

Preparation and characterization of Schiff base Cu(II) complex and its applications on textile materials

G Oylumluoglu¹ and J Oner²,

¹Mugla Sıtkı Koçman University, Department of Physics, Molecular Nano-Materials Laboratory, Mugla, Turkey

²Usak University, Civil Engineering Department, Usak, Turkey

gorkem@mu.edu.tr

Abstract. Schiff base ligands are regarded as an important class of organic compounds on account of the fact that their complexation ability with transition metal ions. A new monomeric Schiff base Cu(II) complex, $[\text{Cu}(\text{HL})_2]$, 1 $[\text{H}_2\text{L} = 2-((\text{E})-(2\text{-hydroxypropylimino)methyl})-4\text{-nitrophenol}]$ has been synthesized and characterized by elemental analysis, UV and IR spectroscopy, single crystal X-ray diffraction and photoluminescence study. While the Schiff base ligand and its Cu(II) complex are excited at $\lambda_{\text{ex}} = 349$ nm in UV region, the Schiff base ligand shows a blue emission band at $\lambda_{\text{max}} = 480$ nm whereas its Cu(II) complex shows a strong green emission band at $\lambda_{\text{max}} = 520$ nm in the solid state at room temperature. The luminescent properties showed that the Schiff base ligand and its Cu(II) complex can be used as novel potential candidates for applications in textile such as UV-protection, antimicrobial, laundry and functional bleaching treatments.

Keywords: Schiff base ligands, copper(II) complex, Photoluminescence, textile application.

1. Introduction

In recent years, transition metal complexes containing Schiff base ligands have attracted a lot of attention with their widespread used for industrial purposes in textile such as stain bleaching and dye-transfer inhibition [1]. Azo-benzene Schiff base ligands are considerable part of light sensitive materials which can absorb UV-radiation to convert it to less harmful energy by change of cis-trans isomerization or intermolecular proton transfer [2]. There are some researches on the photochromic, thermochromics, UV-protection, magnetic and photoluminescence properties of azo-benzene Schiff base compounds in the functional textile materials. Besides, Schiff base complexes can be used as new generation antimicrobial agents for textile applications with excellent biological activities they show [3]. In antimicrobial applications, Schiff-base complexes are considered to be among the most important stereochemical models in main group and transition metal coordination chemistry due to their preparative accessibility and structural variety [4]. In dyeing applications, Schiff base unsymmetrical complex 1:2 chromium has advantage in terms of quick dyeing with giving fast colors to leathers and wools [5]. In addition to this, Azo groups containing metal complexes are used for dyeing cellulose and polyester blending textiles [6]. In textile polymer manufacturing, organocobalt complexes with tridentate Schiff base act as initiator of emulsion polymerization and copolymerization of diene and vinyl monomers [7].



Textile surfaces are very convenient materials that suitable to Schiff base applications due to their elasticity, good hand properties, good biodegradability, biocompatibility and nontoxicity. This study presents the example of the most promising application of Schiff base ligands and their transition complexes.

2. Materials and methods

All chemicals and solvents used for the synthesis were of reagent grade and used without further purification. The synthetic route of the Schiff base ligand and its Cu(II) complex are outlined in Figure 1.

