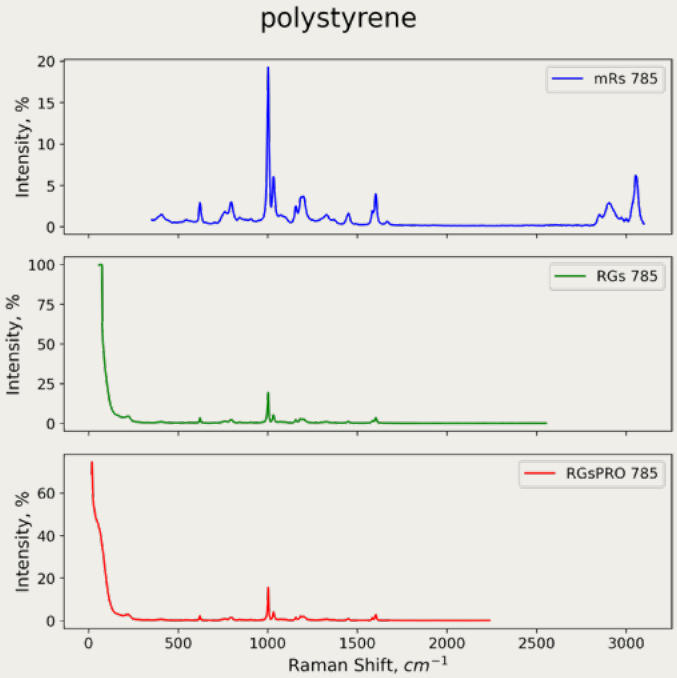


Figure 3. Raman spectrum of polystyrene.

Table 1. Quality of calibration of the devices based on polystyrene peaks positions

Reference peak, cm^{-1}	mRs position, cm^{-1}	mRs offset, cm^{-1}	RGs position, cm^{-1}	RGs offset, cm^{-1}	RGs PRO position, cm^{-1}	RGs PRO offset, cm^{-1}
620.9	622	1.1	622	1.1	620	-0.9
1001.4	1002	0.6	1003	1.6	1002	0.6
1031.8	1032	0.2	1032	0.2	1032	0.2
1602.3	1602	-0.3	1603	0.7	1603	0.7

Calcite

Calcite ($CaCO_3$) was used as a Raman reference material for spectral resolution assessment due to its sharp and well-defined vibrational bands, most notably the symmetric carbonate stretching mode at approximately 1085 cm^{-1}. The narrow linewidth of this feature, together with additional lattice and bending modes at lower wavenumbers, enables evaluation of instrument spectral resolution and verification of consistent peak shapes across the mid-Raman range. The use of calcite for this purpose is consistent with ASTM E1840, which identifies calcite as an accepted reference material for Raman spectrometer performance verification.

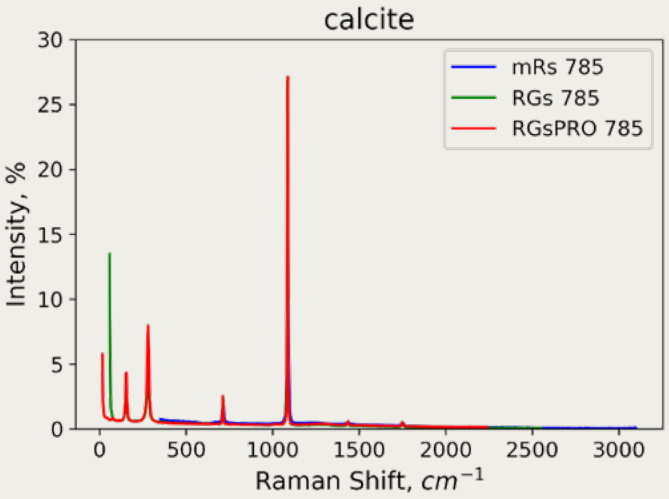


Figure 4. Raman spectrum of calcite.

