

Synthesis and Characterization of Dioxouranium (VI) Complexes of Schiff Bases (Mixed-Ligands Part 2)

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Abstract

The complexes were prepared by reacting equimolar amounts of Schiff bases and H₂O, py, DMF, bipy, phen and Et₃N with UO₂(VI) in absolute ethanol. The general compositions of the UO₂(VI) complexes are [(L¹)(UO₂)(OAc)(py)].H₂O (1), [(L²)(UO₂)(OAc)(H₂O)].H₂O (2), [(L³)(UO₂)(OAc)(bpy)].3H₂O (3), [(L⁴)(UO₂)(OAc)(phen)].H₂O (4), [(L⁵)(UO₂)(OAc)(Et₃N)].2H₂O (5) and [(L⁶)(UO₂)(OAc)(DMF)].3H₂O (6). The complexes were characterized on the basis of elemental analyses, IR, ¹H-NMR and ¹³C-NMR spectra, magnetic susceptibility measurements, electronic spectra and thermogravimetric analyses.

Keywords: Schiff bases, UO₂(VI) complexes of Schiff bases, Mixed ligands.

Schiff Bazlarının Dioksouranyum (VI) Komplekslerinin Sentezi ve Karakterizasyonu (Karışık Ligandlar Bölüm 2)

Özet

Kompleksler Schiff bazları, su piridin dimetilformamid, bipiridin, fenantrolin ve trietilamin ile dioksouranyum(VI)'un mutlak etanol içinde eşit molar miktarlarda reaksiyona sokulması ile hazırlandı. Dioksouranyum(VI) komplekslerinin genel formülü [(L¹)(UO₂)(OAc)(H₂O)].2H₂O (1), [(L²)(UO₂)(OAc)(py)].H₂O (2), [(L³)(UO₂)(OAc)(DMF)].2H₂O (3), [(L⁴)(UO₂)(OAc)(bipy)].H₂O (4), [(L⁵)(UO₂)(OAc)(phen)].H₂O (5) and [(L⁶)(UO₂)(OAc)(Et₃N)].3H₂O (6). şeklindedir. Komplekslerin sentezinde elementel analiz, İnfrared, proton NMR, karbon-13 NMR, elektronik spektrum, manyetik süssebtibilite ve termogravimetrik analiz kullanıldı.

Anahtar Kelimeler: Schiff bazları, Schiff bazlarının UO₂(VI) kompleksleri, Karışık ligandlar

1. Introduction

Among the variety of ligand systems [1,2], Schiff bases are an important class having many applications [3] and many complexes of different Schiff bases have been reported by a number of authors [4,5].

Schiff-base complexes have a wide variety of structures, coordinating to metal in either mono-or bidentate modes, depending upon the aldehyde and amines [6].

Unsymmetrical Schiff-base ligand complexes have been suggested as useful biological models in understanding irregular binding of peptides [7] and also as catalysts in some chemical processes [8]. The presence of transition metals in human blood plasma indicates their importance in the mechanism for accumulation, storage and transport of transition metals in living organisms

[9]. Actinide metal ion especially dioxouranium (VI) are of great interest because of their small size and high formal positive charge [10].

Complexes of Schiff bases with the dioxouranium (VI) ion are therefore potentially model systems for the study of UO₂-protein interaction [11].

In this study we synthesized Schiff base mixed ligands L¹-L⁶ and their dioxouranium (VI) complexes. The thermal analysis and spectroscopic properties of the ligands and their complexes are reported.

2. Experimental

Elemental analyses (C, H, N) were carried out using LECO-932 CHNSO by Technical and Scientific Research Council of Turkey, TUBITAK. IR spectra were recorded on a

Mattson 1000 FT-IR Spectrometer as KBr pellets. $^1\text{H-NMR}$ and $^{13}\text{C-NMR}$ spectra were recorded on a Bruker GmbH Dpx-400 MHz High Performance Digital FT-NMR Spectrometers. Magnetic susceptibilities were determined on a Sherwood Scientific Magnetic Susceptibility Balance (Model MK1) at room temperature using $\text{Hg}[\text{Co}(\text{SCN})_4]$ as a calibrate; diamagnetic corrections were calculated from Pascal's constants. UV-Vis measurements were done using a Shimadzu UV Probe 2.1. TGA curves were recorded on a Shimadzu TG-50 thermo balance.

