

CHAPTER 1 INTRODUCTION

The main objectives of this research project were to synthesise and characterize thermally stable low-temperature ionic copper(II) mixed carboxylates as hybrid heat-light solar-cell materials. The general formula is $K_n[Cu_2(p-OC_6H_4COO)_n(RCOO)_{4-n}]$, where $n = 1-3$, and R = saturated or unsaturated alkyl group. The research was based on the reports that copper(II) carboxylates are dinuclear complexes adopting the paddle-wheel structure, and that electronic communication occurs between the two central copper(II) ions through the ligands, termed the superexchange pathway [1,2].

Thus, it was envisioned that by suitable combination of aromatic and aliphatic carboxylates as ligands, these materials may be transformed into dark coloured complexes (ideally black) in order to harvest a broad spectrum of light energy as well as heat energy from the sun.

The first challenge in this project was to find the correct synthetic method(s) to do this. Two reactions were chosen: one-pot and ligand-exchange. All products obtained from these reactions were analysed as it was uncertain which of the products were the intended ones. Thus, a total of 17 complexes were obtained and characterized by CHN elemental analyses, FTIR spectroscopy, UV-vis spectroscopy, thermogravimetry (TGA), differential scanning calorimetry (DSC), magnetic susceptibility (the Gouy method), and cyclic voltammetry (CV). Suitable complexes were then analysed by photoluminescence spectroscopy to see their energy-storage capability.

The findings from this research were published in two ISI journals and presented in five (5) conferences, either orally or as posters (**Appendix 1**):

1. L. N. Ozair, N. Abdullah, H. Khaledi and E. R. T. Tiekink, *Tetrakis(μ_2 -2,2-dimethylpropanoato-2O,O')bis[(pyridine-N)copper(II)]: a monoclinic polymorph*, Acta Cryst. (2010), E66, m589-m590;
2. Lailatun Nazirah Ozair, Norbani Abdullah and Kong Mun Lo, *Bis(4-hydroxybenzoato- κ^2 O,O')bis(pyridine- κ N)copper(II)*, Acta Cryst. (2011), E67, m952;
3. Lailatun Nazirah Ozair* and Norbani Abdullah, *Copper(II) Conjugated Mixed-Carboxylates As Solar-Cell Material: $K_2[Cu_2(p-OC_6H_4COO)_2(CH_3CH=CHCOO)_2]$* , Regional Conference on Materials 2009, Equotarial Hotel Penang, 16-17 Feb 2009. (poster);
4. Lailatun Nazirah Ozair* and Norbani Abdullah, *Copper(II) Conjugated Mixed-Carboxylates As Solar-Cell Material: $K_2[Cu_2(p-OC_6H_4COO)_2(CH_3CH=CHCOO)_2]$* , Second International Conference and Workshops on Basic and Applied Sciences and Regional Annual Fundamental Science Seminar 2009, Zon Regency Hotel Johor Bahru, 3-4 June 2009. (oral);
5. Lailatun Nazirah Ozair* and Norbani Abdullah, *Synthesis And Thermal Properties Of $K_a[Cu_2(p-OC_6H_4COO)_a(CH_3CH=CHCOO)_{4-a}]$ Ionic Liquids As Solar-Cell Materials*: Regional Conference on Ionic Liquids 2009, Universiti Malaya, 24-25 Nov 2009. (oral);
6. Lailatun Nazirah*, Zaimatul 'Azian* and Norbani Abdullah, *Thermally-Stable Magnetic Metal-Based Ionic Liquid Precursors: $Cu_2(p-HOC_6H_4COO)_2(RCOO)_2]$; $R = CH_3(CH_2)_{14}, CH_3(CH_2)_7CH(CH_2)_5$* : Jan Redjick mini symposium, Universiti Malaya, 24 July 2010. (poster, 3rd prize);
7. Lailatun Nazirah Ozair* and Norbani Abdullah, *Synthesis, Thermal And Magnetic Properties Of Ionic Liquid Precursors: $[Cu_2(p-HOC_6H_4COO)_2(R)_2]$ ($R = trans$ -2-*

butenoato, 2-hexyldecanoato): Seminar Nasional Himpunan Kimia Indonesia 2010, Universitas Hassanudin, 2-3 August 2010. (oral)

This report is divided into five chapters. **Chapter 1** briefly introduces the objectives of the research and lists the research publications and presentation at conferences. **Chapter 2** presents the theory and literature reviews on copper(II) carboxylates, with focus on structural elucidation by CHN elemental analyses, and FTIR and UV-vis spectroscopies, followed by physical characterisation, namely thermal stability, magnetism, redox properties and photoluminescence. **Chapter 3** presents the experimental part of the research, covering the materials used in the research, the two methods used to synthesize the complexes, and the instrumental techniques used to characterise them. **Chapter 4** contains the results and discussions, and **Chapter 5** presents the conclusions and suggestions for future works. A list of references is included at the end of each chapter, and the appendixes are placed at the end of the report.

References

- [1] M. Kato, H. B. Jonassen and J. C. Fanning, *Chem. Rev.* **64** (1964) 99
- [2] G. S. Attard, P. R. Cullum. *Liq. Cryst.*, **8(3)**, 299 (1990)