Spectroscopic Investigation of Organic Chromophores

Research Internship at JMU

Prof. Dr. Frank Würthner's Lab

Personal Report-

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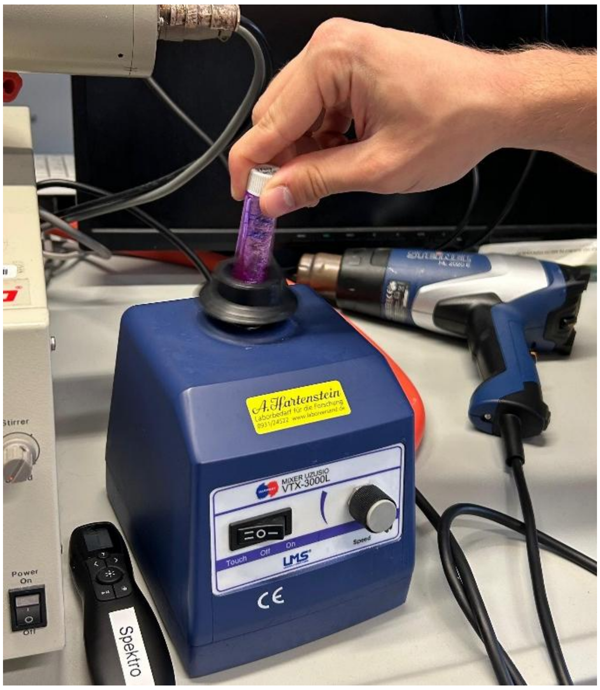
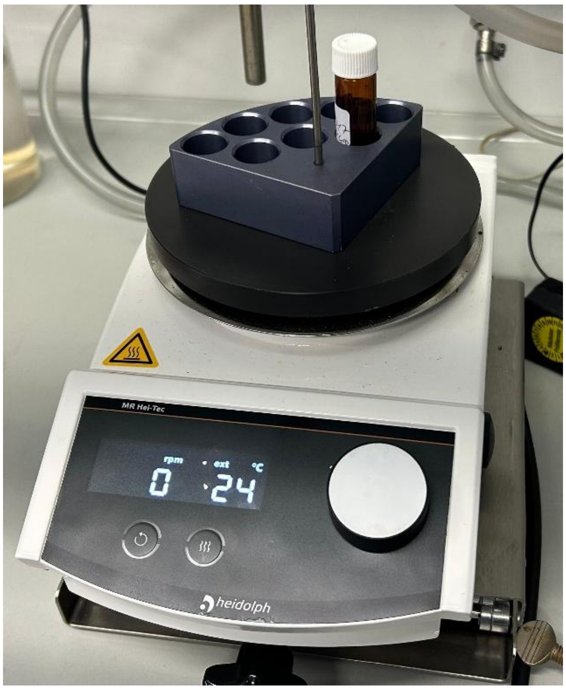
During my research internship, I carried out systematic spectroscopic investigations focused on understanding the photophysical properties of organic chromophores, particularly merocyanine-based systems. The work combined careful sample preparation with steady-state optical characterization to establish structure–property relationships and solvent-dependent behavior.

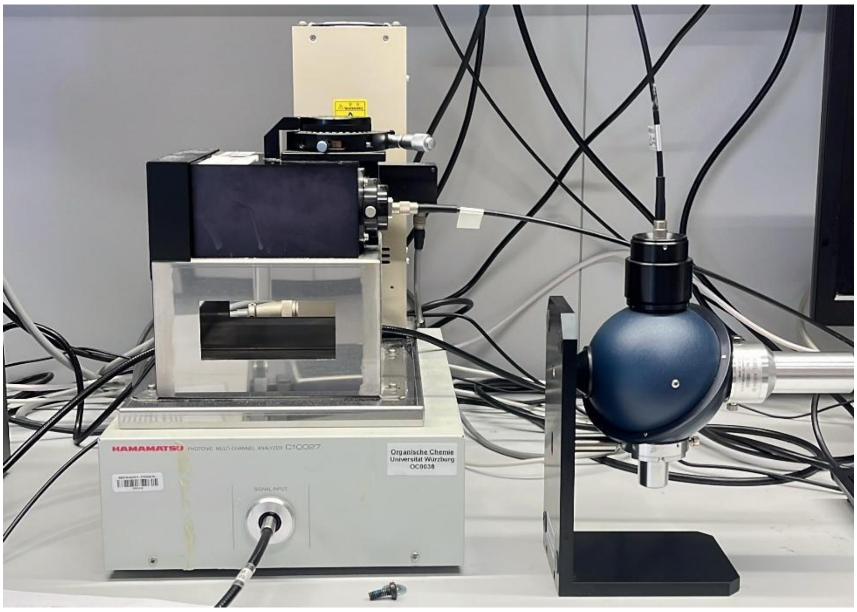
A significant portion of the work involved meticulous sample preparation. Accurate concentration control, clean quartz cuvettes, and optically clear solutions were essential to ensure reproducible and artifact-free measurements. Improper preparation could lead to scattering or aggregation, which would compromise spectral accuracy. Solution homogenization was achieved using controlled mixing setups. For compounds with limited solubility, extended magnetic stirring under regulated conditions was employed. In several cases, samples were stirred for prolonged durations, often overnight, to achieve equilibrium dissolution without molecular degradation.