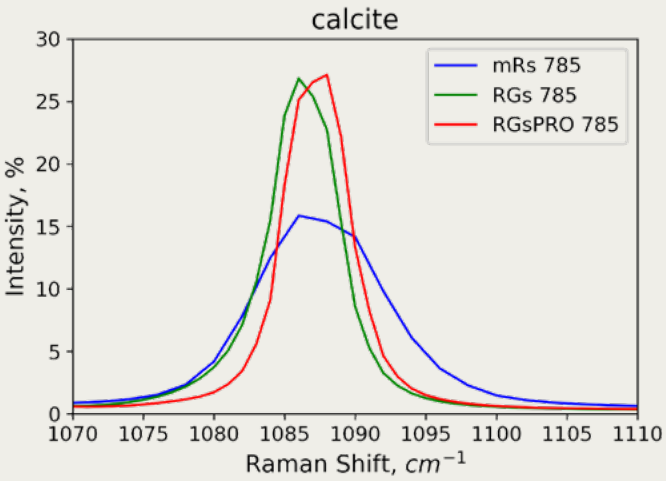


Figure 5. Raman spectrum of calcite.

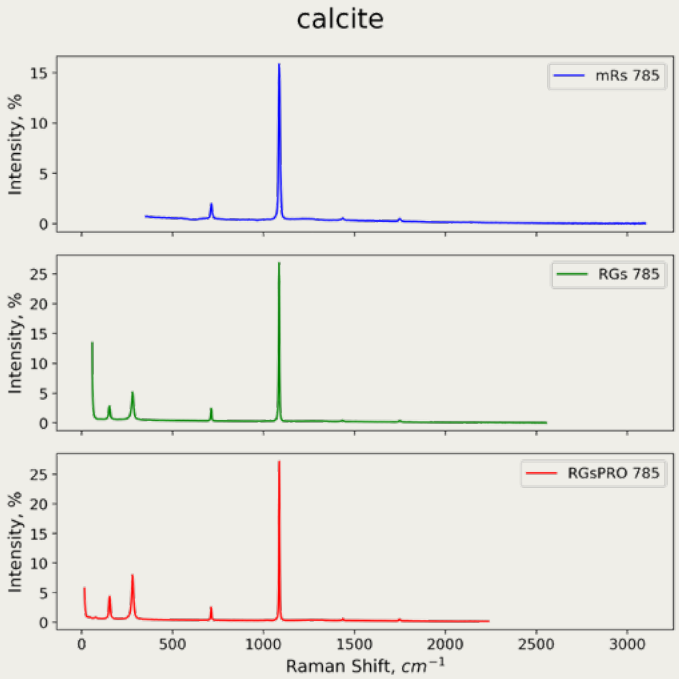


Figure 6. Raman spectrum of calcite.

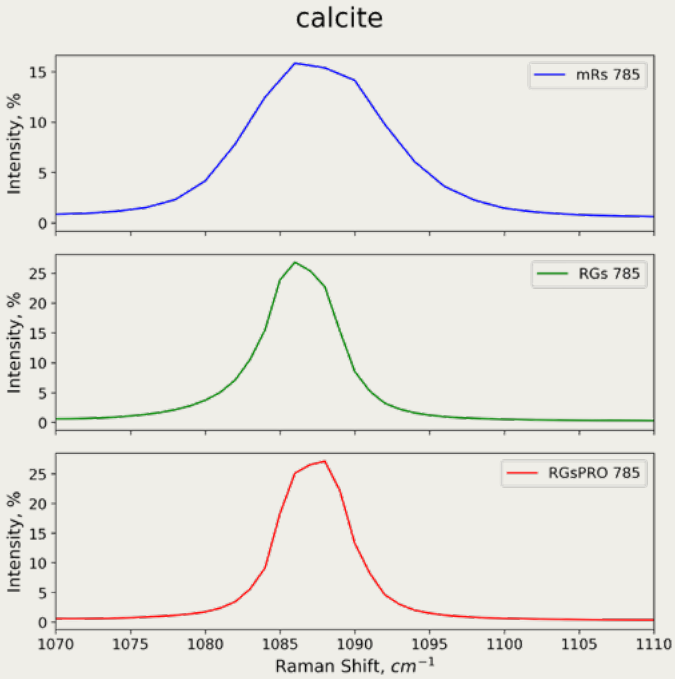


Figure 7. Raman spectrum of calcite.