2.1. Preparation of ligands

The synthesis and characterization of the ligands used in this study have been described previously [12-17].

2.2. Preparation of $[(\text{L}^1)(\text{UO}_2)(\text{OAc})(\text{py})]\cdot\text{H}_2\text{O}$ Complex

A solution of $\text{UO}_2(\text{CH}_3\text{COO})_2\cdot 2\text{H}_2\text{O}$ (3 mmol) in ethanol 20 ml was added to a hot (50°C) solution of the L^1 (3 mmol) and pyridine (3 mmol) in ethanol 20 ml. The complex started to form immediately upon addition of the metal salt solution. The precipitated complex was filtered off, washed with water and ethanol several times and dried in vacuo.

$[(\text{L}^1)(\text{UO}_2)(\text{OAc})(\text{py})]\cdot\text{H}_2\text{O}$ was obtained in IR (cm^{-1} , ν): 435 (U-N_{py}), 450 (M-N), 555 (M-O), 895 (O=U=O), 1010 (N-O), 1335 (Symmetric COO_{acetato}), 1320 (C-O), 1595 (C=N_{oxime}), 1610 (C=N_{azomethine}), 1660 (Asymmetric COO_{acetato}), 3290-3430 (H₂O/OH); $^1\text{H-NMR}$ (DMSO- d_6 , δ): 2.05 (s, 3H, OOCCH₃), 2.20 (s, 3H, -CH₃), 3.3 (H₂O), 6.85-7.70 (m, 8H, Ar-H), 7.21, 7.59, 8.55 (py), 8.58 (s, 1H, N=CH), 10.74 (s, 1H, OH_{oxime}); $^{13}\text{C-NMR}$ (DMSO- d_6 , δ): 11.30 (C₁), 21.37 (C₁₀), 106.07 (C₉), 116.58 (C₁₆), 118.79 (C₁₄), 119.29 (C₁₂), 120.72 (C₅ and C₇), 123.59 (py), 126.49 (C₄ and C₈), 132.19 (C₁₃), 132.97 (C₁₅), 135.73 (C₃), 136.22 (py), 148.00 (C₂), 150.11 (py), 152.81 (C₆), 160.59 (C₁₁), 162.48 (C₁₇).

2.3. Preparation of

$[(\text{L}^2)(\text{UO}_2)(\text{OAc})(\text{H}_2\text{O})]\cdot\text{H}_2\text{O}$ Complex

A solution of $\text{UO}_2(\text{CH}_3\text{COO})_2\cdot 2\text{H}_2\text{O}$ (3 mmol) in ethanol 20 ml was added to a hot (50°C) solution of the L^2 (3 mmol) and water (3 mmol) in ethanol 20 ml. The complex started to form immediately upon addition of the metal salt solution. The precipitated complex was filtered off, washed with water and ethanol several times and dried in vacuo.

$[(\text{L}^2)(\text{UO}_2)(\text{OAc})(\text{H}_2\text{O})]\cdot\text{H}_2\text{O}$ was obtained in IR (cm^{-1} , ν): 445 (M-N), 560 (M-O), 900 (O=U=O), 1005 (N-O), 1340 (Symmetric COO_{acetato}), 1310 (C-O), 1585 (C=N_{oxime}), 1605 (C=N_{azomethine}), 1665 (Asymmetric COO_{acetato}), 3300-3440 (H₂O/OH); $^1\text{H-NMR}$ (DMSO- d_6 , δ): 2.01 (s, 3H, OOCCH₃), 2.14 (s, 3H, -CH₃), 3.4 (H₂O), 6.89-7.74 (m, 8H, Ar-H), 8.63 (s, 1H, N=CH), 10.78 (s, 1H, OH_{oxime}); $^{13}\text{C-NMR}$ (DMSO- d_6 , δ): 11.52 (C₁), 22.01 (C₁₀), 109.11 (C₉), 109.93 (C₁₄), 114.49 (C₁₆), 118.49 (C₁₂), 120.10 (C₅ and C₇), 126.33 (C₄ and C₈), 134.00 (C₁₃), 135.09 (C₃), 135.98 (C₁₅), 147.93 (C₂), 154.11 (C₆), 161.51 (C₁₁), 163.99 (C₁₇).

