From Picoseconds to Milliseconds: Time-Resolved Fluorescence Spectroscopy on Different Time Scales Combined with Spatial Resolution

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Introduction

Time-resolved luminescence spectroscopy combined with microscopic techniques is a valuable and powerful tool to investigate the photophysical properties not only of different classes of molecules and molecular systems, but also of semiconductors[1], solid-state and biological systems. In recent years, the study of luminescence properties has gained in popularity in many scientific fields, e.g. in Life, Materials or Food[2] Sciences.

The investigations to be carried out in each of these fields impose different requirements. On one side, monitoring dynamic processes in the excited state necessitates high time resolution that can be achieved by fast pulsed lasers and detectors along with appropriate time-correlated single photon counting (TCSPC) units and suitable monochromators. On the other hand, high spectral resolution is desirable for fluorophore characterization, which requires detectors with high quantum efficiencies not only over the complete visible range, but also – especially for many semiconductor materials - deep into the IR. Up to now, fluorescence spectrometers have been usually developed towards either one of these two specifications.

Spectrometers, such as the FluoTime300, equipped with pulsed lasers capable of working in a burst mode, fast hybrid detectors and high end TCSPC cards with optional long time range modes offer a combined solution, for most of needs like high time and high spectral resolution. Coupling to a microscopic system (MicroTime 100) allows for applying these features into microscopic domains.

Results and Discussion

We will demonstrate the performance of a spectrometer/microscope assembly in terms of its time resolution, the ability to measure emission spectra, decays (incl. long decays such as phosphorescence, or luminescence of lanthanides using bunched excitation) and record time-gated lifetime images using laser drivers with burst capabilities.

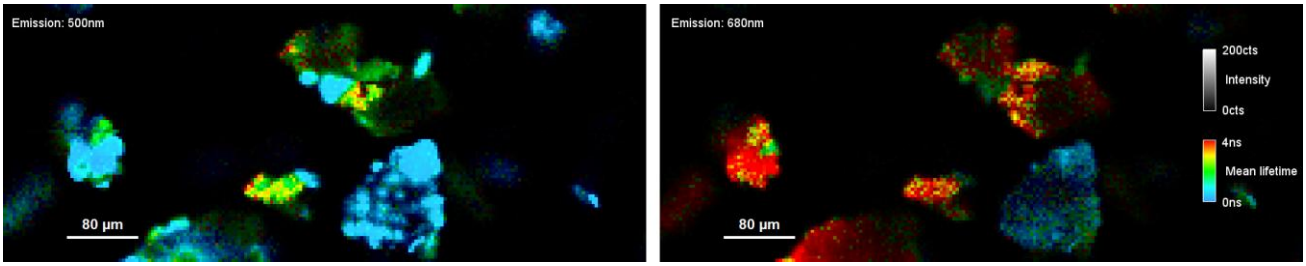

Figure 1: Lifetime images of mixed red paprika and curcuma powder recorded at two different emission wavelengths

Bibliography

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