

Abstract

2,2':6',2''-Terpyridine and its derivatives belong to a group of chelating ligands that are able to form stable complexes with many metals, that are p-block elements, transition metals, as well as lanthanides and actinides. Coordination compounds of these ligands can be employed in catalysis, biological imaging, optoelectronics, as well as they are important due to their interesting magnetic and anti-cancer properties. 2,2':6',2''-Terpyridine and its analogues are usually obtained by one-step and efficient Kröhnke condensation. This method allows for easy modifications of the *terpy* core by introduction of appropriate substituents into the position 4' and replacement of peripheral pyridine rings in *terpy* by another heterocyclic rings.

The doctoral dissertation presents findings of my studies for rhenium(I) complexes with 2,2':6',2''-terpyridine (*terpy*) and 2,6-bis(pyrazin-2-yl)pyridine (*dppy*) derivatives. The ligand modifications were realized by incorporating polycyclic aromatic hydrocarbons (1-naphthyl, 2-naphthyl, 9-anthryl, 2-anthryl, 9-phenanthrenyl and 1-pyrenyl groups) into the position 4' of *terpy* and 4 of *dppy* frameworks. Such ligands, thanks to the presence of polycyclic aromatic hydrocarbons, give a possibility of obtaining bichromophoric systems with enhanced room-temperature emission lifetimes as a result of formation of an excited state equilibrium between the ³MLCT and ³IL states sharing similar energy.

The obtained aryl derivatives of 2,2':6',2''-terpyridine and 2,6-bis(pyrazin-2-yl)pyridine and their rhenium(I) complexes were thoroughly investigated. On the basis of structural, electrochemical and optical studies, their ground and excited states were characterized. For selected rhenium(I) complexes, ultrafast femtosecond transient absorption studies were performed, and dynamics of photophysical processes occurring after the photoexcitation was determined, and the energy level diagrams were proposed. For Re(I) complexes with pyrene-substituted ligands, the excited state equilibrium between the ³MLCT and ³IL states was confirmed.

As a result of the research, rhenium(I) complexes with significantly prolonged luminescence lifetimes at room temperature were obtained, and the ability of Re(I) complexes bearing anthryl-substituted *terpy* ligands for singlet oxygen generation was evidenced. Additionally, preliminary studies towards application of obtained Re(I) complexes in organic light emitting diodes (OLEDs) as emissive layers were carried out. Correlations between *Ar-terpy/Ar-dppy* ligand structure and optical properties of resulting rhenium(I) complexes [ReCl(CO)₃(Ar-terpy-κ²N)] and [ReCl(CO)₃(Ar-dppy-κ²N)], determined within the research, are of significance for better understanding of photophysical processes occurring in transition metals complexes after photoexcitation, as well as they are essential in view of design of new functional materials with well-defined photophysical behaviour for suitable applications.