2.4. Preparation of

$[(\text{L}^3)(\text{UO}_2)(\text{OAc})(\text{bpy})]\cdot 3\text{H}_2\text{O}$ Complex

A solution of $\text{UO}_2(\text{CH}_3\text{COO})_2\cdot 2\text{H}_2\text{O}$ (3 mmol) in ethanol 20 ml was added to a hot (50°C) solution of the L^3 (3 mmol) and 2,2'-bipyridine (3 mmol) in ethanol 20 ml. The complex started to form immediately upon addition of the metal salt solution. The precipitated complex was filtered off, washed with water and ethanol several times and dried in vacuo.

$[(\text{L}^3)(\text{UO}_2)(\text{OAc})(\text{bpy})]\cdot 3\text{H}_2\text{O}$ was obtained in IR (cm^{-1} , ν): 440 (M-N), 570 (M-O), 905 (O=U=O), 1010 (N-O), 1360 (Symmetric COO_{acetato}), 1320 (C-O), 1575 (=N_{bpy}), 1590 (C=N_{oxime}), 1620 (C=N_{azomethine}), 1670 (Asymmetric COO_{acetato}), 3285-3450 (H₂O/OH); $^1\text{H-NMR}$ (DMSO- d_6 , δ): 1.99 (s, 3H, OOCCH₃), 2.17 (s, 3H, -CH₃), 3.2 (H₂O), 6.81-7.60 (m, 8H, Ar-H), 7.30-8.68 (bpy), 8.91 (s, 1H, N=CH), 10.89 (s, 1H, OH_{oxime}); $^{13}\text{C-NMR}$ (DMSO- d_6 , δ): 11.21 (C₁), 21.76 (C₁₀), 108.66 (C₉), 120.53 (bpy), 121.37 (C₁₂), 121.80 (bpy), 122.49 (C₁₆), 123.95 (C₅ and C₇), 127.61 (C₁₃), 129.98 (C₄ and C₈),

132.44 (C₁₅), 135.70 (C₃), 136.77 (bpy), 137.13 (C₁₄), 147.58 (C₂), 149.66 (bpy), 153.67 (C₆), 156.51 (bpy), 161.62 (C₁₁), 163.11 (C₁₇).

2.5. Preparation of

[(L⁴)(UO₂)(OAc)(phen)].H₂O Complex

A solution of UO₂(CH₃COO)₂.2H₂O (3 mmol) in ethanol 20 ml was added to a hot (50°C) solution of the L⁴ (3 mmol) and 1,10-phenanthroline (3 mmol) in ethanol 20 ml. The complex started to form immediately upon addition of the metal salt solution. The precipitated complex was filtered off, washed with water and ethanol several times and dried in vacuo.

[(L⁴)(UO₂)(OAc)(phen)].H₂O was obtained in IR (cm⁻¹, ν): 440 (M-N), 565 (M-O), 910 (O=U=O), 1005 (N-O), 1330 (Simetric COO_{acetato}), 1260 (C-O), 1570 (phen), 1595 (C=N_{oxime}), 1620 (C=N_{azomethine}), 1660 (Asimetric COO_{acetato}), 3240-3430 (H₂O/OH); ¹H-NMR (DMSO-d₆, δ): 1.35 (s, 3H, OOCCH₃), 1.36 (CH₃), 2.15 (CH₂), 2.18 (s, 3H, -CH₃), 3.2 (H₂O), 6.79-7.65 (m, 7H, Ar-H), 7.61-9.16 (phen), 8.69 (s, 1H, N=CH), 10.88 (s, 1H, OH_{oxime}); ¹³C-NMR (DMSO-d₆, δ): 10.85 (C₁), 14.16 (C-CH₃), 21.52 (C₁₀), 63.72 (C-CH₂), 105.45 (C₉), 108.40 (C₁₄), 118.42 (C₁₂), 119.97 (C₅ and C₇), 121.35 (phen), 121.98 (C₁₃), 123.65 (C₁₅), 126.50 (phen), 129.00 (phen), 133.25 (C₄ and C₈), 135.92 (phen), 142.04 (C₃), 146.09 (phen), 147.03 (C₁₆), 147.58 (C₂), 150.21 (phen), 150.75 (C₁₇), 152.04 (C₆), 162.09 (C₁₁).

