application note

Cobolt
High performance lasers

Cobolt Mambo™ 594 nm for Raman spectroscopy

The ”inelastic scattering of light”, or Raman effect, was observed in practice for the first time in 1928 by C.V. Raman, who also won the Nobel Prize in 1930 for his find. Since then a whole discipline, Raman spectroscopy, was born and developed, giving excellent results in material analysis.

Traditionally, Raman researches have made use of ion gas lasers for measuring the Raman spectra. More recently excellent results have been obtained by using a more advanced and lower maintenance technology: diode pumped solid state (DPSS) lasers.

Figure 1 and Figure 2 display a comparison between Raman spectra acquired with an ion gas laser (Ar Coherent Innova 90, 514.5 nm) and with the Cobolt Mambo™ DPSS CW 25 mW (Courtesy of Dr. Alessandro Feis, Department of Chemistry, University of Florence). The sample is pure CCl_4 in both cases. The power at the sample is almost the same. The detector is a Princeton Instruments Spec 10-100 CCD system.

Owing to the λ_4 factor, the Raman scattered light is 1.7 times more intense for 514.5 nm excitation than for 594 nm excitation. Moreover, the grating is blazed at 514.5 nm, therefore the signal at the CCD is higher. The end result is that almost the same intensity is measured when the 514.5 nm excitation is accumulated for 5 s and the 594 nm is accumulated for 30 s.

So, a comparison between the absolute intensities and signal/noise ratio is not possible. However, some hint about the S/N ratio can be obtained comparing a spectral region (see the inset) where the CCD dark noise does not presumably influence the signal (about 10 % of the CCD dynamic range). The S/N ratio is very similar in both spectra, indicating that the spectal output is very pure ie there are no side bands in the 594 nm laser (a feature of Cobolt’s PPKTP frequency doubling technology).

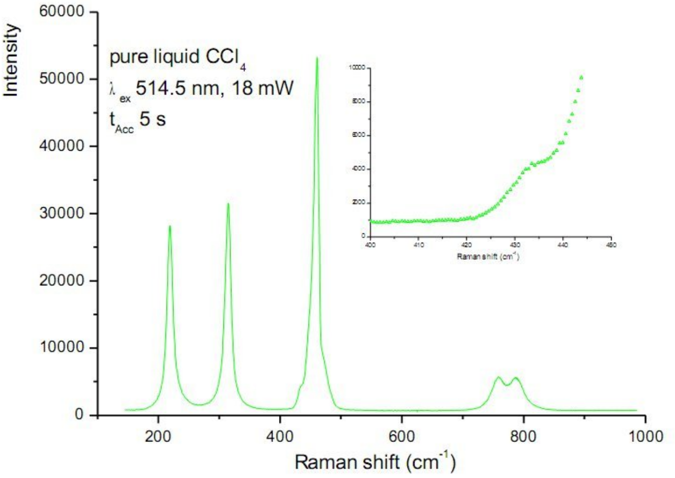


Figure 1.Raman spectra acquired with Ar Coherent Innova 90, 514.5 nm gas laser (Courtesy of Dr. Alessandro Feis, Department of Chemistry, University of Florence).

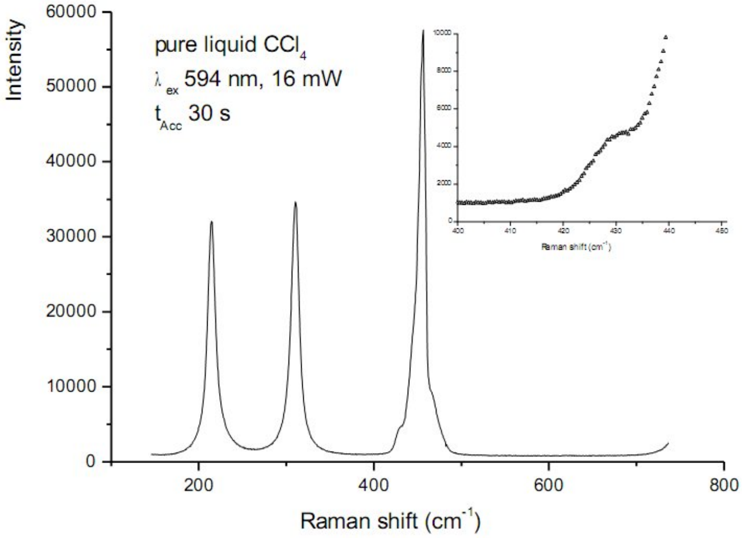


Figure 2. Raman spectra acquired with Cobolt Mambo™ 594 nm (Courtesy of Dr. Alessandro Feis, Department of Chemistry, University of Florence).

