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Use of Single-Frequency DPSS Lasers in Raman

Whilst diode lasers have advantages in terms of cost and efficiency, they are inherently limited in line-width narrowness and spectral purity. It's particularly true for shorter wavelengths as it makes them unsuitable when high resolution is needed. DPSS lasers offer significantly narrower line-widths and spectral purity, and are worth their extra cost. UniKLasers specialise in making mid to high-power CW DPSS lasers with excellent line-width, spectral purity, and long-term stability across the spectrum, including such rare wavelengths as 523, 640, 689, 698, 780.24 nm, and others.

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White Paper: Use of Single Frequency DPSS lasers in Raman Spectroscopy

Introduction:
Raman Spectroscopy is a widely used and versatile form of analysis used throughout biology, chemistry and solid-state physics (1) (2) (3). Like all spectroscopic techniques it observes how light interacts with a sample in order to understand its properties. This can then be used to identify an unknown sample, monitor how stress affects a crystal structure or look for impurities. What makes Raman different from other forms of spectroscopy is that instead of looking at light which is absorbed, emitted or elastically scattered from a sample, it looks at the light that is inelastically scattered.

The Science of Raman Spectroscopy:
When an object elastically scatters off another object, it retains its original energy. Elastic scattering between light and matter is called Rayleigh scattering. It accounts for most scattering events seen between a light source and any given material. However, as discovered by C.V. Raman in 1928 (4), light can undergo inelastic scattering with matter. In this case the photon of light involved has a different energy before and after the scattering event. Having either lost (loses as a Stokes shift) or gained (an anti-Stokes shift) energy from the matter it interacted with. This change of energy can be measured as a change in the wavelength (colour) of the light. See Figure 1.

The energy for this wavelength change comes from a change in the energy state of a molecular bond or bonds. Note this is distinct from an interaction where the photon is absorbed by an atom and then re-emitted at a different wavelength, which is the domain of fluorescence spectroscopy. This means the wavelength shift in the Raman scattered light corresponds directly to the current energy states of the molecular bands in the sample (5). As these are influenced not just by the atoms involved in those bands, but the total crystal structure and the strain the system is under, one can interpret significant useful information from its Raman spectrum that can be difficult to obtain by other means.

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