

CHAPTER 1 INTRODUCTION

The main objective of this research was to study the spin-crossover (SCO) behaviour and mesomorphisms of cobalt(II) and iron(II) complexes derived from 2,6-pyridinedicarboxaldehyde and 1-aminoalkanes.

SCO complexes shows labile electronic configuration which changes from a high-spin (HS) state to a low-spin (LS) state, or vice versa, in response to external stimuli, such as temperature, pressure, light irradiation (commonly referred as light induced excited state spin trapping or LIESST), and magnetic field [1]. As a consequent, these materials show discrete changes in colour and magnetism. Metallomesogens are metal complexes exhibiting liquid crystal properties, normally under the effect of heat (thermotropic liquid crystals). In the liquid crystalline state, these materials possess both the properties of crystals and liquids, such as ordered structures and fluid [2]. Some metallomesogens show unique magnetism (paramagnetic liquid crystals, controls of molecular orientation in magnetic field), luminescent, electrical (conductivity), optical (strong birefringence, dichroism), electro-optical properties (photoelectric and ferroelectric behaviour), colour (thermochromism, photochromism) and even redox-active [3]. A material exhibiting both SCO and liquid crystalline behaviour may have a number of advantages in related field applications, such as facile formation of thin films, enhancement in spin transition signals, switching and sensing, and photo- and thermochromism [4].

For this research, a total of nine Co(II) and five Fe(II) Schiff base complexes were prepared by one-pot syntheses. These materials were characterised by elemental analyses, electrospray ionization mass spectroscopy, Fourier transform infrared spectroscopy, room- and variable-temperature UV-visible spectroscopy, single crystal X-ray crystallography (for crystals), room-temperature magnetic susceptibility by the Guoy method, thermogravimetry and differential scanning calorimetry. Also, variable-

temperature magnetic susceptibilities were measured for selected complexes by superconducting quantum interference device (SQUID) at the University of Manchester, United Kingdom, through a three-month research attachment (13 November 2011 – 10 February 2012) at the School of Chemistry, University of Leeds, United Kingdom, under the supervision of Prof. Dr. Malcolm A. Halcrow.

The findings of this research were accepted for publication in an ISI journal, and were presented in international conferences, as listed below:

1. Norbani Abdullah, Nur Linahafizza Md Noor, Abdul Rahman Nordin, Malcolm A. Halcrow, Douglas R. MacFarlane, Manoj A. Lazar, Jennifer M. Pringle, Duncan W. Bruce, Bertrand Donnio, Benoît Heinrich (2015) *Spin-crossover, mesomorphic and thermoelectrical properties of cobalt(II) complexes with alkylated N₃-Schiff bases*, Journal of Material Chemistry C (published).
2. Norbani Abdullah, Afiq Azil, Anita Marlina and Nur Linahafizza Mohd Noor (2014) *Magnetic, photophysical and thermal properties of Complexes of iron(II) with structurally different Schiff bases*, Asian Journal of Chemistry (published).
3. Nur Linahafizza Mohd Noor, Norbani Abdullah and Malcolm A. Halcrow (2013) *Synthesis and characterization of a spin-crossover metallomesogen [Co(L¹⁶)₂(BF₄)₂]*, 4th International Conference of Young Chemists 2013, 30 Jan – 1 Feb 2013, Georgetown, Penang (oral).
4. Nur Linahafizza Mohd Noor, Norbani Abdullah, Afiq Azil and Anita Marlina (2013) *Thermal studies of iron(II) Schiff base complexes*, Joint Malaysia-UK Symposium on Inorganic Chemistry 2013, 5 Dec 2013, Universiti Malaya, Kuala Lumpur (poster).
5. Nur Linahafizza Mohd Noor, Norbani Abdullah and Malcolm A. Halcrow (2014) *Synthesis and characterization of a spin-crossover metallomesogen*

$[Co(L^{12})_2(BF_4)_2]$, International Conference of Ionic Liquid 2013, 11-13 Dec 2013, Pulau Langkawi, Kedah (oral).

This thesis contains five chapters. **Chapter 1** introduces the objective of the research, the complexes prepared, the instrumental techniques involved, and lists the publications of the research findings. **Chapter 2** presents the theories and literature reviews relevant to the research, namely Schiff bases of cobalt(II) and iron(II), spin-crossover behaviour, and mesomorphisms. **Chapter 3** presents the syntheses of the complexes and the instrumental techniques used to characterise them. **Chapter 4** presents the results and discussions, and finally **Chapter 5** presents the conclusions and suggestions for future works. A list of references is included at the end of each chapter, and appendices at the end of the thesis.

References

- [1] P. Gülich and H. A. Goodwin, "Spin Crossover—An Overall Perspective," vol. 233, pp. 1-47, 2004.
- [2] D. Andrienko, *International Max Planck Research School Modelling of Soft Matter*, p. 2, 2006.
- [3] J. L. Serrano, *Metallomesogen: Synthesis, Properties, Applications*. Weinheim, Federal Republic of Germany: VCH Verlagsgesellschaft mBH (2008).
- [4] A. B. Gaspar, M. Seredyuk, P. Gülich, *Coord. Chem. Rev.*, vol. 253, pp. 2399-2413, 10, 2009.