Fig. 3 displays a 'typical' spectrum obtained when measuring resonance Raman spectra of biological samples There is a broad fluorescence background above which weak Raman bands appear. Some samples have a better Raman/fluorescence ratio, some a worse one.

Fig. 4 displays the Cobolt Mambo™'s emission as measured by the monochromator. 10 spectra with 1 s accumulation time are measured consecutively. The spectral definition is 0.45 cm^{-1} /pixel.

No appreciable shift in the emission was detected within 4 hours highlighting the excellent wavelength stability of the 594 nm laser.

In conclusion, Cobolt Mambo™ 594 nm works as an excellent tool for Raman spectroscopy. Besides giving as good results as a gas laser, using a Cobolt Mambo™ 594 nm has other advantages such as a more compact footprint compared with a gas laser and much longer lifetime and low-cost maintainance.

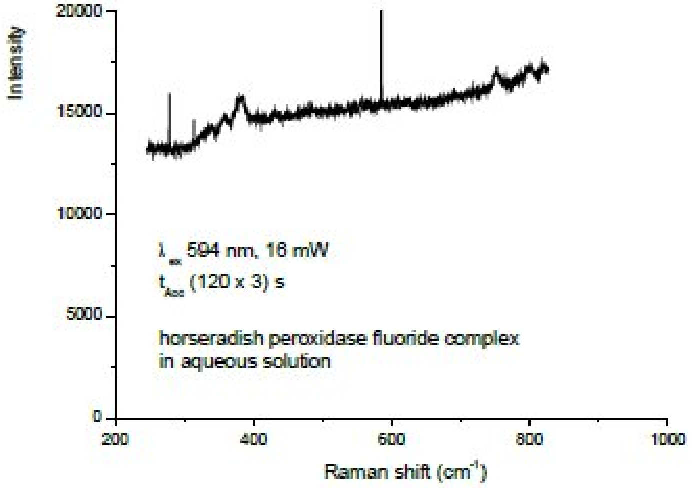


Figure 3. Typical spectrum obtained when measuring resonance Raman spectra of biological samples (Courtesy of Dr. Alessandro Feis, Department of Chemistry, University of Florence).

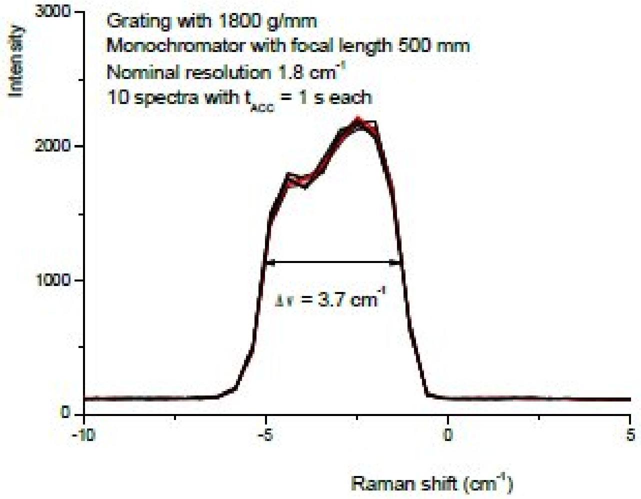
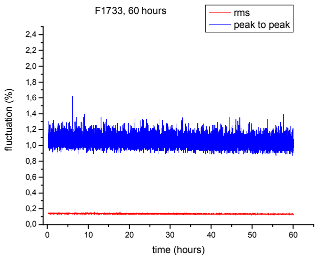


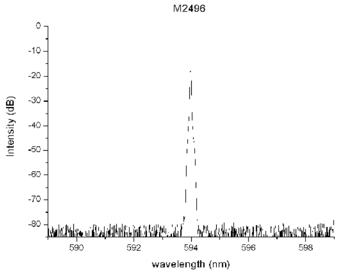
Figure 4. Cobolt Mambo™'s emission as measured by the monochromator (Courtesy of Dr. Alessandro Feis, Department of Chemistry, University of Florence).

Cobolt Mambo™ 594 nm

The Cobolt Mambo™ is a compact orange DPSS laser offering up to 100 mW CW at precisely 594 nm from a hermetically sealed package, with very low intensity noise, excellent spectral purity and wavelength stability in addition to a high quality TEM00-mode and low-divergent beam.

Typical noise performance and spectral purity





Typical noise performance of the Cobolt Mambo^{TM} shows peak to peak noise <3% and rms noise <0.3%. This kind of single-mode DPSS laser is particularly attractive for use in Raman spectroscopy as it provides extremely good power stability, very low intensity noise (rms<0.3%), a spectrally pure spectrum, excellent wavelength stability and a nearly perfect TEM00-mode low-divergent beam (M^2<1.1). These are all performance characteristics that are required for good results.