As it can be seen from the plots above the resolution of tested RG spectrometers is significantly better than the resolution of the miniRaman (5 versus 10 cm^{-1}).

Table 2. Spectral resolutions of the spectrometers

1085 cm^{-1} calcite peak FWHM mRs, cm^{-1}	mRs resolution, cm^{-1}	1085 cm^{-1} calcite peak FWHM RGs, cm^{-1}	RGs resolution, cm^{-1}	1085 cm^{-1} calcite peak FWHM RGs PRO, cm^{-1}	RGs PRO resolution, cm^{-1}
10.51	9.63	5.74	4.95	5.35	4.57

Acetonitrile

Acetonitrile (CH_3CN) was used as a Raman reference sample due to its strong, narrow, and well-isolated C≡N stretching band at approximately 2253 cm^{-1}. This feature provides a reliable marker for wavenumber calibration and monitoring of spectral stability. Acetonitrile is a stable, non-fluorescent liquid under common Raman excitation wavelengths and can be measured reproducibly at room temperature, making it well suited for routine instrument verification.

The 2253 cm^{-1} peak of acetonitrile was well resolved with both mRs and RGs spectrometers however it was outside the spectral range of RGs PRO spectrometer. In addition mRs spectrometer allowed to measure CH stretch mode of acetonitrile (2940 cm^{-1} symmetric CH_3 stretch as well as 2990..3000 cm^{-1} asymmetric CH_3 stretch).

Silicon

Crystalline silicon was used as a Raman reference sample due to its intense, narrow first-order Raman band at approximately 520.7 cm^{-1}. This well-defined feature provides a reliable marker for wavenumber calibration, spectral resolution assessment, and instrument stability monitoring. Silicon is non-fluorescent under common Raman excitation wavelengths and is chemically and mechanically stable, enabling highly reproducible measurements under routine laboratory conditions.

All three instruments were able to measure the 520.7 cm^{-1} peak of silicon.

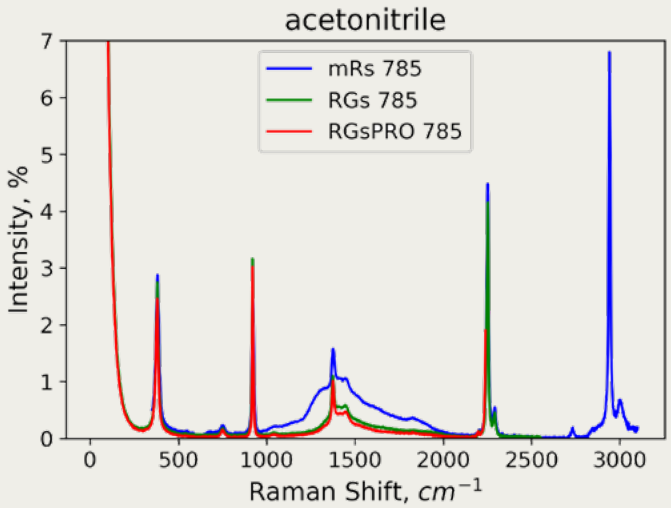


Figure 8. Raman spectrum of acetonitrile.

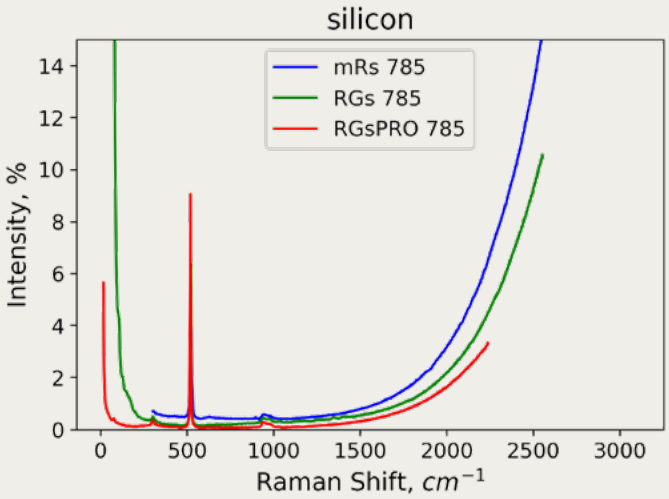


Figure 10. Raman spectrum of silicon.