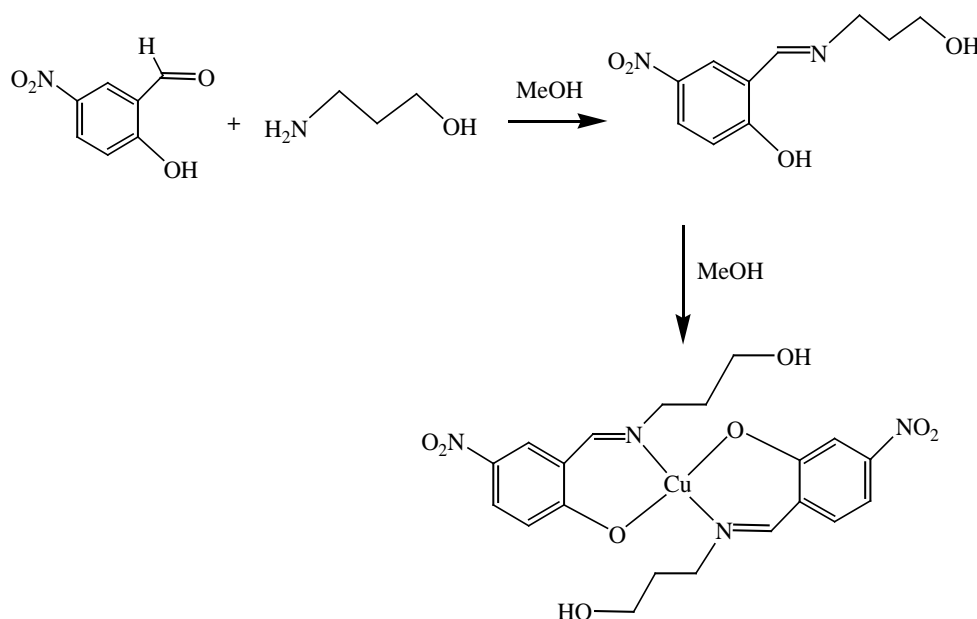


Figure 1. The synthetic route of the Schiff base ligand and its Cu(II) complex.

3. Results and discussion

The title complex crystallize in the monoclinic space group $P2_1/c$ and its asymmetric unit consists of a half of the monomeric $[Cu(HL)_2]$ unit. The CuII atom is located on a center of inversion and coordinated by two singly deprotonated Schiff base ligands (H_2L) through two imine nitrogen (N_{imi}), and two alkoxy oxygen (O_{alk}) atoms in a mutual *trans* disposition.

The Cu(II) complex crystallizes in the monoclinic space group $P2_1/c$, and its asymmetric unit composes of an half of the monomeric $[Cu(HL)_2]$ unit. The Cu(II) atom is located on a centre of inversion and coordinated by two singly deprotonated Schiff base ligand through two imine nitrogen, and two alkoxy oxygen atoms in a mutual *trans* disposition. The free ligand displays a broad emission band at $\lambda_{max} = 480$ nm which may be assigned to the $n \rightarrow \pi^*$ or $\pi \rightarrow \pi^*$ electronic transition (ILCT) [8]. While the free ligand is combined with Cu(II) in complex **1**, intense green emission band exhibits at $\lambda_{max} = 520$ nm.

The molecular structure of Cu(II) and the emission spectrums of the free ligand and its Cu(II) complex in the solid samples at room temperature are given in Figure 2 and Figure 3, respectively.

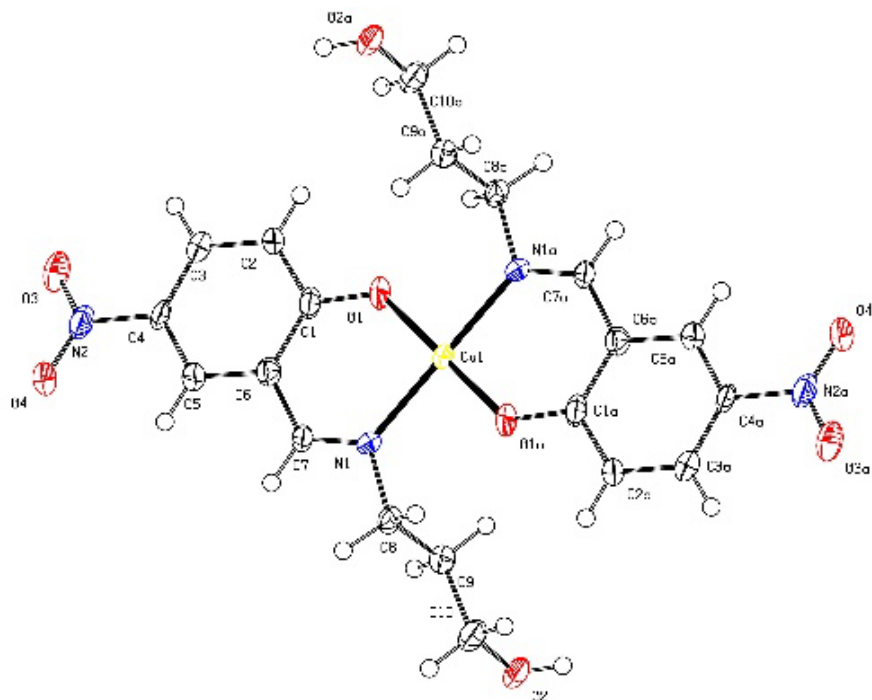


Figure 2. The molecular structure of Cu(II) complex, showing the atom labelling scheme (with 50% probability displacement ellipsoids).

