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Synthesis of a New Cobalt (II) Complex and its Interaction with DNA

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Abstract: A new complex of bis(N-benzyl benzotriazole-N^3) dichloro Co(II) ($Co(II)L_2Cl_2$) was synthesized and its crystal was characterized. The interaction of this new complex with fs-DNA was studied by electrochemical and UV spectrophotometric method. In 0.01 mol/L pH 4.2 Tris-HCl buffer solution $Co(II)L_2Cl_2$ has two reductive peaks with peak potentials at 0.38 V and 0.27 V, respectively, and an oxidative peak at 1.05 V. After the addition of DNA, the peak currents decrease and the peak potential at 0.27 V shifts negatively. The UV spectrophotometric experiment indicates that the maximum absorbance of $Co(II)L_2Cl_2$ at 204 nm decreases and exhibits bathochromic shift after the addition of DNA. All the results reveal that $Co(II)L_2Cl_2$ binds with DNA by intercalation as well as electrostatic interaction.

Keywords: Cobalt complex, DNA, interaction, electrochemistry.

The interaction of metal complexes with DNA has been widely studied by different methods such as spectrophotometry, light scattering technique, fluorometry[1-3]. Many complexes such as $Co(phen)_2^{3+}$,$Co(en)_2^{3+}$,$Fe(EDTA)^{2-}$ *etc.*[4,5] have been synthesized and their effect on DNA has been studied in order to further explain the mechanism of gene mutation, anti-cancer or cancer-induced reason and DNA targeted drugs. In this paper, a new cobalt complex was synthesized, characterized and its recognition interaction to DNA was studied with electrochemical and UV spectrophotometric techniques.

The title complex was synthesized with the following procedure. The ligand of N-phenmethyl benzotriazole was obtained according to literature reported[6]. Solid N-phenmethyl benzotriazole (2.2 g, 10.0 mmol) was dissolved in anhydrous ethanol (50 mL). [$CoCl_2$•$6H_2O$] (1.2 g, 5.0 mmol) was added at room temperature with stirring, and the resulting solution was refluxed for 40 min and then cooled. The blue precipitate was formed, upon collection by filtration, the deposit was washed with ethanol and dried for two days in air. Crystals suitable for X-ray structure determination were obtained by slowly evaporating its acetonitrile solution in air. The selected crystal was mounted on an Rigaku Raxis-IV diffractometer using Mo-Kα radiation (λ=0.71073 Å, T = 293 K) graphite monochromation radiation ω-2θ scan mode. The crystal structure was solved by direct methods using SHELXS-97[7]. All the non-hydrogen atoms were refined on F^2 anisotropically by full-matrix least squares method. The hydrogen atoms were located

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by difference synthesis and refined isotropically. **Figure 1** shows the crystal structure of the title compound.

Typical cyclic voltammetric behaviors of Co(II)L_2Cl_2 in the absence and presence of DNA are shown in **Figure 2**. Curve 1 shows that free Co(II)L_2Cl_2 gives two reduction peaks p_1, p_2 (at 0.38 V and 0.27 V, respectively) and an oxidation peak p_3 (at 1.05 V) in 0.01 mol/L pH 4.2 Tris-HCl buffer solution. After the addition of DNA, all peaks decrease and the peak potential of p_2 shifts to more negative value versus the solution without DNA (curve 2). These results indicate that electrostatic binding exists between DNA and Co(II)L_2Cl_2, which is reasonable because Co(II)L_2Cl_2 is positively charged in pH 4.2 Tris-HCl buffer solution while DNA carrying negative charges on phosphate group.

Figure 1 Crystal structure of Co(II)L_2Cl_2 with the atomic numbering scheme

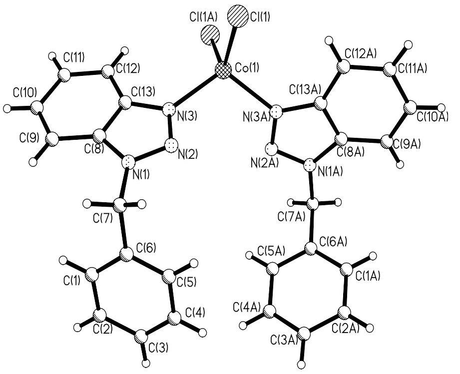
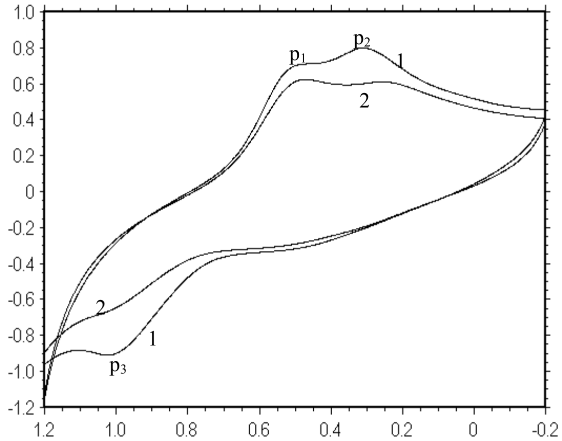


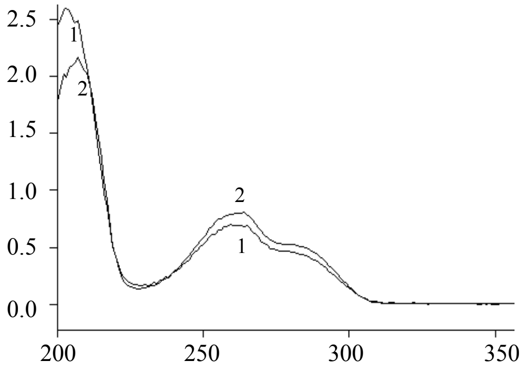
Figure 2 Cyclic voltammograms of Co(II)L_2Cl_2 interaction with DNA



The conditions: 1. 0.01 mol/L Tris-HCl+3.0×10^{-4} mol/L CoL_2Cl_2; 2. 1+1.3×10^{-4} mol/L DNA

Figure 3 shows the UV spectra of Co(II)L_2Cl_2 and Co(II)L_2Cl_2-DNA interaction system. Over the scan range of 200-360 nm, Co(II)L_2Cl_2 has two maximum absorption at 207 nm and 260 nm, respectively (curve 1). After the addition of DNA, the absorbance at 207 nm decreases and shifts to longer wavelength by 4 nm(curve 2), which shows a typical character of DNA intercalation[8].

Figure 3 UV spectra of Co(II)L_2Cl_2 interaction with DNA



The conditions are: 1. 0.01 mol/L Tris-HCl+3.3×10^{-4} mol/L CoL_2Cl_2; 2. 1+1.02×10^{-4}mol/L DNA

Acknowledgments

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