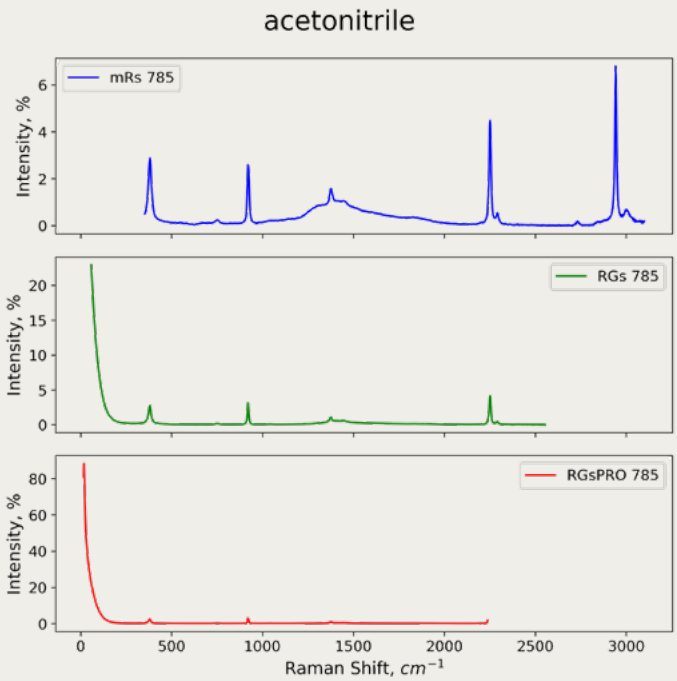


Figure 9. Raman spectrum of acetonitrile.

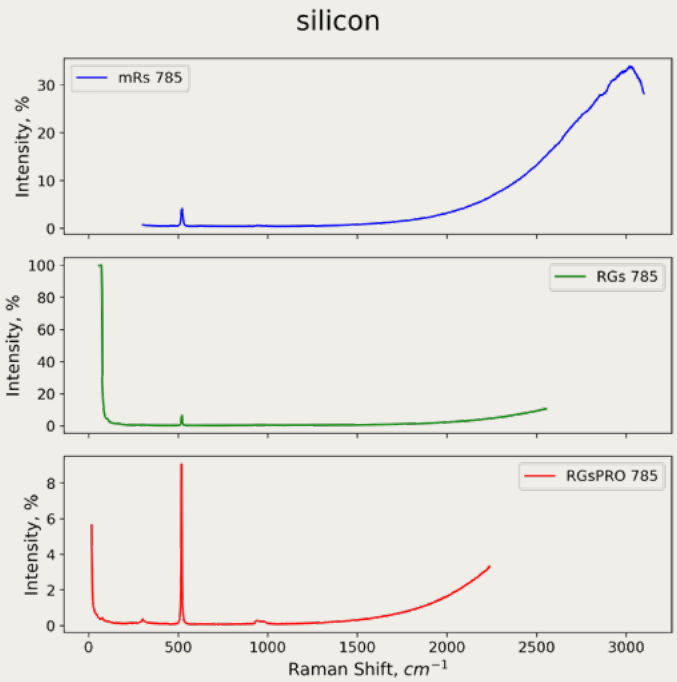


Figure 11. Raman spectrum of silicon.

Paracetamol

Paracetamol was used as a Raman reference material due to its well-defined and reproducible vibrational spectrum featuring multiple sharp bands across the mid-Raman region. Prominent Raman features, including bands near 650, 855, 1235, 1325, and 1610 cm^{-1}, enable verification of wavenumber accuracy, spectral resolution, and relative peak intensity consistency. As a stable crystalline organic compound with low fluorescence under common Raman excitation wavelengths, paracetamol is well suited for routine instrument performance checks and validation of spectral reproducibility.

