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## XANES and EXAFS studies of bioactive metallo-organic complexes in solid and liquid state

M. T. Klepka[1]*, A. Wolska[1], A. Drzewiecka-Antonik[1], P. Rejmak[1], G. Aquilanti[2]

[1] *Institute of Physics Polish Academy of Sciences, Warsaw, Poland*
[2] *Elettra - Sincrotrone Trieste, Italy*

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*e-mail: mklepka@ifpan.edu.pl

Extended X-ray absorption fine structure (EXAFS) and X-ray absorption near edge structure (XANES) spectroscopies already demonstrated their usefulness in studies of disordered systems. These techniques provide information about local atomic neighborhood and coordination polyhedra around metal cations regardless of the state or crystallographic form of the investigated material. It is especially important for structural studies of compounds without long range order like copper(II) complexes of coumarins.

The natural as well as synthetic coumarins, therein hydroxycoumarins, exhibit a large spectrum of biological activity. Such derivatives proved usefulness as anti-coagulants [1], antibacterial agents [2], antifungal agents [3], biological inhibitors [4], chemotherapeutics [5] and as bio-analytical reagents [6]. It has been found out that coordination of metal ions to therapeutic agents (such as simple coumarins) can improve their efficacy and accelerate bioactivity. In many cases such metal complexes are more potent and less toxic comparing to the parent drug. Therefore, among others, also biologically active metal complexes of coumarin based ligands are being widely investigated. Creaven et al. have investigated the antimicrobial activity of a number of coumarin complexes with silver(I), copper(II) and manganese(II) ions. For example, the Cu(II) complexes exhibit antifungal activity against a clinical strain of *C. albicans* comparable to that of the commercially available antifungal drugs, i.e. ketoconazole and Amphotericin B [7].

Our studies presented here were focused on comparison between solid and liquid state of two bioactive hydroxycoumarin complexes. Our goal was to try to simulate environment similar to one during biological activity tests and human body. As solvents DMSO – dimethyl sulfoxide and DMF – dimethylformamide were used. Previously synthesized copper(II) complexes of two hydroxyligands: HL1 and HL2 (Figure 1) were used. These ligands have acetyl group attached at two different positions, C6 and C8, to the rigid coumarin ring. The electrochemical method was applied for the synthesis of the complexes.

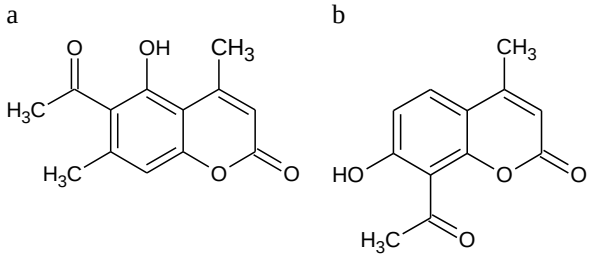


*Figure 1.* Molecular structure of ligands a - HL1 and b - HL2

XAFS measurements were performed at the beamline I811 at MAX-lab in Lund, Sweden and XAFS beamline at Elettra in Trieste, Italy. First samples in the form of microcrystalline powder were investigated in Lund. After that solutions of complexes in organic solvents (DMSO; DMF) were measured in Trieste.

Methodology of the analysis included several steps. First, the compounds were initially characterized by Fourier transformed infrared spectroscopy (FTIR). Next, EXAFS data were fitted in order to get information about local atomic order. XANES spectra revealed that Cu in complexes is mostly 2+. Then, obtained results were used to find proper model with help of the density functional theory (DFT). Finally full potential multiple scattering XANES calculations were performed.

Results of structural analysis for compounds in the form of microcrystalline powder enabled us to propose mechanism of metal-organic ligand interaction. Some differences were observed between powder form and solutions of respective complexes. During the presentation details will be discussed and compared with results from biological activity tests.

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