2.6. Preparation of

[(L⁵)(UO₂)(OAc)(Et₃N)].2H₂O Complex

A solution of UO₂(CH₃COO)₂.2H₂O (3 mmol) in ethanol 20 ml was added to a hot (50°C) solution of the L⁵ (3 mmol) and triethylamine (3 mmol) in ethanol 20 ml. The complex started to form immediately upon addition of the metal salt solution. The precipitated complex was filtered off, washed with water and ethanol several times and dried in vacuo.

[(L⁵)(UO₂)(OAc)(Et₃N)].2H₂O was obtained in IR (cm⁻¹, ν): 445 (M-N), 460 (U-NEt₃N) 560 (M-O), 905 (O=U=O), 1010 (N-O), 1350 (Simetric COO_{acetato}), 1290 (C-O), 1560

(C=N_{oxime}), 1625 (C=N_{azomethine}), 1655 (Asimetric COO_{acetato}), 3250-3400 (H₂O/OH); ¹H-NMR (DMSO-d₆, δ): 1.08-2.56 (Et₃N), 2.00 (s, 3H, OOCCH₃), 2.30 (s, 3H, -CH₃), 3.2 (H₂O), 7.00-7.80 (m, 7H, Ar-H), 8.81 (s, 1H, N=CH), 11.01 (s, 1H, OH_{oxime}); ¹³C-NMR (DMSO-d₆, δ): 11.50 (C₁), 12.85 (Et₃N), 22.00 (C₁₀), 49.25 (Et₃N), 109.10 (C₉), 114.17 (C₁₄), 118.36 (C₁₆), 120.86 (C₁₂), 123.37 (C₅ and C₇), 126.70 (C₄ and C₈), 129.22 (C₁₃), 132.59 (C₃), 136.12 (C₁₅), 147.72 (C₂), 153.12 (C₆), 160.98 (C₁₁), 162.95 (C₁₇).

2.7. Preparation of

[(L⁶)(UO₂)(OAc)(DMF)].3H₂O Complex

A solution of UO₂(CH₃COO)₂.2H₂O (3 mmol) in ethanol 20 ml was added to a hot (50°C) solution of the L⁶ (3 mmol) and dimethylformamide (3 mmol) in ethanol 20 ml. The complex started to form immediately upon addition of the metal salt solution. The precipitated complex was filtered off, washed with water and ethanol several times and dried in vacuo.

[(L⁶)(UO₂)(OAc)(DMF)].3H₂O was obtained in IR (cm⁻¹, ν): 450 (M-N), 565 (M-O), 910 (O=U=O), 1005 (N-O), 1320 (Simetric COO_{acetato}), 1310 (C-O), 1595 (C=N_{oxime}), 1610 (C=N_{azomethine}), 1650 (Asimetric COO_{acetato}), 1665 (DMF), 3290-3430 (H₂O/OH); ¹H-NMR (DMSO-d₆, δ): 2.03 (s, 3H, OOCCH₃), 2.22 (s, 3H, -CH₃), 2.78-2.89 (DMF), 3.3 (H₂O), 6.97-7.84 (m, 8H, Ar-H), 7.91 (DMF), 9.08 (s, 1H, N=CH), 11.05 (s, 1H, OH_{oxime}); ¹³C-NMR (DMSO-d₆, δ): 11.40 (C₁), 21.55 (C₁₀), 31.50 (DMF), 35.70 (DMF), 55.50 (OCH₃), 105.43 (C₉), 108.37 (C₁₄), 112.93 (C₁₂), 119.98 (C₅ and C₇), 121.99 (C₁₃), 123.65 (C₁₅), 133.25 (C₄ and C₈), 133.55 (C₃), 144.45 (C₂), 150.75 (C₁₆), 153.30 (C₆), 155.90 (C₁₇), 162.60 (DMF), 170.00 (C₁₁).

