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SYNTHESIS, CHARACTERIZATION AND THERMAL PROPERTIES OF COPPER (II) COMPLEX AS POTENTIAL METALLOMESOGEN COMPOUND

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ABSTRACT

SYNTHESIS, CHARACTERIZATION AND THERMAL PROPERTIES OF COPPER (II) COMPLEX AS POTENTIAL METALLOMESOGEN COMPOUND

Metallomesogens are metal-containing liquid crystals. The metallomesogens produced from alkoxy groups and short-chain Schiff base ligands are poorly understood. This research aims to learn more by creating a new potential metalomesogen with a short chain spacer and a substituent with a long alkoxy group that may be utilized to create inexpensive electronic device. The main objectives of this research are to synthesize and elucidate the structure of Schiff base ligand (H_2L1) and its Copper (II) complexes (CuL1 and $CuL1C_{16}$) and to study the thermal stability behaviour for the Cu(II) complex. In this study, H_2L1 was successfully synthesized by refluxing 2,5-dihydroxybenzaldehyde and ethylenediamine in ethanol as a solvent for 1 hour. Next, CuL1 also successfully synthesized by refluxing H_2L1 with copper (II) acetate monohydrate in ethanol as solvent for 3 hours. Furthermore, a new potential metallomesogen derived from the salen-type Schiff base with two carbon chain substituent with the long terminal end alkoxy group (hexadecane) coordinated with Cu(II) metal ($CuL1C_{16}$) was also synthesized by refluxing CuL1 with 1-bromohexadecane in DMF as solvent for 4 hours. All the structures were characterized by FTIR and ^{1}HNMR spectroscopies, and the geometry of the metal centre was established by UV-Vis spectroscopy. It has been observed from FTIR spectroscopy that an acetate ion CH_3COO^- is present in the chelating binding mode in both Cu(II) complexes CuL1 and $CuL1C_{16}$ ($\Delta = \nu_{asym} - \nu_{sym} = 92$ cm^{-1} & 93 cm^{-1}, respectively). Square planar geometry at the metal centre has been inferred from the UV-Vis data of the two complexes. On the other hand, TGA was conducted to study the effects of the Cu(II) complex on the thermal properties of CuL1 and $CuL1C_{16}$. The Cu(II) complex of CuL1 was expected to have high thermal stability. However, the TGA of the $CuL1C_{16}$ complex could not be carried out because the instrument malfunctioned. The $CuL1C_{16}$ complex consists of two Cu(II) metal centres, each bonded to two acetate ions in a chelating binding and coordinated with the long alkyl chain (alkoxy group) of hexadecane (C16), evidenced by FTIR. This suggests that the Cu(II) complex may have potential as a metallomesogen, exhibiting mesomorphic behaviour.

CHAPTER 1

RESEARCH BACKGROUND

1.1Background of study

Liquid crystal is a matter that has a characteristic both liquid-like and crystalline at the same time. Metallomesogen refers to liquid crystals that contain metal and can have a variety of molecular geometries as a result of adding metal to the chemical structure thus displaying a clear distinction from organic liquid crystals. When metal is added to a chemical structure to create a particular metallomesogen, it enables the compound to display characteristics of metal ion centres, including high coordination bond polarity, rich oxidation state, variation in geometrical structure, variation in compound colour, redox behaviour, and magnetism (Krishna et al., 2019). These hybrid materials known as metallomesogens have the potential to demonstrate excellent optical, electrical, and magnetic properties, which makes them very appealing for use in smart materials, sensors, and display technologies (Hakemi et al., 2023). As a result, this motivates and draws scientists to devote their time to researching and creating a variety of metallomesogens with unique characteristics and uses.