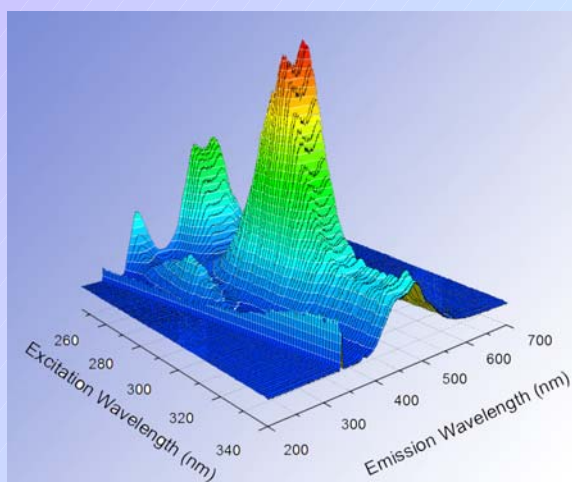


## 3D Fluorescence Detection

In a collaborative research effort, OPOTEK has developed a proof-of-principle prototype 3-D fluorescence instrument for reaction monitoring and trace contaminant analysis. The 3-D fluorescence technique utilized provides unique advantages for a variety of analytical applications, including reaction monitoring and process impurity analysis. These benefits include high sensitivity, high chemical selectivity, and non-destructive analysis. By utilizing an all-solid-state tunable UV OPO laser source, detailed excitation and emission spectra can be simultaneously recorded, providing a detailed "finger print" for each species of interest. The unique advantages of this technique allow both high sensitivity and selectivity in complicated mixtures, with a level of performance that can be significantly higher than for competing non-destructive techniques such as NIR or UV spectroscopy. The laser source provides superior output power over traditional light sources, allowing for high sensitivity detection and unique detector deployment options.

Fluorescence detection can be a powerful analytical technique for the detection and quantification of trace species. The high detection sensitivity of the technique derives from the fact that the fluorescence signal from the target molecule often appears from a condition of virtually no background signal. This can be contrasted with optical absorption detection, in which a very strong baseline signal is attenuated slightly by the target species, and it is this small change in signal that must be detected and quantified in order to obtain analytical results. This high level of sensitivity, when compared with traditional NIR or UV spectroscopic analysis, is important for applications such as trace analysis of process-related impurities and quantification components at low-concentration



In addition the high sensitivity, high chemical specificity, or ability to distinguish between components of a complex mixture, also results due to the unique fluorescence features of different species, such as the spectral characteristics of the excitation and emission, and the temporal characteristics of the emission. The spectral characteristics are particularly important in obtaining specificity in fluorescence measurements, and have been the focus of the instrument under development by OPOTEK. Both the excitation and emission processes have unique spectral features that depend on the molecular structure of the target species. When these spectra are simultaneously recorded at high resolution, a unique and detailed multi-dimensional spectrum of each species can be obtained, which is critical for resolution of multiple components within a complicated mixture.

By utilizing a tunable UV OPO laser system as the excitation source for a 3-D fluorescence instrument, significant performance advantages can be realized over existing instrumentation, including higher sensitivity, higher spectral resolution, and flexible detector deployment via optical fiber. The initial performance demonstrations were able to demonstrate these capabilities in the liquid phase for a variety of aromatic species at solvated at trace levels in several solvents. Additional work was also done on contaminated surfaces, where detection could be performed at a stand-off distance of several centimeters.

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