A Whole New Way to Operate

RAMANtouch

Achievable Performance

when only the best will do!

■ RAMANtouch specifications

Laser	532nm and/or 785nm (and/or others)
Spectrograph	Focal length: 500mm, 3-gratings motorized turret
Detector	Electrically cooled CCD, 1340x400 pixels
Optical microscope	Upright or Inverted
Dimentions	Width: 800mm, Height: 650mm, Depth: 670mm
Weight	75kg

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2011.09

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Spatial Resolution

Spatial resolution of a confocal laser Raman microscope is theoretically calculated by Abbe's equation. The theoretical spatial resolution is typically evaluated from the full-width, half maximum of the Raman scattering profile. This was measured to be about 300nm using a green laser emitting at a wavelength of 532nm and an objective lens, with a numerical aperture is 0.90 (Upper Image, below). The spatial resolution of any microscope system depends on the quality of the laser, the optical system of the microscope and the spectrometer. RAMANtouch can achieve a spatial resolution close to theoretical limit (Middle Image, below showing a resolution of 260nm, with a 1.40 NA oil immersion objective).

Abbe's equation

$$d \fallingdotseq 0.5 \times \frac{\lambda}{NA}$$

d: spatial resolution
λ: wavelength
NA: numerical aperture

Abbe's equation shows that increasing the numerical aperture of the objective lens improves the spatial resolution. Further improvements are of course possible by selecting shorter wavelength laser illumination.

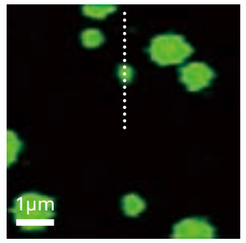
Raman imaging of diamond beads

Planar image
Air objective lens

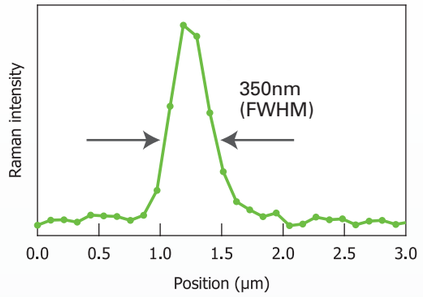
Measuring conditions

Sample: diamond beads(⌀200nm)
Excitation laser: 532nm
Objective lens: 100x, 0.90NA
Measurement area: 6μm x 6μm

Raman image



Intensity profile along the dotted line

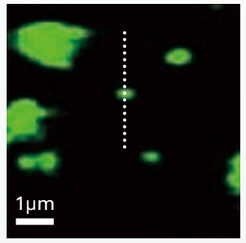


Planar image
Oil immersion objective lens

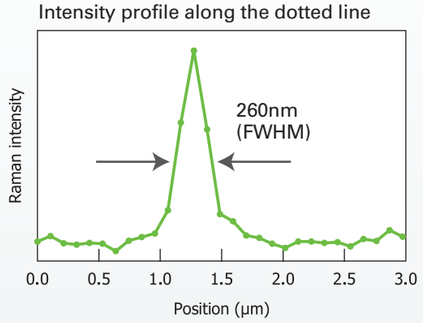
Measuring conditions

Sample: diamond beads(⌀200nm)
Excitation laser: 532nm
Objective lens: 100x, 1.40NA, Oil
Measurement area: 6μm x 6μm

Raman image



Intensity profile along the dotted line

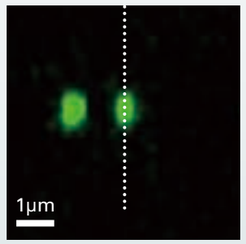


Cross-sectional image
Air objective lens

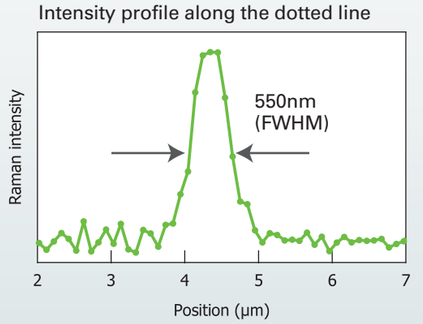
Measuring conditions

Sample: diamond beads(⌀200nm)
Excitation laser: 532nm
Objective lens: 100x, 0.90NA
Measurement area: 6μm x 6μm

