APPENDICES

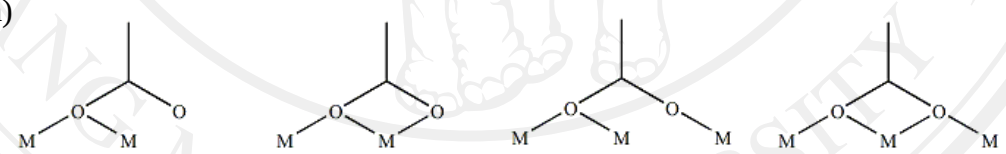
APPENDIX A

NOTATIONS FOR LIGATING ATOMS IN COORDINATION COMPLEXES

μ–Notation

A Greek letter μ (mu) indicates the bridging bonding mode of ligands. The number of metal atoms connected by a bridging ligand is indicated by a right subscript, μ_n, where $n \geq 2$ (Fig. A.1a). The μ is placed before the ligand name and separated by a hyphen (Fig. A.1b). In the case of multiple bridging modes, μ_n is listed in descending order of complexity.

(a)



μ_2–η^2 μ_2–η^2:η^1 μ_3–η^2:η^1 μ_3–η^2:η^2

(b)

μ_4–η^4–1,4–benzenedicarboxylate

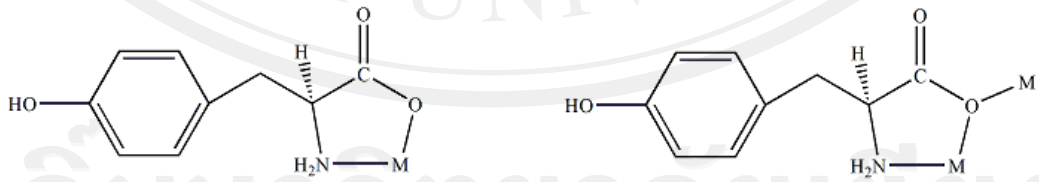
Fig. A.1 Diagrams showing typical coordination modes of (a) carboxylate groups and (b) 1,4–benzenedicarboxylate with corresponding notations.

η–Notation

A Greek letter η (eta) is used to specify the hapticity of a ligand, which is the number of contiguous ligating atoms that are involved in bonding to one or more metals (Fig. A.1). The number of contiguous atoms in the ligand coordinated to the metal is indicated by a right superscript numeral.

κ–Notation

In the case of coordination occurs through one of several possible donor atoms of a ligand, an indication of that donor atom may be desirable. A Greek letter κ (kappa) is used to indicate the attachment of the coordinating atoms of a polydentate ligand bonding to a metal center in the polynuclear complexes. A right superscript numeral is added to the symbol κ in order to indicate the number of identically bound ligating atoms in the flexidentate ligand (Fig. A.2). When a polydentate ligand contains several nonequivalent ligating atoms, each is indicated by its italicized element symbol preceded by κ.



L–*p*–tyrosinato–κ^2*N*,*O* μ_2–*L*–*p*–tyrosinato–κ^3*N*,*O*:*O*

Fig. A.2 Diagrams showing typical coordination modes of *L*–*p*–tyrosinate ligands with corresponding notations.

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APPENDIX B

BAND GAP ENERGY DETERMINATION

VIA TAUC METHOD

The Tauc plot is widely used for the determination of band gap energy. In the case of $EMIm_2[Zn_3(BDC)_3Cl_2]$ and $BMIm_2[Zn_3(BDC)_3Cl_2]$, the band gap energy was estimate from the UV−Vis absorption spectra of the ground crystals in deionized water at room temperature from 200 nm to 800 nm using Perkin Elmer UV LAMDA 25 spectrophotometer. The absorption coefficient was determined near the absorption edge at different photon energies using the relation:

$$\alpha \cdot \nu = 2.303A/t \qquad \ldots (1)$$

where α is the absorption coefficient, ν is frequency, A is the absorbance and t is thickness or path length in the case of suspension sample. The $\alpha \cdot \nu$ value can be expressed by the Tauc relation;

$$\alpha h\nu = \beta[h\nu - E_{op}]^r \qquad \ldots (2)$$

where $h\nu$ is photon energy (h = Planck's constant), E_{op} is band gap energy and β is constant. The exponent r denotes the nature of the transition process, r = 1/2 for direct allowed transition, r = 2 for indirect allowed transition, r = 3/2 for direct forbidden transition and r = 3 for indirect forbidden transition. Since the direct allowed transition is used in this experiment, n =1/2 is used for these complexes. As the relation given in equation (2), the intercept of the linear portion of a plot of $(\alpha h\nu)^2$

versus $h\nu$ on the $h\nu$–axis indicates the value of band gap energy (E_{op}) of the crystals, as illustrated in Fig. 5.11.