3. Results and Discussion

In this study, six Schiff bases ligands used salicyliden-*p*-aminoacetophenoneoxime, 5-bromosalicyliden-*p*-aminoacetophenoneoxime, 5-nitrosalicyliden-*p*-aminoacetophenoneoxime, 3-ethoxysalicyliden-*p*-aminoacetophenoneoxime, 3-chlorsalicyliden-*p*-aminoacetophenoneoxime and 3-methoxysalicyliden-*p*-

aminoacetophenoneoxime were obtained in good yield by literature methods [12-17].

The Schiff bases (mixed ligands) were used for the complexation reaction with dioxouranium (VI). The results of the elemental analyses data show that the metal to ligand ratio in all the complexes is 1:1.

The analytical data of the complexes are given in Table 1. The probable structure of the complexes is shown in Figure 1. The complexes were characterized by the following physical studies.

Table 1. Analytical and physical data of the dioxouranium (VI) complexes

Compounds	Formula (F.W) g/mol ⁻¹	Yield (%)	Elemental analysis		
			Calculated (Found) %		
			C	H	N
(1) [(L ¹)(UO ₂)(OAc)(py)].H ₂ O	C ₂₂ H ₂₃ N ₃ O ₇ U (679.46)	69	38.89 (39.29)	3.41 (3.79)	6.18 (6.50)
(2) [(L ²)(UO ₂)(OAc)(H ₂ O)].H ₂ O	C ₁₇ H ₁₉ N ₂ O ₈ BrU (697.27)	61	29.28 (29.63)	2.75 (2.39)	4.02 (3.89)
(3) [(L ³)(UO ₂)(OAc)(bpy)].3H ₂ O	C ₂₇ H ₂₉ N ₅ O ₁₁ U (837.58)	64	38.72 (38.41)	3.49 (3.61)	8.36 (8.68)
(4) [(L ⁴)(UO ₂)(OAc)(phen)].H ₂ O	C ₃₁ H ₃₀ N ₄ O ₈ U (824.62)	63	45.15 (44.90)	3.67 (3.94)	6.79 (6.46)
(5) [(L ⁵)(UO ₂)(OAc)(Et ₃ N)].2H ₂ O	C ₂₃ H ₃₄ N ₃ O ₈ ClU (754.01)	60	36.64 (37.00)	4.55 (4.90)	5.57 (5.34)
(6) [(L ⁶)(UO ₂)(OAc)(Et ₃ N)].3H ₂ O	C ₂₁ H ₃₁ N ₃ O ₁₁ U (739.51)	75	34.11 (33.87)	4.23 (3.96)	5.68 (5.29)

3.1 Infrared Spectra

The ligands contain four potential donor sites: **1**) the phenolic oxygen, **2**) the azomethine nitrogen, **3**) the oxime oxygen, **4**) the oxime nitrogen. In the IR spectrum of the dioxouranium (VI) complexes the $\nu(\text{C}=\text{N})$ azomethine stretching band appearing at *ca.* 1617-1644 cm^{-1} in the ligands [12-17] are shifted *ca.* 1605-1625 cm^{-1} for the complexes. At the same time the $\nu(\text{C}-\text{O})$ phenolic band at *ca.* 1257-1303 cm^{-1} in the free ligands [9-14] was moved to a lower frequency of at *ca.* 3-17 cm^{-1} after complexes formation. These suggest that the ligands are coordinated to metal ions through the nitrogen and oxygen donors. The practically unchanged $\nu(\text{O}-\text{H})$ oxime) at *ca.* 3240-3450 and $\nu(\text{C}=\text{N})$ oxime at *ca.* 1560-1595 cm^{-1} confirm that the oxime group itself does not coordinate to metal atoms by neither oxygen nor nitrogen atoms [15,16]. The coordination of an acetato group in the complexes are indicated by the appearance of two new bands in the regions 1655-1670 and 1320-1360 cm^{-1} assignable to $\nu(\text{COO})$ asymmetric and $\nu(\text{COO})$ symmetric modes respectively [17]. In the dioxouranium (VI)