Raman image



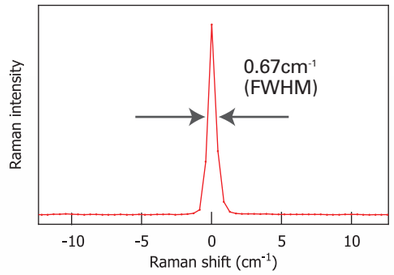
Intensity profile along the dotted line



Spectral Resolution

Spectral resolution is defined as the minimum distance, in wavenumbers, that can resolve two peaks. The spectral resolution is determined by spectrometer parameters, including the number of grating lines; the focal length of spectrometer; the line width of excitation laser and so on. We can evaluate the actual wavenumber resolution of the system by evaluating the full-width of half maximum of Rayleigh scattered laser light in a spectra. Our high wavenumber resolution enables a clear carbon tetrachloride spectrum, as shown on the right.

FWHM of Rayleigh light



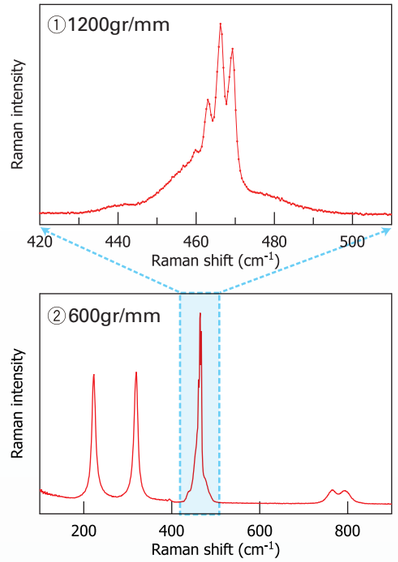
Measuring conditions

Excitation laser: 785nm
Grating: 1200gr/mm
Spectrometer: 500mm

Raman spectrum of CCl 4

Measuring conditions①

Excitation laser: 785nm
Grating: 1200gr/mm
Spectrometer: 500mm



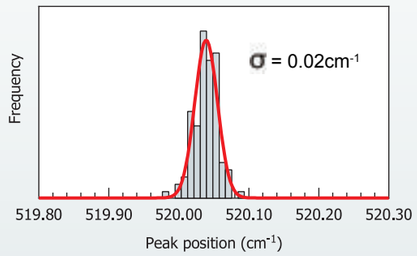
Measuring conditions②

Excitation laser: 785nm
Grating: 600gr/mm
Spectrometer: 500mm

Peak position accuracy

In the measurement of stress, high accuracy of peak positioning is required. The accuracy of peak positioning is shown as the standard deviation of the peak, obtained from multiple sample measurements. In RAMANtouch, peak position is calculated using peak fitting software algorithms.

Histogram of Si peak position



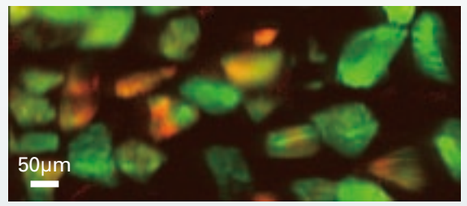
Measuring conditions

Excitation laser: 532nm
Grating: 2400gr/mm
Spectrometer: 500mm
Number of spectra: 6750

Imaging Speed

Imaging time of a Raman observation is greatly affected by the wavelength of the excitation laser, and the sample. A shorter wavelength excitation laser shortens the imaging time, as the Raman scattering cross-section is inversely proportional to the fourth of the excitation wavelength. Samples that exhibit high Raman scattering probabilities also reduce image acquisition times.

Raman imaging of diamond file



Measuring conditions

Excitation laser: 532nm
Objective lens: 10x, 0.30NA
Grating: 600gr/mm
Measurement area: 800μm x 345μm
Number of spectra: 69,200
Measuring time: 101 sec