Femtosecond Stimulated Raman Spectrometer (FSRS)

FEMTOSECOND TIME-RESOLVED RAMAN SPECTROSCOPY

Newport's Femtosecond Stimulated Raman Spectrometer (FSRS) is the first commercially available turn-key FSRS spectrometer. FSRS incorporates Newport's highest quality optics, opto-mechanics, spectrograph, optical chopper, vibration control, delay-line stage, and easy-to-use LabVIEW™ based software to deliver high quality results with consistency. Due to the flexible configuration and layout, FSRS can also easily be used for acquiring low noise femtosecond transient absorption spectra and can adapt to perform several other ultrafast spectroscopy techniques.

The FSRS technique uses a narrowband Raman pump in combination with a supercontinuum probe to provide vibrational spectra with high resolution. Due to the gain of the stimulated Raman scattering process, the detected signal is nearly insensitive to fluorescence and thus allows study of molecules that are difficult or impossible to study with conventional spontaneous Raman spectroscopy. Addition of an "actinic", electronically resonant, pump pulse allows for the study of the excited state Raman spectrum and the evolution in time with femtosecond resolution. This provides additional tools in interpreting and assigning molecular dynamics and detection of "dark" molecular states.

The FSRS Raman pump pulse can be generated internally using a grating based filter. This is configured using the fundamental (800 nm for Ti:Sapphire based lasers), but can be reconfigured to use an external source such as an OPA or an already narrow-band source of radiation. The actinic pulse can be generated in an external OPA or NOPA or at the second harmonic of the fundamental (400 nm for Ti:Sapphire based lasers).

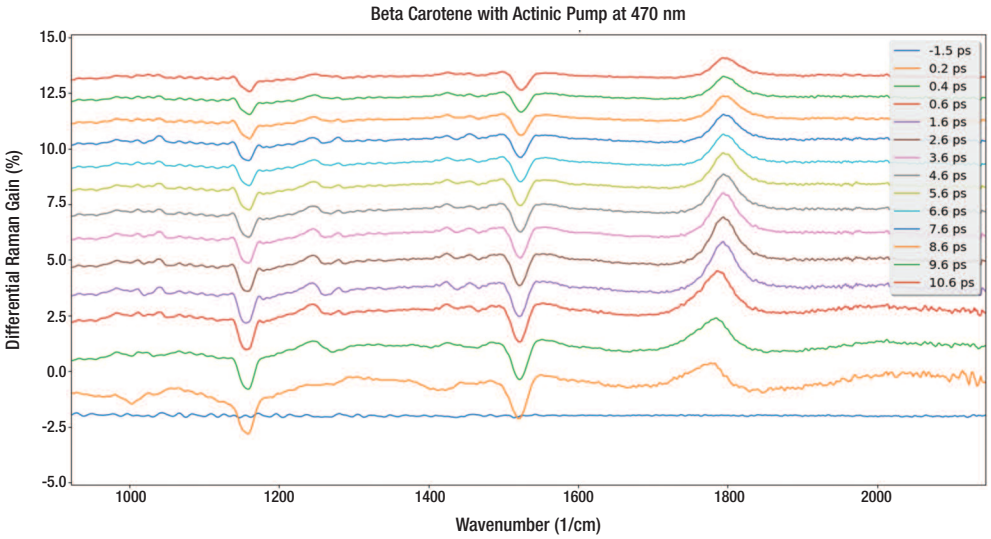
FSRS Specifications	Standard	Maximum Upgrade
Probe Spectral Range	470-1000 nm	350-1600 nm
Pump-Probe Delay Range	4.3 ns	
Delay Stage Step Size	1 fs	
Delay Stage Bidirectional Repeatability	<4 fs	
Delay Stage Maximum Speed	500 mm/s (6.67 ns/s)	
Delay Stage Maximum Acceleration	7.5 m/s^2 (100 ns/s^2)	
Supported Data Acquisition Rate	10 Hz - 2 kHz @ 14-bit	10 kHz @ 16-bit
Spectrometer Spectral Range*	300 to 900 nm	200 nm to 20 µm
Spectrometer Spectral Resolution	0.5 nm (<8 cm^{-1} @ 800 nm)	0.13 to 7.95 nm
Total Raman Spectral Range	>1990 cm^{-1} with 800 nm Raman pump	>3200 cm^{-1} with 790 nm Raman pump
Breadboard Dimensions	2'x4' (600 mm x 1200 mm)	

*Spectrometer is limited by grating options chosen. Probe spectrum can cover 290 – 1600 nm at best, using different crystal and camera for probe generation and detection

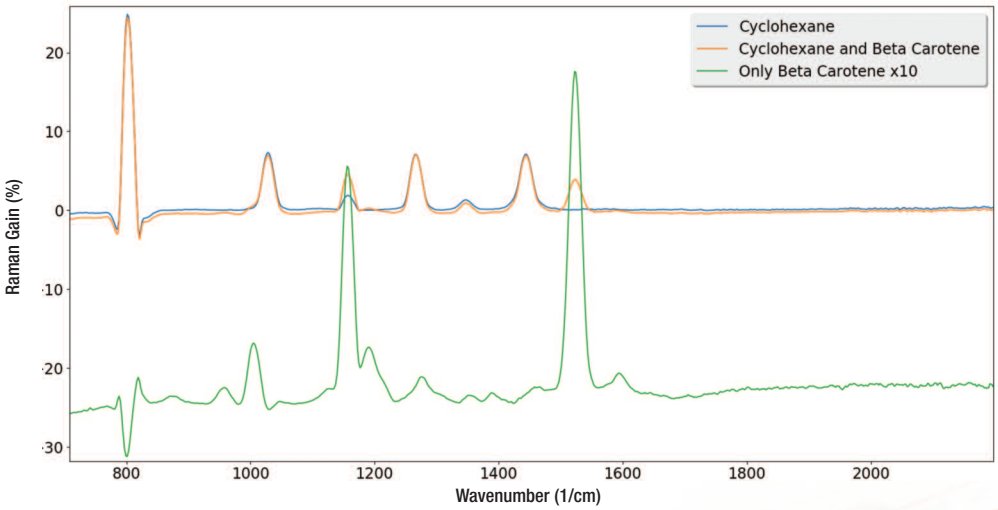
Newport®

Femtosecond Stimulated Raman Spectrometer

MS260i with dual-sensor UV-Vis camera and additional camera on the axial output port.



FSRS of beta carotene with actinic pump at 470 nm and Raman pump at 802 nm at various time delays, showing the evolution of the excited (S_1) state vibrational signatures.



Cyclohexane with and without beta carotene. The solvent spectrum is subtracted and the result is magnified and shifted to reveal small features. Noise at wavenumbers > 1800 cm^{-1} is due to low probe signal.

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