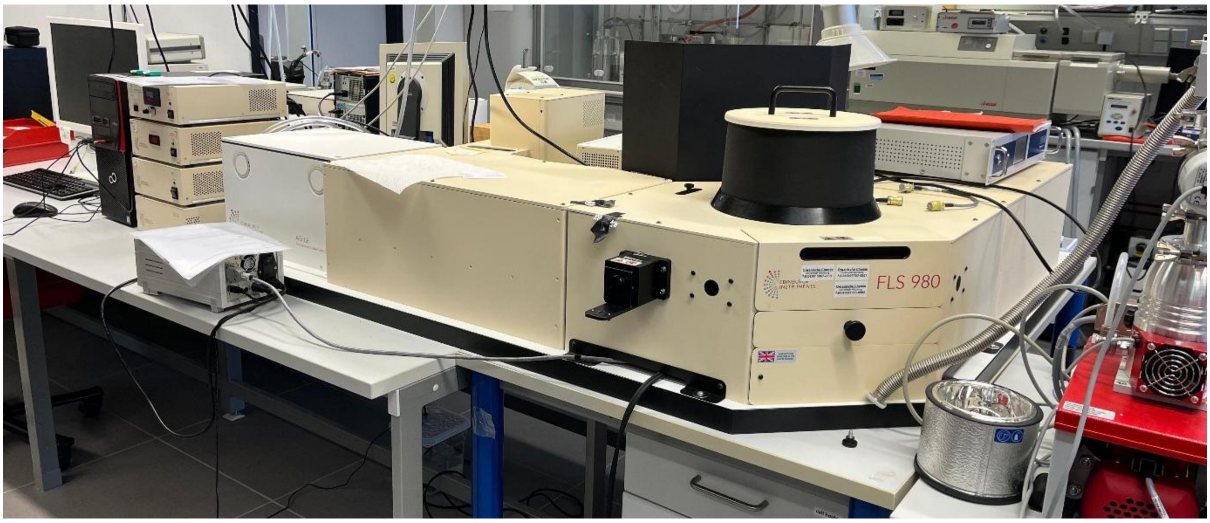


Ground-state absorption studies were performed using UV–visible absorption spectroscopy. These measurements provided essential information on absorption maxima, spectral broadening, and solvent-induced shifts, which were critical for selecting excitation wavelengths and interpreting electronic transitions related to charge-transfer states.

Absolute photoluminescence quantum yield measurements were carried out using an integrating-sphere-based setup. These measurements quantified emission efficiencies and, when combined with steady-state spectral data, helped distinguish between radiative and non-radiative decay pathways.



Steady-state fluorescence measurements were conducted using a fluorescence lifetime spectrometer. Emission spectra were recorded in different solvents to evaluate solvatochromism and radiative decay behavior. The combined absorption and emission data enabled a coherent interpretation of excited-state relaxation processes and solvent stabilization effects.



The solvent-dependent color variations of merocyanine dye solutions provided a clear qualitative confirmation of strong solvatochromic behavior and intramolecular charge-transfer character, supporting conclusions drawn from spectroscopic measurements.

Overall, this internship enhanced my experimental independence and reinforced the importance of rigorous sample preparation, complementary spectroscopic techniques, careful data interpretation, and AI-assisted data analysis. The experience provided valuable insight into molecular photophysics and established a strong foundation for future work combining advanced spectroscopy with data-driven methodologies.