

TABLE OF CONTENTS

Chapter	Page
1 INTRODUCTION	1
Rationale and Motivation	1
Dissertation Objectives	2
Scope and Limitation of the Dissertation	2
Anticipated Outcomes of the Dissertation	2
Dissertation Structure	2
2 LITERATURE REVIEWS	4
Theorem of Thermoelectricity	4
Thermoelectric effect	4
Thermoelectric figure of merit and the thermoelectric Parameter	6
Cement thermoelectric	7
Chemistry nomenclature	7
Thermoelectric properties of cement	8
Zink Oxide	14
3 MATERIALS AND METHODS	18
Materials preparation	19
PC Thermoelectric device fabrication	20
Crystal structure analysis	21
Microstructure analysis	22
Thermoelectric properties measurement	23
Thermoelectric power generation	24

TABLE OF CONTENTS (CONTINUED)

Chapter		Page
4 RESULTS AND DISCUSSION		26
Materials preparation		26
Crystal Structure		27
Microstructure Analysis		29
Thermoelectric Properties		34
Power generation of PC thermoelectric Devices		41
5 CONCLUSION AND SUGGESTION		46
Conclusion		46
Suggestion		46
REFERENCES		47
APPENDIX		50
Appendix A Conferences		51
Appendix B Publications		53
HISTORY		64

LIST OF TABLES

Table	Page
1 The element composition of cement	7
2 EDS result of nano ZnO added 10%	32
3 EDS result of nano ZnO added 20%	32
4 EDS result of nano ZnO added 30%	33
5 EDS result of nano ZnO added 40%	33
6 EDS result of nano ZnO added 50%	34

LIST OF FIGURES

Figure	Page
1 Seebeck coefficient calculated at the age of 28 days	9
2 Thermal conductivity of the samples at the age of 28 days	9
3 Electrical conductivity vs. ZnO (wt%) and AZO (wt%) at the age of 14, 28, and 90 days	10
4 The Seebeck coefficient of EGCC depend on temperature	11
5 The electrical conductivity of EGCC depend on temperature	11
6 The power factor of EGCC depend on temperature	12
7 The Seebeck coefficient of CNTs/CC depend on temperature	13
8 The electrical conductivity of CNTs/CC depend on temperature	13
9 The power factor of CNTs/CC depend on temperature	14
10 SEM morphology of powder of bulk ZnO after annealing at (a) 400 °C, (b) 450 °C, (c) 500 °C, (d) 550 °C, (e) 600 °C and (f) 650 °C	16
11 The thermopower depend on annealing temperature	17
12 The schematic diagram of methodology	18
13 Portland cement (a) PC-A, (b) PC-B, (c) PC-C, (d) PC-D, (e) PC-E and (f) PC-F	19
14 The model of PC thermoelectric device design (a) material and (b) size	20
15 The PC thermoelectric device	21
16 Portland cement bulk samples of (a) Cu electrode connecting and (b) diagram of electrical resistivity and Seebeck coefficient measurement	24

LIST OF FIGURES (CONTINUED)

Figure	Page
17 Schematic diagram of power generation measurement of Thermoelectric	25
18 Portland cement samples of (a) PC-A, (b) PC-B, (c) PC-C, (d) PC-D, (e) PC-E and (f) PC-F	26
19 The PC-C samples added with nano ZnO (a) 10%, (b) 20%, (c) 30%, (d) 40% and (e) 50%	27
20 XRD patterns of PC powders samples	28
21 XRD patterns of nano ZnO added PC-C (10 – 50 wt%) powders samples	28
22 SEM images of (a) PC-A, (b) PC-B, (c) PC-C, (d) PC-D, (e) PC-E and (f) PC-F bulk samples	29
23 SEM images of (a) 0% nano ZnO added PC-C, (b) 10% nano ZnO added PC-C, (c) 20% nano ZnO added PC-C, (d) 30% nano ZnO added PC-C, (e) 40% nano ZnO added PC-C and (f) 50% nano ZnO added PC-C bulk samples	30
24 EDS mapping of (a) 10% nano ZnO added PC-C, (b) 20% nano ZnO added PC-C, (c) 30% nano ZnO added PC-C, (d) 40% nano ZnO added PC-C and (e) 50% nano ZnO added PC-C bulk samples	31
25 The schematic diagram of (a) Seebeck coefficient and (b) electrical resistivity measurement	35
26 Electrical voltage dependence on temperature difference of PC bulk samples	36
27 Seebeck coefficient of PC bulk samples	37

LIST OF FIGURES (CONTINUED)

Figure	Page
28 Electrical resistivity of dependence on temperature difference PC bulk samples	37
29 Electrical resistivity of PC bulk samples	38
30 Figure 30 The power factor of PC bulk samples	38
31 The Seebeck coefficient of ZnO added PC bulk samples	40
32 The electrical resistivity of ZnO added PC bulk samples	40
33 The Seebeck coefficient of ZnO added PC bulk samples	41
34 The power generation of PC thermoelectric device depend on load resistance	42
35 The open circuit voltage dependence on temperature difference of PC thermoelectric devices	43
36 The voltage dependence on temperature difference of PC thermoelectric devices	43
37 The current dependence on temperature difference of PC thermoelectric devices	44
38 The power dependence on temperature difference of PC thermoelectric devices	45