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Taking Raman Spectroscopy into the Deep UV

ISI's latest development is the deep UV Raman spectrometer (Odin). The instrument utilizes a 228.5 nm diode-pumped solid-state laser design especially for ISI by TOPTICA Photonics. The laser requires no cooling or gas purge and is fibre coupled to a bespoke spatial heterodyne spectrometer and a Raman collection probe. At 228.5 nm, the Raman and fluorescence photons become spectrally separated meaning peaks that were previously masked by the sample's fluorescence background are now detectable, see Figure 1. Obtaining fluorescence-free Raman spectra is not the only benefit of the Odin instrument, the deep UV wavelength often induces sample resonance which together with the λ^{-4} relationship can substantially enhance Raman scattering intensity. Comparison of spectra captured at 228.5 nm and 785 nm excitation wavelengths highlights noticeable differences in the detectable peaks, with more distinct peaks being detected when using Odin.

Odin was developed with the analyses of biological samples in mind; these tend to be expensive to purchase or at limited resource levels when sampled by patients. To reduce the sample damage caused by the laser, a bespoke stage has been designed that moves the sample in a custom pattern to prevent too much interaction between the laser and the sample. Additionally, a flow-cell has been evaluated for the analyses of liquid samples, this could be introduced into a system for process monitoring to confirm sample specifications are within range and to detect any contaminants. The data collected throughout these studies show an array of differences in the sample degradation via raw count analysis as well as varied peak detection.

Odin was used to analyse a series of samples that were extracted from different stages of a domain antibody purification process. The project goal was to determine if Odin could be used to confirm at which stage in the process the sample was extracted from, and if the final sample was indeed within the correct specifications. Clear spectral differences were observed between each of the stages analyzed, confirming that this technique can be used to quality check the process in the future. By comparison with the known data, it can be confirmed if the next step in the process can be taken, preventing time/product loss and assisting in the increase of yield.

References

Foster, M., Brooks, W., Jahn, P., Hedberg, J., Andersson, A., Ashton, L. (2022). "Demonstration of a compact deep UV Raman spatial heterodyne spectrometer for biologics analysis".

Figures

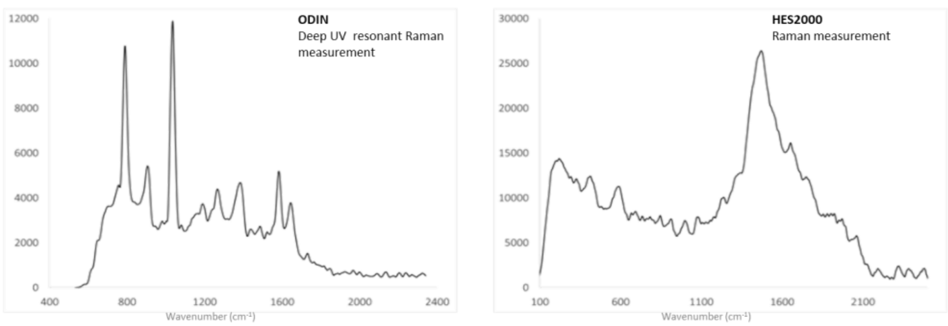

Figure 1: Tryptophan measurement using two ISI spectrometers, Odin (LHS) and HES 785nm (RHS).