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Scholarship

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Research grant

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- Synchrotron Light Research Institute (Public Organization), Nakhon Ratchasima, THAILAND, 2009 (Research Assistant).
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Research experience

- Research activity at University of Hull, Hull, UNITED KINGDOM under the supervision of Dr. Timothy J. Prior, May 10th–October 31st, 2012.

Publications

- T.J. Prior, A. Rujiwatra, W. Tapala, "A chiral decorated metal–isonicotinate coordination polymer", *Journal of Chemical Crystallography*, 43 (2013), 299–305.
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International & National conferences

- Oral presentation: "Ionothermal synthesis and crystal structures of new metal–organic materials: $BMIm_2[Zn_3(BDC)_3Cl_2]$ and $EMIm_2[Zn_3(BDC)_3Cl_2]$", *RGJ–Ph.D. Congress XIV*, Jomtien Palm Beach Hotel and Resort Pattaya, Chonburi, THAILAND, April 5^{th}–7^{th}, 2013.
- Poster presentation: "New d^{10} blue luminescent metal–organic material, $BMIm_2[Zn_3(BDC)_3Cl_2]$: synthesis, crystal structure & spectroscopic properties", *RGJ Seminar Series XCIV: Materials Science for the Sustainable Society*, Chiang Mai University, Chiang Mai, THAILAND, February 22^{nd}, 2013.

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- Poster Presentation: "Microwave –hydrothermal synthesis and sintering behavior of lead titanate fine powders", *PERCH–CIC Congress VI,* Jomtien Palm Beach Hotel and Resort Chonburi, THAILAND, May 3rd–6th, 2009.
- Poster Presentation: "Development of soft chemical technique for the preparation of lead titanate powders", *CGI Award Contest 2008,* Chulabhorn Graduate Institute, Bangkok, THAILAND, November 21st–22nd, 2008.
- Poster Presentation: "Influences of synthetic conditions and acoustic wave on lead zirconate powder prepared *via* hydrothermal technique", *Smart/Intelligent Materials and Nanotechnology and 2nd International Workshop on Functional Materials and Nanomaterial (Smartmat–08' & IWOFM–2),* Imperial Mae Ping Hotel, Chiang Mai, THAILAND, April 22nd–25th, 2008.
- Poster presentation: "Sonocatalyzed microwave–hydrothermal preparation of fine lead titanate powder", *Pure & Applied Chemistry Conference (PACCON 2008),* Sofitel Centara Grand, Bangkok, THAILAND, January 31st–February 1st, 2008.

Awards

- 1st Prize poster presentation, Title "New d^{10} blue luminescent metal–organic material, $BMIm_2[Zn_3(BDC)_3Cl_2]$: synthesis, crystal structure & spectroscopic properties", *RGJ Seminar Series XCIV: Materials Science for the Sustainable Society*, Chiang Mai University, Chiang Mai, THAILAND, February 22nd, 2013.
- Outstanding poster presentation, Title "Microwave–hydrothermal synthesis and sintering behavior of lead titanate fine powders", *PERCH–CIC Congress VI*, Jomtien Palm Beach Hotel and Resort Chonburi, THAILAND, May 3rd–6th, 2009.
- 1st Prize professional vote, Title "Influences of synthetic conditions and acoustic wave on lead zirconate powder prepared via hydrothermal technique", *Industrial and Research Projects for Undergraduate Students (IRPUS) Exhibition 2007*, Royal Paragon Hall, Bangkok, THAILAND, April 20th–22nd 2007.

Activities

- Participant in 2012 RSC Northern Region Dalton Division Meeting, School of Chemistry, University of Leeds, UK, June 25th, 2012.
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- Participant in ICMS–Cambridge University Winter School on Chemistry and Physics of Materials, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, INDIA, November 30th–December 5th, 2009.
- Participant in Sokendai Asian Winter School "Molecular Sciences on Different Space–Time Scales", Okazaki Conference Center, National Institutes for Natural Sciences, Okazaki, JAPAN, December 9th–12th, 2008.
- Teaching Assistant of Chemistry Laboratory Course, Chiang Mai University, Chiang Mai, THAILAND, 2007–2011.
- Participant in the 4th Siam Photon Science Camp, Synchrotron Light Research Institute, Nakorn Ratchasima, THAILAND, October 24th–28th, 2007.
- Participant in the 2nd Congress of Science and Technology for Youth, Kasetsart University, Bangkok, THAILAND, March 21st–22nd, 2007.