

Author: Jędrzej Solarski

Title: Quenching of the excited 3MLCT (metal-to-ligand-charge transfer) states in energy transfer processes.

Supervisor: prof. Dr hab. Andrzej Kapturkiewicz

Abstract

The general aim of presented dissertation is to contribute to understanding of factors that govern kinetics of the Dexter-type energy transfer in the liquid media between excited triplet $^3\text{MLCT}$ *metal-to-ligand-charge-transfer* states (acting as energy donor) and organic molecules (acting as energy acceptors). We decided to investigate this topic since so far published data indicated that the commonly known kinetic models (Sandros and Balzani) cannot correctly interpret experimentally obtained kinetic for this kind of processes.

The main object of investigation were luminescent Ir(III) complexes. Due to their unique properties (long life-times in μs range and high quantum yields up to 90%) the time resolved emission spectroscopy technique could be utilized to obtain energy transfer rate constants. Also the use of time resolved emission spectroscopy allowed to develop a more accurate method for obtaining energy transfer rate constants than extracted from commonly used transient absorption technique studies. The analysis of obtained luminescence decays profiles allowed examination of energy transfer processes in both iso-energetic and exothermic regions. Research conducted in room temperature for selected model systems (iridium (III) complex – aromatic hydrocarbon) in different protic and aprotic solvents. Additionally for two selected systems ($\text{Ir}(\text{ppy})_3$ – chrysene and $\text{Ru}(\text{bpy})_3^{2+}$ – pyrene) the studies of energy transfer kinetics in different temperatures were performed.

On the basis of obtained results a new kinetical model (which includes quantum magnetic conservation rule) was proposed. The outcome of the performed research could not be explained in the terms of two models proposed by Sandros and Balzani. A general conclusion is that proposed model with quantum magnetic number conservation leads to the proper prediction of the solvent viscosity effects as well as temperature dependence.