SNURF: The Steady state and Nanosecond Ultraviolet Raman Facility

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The SNURF (Steady-state and Nanosecond Ultraviolet Raman Facility) laboratory has recently been set up to provide a diverse range of spectroscopic techniques to enable the structure and reactivity of a wide variety of samples to be studied in the ultraviolet to visible wavelength range. The laboratory is shown in Figure 1.

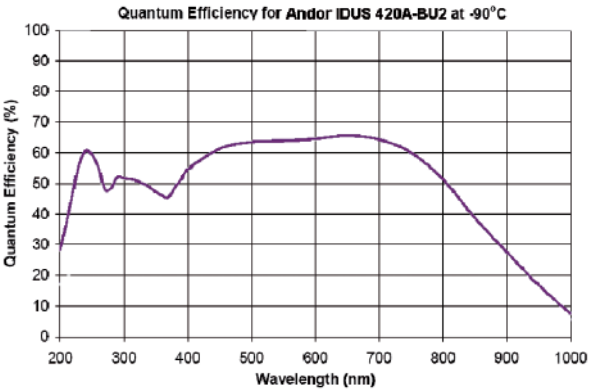
Lasers

Currently, the laboratory houses an Innova FRED 300c Argon Ion laser to provide fundamental CW wavelengths from 514 nm to 351 nm with Second Harmonic Generation option for 244 nm and 257 nm. The available wavelengths and powers are given in Table 1.

Wavelength (nm)	Power (W)
257.2	0.20
244.0	0.125
351.1	0.14
363.8	0.14
ML UV	0.40
457.9	0.35
476.5	0.60
488.0	1.50
496.5	0.60
501.7	0.40
514.5	2.00
528.7	0.35
ML VIS	5.0

Table 1. Wavelengths and powers available for the FreD laser.

In the coming months, the Continuum Nd:YAG/Sirah dye/doubler will be installed to give tunable nanosecond (~8 ns) laser light from 215 nm to 850 nm along with the fundamental YAG wavelengths which will allow transient absorption measurements to be carried out.



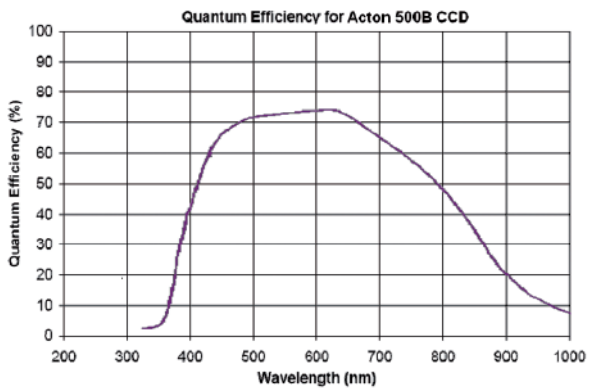


Figure 2. Spectral response of Andor and Acton detectors.

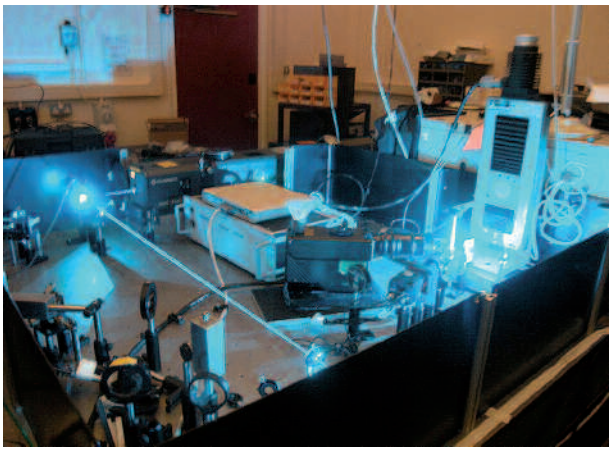


Figure 1. SNURF laboratory set-up.

Raman detectors and spectrometers

There are two detectors available to enable detection from the UV to NIR. The Andor DU420A CCD camera gives ~50% efficiency from UV to visible wavelengths and has a 1024 × 255 array of 26 μm^2 pixels to give high dynamic range and resolution. The camera has recently been fitted with a cylindrical collection lens for optimum collection efficiency. The Acton 500B CCD detector is a back-illuminated liquid nitrogen cooled CCD. The highly sensitive (55 photons/count) 1024 × 1024 pixel sensor, paired with 62k dynamic range and low noise characteristics, enables resolution of very low intensity signals in the Near IR spectrum.

The laboratory is equipped with two spectrometers, a triple stage and a single stage. The triple stage spectrometer has UV and visible blaze gratings to give high throughput and wide dispersion in the UV region. The single stage is used in conjunction with notch filters for Rayleigh light rejection. The Raman spectrometers can be configured in 90° or back-scattering geometry.

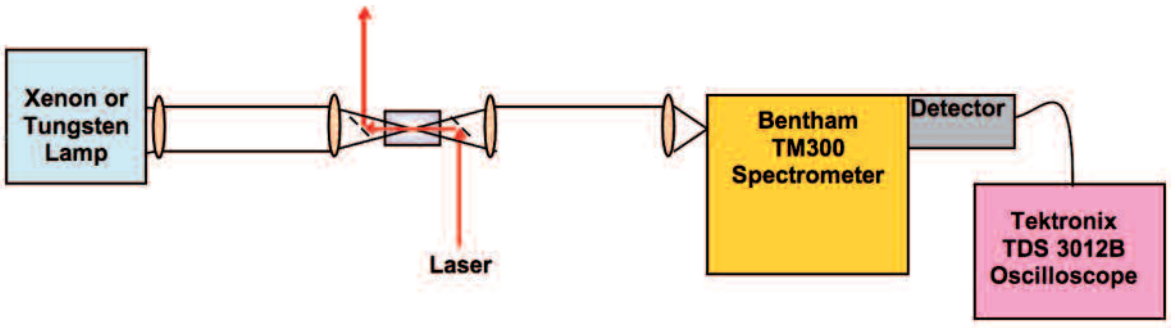


Figure 3. Laser Flash Photolysis schematic.

Sample handling

Solid or liquid samples can be studied. Two pumps are available for flowing liquid samples (~25-50 ml) – a gear pump or peristaltic and ~1 ml samples can be spun in quartz cells. Small volume liquid samples (~10 µl) can be mounted in a copper loop. Solid samples can be spun or static and can be mounted as powders, pellets or discs. A spectro-electrochemistry cell is also available for detection of ions in flow system by connecting the bulk electrolysis cell to a Raman flow system.

Ultraviolet (UV) resonance Raman spectroscopy

The main technique in the laboratory is the investigation of molecular structure, in particular, systems of biological interest as the UV light is ideally suited to the investigation of proteins and amino acids. Samples can be solid or liquid and can be as small as 10 µl volumes.

Laser Flash Photolysis (LFP)

The LFP system has a Xenon or Tungsten analysing lamp for monitoring signals from the UV to the near IR and a Bentham TM300 spectrometer. A schematic is shown in Figure 3. The detectors available are either an Advanced Photonix Large Area Avalache Photodiode (LAAPD) or an IP28 photomultiplier tube. These detectors allow detection from 200 nm to 800 nm with high efficiency and a response time of ~50 ns. Data is collected and stored on a Tektronix TDS3012B oscilloscope.