SPECTROSCOPIC PROPERTIES OF WATER SOLUBLE AXIAL SUBSTITUTED Zr(IV) AND Hf(IV) PHTHALOCYANINES IN SOLVENTS


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The unique structure and chemical properties of phthalocyanines allow them to be biologically and chemically useful macrocyclic compounds. Several derivatives of these compounds have been used as sensitizing agents for photodynamic therapy due to their ability to absorb light in the near-infrared spectral region. Most often, in photodynamic therapy, DMSO solutions of phthalocyanine have been used, because DMSO, with the substance dissolved in it, is able to penetrate directly the tissues and cells, and that is the reason for particular attention given to the absorption and emission properties of phthalocyanines in DMSO solutions. In this work we presented a comparative UV-VIS spectral investigation of eights Zr(IV) and Hf(IV) phthalocyanine complexes with gallic, 5-sulfosalicylic, oxalic acids and methyl ether of gallic acid as metal coordinated axial ligands in water and organic solvents (MeOH, EtOH, DMSO, DMF, Acetone, CH₂Cl₂ and CHCl₃). Moreover, fluorescent properties of these complexes in DMSO solution have been examined. As for all phthalocyanines, absorbance spectra of axial substituted Zr(IV) and Hf(IV) phthalocyanines are characterized by presence of ultraviolet Soret band ($\lambda_{max}$ are in the range of 335 to 350 nm) and visible Q band ($\lambda_{max}$ are in the range of 675 to 701 nm). The position of $\lambda_{max}$ in the Soret region depends on the solvent polarity - the lower is Reichardt empirical parameter of polarity for solvent, the higher shift of $\lambda_{max}$ into the red is observed. Fluorescent analysis shows that in DMSO solutions, when $\lambda_{max}$ of excitation is 410 or 420 nm, the maxima of emission spectra for all the investigated complexes are located in the range from 725 to 737 nm. Moreover, for the complexes with the same axial ligands, $\lambda_{max}$ of emission for Hf(IV) complexes in relation to $\lambda_{max}$ of emission for Zr(IV) were 10-15 nm shift into the red. The Stocks shifts for researched complexes are about 45 nm.