

Salicylaldehyde Schiff Base Complexes: Synthesis and Characterization

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Structured Abstract

Background: This study focuses on the synthesis and characterization of Schiff base ligands derived from salicylaldehyde, which are known for their effective chelating abilities with transition metals. Schiff base ligands were selected due to their potential thermal and electronic properties, particularly when coordinated with metal ions such as Cu(II) and Zn(II). The goal was to evaluate their structural, thermal, and spectral properties.

Methods: Two Schiff base ligands, LA and LB, were synthesized through a condensation reaction involving salicylaldehyde with 4-methylaniline and 4-methoxyaniline, respectively. These ligands were then complexed with Cu(II) and Zn(II) salts in a 2:1 ligand-to-metal molar ratio. Characterization techniques included melting point determination, elemental (CHN) analysis, Fourier-transform infrared (FTIR) spectroscopy, nuclear magnetic resonance (NMR) spectroscopy, ultraviolet-visible (UV-Vis) spectroscopy, and magnetic susceptibility measurements.

Results: Elemental analysis revealed good agreement between experimental and theoretical values, confirming compound purity. FTIR spectra showed coordination through azomethine nitrogen and phenolic oxygen, evidenced by a shift in the C=N band from $\sim 1619\text{ cm}^{-1}$ to $\sim 1611\text{ cm}^{-1}$. NMR spectra confirmed the presence of imine protons, verifying successful ligand formation. UV-Vis spectra displayed $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$, and ligand-to-metal charge transfer (LMCT) transitions, with red shifts observed in the metal complexes. The metal complexes also exhibited significantly higher melting points (above 200°C) compared to free ligands ($\sim 90^\circ\text{C}$), indicating improved thermal stability.

Conclusion: In conclusion, the Schiff base ligands and their Cu(II) and Zn(II) complexes were successfully synthesized and characterized. The data support enhanced thermal, spectral, and magnetic properties upon metal coordination, indicating their potential application in coordination chemistry and related functional materials.

Keywords: Schiff base, salicylaldehyde, Cu(II), Zn(II), coordination chemistry

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