complexes two additional sharp bands are observed at *ca.* 895-910 which is assigned to $\nu(\text{UO}_2)$ asymmetric mode respectively. These observation suggests that the $\text{O}=\text{U}=\text{O}$ moiety are virtually linear in these complexes [18,19]. The IR spectra of **(3)** and **(4)** complexes show a change in the ring (=N-) nitrogen frequencies of (bpy) and (phen). The spectra of the complexes **(1)** and **(5)** show the $\nu(\text{U}-\text{N})$ (N of py and Et₃N) at 435 and 460 cm^{-1} respectively.

3.2. NMR Spectra

The ¹H and ¹³C-NMR spectra of the ligands and dioxouranium (VI) complexes were recorded in DMSO-d₆. Characteristic ¹H-NMR peaks of ligands occur at *ca.* 13.09-13.99 $\delta(\text{OH})$ phenolic 10.75-11.02 $\delta(\text{OH})$ oxime, 8.62-9.53 $\delta(\text{N}=\text{CH})$ and 1.36-2.30 ppm $\delta(-\text{CH}_3)$ [13,15]. As can be seen in the ¹H-NMR spectra of complexes there is no OH peaks expected. The absence of the phenolic $\delta(\text{OH})$ proton signals in the complexes indicates the coordination by phenolic oxygen to the metal ion after deprotonation [20]. The coordination of the azomethine nitrogen is inferred by the upfield shifting of the $\delta(\text{CH}=\text{N})$

proton signal from 8.62-9.53 ppm in the ligands to 8.58-9.08 ppm in the complexes [21].

In the $^1\text{H-NMR}$ spectrums the complexes show the presence of a coordinated acetate molecule at *ca.* 1.35-2.05 ppm. $^1\text{H-NMR}$ spectrum of the complexes have $\delta(\text{H}_2\text{O})$ proton at *ca.* 3.2-3.4 ppm.

More detailed information about the structure of the ligands was provided by $^{13}\text{C-NMR}$ spectral data $\delta(\text{C-O})$, $\delta(\text{CH=N})$ and $\delta(\text{C-N})$ carbon atoms are observed at *ca.* 150.75-163.09, 158.98-166.45 and 152.04-153.75 ppm respectively for ligands. $^{13}\text{C-NMR}$ spectra of the complexes $\delta(\text{C-O})$, $\delta(\text{CH=N})$, $\delta(\text{C-N})$ $\delta(\text{CH}_3\text{COO})$ and $\delta(\text{CH}_3\text{COO})$ carbon atoms are observed at *ca.* 152.75-163.99, 160.59-170.00, 152.04-154.11, 105.43-109.11 and 21.37-22.00 ppm respectively. The rest of carbon atoms likewise showed similar diagnostic features for the free ligands as well as their complexes as expected. The signals corresponding to the $\delta(\text{OH})$ proton and $\delta(\text{CH=N})$ carbon (both in oxime) [22] groups are unchanged in the ^1H and $^{13}\text{C-NMR}$ spectra of the complexes, indicating that these oxime groups do not take part in complexation.

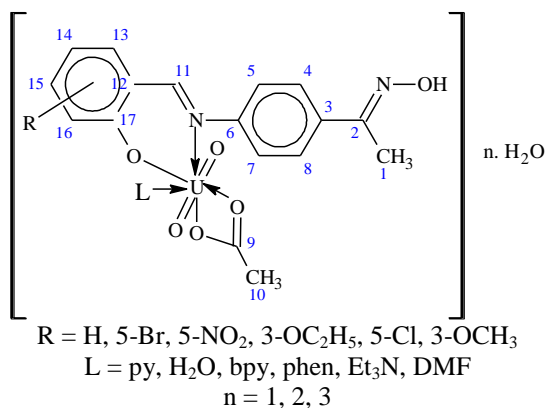


Figure 1. Suggested structure of the dioxouranium (VI) complexes

3.3. Magnetic Properties and Electronic Spectra

The dioxouranium (VI) complexes were found to be diamagnetic as expected and did not give any significant values for the magnetic moment.