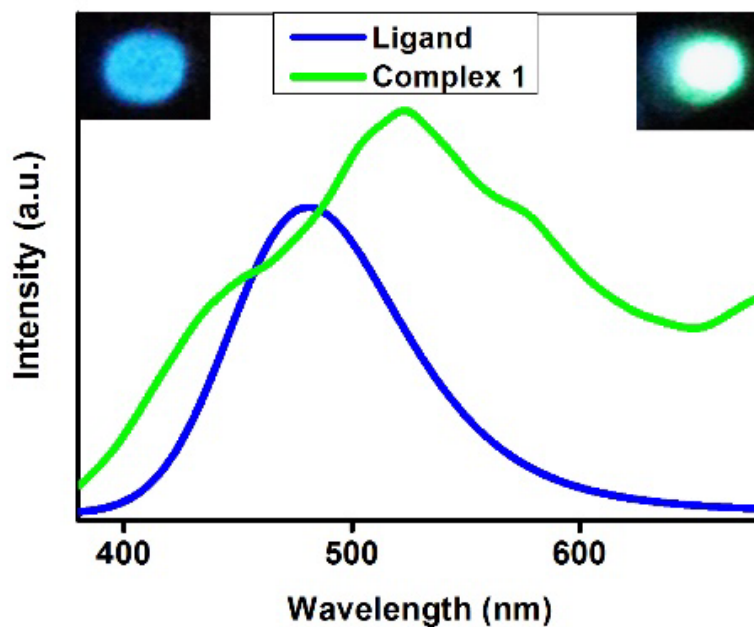


Figure 3. The emission spectrums of the free ligand and its Cu(II) complex in the solid samples at room temperature ($\lambda_{\text{exc.}} = 349 \text{ nm}$).

4. Conclusion

A novel monomeric Schiff base Cu(II) complex, **1** has been synthesized and characterized by elemental analysis, UV and IR spectroscopy, single crystal X-ray diffraction and photoluminescence study. Crystal structure analysis of **1** shows that the Cu(II) atom is located on a centre of inversion and square planar geometry. Cu(II) atom is coordinated by two singly deprotonated Schiff base ligands (H₂L) using ONON donors. The aliphatic –OH group of the ligand is not coordinated and moves away from the metal coordination zone. The intermolecular O–H···O hydrogen bonds link the molecules which form 1D chains along b axis. C–H··· π and π ··· π contacts also connect the molecules which form to 3D structure. Furthermore, photoluminescence studies of complex **1** show the red shift and the stronger of the emission compared with its free ligand as a result of the influence of the coordination of metal atom to the ligand.

The luminescent properties showed that the photoluminescence arose from the intraligand emission, and that it is novel potential candidates for applications in optoelectronic devices and functional textile materials.

As a future work, it can be focused on the analyzing at the synthesis of Schiff base Cu(II) complex with the textile surface by experimental tests. And also, to ensure a chemical reaction between the Schiff base synthesis and the fibers, microscopic views of the textile surface after application may be investigated.

References

- [1] Hage R and Lienke A 2006 *Angewandte Chemie International Edition* **45** 206-222
- [2] Hou A, Zhang C and Wang Y 2012 *Carbohydrate Polymers* **87** 284-288
- [3] Simoncic B and Tomsic B 2010 *Text. Res. J.* **80**, 1721-1737
- [4] Keypour H, Rezaeivala M, Valencia L, Perez-Lourido P and Khavasi HR. 2009 *Polyhedron* **28** 3755-3758
- [5] Mennicke W and Westphal DE 1984, *Chem. Abstr.* **104** (1986), 111359
- [6] Dehnert J and Juchemann W 1983 *Chem. Abstr.* **103** (1985). 106288.
- [7] Young R J and Cooper G W 1983 *J Reprod Fertil*, **69**, 1-10
- [8] Feng X, Feng YQ, Chen JJ, Ng SW, Wang L-Y and Guo, JZ. 2014 *Dalton Trans.* **44** 804–816