FP-I: Fluorescence and Phosphorescence

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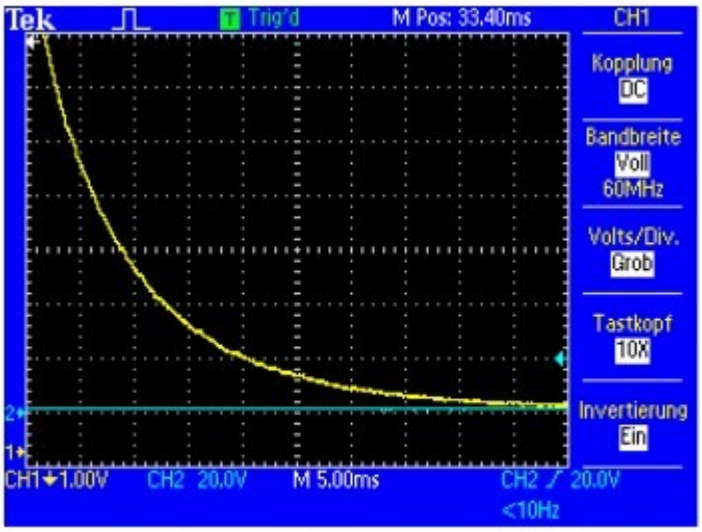

Introduction

Luminescence is most conveniently defined as the radiation emitted by a molecule, or an atom, after it had absorbed energy to go to an exited state. The main types of luminescence consist of fluorescence and phosphorescence. The goal of this experiment is to investigate the properties of optical excitations in organic crystals and to understand the processes that lead to phosphorescence and fluorescence.

Goal of the experiment

Observe the phenomenon of fluorescence and phosphorescence

There are a number of ways an excited molecule can return to its ground state. Radiationless deexcitation transitions such as internal conversion (which happens between excited states of different spins), and vibrational relaxation happen in a time scale of approx. 10^{-12} seconds and channel energy to the neighbor molecules. Fluorescence is the radiative deexcitation of a molecule from the excited singlet state S1 to the groundstate S0 and happens on the time scale of 10^{-8} seconds. Even longer time scales are observed for (radiative) transitions from the metastable triplet state T1 to the ground state S0, called phosphorescence (10^{-4} - 10^{1} seconds). In molecular cristals further processes occur: diffusion and annihilation of excited states, e.g. delayed fluorescence (on similar timescales as phosphorescence). The latter time scale is easily accessible for measurements.

Experiment

The molecules in a sample crystal are excited by a mercury lamp. Fluorescence and phosphorescence are detected with a photomultiplier tube. The experimental apparatus controls a shutter system that automatically closes the detector window during excitation and vice versa. This prevents the sensitive detector from getting directly exposed to the intense excitation light that would destroy the tube. The photomultiplier output is then displayed on a oscilloscope as a function of time. It can be averaged and

transferred to the linked computer for further analysis.

Measurement

- A thorough understanding of the principle and the setup of the experiment is essential.
- It is advised to work in a nearly dark environment

Full Description

A full description is available as pdf document.

Bibliography

- College level atomic physics and quantum mechanics books
- E. B. Priestley and A. Haug, Phosphorescence Spectrum of Pure Naphthalene, J. Chem. Phys. 49, 622-629, (1968). (As pdf.)
- Molecular Crystals 5, 37-77, (1968).
- John B. Birks, Photophysics of Aromatic Molecules, Wiley-Interscience, New York, (1970)
- Molecular Spectroscopy of the Triplet State, S. P. McGlynn, T. Azumi, and M. Kinoshita (eds.), Prentice-Hall, Englewood Cliffs, N.J., (1969)

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