The diffuse reflectance spectrums of complexes two spectral band at *ca.* 261-270 nm

($\epsilon = 551\text{-}560 \text{ L mol}^{-1} \text{ cm}^{-1}$) and 331-340 nm ($\epsilon = 395\text{-}420 \text{ L mol}^{-1} \text{ cm}^{-1}$) assignable to $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transition respectively of the azomethine linkage. The third band appearing at *ca.* 415-425 nm ($\epsilon = 380\text{-}400 \text{ L mol}^{-1} \text{ cm}^{-1}$) in these complexes are assigned to the $^1\Sigma_g^+ \rightarrow ^3\Pi_u$ transition typical of the O-U-O symmetric frequency $\nu_s(\text{O=U=O})$ for the first excited state [23].

3.4. Thermal Studies

The Thermal behavior of the complexes has been investigated using thermogravimetric techniques in the temperature range from ambient to 800°C at a heating rate of 10°C/min.

The TGA curve of complexes shows a first weight loss was observed at *ca.* 95-120°C due to elimination of lattice water [24] molecules (Found/Calcd. %; 2.65/2.11, one water molecules for (1), Found/Calcd. %; 2.57/2.88, one water molecules for (2), Found/Calcd. %; 1.16/1.60, three water molecules for (3), Found/Calcd. %; 2.18/1.92, one water molecules for (4), Found/Calcd. %; 4.77/4.98, two water molecules for (5), Found/Calcd. %; 7.30/7.52, three water molecules for (6)). The complex (2) shows a further weight loss of 2.65% (calc. 3.00%) at 175 °C corresponding to removal of one coordinated water molecule [25].

The inflation of the TGA curves of all the complexes at a temperature below 750 °C indicates the decomposition of the fully organic part of the chelate, leaving the metallic oxide at the final temperature [26]. All the complexes undergo complete decomposition to the corresponding thermodynamically stable metal oxides, UO₂ (residue: 40.04% for (1), 39.05% for (2), 32.51% for (3), 33.02% for (4), 36.03% for (5), 36.97% for (6)).

4. Conclusion

Our group has been heavily engaged in synthesis of substituted oximes and their Schiff-base mixed ligands derivatives. Many Schiff-base derivatives, containing substituted oximes, were synthesized, characterized in detail and used for complexation with some transition metal salts. Functional groups, such as oxime, on

the complexes have no effect. These functional groups are very far from the pendants taking part in the complexation.

The Schiff-base mixed ligands and their $\text{UO}_2(\text{VI})$ complexes were synthesized and characterized by elemental analyses, IR, ^1H - and ^{13}C -NMR spectra, UV spectra, magnetic susceptibility measurements and thermogravimetric analyses (TGA). According to results obtained from TGA, IR and elemental analyses, there are lattice/coordinated water molecules in the complexes.

For these complexes additional analytical and physical data are given in Table 1. The suggested modes of coordination are shown in Figure 2. The complexes were of the general formula $[(\text{L}^1)(\text{UO}_2)(\text{OAc})(\text{py})].\text{H}_2\text{O}$ (1), $[(\text{L}^2)(\text{UO}_2)(\text{OAc})(\text{H}_2\text{O})].\text{H}_2\text{O}$ (2), $[(\text{L}^3)(\text{UO}_2)(\text{OAc})(\text{bpy})].3\text{H}_2\text{O}$ (3), $[(\text{L}^4)(\text{UO}_2)(\text{OAc})(\text{phen})].\text{H}_2\text{O}$ (4), $[(\text{L}^5)(\text{UO}_2)(\text{OAc})(\text{Et}_3\text{N})].2\text{H}_2\text{O}$ (5) and $[(\text{L}^6)(\text{UO}_2)(\text{OAc})(\text{DMF})].3\text{H}_2\text{O}$ (6).

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