Excitation-emission spectroscopy becomes increasingly useful in the study of photo-luminescent materials. The spectral selectivity of the technique enables the quantification of multiple emitting sites in rare-earth doped crystals as well as the rapid acquisition of polycyclic aromatic hydrocarbons (PAH) in contaminated water. In order to obtain a complete spectral fingerprint via excitation-emission spectroscopy, scans at multiple excitation wavelengths over the emission spectra are required. Especially in the case of rare-earth materials with narrow emission linewidths, this is extremely demanding in terms of resolution. The acquisition time of such excitation-emission maps (EEM) can be significantly reduced by using Charge Coupled Device (CCD) detectors. A CCD detector contains an array of photo-sensors which enables the detection of light with spatial resolution. CCD detectors for the visible and NIR range can be integrated into the Edinburgh Instruments range of fluorescence spectrometers. Consequently, multiple wavelengths are recorded simultaneously with this approach, so that an entire emission spectrum can be acquired in a single shot. Measurements such as excitation-emission maps are therefore much faster with a CCD compared to standard photomultiplier tube (PMT) detectors. In addition, this enables the acquisition of highly resolved excitation emission maps in a rapid manner compared to traditional PMT detectors used in spectroscopy, as will be outlined in this application note.

EXPERIMENTAL SETUP

In an FLS980 Fluorescence Spectrometer configured for CCD detection, a single emission monochromator is used as a spectrograph that directs the emission from the sample to the input window of the CCD camera. The monochromator has one port with a computer-controlled slit for PMT detection, and a second imaging port with a wide aperture for the CCD (Figure 1). When acquiring spectral data with the CCD camera, the monochromator is set to the centre wavelength of the emission spectrum.


REFERENCES

Figure 3: Excitation-emission map of LaPO₄: Ce,Tb acquired with an iDus DU420A camera cooled down to -70°C. Measurement conditions: Δλₜex=0.50 nm, stepₓex=0.20 nm, λₓex=550 nm, Δλₓem=0.3 nm, stepₓem=0.568 nm, tₑ=0.5s, tₑ=0.5s. The cross section is at λₓex/λₓem=290 nm/544 nm and a 3D map is shown in the inset.

Figure 4: Excitation-emission 3D map of Nd: YAG acquired with an iDus DU491-A 1.7 camera cooled down to -70°C. Measurement conditions: Δλₓex=0.50 nm, stepₓex=2 nm, λₓex=1100 nm, Δλₓem=0.5 nm, stepₓem=0.118 nm.

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