The paracetamol peaks in the fingerprint region were well resolved with all three spectrometers. RGs Pro spectrometer allows access to low frequency region of paracetamol providing the information on supramolecular structure and polymorphism of the sample while the miniRaman spectrometer allows to measure the CH stretch band of paracetamol.

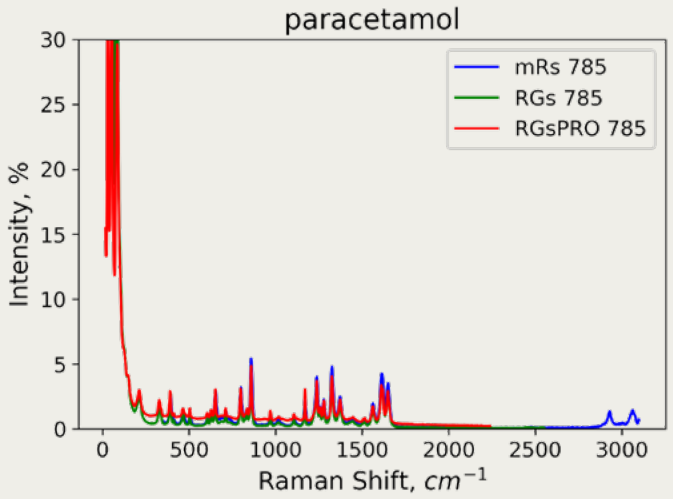


Figure 12. Raman spectrum of paracetamol.

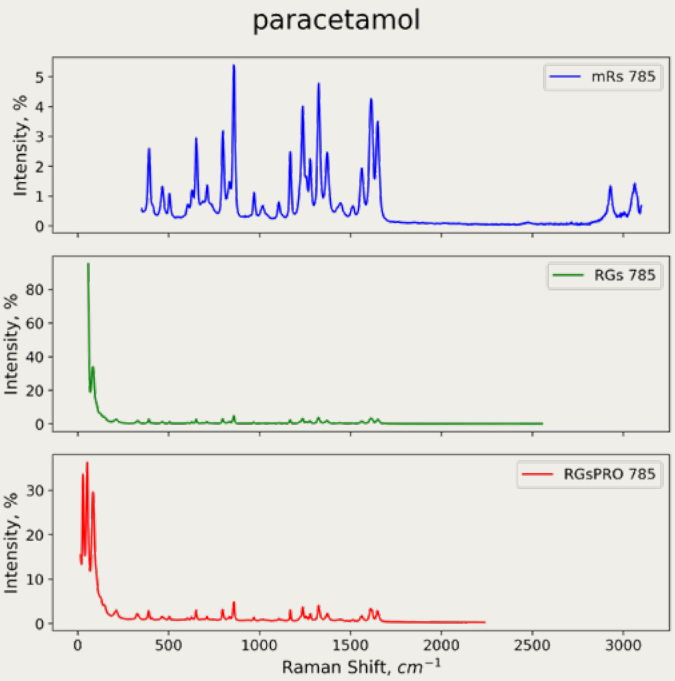


Figure 13. Raman spectrum of paracetamol.

Conclusions

We have demonstrated that all three tested spectrometers show similar spectral response in fingerprint region in terms of spectral intensity. RGs and RGs PRO spectrometers provide significantly better spectral resolution than miniRaman (5 vs 10 cm^{-1}). The advantage of RG PRO spectrometer is that it allows to access Raman shifts as low as 25 cm^{-1}. The spectral region below 200 cm^{-1} provides information on supramolecular structure of the sample. At the same time the low frequency cut off of RGs spectrometer is approximately 65 cm^{-1} while for miniRaman spectrometer it is equal to 350 cm^{-1}. On the high frequency side, the RGs PRO spectrometer is able to measure up to 2240 cm^{-1} while RGs spectrometer is able to measure up to 2550 cm^{-1}. Although limited in the low frequency range, the advantage of miniRaman in this case is that it can measure up to 3100 cm^{-1} in the high frequency range.

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